



Internationally indexed journal

Indexed in Chemical Abstract Services (USA), Index copernicus, Ulrichs Directory of Periodicals, Google scholar, CABI ,DOAJ , PSOAR, EBSCO , Open J gate , Proquest , SCOPUS , EMBASE ,etc.



Rapid and Easy Publishing

The “International Journal of Pharma and Bio Sciences” (IJPBS) is an international journal in English published quarterly. The aim of IJPBS is to publish, peer reviewed research and review articles rapidly without delay in the developing field of pharmaceutical and biological sciences



Pharmaceutical Sciences

- Pharmaceutics
- Novel drug delivery system
- Nanotechnology
- Pharmacology
- Pharmacognosy
- Analytical chemistry
- Pharmacy practice
- Pharmacogenomics
- Polymer sciences
- Biomaterial sciences
- Medicinal chemistry
- Natural chemistry
- Biotechnology
- Pharmacoinformatics
- Biopharmaceutics



Biological Sciences

- Biochemistry
- Biotechnology
- Bioinformatics
- Cell biology
- Microbiology
- Molecular biology
- Neurobiology
- Cytology
- Pathology
- Immunobiology

**Indexed in Elsevier Bibliographic Database
(Scopus and EMBASE)
SCImago Journal Rank 0.329
Impact factor 5.121***



Elsevier Bibliographic databases (Scopus & Embase)

SNIP value – 0.538

SJR - 0.274

IPP - 0.34

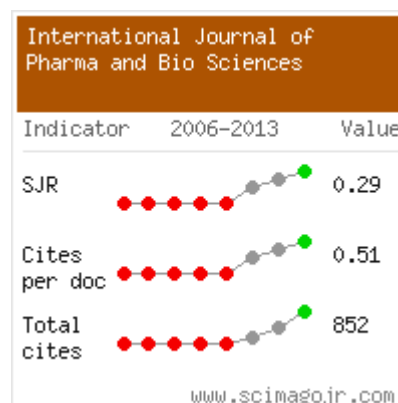
SNIP – Source normalised impact per paper

SJR – SCImago Journal rank

IPP – Impact per publication

Source – www.journalmetrics.com

(Powered by scopus (ELSEVIER))



LUND
UNIVERSITY



Jacksonville State University
Houston Cole Library
USA (Alabama)



Oxford, United Kingdom

*And indexed/catalogued in
many more university*



*Instruction to Authors visit www.ijpbs.net

For any Queries, visit "contact" of www.ijpbs.net

International Journal of Pharma and Bio Sciences (IJPBS)

**Special Issue on
“Medical Science”
April 2017**

Guest Editors

V. Saravanakumar

V. Janarthanan

S. No	Title / Author(s)	Page No
1	Research on the Effect of Neuro Feedback Training on Academic Anxiety Progression of Middle School Student Using BCI (Brain Computer Interface) <i>Sang-Kyun Ahn</i>	01-07
2	The Effects for Stress by SUKI Alternative Therapy <i>Soung-Kwang Yoon and Seong-Gyun Hong</i>	08-15
3	Factors Associated with Diabetes Self-Efficacy among Koreans <i>Kawoun Seo, Kemok, Bohyun Kim and Youngshin Song</i>	16-22
4	The Relations among Oral Health Literacy and Oral Health-Related Quality of Life of Elderly living in a Community <i>Young-Sook Kwon and Kyung-Shin Paek</i>	23-28
5	Fetal Transverse Cerebellar Diameter Measurement for Prediction of Gestational Age in Second Trimister and to Derive its Nomogram in Indian Population <i>Dr.S. Arun Kumar and Dr.P.S. Sangeetha Devi</i>	29-35
6	A Strategic Approach to Medical Technology System to Improve Life Quality after Salpingo-Oophorectomy <i>Seong-Ran Lee</i>	36-41
7	Comparison of Shoulder Ranges of Motion during Nordic Pole Walking and General Walking in the Elderly <i>Suzy Kim, Jemyung Shim, Sungjoong Kim, Seung Namkoong and Hyolyun Roh</i>	42-46
8	The Effects of Task-Oriented Activities on Weight Support by the Paretic Side in Stroke Patients <i>Sung-Ryoung Ma, Jong-Bae Choi and Jong-Eun Yang</i>	47-51
9	The Comparison of the Upper Limb Muscle Activity According to Shoulder Angle with the Push Up Plus Exercise <i>Shin-Hye Baek, Eun-Sil Mun, Ji-Heon Hong, Jae-Ho Yu and Dong-Yeop Lee</i>	52-58
10	Meaning of Recovery of Drug Addicts: Focus Group Study <i>Gyun-Young Kang, Youn-Sil Kim and Se-Jin Ju</i>	59-67
11	Evaluation of the Image Quality on Computed Tomography <i>Kwanghyun Chang, Joonkoo Choi, Ghajung Kim, Joongseok Go, Seunggi Kim and Sinyoung Yu</i>	68-78
12	The Effect of Inhaling Aromas on the Quality of sleep and Fatigue of Three Shift Working Nurses <i>Min-Sook Seo and Dahye Park</i>	79-83
13	Evaluation of Rectal Dose According to Body Mass Index (BMI) Using the Adjacent Organs and Belly Board <i>Shim Jae-Goo and Jung Hong-Ryang</i>	84-89
14	Imaging Radiation Dose Reduction with Adaptive Statistical Iterative Reconstruction in Brain CT <i>Yoonjeong Kim, Danbi Lee, Ino Yu, Su Chul Han, Hong-Ryang Jung and Cheong-Hwan Lim</i>	90-95
15	The Study of Psychological Factors Analysis on Elderly with EEG in Hospital <i>Mi-Hyun Jung, Tae-Young Moon, Jee-Hee Kim and Byung-Jun Cho</i>	96-101

16	The Effect of Hospital Nurses' Emotional Labor on Turnover Intention with Focus on the Mediating Effect of Burnout <i>KyoungEun Kim</i>	102-109
17	A Study on the Influencing factors of Mental Health in Female College Students Focusing on Self-Esteem and Smartphone Addiction <i>Je Woo Choi and GeumSook Oh</i>	110-115
18	A Study of Coil Embolization for Cerebral aneurysm Patients (Around the Coil Amount) <i>Seunggi Kim, Joonkoo Choi, Ghajung Kim, Joongseok Go, Kwanghyun Chang and Sinyoung Yu</i>	116-126
19	A Study on Setting Expansion and Surface Condition Depending on the Mixed Method and the W/P Ratio for a Type-IV Dental Stones <i>In-Ho Jeong, Soo-Chul Park and Sang-Yong Nam</i>	127-133
20	Study on Effectiveness of Auxiliary Device for Examining Cubital Tunnel Syndrome <i>Sun-Youl Seo, Man-Seok Han, Yong-Kyun Kim, Jae-Uk Jang, Gab-Jung Kim and Woo-Jin Jeon</i>	134-140
21	A Study on Usability of the Shielding Clothing Bismuth During Mammography <i>Sun-Youl Seo, Man-Seok Han, Se-Jong Yoo, Min-Cheol Jeon, Hyun-Kuk Lee and Su-Jeong Yu</i>	141-146
22	A Study on the Ultrastructure of Actinomycosis in Women with IUDs <i>Mi-Soon Park, Mi-Hwa Lee and Byoung-Soo Chang</i>	147-154
23	A Study on the Utility of Automatic Exposure Control Function in a Diagnostic Digital Radiography System <i>Ye-Won Park and Cheong-Hwan Lim</i>	155-160
24	Research about Contrast Media Volume Injection by Body Mass Index in Cardiac Computer Tomography <i>Kyoo-Hyung Kim and Chung-Hwan Lim</i>	161-166
25	The Importance of Radiation Safety Control for Those Close to the Patient and Radiation Worker throughout the Course of PET-CT <i>Sang-Tae Kim and Jung-Keun Cho</i>	167-172
26	Effect of Proper Defensive Equipment in the Radiological Examination Environment <i>Sang-Tae Kim and Jung-Keun Cho</i>	173-179
27	Controlling Spatiotemporal Chaos in Coupled Chaotic Lattices with Small-World Connectivity <i>Jeongho Cho</i>	180-188
28	Effects of Stabilization and Traditional Exercises on the Daily Life of Herniated Lumbar Disc Patients Treated with Epidural Steroid Injection <i>Young-Bae Kim and Dae-Hun Kim</i>	189-194
29	Effects of Emotional Control Program for Drug Addicts <i>Se-Jin Ju, Youn-Sil Kim and Gyun-Young Kang</i>	195-200
30	Depression and the Related Factors of Osteoporosis among Korean Women <i>Myoung-Hee Kim</i>	201-207

31	The Effects of Different Exercise Treatment Methods on the Spinal Curvature Structure, Cervical Pain and Neck Disability Index of Chronic Neck Patients with Kyphosis <i>Hyunghun Moon, Yonggon Seo, Sangseo Park, Jaeho Yu, DoYoun Kim and Yunjin Park</i>	208-215
32	Health-related behaviors and Osteoporosis among Korean Men: Based on KNHANES 2008-2011 <i>Myoung-Hee Kim</i>	216-222
33	A Survey on Recognition of Dental Care Customers according to a Health Insurance Support Project for Smoking Cessation Treatment <i>Yu-Ri Choi, Sun-Ok Jang, Youn-Soo Shim and Eun-Mi Choi</i>	223-230
34	The Effect of Samumgyo(SP-6) Acupressure on Bowel Functions and Constipation in Women <i>Kwang Ok Lee, Hyo rim Kim, Da Hae Kim, Ok young Shin, Jeong Hwa Lee, Ha Young Lim and Eun Jin Hwang</i>	231-236
35	The Need to Change the Roles of the Emergency Medical Service System in the National Response System due to the East Respiratory Syndrome Coronavirus (MERS-CoV) Crisis in the Republic of Korea in 2015 <i>Sang-Sub Park and Yoon-Ho Lee</i>	237-242
36	Comparison of Scapular Stabilizer Muscle Activity during PushUp Plus on the Static Ground and on the Unstable Ground Condition in Subject with Scapular alata <i>Ji-won Kim and Byeong-Ho Jeong</i>	243-248
37	Effects of the Pelvic Control Strategy on Trunk and Hip Extensor Muscle Activity during Leg Lift Task in Prone Position in Person who has Lumbar Spine Uncontrolled Movement Patterns <i>Ji-won Kim and Byeong-Ho Jeong</i>	249-255
38	Korean Dental Hygienists' Perceptions of Antismoking Intervention Activities and Obstructive Factors <i>Ji-Hye Han and Sung-Suk Bae</i>	256-262
39	The Effects of Interval Walking Training on Serum Cytokines and Insulin Resistance <i>Beak, Soon-Gi and Kim, Do-Jin</i>	263-267
40	Development of Smart Checking System for the Balance Anesthesia Detection <i>Bong-Hyun Kim and Yong-Sung Suh</i>	268-274
41	Characteristics of Intentional Acute Drug Intoxication Patients in Emergency Medical Center <i>Ye-Jin Han and Hong-Ryang Jung</i>	275-281
42	A Study on the National Vaccination of Infants Under 3 Age <i>Jeong-Hee Kim, Cheong-Hwan Lim, Ok-Ja Jang, Hong-Ryang Jung and Ki-Jeong Kim</i>	282-286
43	Mediating Effect of Subjective Health Status In Relation between Stress and Health-Related Quality of Life <i>Kyoungho Choi</i>	287-292
44	The Effect of Reducing Exposure Dose in Neurocranium Angiography CT Scan based on 3D Computer Image Processing <i>Chang-Gyu Kim</i>	293-298

45	A Study on the Food Hygiene Knowledge, Attitude, and Practice of Directors and Teachers in the Home Day Care Centers <i>Joo-eun Lee</i>	299-306
46	An Investigation of Self-Evaluated Performance on Foodservice Management among Directors and Teachers in Home Day Care Centers <i>Joo-eun Lee</i>	307-314
47	Influences of Patient-Healthcare Provider Communication and Diabetes Self-efficacy on Diabetes Self-Care Management <i>Yoon-Shin Hwang, Youngshin Song, Chi-Hye Kim, Kyeong-Hee Bossard and Keumok Park</i>	315-320
48	The Associations among Diabetes Exercise Self-Efficacy, the Needs for Exercise and Perceived Health Status in Patients with Diabetes <i>Keumok Park, Kawon Seo, Bohyun Kim, Yoonhee Lee, Ancho Lim and Youngshin Song</i>	321-326
49	Psychometric Properties of the Korean Version of Barriers to Insulin Treatment Scale <i>Hyunjin Lee, Heebum Yang, Yoonhee Lee, Ancho Lim and Youngshin Song</i>	327-332
50	Effect of Psychomotor and Art Therapy Program on the Children with ADHD <i>Dae-heon Moon, Bung-il Kang and Youn-tae Suh</i>	333-341
51	Factors Influencing Body Mass Index in the Elderly According to Hypertension Status <i>Young-Hee Kim and Myoung-Jin Kwon</i>	342-348
52	Effects of Physical and Psychological Factors on Stress in Patients with Hypertension <i>Myoung-Jin Kwon and Sung-Yun Ahn</i>	349-355
53	A Study on the Postpartum Depression after Delivery <i>Hyun-Jung Jang</i>	356-360
54	A Study on Reducing Exposure Dose of Radiographer Assistants during CT Scan of Injury Patients without Spontaneous Breath <i>Chang-Gyu Kim and Sun-Youl Seo</i>	361-367
55	An Efficient Healthcare Service Model Using IoT Device and RFID Technique in the Hospital Environment <i>Yoon-Su Jeong and Seung-Soo Shin</i>	368-380
56	The Effects of Gami-Shinkiwihan On Aging-Related Osteoporosis and Muscle Atrophy <i>Sun-Young Park, Ho-Hyun Kim, Ki-Bong Kim and Sang-Hyun Ahn</i>	381-388
57	Effect of Ankle Stabilization Exercise on the Balance of Ankle Instability Patients after Using Two Taping Methods <i>Bum-Chul Jung, Kyung-Tae Yoo, You-Na Woo and Hye-Ri Kim</i>	389-396
58	Evaluation on the Dose Distribution According to the Use of Flattening Filter(FF) or Flattening Filter Free(FFF) Portal Dosimetry in a Linear Accelerator <i>Gha-Jung Kim, Joon-Koo Choi, Geum-mun Back and Tae-Hyung Kim</i>	397-402
59	Effects of Communal Exercise with 'Parkinson Home Exercise' Application on Gait Ability for Parkinson's Disease Patients <i>Yunjin Park, Jaeho Yu, Younghwa Song, Ryng Hwang, Sungwon Kim, Hyunghun Moon, Sungki Lee, Sukyool Jung and Hyeyoung Cho</i>	403-408

60	Effect of MAD (Mandibular Advancement Device) on Obstructive Sleep Apnea and Quality of Sleep <i>Chung-Poong Hwang, Ka-Eun Kim, Soon-Kwon Park and Il-Young Cho</i>	409-416
61	Effect of a Combined Aerobic and Resistance Exercise Program on Cardiovascular Disease Risk Factors in Hypertensive Patients <i>Young-Ho Ko and Doug-Soo Shin</i>	417-425
62	Usefulness of Prophylactic Extraction 3rd Molar: A Case Report <i>Lim Kun Ok and Kam Ji Young</i>	426-430
63	The Development of Prevention System for Repeat Radiographs and Fall Accident by Patient Movement <i>Sinyoung Yu, Joonkoo Choi, Ghajung Kim, Joongseok Go, Seunggi Kim and Kwanghyun Chang</i>	431-437
64	Serf Architecture for the Transpose-Minify Framework Using Cloud Computing <i>Dr.M. Sunil Kumar and V. Abirami</i>	438-443
65	Improve Package Cohesion through Automization of Service Interface by Using Refactoring Approach <i>Dr.M. Sunil Kumar and T.N. Gayathri</i>	444-461
66	Evaluating the Unification and Refactoring Activities of Software Clones <i>Dr.M. Sunil Kumar and K. Kavya</i>	462-472
67	A Survey on Feast of Diverse Scheduling Techniques in Resource Management in Cloud Computing <i>P. Neelima and Dr.A. Rama Mohan Reddy</i>	473-478
68	N-Keyword Search over Efficient Encrypted ad hoc Mobile Cloud Data <i>K. Ravichandran and Dr.S. Saravana Kumar</i>	479-484
69	Bandwidth Recycling in Metropolitan Area Networks <i>B. Sangamithra and Dr.M. Sunil Kumar</i>	485-496



ISSN
0975-6299

Research on the Effect of Neuro Feedback Training on Academic Anxiety Progression of Middle School Student Using BCI (Brain Computer Interface)

Sang-Kyun Ahn*, Department of Neuroscience, Seoul University of Buddhism, Seoul, Korea. E-mail:askykhk@hanmail.net

Abstract---

Background/Objectives: This study was to examine the effectiveness of neuro feedback training by observing the pre and post brainwave measurement.

Methods/Statistical analysis: The study took place at neuro-training center B, in between the months of Jun. 2015 and Dec. First group which is different number of training from the date of each client's request by 40 times or more men decided.

Findings: Results of about 60 (experimental group 30, comparative group 30) subjects who have shown academic anxiety progression. As the brainwaves are adjusted by time series linear analysis. The result confirmed the differences of both activity quotient, emotion quotient and academic anxiety.

Improvements/Applications: The result of the study suggest neuro feedback technique's using BCI(Brain Computer Interface) possibility in positively affecting the subjects' academic anxiety progression.

Keywords--- Academic Anxiety, Activity Quotient, Brainwave, Emotion Quotient, Neuro Feedback.

**Corresponding Author*

Special Issue on "Medical Science"

I. INTRODUCTION

The focus is on the characteristics of the trends in education is a successful learner, and education leaders are not the ideal school life preparing for life's Interest for their emotions to cope with the test. A desirable direction of the potential learners by helping at a person's self-realization, various changes that the purpose of education in modern society Formed right educational growth of teenagers who grew up as a guide involved to get out I will say that it is very important¹.

The reality of our country today schooling is poor physical environment and entrance of excessive burden on students in the entrance examination competition and pressure to do about the study And already suffering so much schoolwork anxiety, adjustment problems have emerged on what many ways². In particular, adolescence is growing as a transitional phase from childhood to adulthood, many changes have been sharply in physical development as well as psychological development to exist³.

The adolescent brain is because I can do it with plenty of potential changes in value and potential of the study is very high.

In particular, soon the development of adolescent mental characteristics of a sense of self identity and self-esteem go look for a transitional time⁴.

Theoretical premise of this study is characterize brain of adolescents and appropriate experience by providing education to be successful for hotness level.

Closely associated with anxiety and adjustment in our daily lives because adaptation aspects of the vary depending on individual's level of anxiety and serious physical and mental health Affecting the behavior may be present in a problem⁵.

Academic skills responding effectively to instability have not developed sufficiently in adolescents, many amateurish way of the possibility of prepared. But academic anxiety problems both for teens to receive behavior, nor, I can't say he showed up in such a way as how to deal with situations that emerge from unrest Results are different⁶.

Recently, along with the use to the bci technology, citing bci is now actively being studied with a variety of infrastructure technology.

Also applied sports psychology, psychology skills training in the field of study and an objective methodology for measuring bci to optimizing the use and other studied be useful as a tool for analysis and training, important, bci applications shows that we could.

Academic anxiety being discussed about a variety of approaches to the neuro feedback in this study of research using space technology is being the case without feedback. To train effective it can be scientifically proven actual aim to be addressed through an experiment. To measure neural impulses and training before and after the differences through an objective and to reach the results in such a way that the neuroscience of brain function.

II. THEORETICAL BACKGROUND AND THE RESEARCH METHODS

Neuro feedback is, alias called EEG biofeedback and feedback is associated with the function that we can not control ourselves by the body did we find information I gave you the information that we were turned, I can't control or control functions that can not be adjustable in a manner that is to year. Neuro feedback homeostasis of the brain uses brainwaves to the principles of feedback out of control in the brain, enhances improve skills, i.e. his brain plasticity see, hear, and training themselves feel⁷.

Called brain waves into electrical signals generated when information is exchanged between the brain tissue. Activities of the brain or brain waves and active have important information that shows, and the states of consciousness and mental activity to vary according to a certain pattern. The brain waves on the human brain is like as shown in table 1.

To measure neural impulses, objective, a sequence, simply to continuous brain function that can be assessed in real time the state very best can be replaced by the neuroscience of tests⁸.

Table 1: Type and Characteristics of Brain Wave

brainwave type	state	A wavelength range	Consciousness
delta(δ)wave	↑ Slow wave	0.1 - 3 Hz	deep sleep, abnormal brain
theta(θ)wave		4 - 7 Hz	sleep state
alpha(α)wave		8 - 12 Hz	relaxation and rest conditions
SMR		12 - 15 Hz	state condition
low beta(β)wave	Fast wave ↓	16 - 20 Hz	concentration, Activities
high beta(β)wave		21 - 30 Hz	state of tension, stress

Brain function analysis developed in the Korea Institute of psychiatry program, bq test, using the angular spectrum band usage analysis obtained by the ratio of brainwaves measured by numbers Factors as the functions of the brain in a comprehensive index to assess brain quotient⁹.

In this study, using frequency spectrum analysis series by interconnections between existing independent analysis of the band are to identify about fast wave, and slow wave Such as slow wave and about fast wave a time-series analysis instead of simply to security of materials and the disadvantage of not a closer analysis or power that relies only on existing spectrum Than analysis method a variety of information¹⁰.

Using the index took on the brain dysfunction, purpose or under the scope of application can used as optional. Used in this study index is like as shown in table 2.

Table 2: The Characteristics of Brain Quotient by Brain Wave Measurement

brain quotient	mean
activity quotient(ACQ)	active decision of the brain
emotion quotient(EQ)	brain's emotional balance estimate

Learner's overall anxiety academic coursework that relate to face in everyday life of concerns about the threat posed, strain, anxiety, and other emotional responses Classes for achievements, made by worries the entire academic anxiety about speaking in a similar nature.

Neuro feedback on training junior high school students ' schoolwork anxiety this study to analyse the effect of Pirce postwar design a similar experimental research. Roman feedback training, and dependent variables are independent variables activity quotient, emotion quotient and academic anxiety test paper. Research design is like as shown in table 3.

Table 3: Research Design

	pretest	neuro-feedback	posttest
EG	Ye1	x	Ye2
CG	Yc1		Yc2

xneuro-feedback training

Until December 2012 in June 2012, b (group 30, 30, contrast) 60 client visiting academic anxiety and improve the training center of the brain neuro feedback by examining their brain waves of feedback The training was trying to see in the brain function before and after training, academic anxiety.

First group which is different number of training from the date of each client's request by 40 times or more parties after six months after his death, primary, a talk, in the control group, dictionaries, brain waves, measured in comparison. Studied for a distribution is as shown in the table 4.

Table 4: Detailed Distribution of the Subjects

	Experimental Groups	Control Groups
man	16	15
woman	14	15
total	30	30

2 of this measurement tools developed on 'Korea Institute of psychiatry' used in the study, channel system mobile measuring machine be installed on your computer brain waves. Roman feedback system of spectrum amplitude of each program as the bullet passing through the Analysis (fast : fft Fourier transform) pyurie to save the century. The strength of the amplitude voltage used for (μ v) activity also was used as a (activity) price. Korea Institute of psychiatry (feedback – neuro system ,brain tech corp, korea.) developed in Neuro, dry electrode lead, earlobes, the system are met with better to know really know much feedback supply that injured Brain wave scale, grass system of the value of alpha, beta, theta wave at the mercy of brain waves and (USA) correlation coefficient of .916 is proven reliability as it was revealed ($p < .001$)¹¹.

Academic anxiety test tool yujae chung (2000) correction it by reconfiguring the questionnaire based on the results of research. A total of 25 questions, and five points likert scale rating scale consists of. Appeared to cronbach's α .692 of this testing tool¹².

B the training center of the brain is a militant training camp, Neuro feedback system on a computer equipped with an apparatus. Three times a week, one time training is carried out in 40 minutes, and training method, head band attached to the forehead to come in the middle, tofu in a series fpz, or electrode of parts in the head reference electrode in tying the appropriate century left earlobes to install, and then plug headphones. After first breath take comfort from the order training carried out a 'to make a cup' game, and by tension relaxation training, and then with attention training 'archery' my planet 'It was put together by' to remember games. In a comfortable position with precautions made it to minimize movements¹³.

Statistical data coding process (data coding) for processing data collected in this study, spss, through the (statistical package for social science) v, regulated at 21.0 statistics using the program package Analysis. Roman feedback training before and after the change differences between groups of covariance analysis of all the materials used , and the mean and standard deviation calculations. The statistical significance level of data * $p < .05$, ** $p < .01$, *** $p < .001$.

III. RESULTS

As a result of covariance analysis just as it has been table 5, with activity quotient is the ($F=6.616, p = .013$) and ($F = 14.386, p = .000$) the right seemed to have a meaningful difference in emotion quotient($F = 6.795, p = .012$).

Table 5: Activity Quotient, Emotion Quotient ANCOVA

	Type III SS	df	mean square	F	p
ACQ left	5233.381	1	5233.381	28.480	.000
neuro-feedback	1215.816	1	1215.816	6.616	.013*
ACQ right	5956.195	1	5956.195	41.305	.000
neuro-feedback	2074.491	1	2074.491	14.386	.000***
EQ	75.032	1	75.032	4.659	.035
neuro-feedback	109.423	1	109.423	6.795	.012*

* $p < .05$, ** $p < .01$, *** $p < .001$

Two groups of activity quotient, emotion quotient of average score is equal to table 6 after training, coordinated and standard deviation.

Table 6: Comparison of M, SD, Between Experimental and Control Groups

variable	Group	before		after		after adjustment	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
ACQ left	EG	67.09	16.84	67.42	19.20	66.68	2.48
	CG	64.12	21.23	56.91	13.16	57.65	2.48
ACQ right	EG	66.92	15.93	68.71	17.34	68.28	2.19
	CG	65.38	20.51	56.09	13.71	56.51	2.19
EQ	EG	79.24	5.29	81.95	5.00	82.02	.733
	CG	79.91	5.37	79.39	3.04	79.31	.733

As a result of an analysis of covariance neuro feedback with table 7 appeared to have a meaningful difference in ($F = 11.097$, $p = .002$) and it is differences between groups before and after training in the group academic unrest is meant to be improved.

Table 7: Academic Anxiety ANCOVA

	Type III SS	df	mean square	<i>F</i>	<i>p</i>
Academic Anxiety	61.456	1	61.456	4.763	.033
neuro-feedback	143.169	1	143.169	11.097	.002**

* $p < .05$, ** $p < .01$

Average score was table 8 after training, coordinated and standard deviation and two sets of academic anxiety.

Table 8: Comparison of M, SD, Between Experimental and Control Groups

variable	Group	before		after		after adjustment	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Academic Anxiety	EG	31.47	4.69	34.17	3.69	34.08	.66
	CG	30.77	3.92	30.90	3.73	30.98	.66

IV. CONCLUSIONS AND DISCUSSIONS

In this research, a group of middle school students and neuro feedback to measure the electrical pulses to improve certain regions of the brain function, to train and instability can you improve their work research and analysis to see the real world experiment, said. The research results as follows :First, neuro feedback training given to the group that supports the hypothesis that there would be a difference in activity quotient, emotion quotient. Second, the training given to feedback neuro group supports the hypothesis is that it may be the difference is academic anxiety test site.

Activity quotient is alpha (α) beta (β) about the wave green onion of work of brain activity as alpha (α) of the right hemisphere and the left wing, and indicators that reflect the activity and low(β) beta wave activity quotient, indicating a degree and overall relationship between the right side and the right or left active mental activities and thinking skills and behavioral tendencies used as index to judge¹⁴. Activity quotient values are relative strength and absolute strength, logarithmic, much determined by compiling the comparison and arithmetic. High levels of activity than changed existing learning routine tasks that the new situation and existing response to creativity and reshaping and transforming experience meaning that cognitive functions are associated with govs.

Emotion quotient is emotional stability and Alpha (α) between the right side and the right or left by factors that represents the wave amplitude of differences and can save by an interconnection¹⁵. To judge emotion quotient the inclination of playful and melancholy, means gay has a high alpha (α) wing of the century to the right side, and orientation is the left side is relatively depressed strength of alpha (α) Farr says a high Emotional state and joy, many, a lot of energy occurred when she was playful, positive but correct reason and judgment and consideration for other people, while sentiment has depression, negative his shyness, anxiety, anxiety appears when depression, guilt, depression, also have a sense of inferiority¹⁶.

In particular, characteristic of plasticity of the adolescent brain and ironic a synaptic plasticity caused by overproduction of the antics could obtain decisions to unpredictable and can too. Emotion quotient is emotionally balanced conditions and tendencies as index to see relevant change in the subsequent emotional stability, to maintain a balance and a feedback exercise previously believed. During adolescence, reported internal control that the more if emotional stability. In other words, a good test or perform a task well academically or when struggling for success when the cause or likely to turn his inner factors, such as strong I think this will end¹⁷.

Anxiety is a vague fear, driven by emotional or physically offensive condition that involve the emotion. That adolescents feel to anxiety and so on the types of anxiety that include test anxiety, anxiety, learning ability. These factors evaluated their ability test anxiety or fear you feel in special situations of concern, regarding, which showed physical, including both an emotional response. The change in emotion quotient indicates emotional stability and instability in the outcome of this study condition the adolescents feel that ways can solve the academic malaise current topics¹⁸. In addition, all over the asymmetry frontal lobe brain waves sentiment indicator that reflects the differences in the trend change in emotion quotient lower its malaise, control will improve capacity. We believe.

As a store and a limit of the study notes, first, the target areas with limited targeted when I for to generalize, throughout the research resulting limited with benefits, lack of. Second, studies can be represented by a variety of approaches will have to and research data will need to be required to be the scale. Third, If yes, a case which is much applying the findings of study according to the number of training guide You think he can be in post management. Further research be helpful to the research guidelines is hoped for.

REFERENCES

- [1] D. H. Kim. The influence of self-regulation ability stress and emotional intelligence upon learning motivation patterns. *Unpublished Doctoral Dissertation, Kwandong University*, 2008.
- [2] Punitha A, Kalaiselvi GM. Driver eye state detection using minimum intensity projection - An application to driver fatigue alertness. *Indian Journal of Science and Technology*. 2015 Aug; 8(17):1-9.
- [3] E. S. Jung. On relationship between middle school students' stress and anxiety from schoolwork and their PSTR responses. *Yeungnam University*, 2007.
- [4] J. Y. Park. A study on the development and the effects of self-directed learning model by project method", *Unpublished Doctoral Dissertation, Kwandong University*, 2008.
- [5] Kanniga E, Selvamarathnam K, Sundararajan M. Embedded control using mems sensor with voice command and CCTV camera. *Indian Journal of Science and Technology*. 2013 Sep; 6(6):4794-6.
- [6] H. W. Weon. A study on the effect of neuro feedback training on the hemispheric asymmetry of brain & scholastic achievement. *Unpublished Doctoral Dissertation, Seoul Venture and Information University*, 2008.
- [7] Mahalakshmi S, Velmurugan T. Detection of brain tumor by particle swarm optimization using image

- segmentation. *Indian Journal of Science and Technology*. 2015 Sep; 8(22):1-7.
- [8] D. S. Kim, C. O. Choi. Electroencephalogram. Korean Medical Book Publishing Company: Seoul, 2001.
- [9] P. W. Park. Foundation of neurofeedback. Korea Research Institute Jungshin Science: Seoul, 2005.
- [10] Rani BJA, Umamakeswari A. Electroencephalogram-based Brain Controlled Robotic Wheelchair. *Indian Journal of Science and Technology*. 2015 May; 8(9):188-97.
- [11] Y. J. Kim. Development of brain circulation learning model based on EEG analysis of learning activities. *Unpublished Doctoral Dissertation, Seoul National University*, 2000.
- [12] Somassoundaram T, Subramaniam NP. High performance angiogram sequence compression using 2D bi-orthogonal multi wavelet and hybrid SPIHT-DEFLATE algorithm. *Indian Journal of Science and Technology*. 2015 Jul; 8(14):1-6.
- [13] Khoobjo E. New Hybrid Approach to Control the Arm of Flexible Robots by using Neural Networks, Fuzzy Algorithms and Particle Swarm Optimization Algorithm. *Indian Journal of Science and Technology*. 2015 Dec; 8(35):1-5.
- [14] Wonjae Choi, Seungwon Lee, Junhyuck Park. EEG-biofeedback Intervention Improves balance in Stroke Survivor. *Indian Journal of Science and Technology*. 2015 Aug; 8(18):1-6.
- [15] S. K. Sutton, R. I. Davidson. Prefrontal brain a symmetry: A biological substrate of the behavioral approach and inhibition system. *Psychological Science*. 1997, 8, pp. 204-210.
- [16] S. K. Ahn. Research on the effect of prefrontal neuro feedback training on self control and learning motivation of adolescents. *Unpublished Doctoral Dissertation, Seoul University of Buddhism*, 2011.
- [17] K. J. Baik. A Study on the effects of neuro feedback training on the resistance stress of children. *The Korea Academia-Industrial Cooperation Society*. 2010, 11(3), pp. 1066-1071.
- [18] Tung Kai Xu, M. P. Paulraj. Aggressiveness Level Assessment using EEG Inter Channel Correlation Coefficients. *Indian Journal of Science and Technology*. 2015 Sep; 8(21):1-10.



ISSN
0975-6299

The Effects for Stress by SUKI Alternative Therapy

Soung-Kwang Yoon*, Mokpo Medical Rehabilitation Center Korea. E-mail:kpta06324@hanmail.net

Seong-Gyun Hong, Dept. Integrative Medicine of Nam Bu University. E-mail:brain@nambu.ac.kr

Abstract---

Objects: Modern peoples are enjoyed the various benefits of civilization, but they exposed to physical and mental stress in order to adapt to those changes. The purpose of this study is to know the brain stress changes through stimulate to the special muscle regions by the SUKI(Superficial Using Ki energy Instrument)alternative medicine techniques. The upper trapezius muscle trigger points make causing by multi-kinds of structural imbalances in the human body.

Methods/Statistical Analysis: SUKI stimulation region is an upper trapezius muscle points. That point is a chronic cervical pain and headaches. An electrical stimulation was then applied for 20 min. The Measurement in EEG activity were evaluated before application and 3 min following application therapy. Experimental time was performed 5 times in a week interval, according to the technique of the first method. All the data was analyzed with SPSS 22.0 for window program.

Findings: This study subject is a total 12 (female 6, male 6) with chronic neck pain (neck disability index more than 15), but without the medical diagnosis. The aim of this study was to find the impact of chronic neck pain and stress reduction SUKI stimulation via EEG analysis. SUKI stimulation region is an upper trapezius muscle points. That point is a chronic cervical pain and headaches. All the data was analyzed with SPSS 22.0 for window program. The results of comparing the before and after treatment using SUKI techniques, The points of Fp2, F3, F4 of EEG was showed a significant differences but Fp1, T3, T4, P3, P4 points did not showed. Therefore, It is need to continuous research in the future.

Improvements/Applications: Fp2 showed a 22.58 ± 2.51 compared to post a significant decrease from 24.33 ± 3.95 in the prior compress technique of SUKI after that before applying for the stress index in the area ($p < 0.05$). F3 in areas that were compared before and after compress technique of SUKI significant decrease from 21.98 ± 2.82 to 23.84 ± 4.32 in the prior post about the stress level ($p < 0.05$). F4 in comparison before and after compress technique of SUKI to stress in the area were significantly reduced to 21.48 ± 2.51 in the prior 26.28 ± 6.60 ($p < 0.05$).The result was that the SUKI alternative medicine techniques had a reduced effect for the some kind of brain stress.* $p < 0.049$, * $p < 0.042$, * $p < 0.019$

Keywords--- SUKI, Upper Trapezius Muscle, Stress, Trigger Point, Alternative Medicine.

*Corresponding Author

Special Issue on "Medical Science"

I. INTRODUCTION

Modern peoples are enjoy the economic and material prosperity with the development of cutting-edge science and industry but exposed the multi-stress in their lives as problems with side effects such as mental poverty, identity lacking, confusion of values to adapt the changes with a rapid growth and structural diversity of society¹.

This kinds of chronic and comprehensive responses by this stress accumulation had a negative impacts on physical activity and mental health^{2,3}. That gives effect a limiting factor to carry out the normal role as a community and family members.

Labour Organization of the United Nations (ILO)was reported "The stress is a newly kinds of global diseases". In Korea has suffered a 95% by stress of the nation's workers, America was reported 80% of the patients suffered relate with the stress disease⁴.

Stress is an influence of the environmental factors than the psychological factors, and the health conditions of the peoples which are not better exposure high levels of stress than the low levels of stress⁵.

When peoples get stress, the human body has showed an autonomicallysymptoms⁶that will occurs an increase the heart rate, and muscle tension, anxiety, fear, anger, etc⁷.

These symptoms can cause a serious systemic problem.

It occupies the highest frequency of the structural impact of the human body and the cause of stress is the tension of the muscles around the neck, including the upper trapezius muscle.

This is the cause of headache accompanied by neck and shoulder pain⁸.

Neurologically upper trapezius muscle is the innervation of accessory nerves there are two locations of trigger point.

Trigger point is to induce pain in the posterior and lateral cervical, occipital lower triangular region, zygomatic area, pains in the teeth, migraines or headaches, dizziness. It could be occurs especially stress⁹.

SUKI therapy is a kind of treatment to healing pain by stimulated the skin with a branch of alternative medicine therapy.

SUKI alternative medicine gives to adjust the electrical energy with negative energy(ying) of the human body regulate the autonomic nervous system and circulating stagnantKienergy¹⁰.

In¹¹ was reported that SUKI alternative medicine techniques was showed significantly reduced systolic and diastolic blood pressure in experimental research on effects for high blood pressure¹¹, In¹²SUKI alternative medicine techniques have been reported as effectiveness for pain and relax the muscle tensions in the impact study on pain of tennis elbow patients with muscle tone¹².

In¹³Sin Moon meridian point stimulation by SUKI alternative medicine therapy was reported that the impact Sin Moon meridian point stimulating for the research on EEG valid for positive EEG changes¹³.Others preview showed the effectiveness by SUKI with stimulated meridian point, foot reflex, Shin Soo meridian point etc.

This purpose of this study is to give a provide information for the some alternative medicine experts who has the specific well-being natural therapy(SUKI) with a control the superficial ki energy flow in the human body for the upper trapezius muscle trigger points.

That is useful for the maintaining body energy balance and offered more energetic and be able to make a happy life with comfortable and a stable life, health liveness for the modern peoples with stress.

II. THEORETICAL BACKGROUND

A. *SUKI(Superficial Using Ki Energy Instrument)*

SUKI alternative medicine is a kind of oriental energy therapy that could be control the flow of ki energy in the human body and it helps the circulation the blood flow with the functional stability and a harmony and balance of the autonomic nervous system(ANS) as like a relax therapy.

As a tool, that is designed for controlling the electrical energy flowing through the body surface. SUKI diameter is 2mm with a special metal material, 4mm Grip portion diameter, the entirely length is 65mm with cone type(ending region of SUKI).

SUKI alternative medicine is to activate the body's external and internal communication of electrical energy and promote recovery of physical and mental health.

SUKI technique is too simple without being affected by the location and all the alternative medicine that can be comfortably and effectively promote a group of the human body.

SUKI is a different therapy instrument. That has an advantage it could be accessed easily and securely, such as the public or professionals. In addition, when implemented in conjunction with other manual therapy show a strong synergistic effect.

When normally ki energy flow it can be help make a body communication and be free from the disease and can maintain a health condition for human body¹⁴.

Anatomical Study of the Upper Trapezius Muscle

Trapezius muscles is to originate from the occipital bone and cervical spine, thoracic spine and scapular and clavicle to insertion.

Trapezius muscles are covered the whole body of back and consist of upper trapezius, middle trapezius, lower trapezius section. It was located T6-T12 spine with latissimusdorsi muscle and it was located on the upper layer region of lower trapezius muscle.

The upper trapezius muscle innervated from 12th cranial nerve (accessory nerves) and that is sensitive to stress. The upper trapezius muscle is originate from external occipital protuberance, inner 1/3 regions of external occipital nuchal ligaments to insertion of outer 1/3 regions of clavicles.

It is a structurally involved in control the movements and anterior-posterior balance of the head and neck muscles and the rib cage

The upper trapezius muscle is rotation of opposite side of cervical, side flexion of cervical, extension of cervical, rotation of clavical, adduction and upward rotation of scapular.

The upper trapezius muscle (neck and shoulder) and a sterno-cleido-mastoideus muscles are wrapped in superficial fascia surrounding the entire neck.

Therefore, it should be considered to improve the functional region with a sterno-cleido-mastoideus muscle. Specially, when the last angle of rotation of cervical works together and if it has some kind of limitation of last angle that should be treatment both muscles¹⁵.

The upper trapezius muscle originate from the dorsal region of human body.

Sternocleidomastoideus muscle originates from the ventral region of body. That is the ventral muscle. These two muscles are the same time period by genetic and it wrapped superficial fascia with deltoid muscle, pectoralis major muscle, latissimusdorsi muscle.

The platysma fascia that creates a fold in the neck is located on the superficial fascia.

And so, when treatment the anterior neck adhesion (hyoid bone movement, hyoid bone treatment, dysphagia), neck fold and face it should consider with these relations.

A body types with a chronic cervical hyper extension occur limited the range of motions of cervical spine with hyper tension on the upper trapezius, splenius muscle, sub occipital muscles. And that makes a chronic headache, blood pressure, cerebrovascular diseases with entrapment of great occipital nerve and artery and it specially caused the stress and uncontrolled body temperature. That is the directly cause.

The mainly problems at the upper trapezius trigger points are two sites (Figure 1).

The trigger point occur the posterior ear pain, temporal pain, posterior lateral of cervical pain, lateral of posterior cervical, mastoid process, temples around, occipital pain, pain of molar, tension headache, and caused the dizziness.

The factors of activate to trigger point that cause by the leg length differences, pelvic asymmetry and hemi pelvis, short humerus, shoulder elevation, poor posture, hard pillows due to the asymmetric and bad habits of the skeleton posture imbalances¹⁶.

Muscle & Fascia Connection

The upper fibers of trapezius is connected functionally with an anterior deltoid fibers originate a third of the clavicle. A sub clavus muscle is located a superficial layer of upper trapezius and deep layer of anterior deltoid muscle.

And so the shortening of upper trapezius muscle gives effect an anterior deltoid muscle and subclavius muscle (originate clavicle to inserted ribs, its function has a clavicle immobilization and extension of rib cage when breath). It occurs some kind of symptoms related with breath and movements of clavicle.

Also the shortening of anterior deltoid fibers and clavicle region fibers of upper trapezius will cause abnormal movement of shoulder joint and it makes a chronic unstable humerus head in shoulder joint cavity by internal rotation of humerus.

The superficial layers of upper trapezius, sternocleidomastoideus connected with platysma fascia, deltoid fascia, pectoralis major fascia are immobilized to lateral septum that will be a facial asymmetry.

A prevertebral fascia locating inner upper trapezius muscle and supraspinatus muscle and levator scapula muscle, scalene muscle is connected with rib cage fascia which effects ribs cage.

A prevertebral fascia connected with covering the lungs and kidneys fascia focusing with trapezius fascia and when breathe both fascia has a movement together.

And so the problems of upper trapezius muscle gives effect limited to mobilization of lungs and kidneys fascia and internal organs and breath.

Upper trapezius muscle located 1-5th spinous process, nuchal ligament, an external occipital protuberance.

Also it connected with occipitalis, frontalis from occipital bones and that involved the forehead wrinkle, downward eyelids, changing Injung region and deformation of the nose.

Upper trapezius muscle tensions stimulate continuously to occipital protuberance and it can be causes of recurrent headaches and will be causing a deep muscle layer tensions same as semi spinals, sub occipital is muscle groups. It could be occurs a general symptoms with circulatory disturbance caused by headaches, limited of mobilization of dura matter, pressure of vertebral artery

Posture Consideration

The pelvic posterior tilting with a weakness of upper trapezius muscle, latissimus dorsi muscle, electospine muscle will increase the kyphos which is cause the hyper extension of upper cervical regions and chin. And an excessive tension of upper trapezius muscle will be limitation of rib cage and sternocleidoid joint.

And more, the limitation of movements of clavicle will be limited ROM of shoulder joints.

The limitation of movement of clavicle is effects to limited activities of subclavius muscle, cost ocoracoid membrane, fascia investing pectoralis, suspensory ligament of axilla, axillary fascia. And so it also considered when an axillary special treatment, chest treatment, frozen shoulder, limited shoulder joint exercises etc.

The weakness of one side upper trapezius will seems moved away between a same side acromion process to a cervical area and tilting head the opposite side and downed shoulder joint.

Also, the weakness of both side upper trapezius muscle will seems the acromion process located lower than 1th thorax and the downed shoulder will occurs a chronic fatigue of shoulder girdles , and it comes diminished extension of head and neck. The shortening of both upper trapezius will seems the acromion process located upper than 1th thorax and the upper scapula and acromion with a total shoulder girdle region and will be relaxed latissimus dorsi muscle, middle lower trapezius muscle.

Also the shortening of both upper trapezius muscle will seems a rounded shoulder conditions with upward arms, it occurs limited the mobilization of acromioclavicular joint and limited free glenohumeral joint movements.

A chronic scapula girdle movements limitation occurs the shortening of cervical region muscles.

That will be make an angled chin and wrinkled face. It also developed shortening a platysma fascia located same layers like anterior deltoid fascia and pectoralis minor fascia and if the shortening of a depressor angulioris muscle will be downed mouth angle.

EEG(Electroencephalogram)

EEG was first attempted by the neural physiologist Hans Berger germany, it means a potential measured by the electrode signals of the fine brain surface is shown an electrical signal generated in the synthesis of the cranial nerves.

That will amplify the brain to record electrical activity in the cerebral cortex nerve cell, the population analyzed the potential longitudinal axis and the horizontal axis indicates time.

Brain wave signal is specially changed in accordance with the static periods, at the time of brain activity or brain function measurement.

EEG has a brain wave signal with the essential process characteristic of the frequency bands, the characteristics in the time domain, the special characteristics associated with brain function for diagnosing the brain function and disability.

Brain wave has a frequency of 1~60Hz and amplitude of about 10 ~ 200 μV , brain waves are generated by a change in the electrical discharge of cortical neuronal membrane.

Types of brain waves are generally according to the frequency δ waves of 0.1-3Hz, θ waves of 4-7Hz, α wave of 8-13Hz, SMR wave of 12-15Hz, low β waves of 16-20, high β wave of 21-30Hz.

EEG δ wave sleep, a very slow time appears in a coma EEG looks at the case of newborns and infants, normal adult sleep.

However, even in infancy, the emergence and awakening corresponds to the wave of α in adult and newborn infant δ waves.

θ wave is dozing or asleep when a β wave appears, than four times at two times slower reflects a deep meditative state between wake and sleep. It appears more children than adults called border state of perception and dreams.

At this time, it also often the creative force looking at the images that accentuated in the past to decorate your fantasy seen as unrealistic and mystery fantastic condition and gives an idea of the difficulties faced for a long time troubleshooting¹⁷.

III. MATERIALS AND METHODS

A. Test Method

This study subject is a total 12 (female 6, male 6) with chronic neck pain (neck disability index more than 15), but without the medical diagnosis (Table 1).

Table 1: Characteristics of the Study Participants

Characteristic	n = 12
Age (years), mean (SD)	24 (2)
Height (cm), mean (SD)	166 (5)
Weight (Kg) , mean (SD)	62 (6)
Gender, n male/female(%)	6 (50)

M $\pm$ SD: Mean $\pm$ Standard deviation

The aim of this study was to find the impact of chronic neck pain and stress reduction SUKI stimulation via EEG analysis

SUKI stimulation region is an upper trapezius muscle points. That point is a chronic cervical pain and headaches. All the data was analyzed with SPSS 22.0 for window program.

- 1) Stimulation region: upper trapezius muscle's two trigger point.
- 2) Measurement: before application and 3min after the application therapy.
- 3) Experimental time: performed 5 times in a week interval, according to the technique of the first method.
- 4) Attaching the measuring electrodes for the study: Fp1, Fp2, T3, T4, P3, P4 International 10/20 electrode patch method on the head surface.
- 5) Reference electrode: A1 of the ground electrode was attached to the back ear.
- 6) Measurement for Trigger Point 1 (upper trapezius muscle) by EEG.
- 7) Measurement for Trigger Point 2 (upper trapezius muscle) by EEG.
- 8) EEG model: QEEG-8 / Telescan (LXE5208) program for the data collection and analysis.
- 9) Method: measured brain waves.
- 10) EEG measurement site: frontal lobe, temporal lobe, occipital lobe.
- 11) SUKI grip method: by using only thumb, digital 1, 2 were less than 20g.

IV. RESULT

A. Test Result

The data processing of the study the measurements of all items, using the SPSS 22.0 for window average (mean: M): was calculated as (standard deviation SD) and the standard deviation.

The whole subject was the Shapiro-Wilk normality. It was showed a validated general characteristics of the subjects which using descriptive statistics. It was carried out paired t- test to compare the difference before and after the point compress technique of SUKI of subjects, statistical significance was set at $p < .05$.

The stress level of the brain waves (before and after in research process) are as follows (Table 2).

Table 2: A compared of stress index between the pre-test and post-test in each area (Mean $\pm$ SD)

	Variables	Pre-test	Post-test	t	p
Stress	Fp1	25.47 $\pm$ 3.93	23.96 $\pm$ 2.49	1.915	.082
	Fp2	24.33 $\pm$ 3.95	22.58 $\pm$ 2.51	2.213	.049*
	F3	23.84 $\pm$ 4.32	21.98 $\pm$ 2.82	2.332	.042*
	F4	26.28 $\pm$ 6.60	21.48 $\pm$ 2.51	2.757	.019*
	T3	26.61 $\pm$ 5.27	25.13 $\pm$ 4.79	.645	.532
	T4	29.37 $\pm$ 6.49	27.22 $\pm$ 5.03	1.120	.287
	P3	24.19 $\pm$ 7.25	23.79 $\pm$ 7.07	.168	.870
	P4	23.66 $\pm$ 7.67	24.30 $\pm$ 7.86	-.234	.819

Fp2 showed a 22.58 ± 2.51 compared to post a significant decrease from 24.33 ± 3.95 in the prior compress technique of SUKI after that before applying for the stress index in the area ($p < 0.05$). F3 in areas that were compared before and after compress technique of SUKI significant decrease from 21.98 ± 2.82 to 23.84 ± 4.32 in the prior post about the stress level ($p < 0.05$). F4 in comparison before and after compress technique of SUKI to stress in the area were significantly reduced to 21.48 ± 2.51 in the prior 26.28 ± 6.60 ($p < 0.05$) (Table 2). In terms compress technique of SUKI were compared before and after the change, Fp2, F3, F4 in the area showed significant differences in the other five areas were no statistically significant differences ($p > 0.05$) (Table 2) (Figure 1 and figure 2).

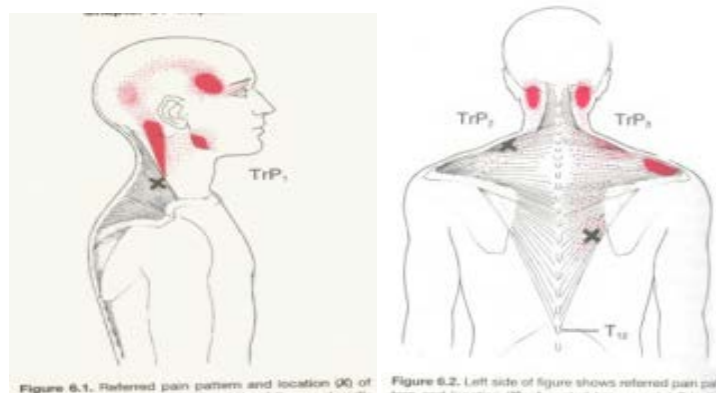
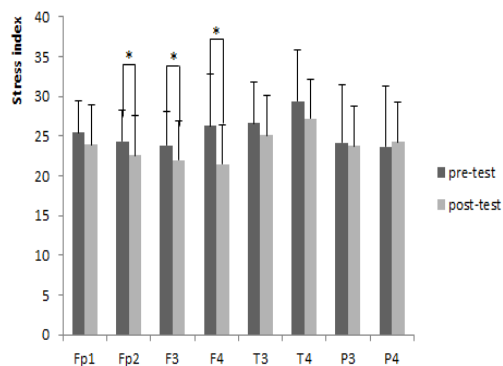


Figure 1: Upper Trapezius Muscle Trigger Point



* $p < 0.05$

Figure 2: Comparison of Stress Index Between Pre and Posttest in Each Area

V. DISCUSSION AND CONCLUSION

This study was designed for the effectiveness of SUKI alternative medicine therapy to the upper trapezius muscle trigger points pain by stress with "G" Metropolitan "N" university Students (over the neck disability index 15 points with female 6, male 6) of chronic pain in the neck.

The purpose of this study is to know the effects of changed brain waves of SUKI alternative medicines (pressure techniques) to stimulate the trigger points of upper trapezius muscle caused by the structural imbalances with stress.

The trigger points (No 1, No 2) of upper trapezius muscle is so sensitive from the stress and that is located upper trapezius muscle innervate by 11th accessory nerve of cranial nerves. The upper trapezius muscle surrounded by superficial muscle layer with sternocleidomastoideus muscle, pectoralis muscle, deltoids muscle, latissimus dorsi muscle.

And so that is a pain occurring muscles to the stress, headache, severe neck pain, shoulder joints, shoulder girdles. An upper trapezius muscle with a strong tensioning patterns easily showed mainly excessive mental and body postures tensions. It is sensitive the cold and overwork, fatigue which occurs the cold with failed body temperature control, it also evaluate control the temperature for human body.

Eastern and western medical approach and techniques for the treatment of muscles hyper tension and stress-related disorders of upper trapezius muscle pain is very diverse.

According to the results of ⁶. Reported by⁷, upper trapezius muscle tonus and shoulder pains with myofascial release therapy and stones therapy groups reduced.

In ⁸ was reported the experiment groups showed a significant difference in the effect for pain relieve of neck & shoulder muscle fascia pain syndromes by Meridian Scraping therapy.

And ⁹ was reported increased the muscle activities of experiment group's muscle activities in the effects for muscle activities with upper trapezius muscle fascia pain by TENS stimulation.

In previous studies, it has been widely used such as the alternative therapy interventions for the increasing leverage of healing therapy program.

It used mainly intervention ways like this : Yoga, Myofascial release therapy, Pilates, Stone therapy, CST, Massage, EDT, Stretching, EST, Meridian Scraping therapy etc.

These natural remedies are a trend that is increasing the frequency of using is proven.

In this study, to know the effect for brain stress by stimulating trigger points 1,2 in the upper trapezius muscles using SUKI alternative medicine therapy (affecting the stabilization of the autonomic nerve system through the conducting the energy flow).

The result is as follow.

Results of comparing the change before and after treatment with SUKI therapy FP1, Fp2, F3, F4, T3, T4, P3, the P4 8 region of Fp2, F3, F4 region showed a significant difference and others was showed no different.

Over the results of the present study findings and research as a linear, a various techniques and tools can be seen that it is being used in a variety of ways for effective healthcare.

Therefore, the study suggests that require the use of tools such SUKI in order to improve function through the muscles and fascia associated pain and stress reduction has the advantage that they can easily and securely access public science professionals.

REFERENCES

- [1] Jeong G H. stresses of college life on the psychological wellbeing effect: Focusing on Moderating Effect of Mindfulness, Sookmyung Women's University, Master's Thesis, 2011.
- [2] Gyeong G B. Stress and Psychosomatic Medicine (Second Edition) Seoul: Il Jo Gak, 2010.
- [3] Min W J, woo B J, Young L J. Development of the concept and mental health promotion, Korea Nerve Psychiatric Association, 2010, 49 (2), pp.163-70.
- [4] Suk J J. The effects of the Stress and the Balance for Left & Right Scapula with the Craniosacral Therapy, Daejon University Master's Thesis, 2012.

- [5] Sanderson CA. Moderation and Mediation of HIV-Prevention Interventions: Relationship St, 2006.
- [6] Jin O S, hee K Y, song K C, il K H, sik S M, min Y G, gyu Y D, hang L Y, han L J, il LJ, yeon J T, suk H J. Human behavior and psychology, 3rd (edn.), Seoul : hakjisa, 2014.
- [7] Seok K K, jong B, yeon B B, gil K S, youn H G. Firefighters are on depression and fatigue of the Korea Contents Association, 2014, 14 (3), pp. 203-23.
- [8] Jung K Y. A study on job stress and coping patterns of ICU nurses, Hanyang University Master's Thesis, 2006.
- [9] Kwang Y S. Muscles management program effects, Health Nambu University doctoral dissertation on the neck dysfunction and emotional indicators of chronic neck pain patients, 2013.
- [10] Gyun H S. SUKI Alternative Medicine Part 1 Gwangju: Pan rider, pp.1-14, pp.111- 117, 2010.
- [11] Ja B B. The effects on high blood pressure by SUKI alternative medicine techniques Nambu University Graduate School of Health Management Master's Thesis, 2011.
- [12] Jun B S. SUKI alternative medicine techniques and pain of tennis elbow patients muscle tone effects, Master thesis in the University of Nambu, 2011.
- [13] Hwan S J, The EEG Sin moon meridian point stimulation by SUKI alternative medicine therapies impact, in numerous leading articles such as southern University Master's Thesis, 2014.
- [14] Gyun H S. SUKI Alternative Medicine, Part 2 Seoul: Bumdusa, 2010.
- [15] Kwang Y S. Effect the muscles Management Program on sentiment indicators and the Neck Disability Index of chronic neck pain patients, Nambu University Master's Thesis, 2013.
- [16] Young moon S. Travel & Simons, My ofascial Pain and Dysfunction the Trigger Point Manual, Publisher, 2007.
- [17] Jun B S. SUKI alternative medicine therapy relaxes the stress / arousal effects on brain activity, South University doctoral dissertation, 2013.



ISSN
0975-6299

Factors Associated with Diabetes Self-Efficacy among Koreans

Kawoun Seo, Doctoral Course, College of Nursing, Chungnam University, Munhwa 1-dong, Jung-gu, Daejeon, Republic of Korea. E-mail:ania24@naver.com

Kemok, Doctoral Course, College of Nursing, Chungnam University, Munhwa 1-dong, Jung-gu, Daejeon, Republic of Korea. E-mail:epepk@naver.com

Bohyun Kim, Master's Course, College of Nursing, Chungnam University, Munhwa 1-dong, Jung-gu, Daejeon, Republic of Korea. E-mail:bhkim@cnu.ac.kr

Youngshin Song*, Associate Professor, College of Nursing, Chungnam University, Munhwa 1-dong, Jung-gu, Daejeon, Republic of Korea. E-mail:yssong87@cnu.ac.kr

Abstract---

Background/Objectives: This study was designed to investigate the effects of the communication competence of and support from health care providers on the diabetes self-efficacy of Korean patients.

Methods/Statistical Analysis: A cross-sectional descriptive study was conducted. The 303 study participants were recruited from among all diabetes patients who were endocrinology outpatients of C University Hospital. The data analysis included measurements of descriptive statistics, Pearson's correlation coefficients, and multivariate analysis using SPSS 22.0. The three models extracted during the hierarchical regression analysis were tested to determine the predictors of diabetes self-efficacy.

Findings: The findings showed positive associations among health care provider communication, support from health care providers, and diabetes self-efficacy. In the first model, personal factors such as age and religion were significant and accounted for 2.4% of the variance, whereas age, religion, admission experiences, and diabetes education were the key factors in the second model, accounting for 6.9% of the variance. Finally, when personal factors, health care provider communication, and support from health care providers were entered into the final model, having a spouse ($\beta = -.123$, $p = .040$), strong religious beliefs ($\beta = .142$, $p = .018$), and support from health care providers were all significant. This final model, which included both personal factors and main variables, accounted for 15.6% of the variance.

Improvements/Applications: Support from health care providers was an important factor in diabetes self-efficacy. Therefore, health care providers should make efforts to more fully understand the factors influencing patients' self-efficacy in diabetes management, and provide support thereof.

Keywords--- Diabetes Mellitus, Self-Efficacy, Health Care Provider, Support, Communication.

**Corresponding Author*

Special Issue on "Medical Science"

I. INTRODUCTION

More than 1 out of 10 (11.1%) Korean adults over the age of 30 have diabetes. As such, diabetes is one of the most significant chronic diseases in the nation¹. Diabetes is a chronic metabolic disease that is especially difficult to cure, because it is not always easy for patients to maintain optimal blood glucose levels in their daily lives². To prevent diabetes complications, health care providers have recently tried to maximize their efforts to maintain patients' appropriate blood sugar levels³.

Diabetes management may depend on patients' abilities to self-manage their condition⁴. However, many patients with diabetes do not have the necessary knowledge and skills required for diabetes control and prevention, thus necessitating health care provider support². Such support may enhance individuals' confidence concerning health care, including their self-efficacy and their ability successfully complete a variety of health-related actions⁵. The American Association of Diabetes Educators [AADE] has proposed that self-efficacy is necessary for patients to perform self-care behaviors, and its role is to play the antecedent in patients' forming of diabetes self-management behaviors. According to Bandura⁶, self-efficacy is the belief that individuals can successfully change something within themselves that will enable them to perform particular behaviors. For the successful control of blood sugar in patients with diabetes, lifestyle changes performed on the basis of self-efficacy are necessary, because self-efficacy may be responsible for organizing and executing these lifestyle changes⁷. In addition, self-efficacy influences the degree of susceptibility to perform diabetes self-care and diabetes-related physiological indicators such as hemoglobin A1c⁸⁻¹⁰. Health care providers can aid in enhancing diabetes self-efficacy by using proper communication¹¹. A study by Wardian and Sun¹⁰ showed a high correlation between patients' diabetes self-efficacy and health care provider support. Moreover, Sarkar et al.¹² reported that 40% of subjects who communicated better with their health care providers had better control over their diabetes.

Therefore, it should be useful to investigate the relationship between the degree of health care provider (HCP) communication, HCP support, and diabetes self-efficacy in promoting self-management. The purpose of this study was to identify the factors such as HCP communication and support from HCPs associated with diabetes self-efficacy for Korean patients.

II. METHODS

A. Study Design and Sample

This descriptive cross-sectional study examined the effect of HCP communication and support from HCPs on diabetes self-efficacy. The participants of this study were recruited from among endocrinology outpatients of C university hospital in D city, who voluntarily agreed to participate. A total of 340 subjects responded to a self-report questionnaire; the response rate was 87%. Among these, 37 questionnaires were excluded from the analysis because of insufficient data. Thus, 303 questionnaire responses were analyzed in total.

B. Measurement

Self-efficacy was measured using Rapley, Passmore & Phillips's (2003) Diabetes Self-efficacy Scale (DSES)¹³. This tool consists of 5 subscales: diet (3 items), self-treatment (5 items), routines (4 items), certainty (4 items), and exercise (2 items), all assessed with a six-point Likert scale. Higher DSES scores indicate greater diabetes self-efficacy. The reliability of the original DSES was a Cronbach's alpha score of 0.61-0.76¹⁴. In this study, the reliability was 0.64-0.87.

Communication with HCP was measured using the Korean version of the Interpersonal Processes of Care Survey (ICP-12K). The ICP-12K consists of 12 items across two subdomains, such as HCP and HCP helper, which address communication, decision-making, and interpersonal style choices over the past 12 months. Responses to this tool are made using a five-point Likert scale; higher scores indicated more effective communication with the HCP. The reliability of the ICP-12K in this study was a Cronbach's alpha measurement of 0.90.

HCP support was measured using the Diabetes Care Profile (DSP)¹². The DSP consists of 2 facets (social support needs: i.e., "How much support will you need from the HCP in the future?"; and receipt of social support: "How much support do you currently receive from the HCP?"), each made up of 6 types of diabetes tasks with responses made using a five-point Likert scale. Higher DSP scores indicate greater HCP support. Its reliability was Cronbach's alpha = 0.82 - 0.91 for this study.

C. Statistical Analysis

Descriptive statistics, Pearson's correlation r , and multivariate analysis were performed using the IBM SPSS Statistics 22.0 program. Sample characteristics was summarized using frequency, percentages, means, and standard deviations. Diabetes self-efficacy, HCP communication, and support from HCP were analyzed using a t-test and ANOVA with Scheffe's test, in accordance with the demographic information. A hierarchical multiple regression was conducted to examine the predictors of diabetes self-efficacy. Model 1 included personal factors such as sex, age, religion, educational level, and having a spouse. Model 2 added health conditions such as depression, HbA1c, admission experiences, alternative therapies, diabetes education experiences, and number of diabetes complications. HCP communication and support were then entered into Model 3 as predictors of diabetes self-efficacy.

The statistical significance level was determined to be $\alpha = 0.05$.

D. Ethical Considerations

All study procedures were approved by the C University's Institutional Review Board (IRB No.2-1046881-A-N-01-201410-HR-046). Before the survey was conducted, the participants listened to an explanation of the study's purpose, procedure, benefits, potential harm to the patients, confidentiality, and full details concerning the participants' rights, and they provided their written informed consent. After they completed the questionnaire, they received \$10.

III. RESULTS

A. Sample Characteristics

The study subjects' general characteristics are summarized in Table 1. The study subjects consisted of 165 men (54.5%) and 138 women (45.5%). Their average age was 59.87 (± 12.61) years. About 37% of them had graduated from high school, and 248 participants (82.2%) had a spouse. Among all subjects, 118 (38.9%) had religious beliefs, while 185 (61.1%) had none. Most subjects did not have any experience of depression (89.8%) or hospitalization (84.2%).

The average serum HbA1c level was lower than 7.5% for 162 (60.7%) patients.

One hundred forty patients (46.2%) had received some diabetes education, whereas 153 patients (53.8%) had not received any.

Table 1: General Characteristics of Participants (N=303)

Variables	n or Mean		(%) or $\pm$ SD
Gender	Male	165	54.5%
	Female	138	45.5%
Age, years		59.87	± 12.61
Education level	Illiteracy	14	4.6
	Elementary	42	13.9
	Middle school	55	18.2
	High school	111	36.6
	more	81	26.7
Having spouse	Yes	249	82.2
	No	54	17.8
Having religion	Yes	118	38.9
	No	185	61.1
Having depression	Yes	31	10.2
	No	272	89.8
HbA1c	Less than 7.5	162	60.7
	More than 7.5	105	39.3
Experience of admission	Yes	48	15.8
	No	255	84.2
Alternative therapy	Yes	77	25.4
	No	226	74.6
Experience of diabetes education	Yes	140	46.2
	No	163	53.8
Number of complication		1.20	± 1.52

B. Descriptive Statistics Concerning Diabetes Self-efficacy, HCP Communication, and Support from HCP

The mean scores of diabetes self-efficacy (71.96 ± 14.70 , ranging from 18 to 108) HCP communication (59.63 ± 10.06 , ranging from 12 to 60), and support from the HCP (21.58 ± 5.46 , ranging from 6 to 30) are presented in Table 2.

Table 2: Diabetes Self-Efficacy, HCP Communication, and Support from HCP

Variables	Mean	$\pm$ SD	Min	Max	Range
Diabetes self-efficacy	71.96	± 14.70	18	108	18~108
HCP communication	59.63	± 10.06	33	75	12~ 60
Support from HCP	21.58	± 5.46	6	30	6~ 30

C. Correlations Between HCP Communication, Support from HCP, and Diabetes Self-Efficacy

The correlational r -values between the HCP communication, support from the HCP, and diabetes self-efficacy variables are shown in Table 3.

HCP communication was positively correlated with HCP support ($r = .424$, $p < .001$) and diabetes self-efficacy ($r = .218$, $p < .001$). Moreover, HCP support and diabetes self-efficacy were positively correlated ($r = .331$, $p < .001$).

Table 3: Correlation among HCP Communication, Support of HCP, and Diabetes Self-Efficacy (N=303)

Variables	1	2	3
1. HCP communication	1		
2. Support from HCP	0.424($p < .001$)	1	
3. Diabetes self-efficacy	0.218($p < .001$)	0.331($p < .001$)	1

D. Factors Associated with Diabetes Self-Efficacy

The results obtained from a hierarchical regression model for diabetes self-efficacy are presented in Table 4.

Personal factors, including demographic information, were entered into Model 1, and the regression equations were significant ($F = 2.331$, $p = .043$). The explanatory power for diabetes self-efficacy was 2.4%. Age ($\beta = .132$, $p = .054$) and religious beliefs ($\beta = .130$, $p = .040$) were significant predictors of diabetes self-efficacy in this model.

When health condition was added in Model 2, the regression equations were still significant ($F = 2.787$, $p = .002$). Age ($\beta = .137$, $p = .043$) and religious beliefs ($\beta = .144$, $p = .022$) remained as predictors. Additionally, diabetes education experiences ($\beta = -.167$, $p = .006$) were significant variables in Model 2, and accounted for 6.8% of the variance in the other variables.

Finally, HCP communication and support was entered into Model 3; therefore, Model 3 was significantly altered ($F = 4.768$, $p < .001$). Support from the HCP ($\beta = .258$, $p < .001$) was observed to be a strong predictor of diabetes self-efficacy.

Moreover, having a spouse ($\beta = -.123$, $p = .040$) or religious beliefs ($\beta = .142$, $p = .018$), as well as complication numbers ($\beta = -.113$, $p = .054$) were significant predictors in the last model, accounting for 15.6% of the variance.

Table 4: Hierarchical Regression Models Examining the Association of Diabetes Self-Efficacy

Model	β	t	p	Adjusted R ²	F(p)
Model 1 (constant)		8.047	.000	0.024	2.331(.043)
Sex (1=female, 0=male)	-.060	-.928	.354		
Age	.132	1.933	.054		
Education level	.093	1.347	.179		
Having spouse (1=yes, 0=no)	-.079	-1.262	.208		
Having religion (1=yes, 0=no)	.130	2.064	.040		
Model 2 (constant)		5.436	.000	0.069	2.787(.002)
Sex (1=male, 2=female)	-.090	-1.406	.161		
Age	.137	2.036	.043		
Education level	.045	.653	.514		
Having spouse (1=yes, 0=no)	-.114	-1.831	.068		
Having religion (1=yes, 0=no)	.144	2.299	.022		
Depression symptoms (1=yes, 0=no)	.106	1.746	.082		
HgA1c	-.044	-.723	.471		
Experience of admission (1=yes, 0=no)	.121	1.986	.048		
Alternative therapy (1=yes, 0=no)	-.068	-1.125	.262		
Experience of diabetes education (1=yes, 0=no)	-.167	-2.753	.006		
Number of complication	-.092	-1.512	.132		
Model 3 (constant)		3.375	.001	0.156	4.768(.000)
Sex (1=male, 2=female)	-.051	-.835	.405		
Age	.105	1.636	.103		
Education level	.024	.373	.709		
Having spouse (1=yes, 0=no)	-.123	-2.063	.040		
Having religion (1=yes, 0=no)	.141	2.372	.018		
Depression Symptoms (1=yes, 0=no)	.080	1.370	.172		
HgA1c	-.070	-1.199	.232		
Experience of admission (1=yes, 0=no)	.093	1.595	.112		
Alternative therapy (1=yes, 0=no)	-.055	-.949	.344		
Experience of diabetes education (1=yes, 0=no)	-.093	-1.566	.119		
Number of complication	-.113	-1.934	.054		
HCP communication	.104	1.658	.098		
Support from HCP	.258	3.981	.000		

HCP: Health Care Providers

IV. DISCUSSION & CONCLUSION

This study was designed to evaluate the impact of HCP communication and support from HCPs on diabetes self-efficacy. The present results demonstrated significant positive correlations among HCP communication, support from HCPs, and diabetes self-efficacy. These results were consistent with previous studies that mentioned significant associations among these three factors for diabetes management^{11,16}. However, in the multivariate analysis, HCP communication was not a predictor of diabetes self-efficacy, whereas support from the HCP was an important factor in the final model. HCP communication did not affect diabetes self-efficacy among Korean patients with diabetes. Possible reasons for these results can be inferred in terms of the Korean cultural health care environment. The patients could not easily communicate with their primary health care providers, because health care providers in Korea interview and treat their patients only for a limited time in clinics. In some cases, patients only get 3 minutes to see their doctors. This brief treatment time is not sufficient for encouraging self-efficacy in disease management among diabetes patients. Hence, diabetes education nurses tend to play a more important role in helping Korean diabetes patients manage their disease. Recently, hospital diabetes education nurses in Korea have begun conducting counseling and education for patients as diabetes management coordinators, and patients are generally satisfied with this arrangement^{11,14}. Since diabetes management within a health care setting changes along with patients' needs in terms of education and counseling, the patterns of communication between diabetes education nurses and patients should be explored further in future studies. Additionally, it will be necessary to consider the impact of HCP communication for diabetes self-efficacy based on the revealed patterns of communication.

Personal factors such as age and religion affected diabetes self-efficacy in this study. Patients who were older had greater diabetes self-efficacy. The mean age of the participants was about 60 years. In consideration of this, the higher score on the diabetes self-efficacy measurement may be atypical, because "aging" should have an adverse effect on the self-management capabilities of elderly diabetic patients. Jin and Chung¹⁶ reported that "aging" problems inherent in elderly diabetic management may lead to much compromise and resolve. Based on this result, diabetes management enhancement for the elderly should focus on improving diabetes self-efficacy. Moreover, in the final model, the presence of a spouse and religious beliefs were significant predictors of diabetes self-efficacy in our study. These two factors may have acted as sources of moral and social support for the diabetes patients. Rogers et al.¹⁷ classified the system of support as health professionals and non-health professionals, according to health-related and health-relevant functions. They grouped support systems into voluntary community groups and personal communities. The support received from spouses and religious belonging may function as a form of non-health professional support. Support from HCPs was also found to be an important predictor of diabetes self-efficacy as a health professional support system. From these findings, it can be inferred that combining both professional and non-professional support may enhance the self-efficacy of diabetes patients. Therefore, future studies should investigate the role of support obtained from various sources in constructing diabetes self-efficacy enhancing interventions.

ACKNOWLEDGMENT

The corresponding author, Y Song, was supported by the Mid-career Researcher Program through a National Research Foundation (NRF) grant, which is funded by the Ministry of Education, Science, and Technology (MEST) (NRF-2015R1A2A2A01002394).

REFERENCES

- [1] Devi, M. N., alias Balamurugan, A., Kris, M. R. (2016) Developing a modified logistic regression model for diabetes mellitus and identifying the important factors of type II DM. *Indian Journal of Science and Technology*, 2016 Jan., 9(4).
- [2] Yang, N. H., Park, J. K., Jung, Y. J., Yu, G. W., Ha, Y. J., Kim, Y. K. The effects of self-efficacy on the relationships between familial support and self-care of diabetes mellitus patients. *Korean Journal of human ecology*. 2008, 11(1), pp. 73-85.
- [3] Kim, H. S. The effects of elderly diabetic patients' self-care agency on their self-care behavior. *Indian Journal of Science and Technology*. 2016 May, 9(20). DOI:10.17485/ijst/2016/v9i20/94680.
- [4] Gu, Mee-ock.. A study of the relationship among self efficacy, self regulation, situational barriers and self care behavior in patients with diabetes mellitus. *Journal of Korean Academy of Nursing*. 1994 Dec., 24(4), pp. 635-51
- [5] Anderson, R. M., Funnell, M. M., Fitzgerald, J. T., & Marrero, D. G. The diabetes empowerment scale: A measure of psychosocial self-efficacy. *Diabetes care*. 2000 Jun., 23(6), pp. 739-43. <http://dx.doi.org/10.2337/diacare.23.6.739>
- [6] Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychological review*. 1978, 84(2), pp. 191-215
- [7] Keum, H. S., Suh, S. R. HbA1c, self-efficacy and self-care activities depending on the disease duration of type 2 diabetes mellitus patients. *Journal of the Korea contents association*. 2014 Dec., 14(12), pp. 303-12. <http://dx.doi.org/10.5392/JKCA.2014.14.12.303>
- [8] Sacco, W. P., Wells, K. J., Friedman, A., Matthew, R., Perez, S., & Vaughan, C. A. Adherence, body mass index, and depression in adults with type 2 diabetes: the mediational role of diabetes symptoms and self-efficacy. *Health Psychology*. 2007 Nov., 26(6), pp. 693-700. <http://dx.doi.org/10.1037/0278-6133.26.6.693>
- [9] Venkataraman, K., Kannan, A., Kalra, O., Gambhir, J., Sharma, A., Sundaram, K. R., et al. Diabetes self-efficacy strongly influences actual control of diabetes in patients attending a tertiary hospital in India. *Journal of Community Health*. 2012 June, 37 (3), pp. 653-62. <http://dx.doi.org/10.1007/s10900-011-9496-x>
- [10] Wardian J., Sun F. Factors associated with diabetes-related distress: implications for diabetes self-management. *Soc Work Health Care*. 2014 Apr., 53(4), pp. 368-81.
- [11] Nam, S., Nam, S., & Song, Y. Role of self-efficacy in the relationship between patient-provider relationships and psychological insulin resistance among patients with Type 2 diabetes. *Journal of*

- Contemporary Diabetes Res.* 2014 Aug., 1(1), pp. 1-15.
- [12] Sarkar U., Piette JD., Gonzales R., Lessler D., Chew LD., Reilly B., Johnson J., Brunt M., Huang J., Regenstein M., Schillinger D. Preferences for self-management support: findings from a survey of diabetes patients in safety-net health systems. *Patient Education and Counseling*. 2007 Jan., 70(1), pp. 102-10.
 - [13] Rapley P., Passmore A., Phillips M. Review of the psychometric properties of the diabetes self-efficacy scale: Australian longitudinal study. *Nursing Health Science*. 2003 Nov., 5(4), pp. 289-97.
 - [14] Song, Y., Song, H. J., Han, H. R., Park, S. Y., Nam, S., Kim, M. R. Unmet needs for social support and effects on diabetes self-care activities in Korean Americans with type 2 diabetes. *Diabetes Education*. 2012 Feb., 38(1), pp. 77-85.
 - [15] Lee, M. H., Kim, Y. Y. Relationship between knowledge on diabetes, self-care activities, and self effectiveness of diabetics patients. *The Journal of Korea Academia*. 2003, 10(1), pp. 15-25.
 - [16] Jin, H. K., Chung, H. K. Self-reported goals in aged patients with type 2 diabetes mellitus. *Korean Diabetes Journal*. 2009 Oct, 33(5), pp. 439-47. DOI : 10.4093/kdj.2009.33.5.439
 - [17] Rogers, A., I. Vassilev, C. Sanders, S. Kirk, C. Chew-Graham, A. Kennedy, J. Protheroe, et al. Social networks, work and network-based resources for the management of long-term conditions: A framework and study protocol for developing self-care support. *Implementation Science*. 2011 May, 6(1), p. 1.



ISSN
0975-6299

The Relations among Oral Health Literacy and Oral Health-Related Quality of Life of Elderly living in a Community

Young-Sook Kwon, Assistant Professor, Dept. of Nursing, Joongbu University, Geumsan-Gun, Chungnam, Korea.

E-mail:yskwon@jbm.ac.kr

Kyung-Shin Paek*, Professor, Dept. of Nursing, Semyung University, Jecheon-City, Chungbuk, Korea.

E-mail:kspaek@semyung.ac.kr

Abstract---

Background/Objectives: This study is to examine the oral health literacy and oral health-related quality of life in community elderly and to identify their relationship.

Methods/Statistical analysis: Participants in this cross-sectional survey were 285 aged over 65 elderly. Data were collected from Aug. 4 to 29, 2015 using the self-report questionnaire. ANOVA and t-test were conducted to examine the oral health literacy by the characteristics of the participants. The relationships between oral health literacy and oral health-related quality of life was estimated by the Pearson correlation coefficients.

Findings: The mean score of oral health literacy was 34.19(± 14.54). 57.9% of participants were at a 4th to 6th grade level of oral health literacy and 23.5% were at a 7th or 8th grade level of oral health literacy. The mean score of oral health-related quality of life was 14.27(± 12.04). Oral health literacy was correlated negatively with oral health-related quality of life ($r = -.347$, $p < .001$). All of the correlations between oral health literacy and seven domains of oral health-related quality of life were significant.

Improvements/Applications: These findings show the importance of establishing intervention programs to strengthen the oral health literacy of elderly to help them increase the oral health-related quality of life.

Keywords: Oral Health Literacy, Oral Health-Related Quality of Life, Oral Health Status, Elderly, Community-Dwelling.

**Corresponding Author*

Special Issue on "Medical Science"

I. INTRODUCTION

Follow an increase in elderly people, they are concerned about physical and mental health problems but seem to be little interested in oral health problems ¹. Korea national health and nutrition examination survey of 2014 announced the prevalence of periodontal disease was 49.8% of 60- 69 years and 41.6% of aged over 70. The rate of restricted oral function such as chewing discomfort by oral problems, the difficulty of pronunciation was 42.5% of 60-69 years and 51.5% of aged over 70 ². Many older adults had enough experience poor oral health.

Many aspects of general health are influenced by oral disease and it can have an effect on oral health ³. Extensive tooth loss impairs chewing efficiency ⁴ and can limit food choices⁵ and lead to the imbalance of nutrients. Also, It has difficulty of speech, which limits social life ⁶ and lower self-esteem ⁷. The elderly with poor oral health degrade their satisfaction with life and quality of life ^{3,8}. Prevention of respiratory infection in elderly keeps a good oral health ⁹.

It is defined dental health literacy as "the degree to which individuals have the capacity to obtain, process and understand basic oral health information and services needed to make appropriate health decisions" ¹⁰.

As age increased, general and oral health often get worse simultaneously ^{11,12}. Elderly person with low health literacy have a difficulty controlling their dental health ¹³ and accessing the oral health care ³ and some oral health disparities ¹³.

Oral health literacy is bound up with dental health status and oral health-related quality of life ¹⁴. Low oral health literacy gives the elderly a hard time to get the information about oral health and lead a poor oral health ^{10,15}

Despite importance of oral health, it pay less attention to oral health literacy in nursing until now ^{1,16}.

Thus, this study is to examine the oral health literacy and oral health-related quality of life of the elderly living in a community and to identify their relationship.

II. MATERIALS AND METHODS

The aged over 65 elderly in a community were used as a sample by a convenience sampling technique. Data were collected between Aug. 4 and 29, 2015. Questionnaires were distributed to 300 the elderly, of which 285 questionnaires were returned.

Oral health literacy was measured using the instrument of Richman et al ¹⁷ modified by Ju et al ¹⁸. It consists of 66 words with a dichotomized scale (understanding=1, not understanding=0). The number of words the participant knows rightly is scored and the total score ranges from 0 to 66. The higher the total score, the better the subject is indicated to have oral health literacy. The Cronbach's alpha reliability coefficient was .904. Total oral health literacy scores divided into 4 levels¹⁹. Scores from 0 to 18 represented "level of below 3rd grade", 19-44 corresponded to "4th to 6th grade level", 45-60 represented "7th or 8th grade level", 61-66 corresponded to "level of over 9th grade".

An oral health impact profile (OHIP-14) developed by Slade ²⁰ was used to evaluate an oral health-related quality of life. It has a total of 14 items, which has two questions in each domain including seven domains: physical disability, psychological discomfort, physical pain, functional limitations, psychological disability, social disability and handicaps. It was applied with a 5-point scale with scored scores ranging from 0 to 4. The higher the total score, the more negative influence the subject is indicated to have oral health-related quality of life. Potential count scores range from 0 to 56. The Cronbach's alpha reliability coefficient was .936. Data were analyzed descriptively to examine the characteristics of the participants, oral health literacy and oral health-related quality of life. ANOVA and t-test were conducted in order to examine the oral health literacy based on the characteristics of the participants. The relation of oral health literacy and oral health-related quality of life was estimated by the Pearson correlation coefficients.

III. RESULTS

A. General Characteristics and Difference in Oral Health Literacy

As shown in table 1, of 285 elderly persons, 52.6% of participants were males. Mean age was 76.00 years (± 6.72). 37.9% were the elderly living alone. 40.7% graduated from elementary school. 45.3% have an artificial tooth. 33.3% represented "poor" subjective oral health status. A result of examining the differences

in oral health literacy by general characteristics, there were significant differences by gender ($t=4.08$, $p<.001$), age ($F=7.35$, $p<.001$), spouse ($t=3.80$, $p<.001$), cohabitant ($t=2.13$, $p<.05$), education level ($F=37.15$, $p<.001$), monthly income ($t=2.64$, $p<.01$), job ($t=3.86$, $p<.001$), use of artificial tooth ($t=-3.84$, $p<.001$) and subjective oral health status ($F=8.73$, $p<.001$).

Table 1: General Characteristics and Difference in Oral Health Literacy (N=285)

Variables	Categories	Number	Percentage(%)	Mean($\pm$ SD)	t or F	Scheffe
Gender	Male	150	52.6	37.44($\pm$ 15.05)	4.08***	
	Female	135	47.4	30.58($\pm$ 13.08)		
Age	65-69 ^a	64	22.5	40.53($\pm$ 13.28)	7.35***	a>c, d
	70-74 ^b	48	16.8	35.18($\pm$ 14.65)		
	75-79 ^c	77	27.0	33.61($\pm$ 13.38)		
	≥ 80 ^d	96	33.7	29.94($\pm$ 14.81)		
Spouse	Have	157	55.1	37.08($\pm$ 14.06)	3.80***	
	Not have	128	44.9	30.64($\pm$ 14.37)		
Cohabitant	Yes	177	62.1	35.62($\pm$ 14.18)	2.13*	
	No	108	37.9	31.85($\pm$ 14.87)		
Education level	No formal education ^a	30	10.5	23.26($\pm$ 11.44)	37.15***	e>a, b, c, d
	Elementary school ^b	116	40.7	28.33($\pm$ 11.30)		
	Middle school ^c	57	20.0	34.80($\pm$ 12.20)		
	High school ^d	58	20.4	43.13($\pm$ 13.76)		
	$\geq$ College ^e	24	8.4	53.12($\pm$ 8.35)		
Monthly income	Yes	177	62.1	35.95($\pm$ 14.23)	2.64**	
	No	108	37.9	31.31($\pm$ 14.64)		
Current job	Yes	46	16.1	41.60($\pm$ 14.19)	3.86***	
	No	239	83.9	32.76($\pm$ 14.19)		
Use of artificial tooth	Yes	129	45.3	30.64($\pm$ 14.18)	-3.84***	
	No	156	54.7	37.13($\pm$ 14.21)		
Subjective oral health status	Bad ^a	95	33.3	30.12($\pm$ 13.57)	8.73***	a<c
	Moderate ^b	119	41.8	34.33($\pm$ 14.63)		
	Good ^c	71	24.9	39.40($\pm$ 14.11)		

* $p<.05$, ** $p<.01$, *** $p<.001$

B. Oral Health Literacy and Oral Health-Related Quality of Life

As shown in table 2, the average of oral health literacy was 34.19($\pm$ 14.54). Those of male and female were 37.44($\pm$ 15.05) and female 30.58($\pm$ 13.08), respectively. According to the classification of oral health literacy by REALM (Rapid Estimate of Adult Literacy in Medicine)¹⁹, 15.8% of participants were at a level of below 3rd grade, 57.9% were at a 4th to 6th grade level, 23.5% were at a 7th or 8th grade level, 2.8% were at a level of over 9th grade.

Table 2: Oral Health Literacy Levels by REALM (N=285)

Score	Categories	Number	Percentage (%)	Mean($\pm$ SD)
0-18	0-3 (3 rd grade in elementary school)	45	15.8	34.19($\pm$ 14.54)
19-44	4-6 (4 th -6 th grades in elementary school)	165	57.9	
45-60	7-8 (1 st -2 nd grades in middle school)	67	23.5	
61-66	≥ 9 (above 3 rd grade in middle school)	8	2.8	

REALM=Rapid Estimate of Adult Literacy in Medicine

As shown in table 3, the average of oral health-related quality of life was 14.27($\pm$ 12.04). Regarding the mean score of each domain, those of physical disability, psychological discomfort, and physical pain were 2.14($\pm$ 2.24), 2.11($\pm$ 2.03) and 2.91($\pm$ 2.19), respectively. Those of functional limitations, psychological disability, social disability and handicaps were 2.51($\pm$ 2.43), 2.14($\pm$ 2.02), 1.36($\pm$ 1.79) and 1.60($\pm$ 1.97), respectively.

Table 3: Oral Health-Related Quality of Life (N=285)

Domain	Mean($\pm$ SD)
Physical disability	2.14($\pm$ 2.24)
Psychological discomfort	2.11($\pm$ 2.03)
Physical pain	2.91($\pm$ 2.19)
Functional limitations	2.51($\pm$ 2.43)
Psychological disability	2.14($\pm$ 2.02)
Social disability	1.36($\pm$ 1.79)
Handicaps	1.60($\pm$ 1.97)
Total	14.27($\pm$ 12.04)

C. Correlation Between oral Health Literacy and Oral Health-Related Quality of Life

As shown in table 4, oral health literacy was correlated negatively with oral health-related quality of life ($r=-.347$, $p<.001$). Oral health literacy and seven domains of oral health-related quality of life showed significant relationships. Negative correlations were found between oral health literacy and physical disability($r=-.263$, $p<.001$), psychological discomfort($r=-.324$, $p<.001$), physical pain($r=-.242$, $p<.001$), functional limitations($r=-.318$, $p<.001$), psychological disability($r=-.236$, $p<.001$), social disability($r=-.298$, $p<.001$) and handicaps($r=-.314$, $p<.001$).

Table 4: Correlation between Oral Health Literacy and oral Health-related Quality of Life (N=285)

	Oral health literacy
Oral health-related quality of life	-.347***
Physical disability	-.263***
Psychological discomfort	-.324***
Physical pain	-.242***
Functional limitations	-.318***
Psychological disability	-.236***
Social disability	-.298***
Handicaps	-.314***

*** $p<.001$

IV. DISCUSSION

This study was to examine the oral health literacy and oral health-related quality of life in community elderly and to identify their relationship. According to the classification of health literacy by Hwang ²¹, health literacy scores from 0 to 44 represented a low health literacy level, 45-60 represented a marginal health literacy level, 61-66 represented a sufficient health literacy level. In the present study, 73.7% of participants appeared to have a low oral health literacy, 23.5% have a marginal oral health literacy, only 2.8% showed a sufficient oral health literacy. This means that three of ten elderly persons had a low oral health literacy level and most of the others correspond to the marginal level of oral health literacy. This result was consistent with the domestic research of Lee et al ¹ reporting oral health literacy of elderly, but this was at a much lower oral health literacy level compared to findings of research conducted oral health literacy of adults ^{18, 22}. The result of current study showed a very low oral health literacy of elderly. This shows that they have a problem with understanding of written health care information because persons with oral health literacy of level beyond the 12th grade ²³ can understand a lot of dental reading materials.

Oral Health Impact Profile (OHIP) is one of the instruments which is evaluating an awareness of people of the physical, psychological, social effect of oral health ²⁰. In this research, the average score of the oral health-related quality of life was 14.27. The findings of previous studies were lower ^{24, 25} (10.43-10.45) or higher ²⁶ (26.2) scores compared to our finding. The mean scores of each domain in this study ranged from 1.36 to 2.91, social disability was the lowest score and physical pain scored the highest on seven domains. It is not consistent with the result of Back ²⁶ which reported that the mean scores of each domain ranged from 2.08 to 2.69, the mean scores of all domains except physical pain were higher than our study and handicaps was the lowest score and functional limitation scored the highest on seven domains. Zini ²⁴ demonstrated that this difference may include methodological issues such as data collection, sampling, reliability and validity of scale and cultural and socio-economical factors related to different participants. There has been little research focusing on the oral health-related quality of life of elderly in nursing ²⁵. Thus, repeated studies are necessary to consider the oral health-related quality of life among the elderly.

Oral health literacy of this study had a significantly negative correlation with oral health-related quality of life. Oral health literacy was significantly correlated with seven domains of oral health-related quality of life. It indicates that elderly who had lower oral health literacy tend to have more difficulty of oral health and their oral health-related quality of life is lower in comparison with elderly who had higher oral health literacy. It is consistent with the result of Lee et al ¹⁴ which reported that oral health literacy was significantly related to the oral health-related quality of life. Poor oral health literacy may result in poor dental outcomes ²². This result implies that oral health literacy is an important relationships with oral health-related quality of life and has an effect on well-being of elderly.

V. CONCLUSION

This study has tried to provide a basic data for developing effective intervention to improve the oral health literacy of elderly by figuring out the relation of oral health literacy and oral health-related quality of life.

In our research, a great number of elderly persons have a low oral health literacy and oral health literacy has a correlation with oral health-related quality of life. Results of this study indicate that many elderly people have the difficulty of oral health and may hinder them from management and maintenance oral health, because of low oral health literacy. Therefore, health care providers help elderly understand information related to oral health and identify them with low oral health literacy and. Also, it requires programs to improve the oral health literacy to manage effectively oral health of elderly.

REFERENCES

- [1] Lee KE, Yom YH, Kim SS, Han JH. Gender differences in oral health literacy related factors among elderly people. *Journal of Korean Academy of Community Health Nursing*. 2014 March, 25(1), pp. 54-64.
- [2] Ministry of Health & Welfare. Korea health statistics, 2014: Korea national health & nutrition examination survey. Ministry of Health & Welfare: Seoul, 2016.
- [3] Susan O, Jones JA, Brunson D, Griffin PM, Balley WD. 2012, Burden of oral disease among older adults and implications for public health priorities. *American journal of Public Health*. 2012 March, 102 (3), pp. 411-18.
- [4] Sarita PT, Witter DJ, Kreulen C, Van't Hof M A, Creugers NH. Chewing ability of subjects with shortened dental arches. *Community Dentistry & Oral Epidemiology*. 2003 October, 31(5), pp. 328-34.
- [5] Ervin RB, Dye BA. The effect of functional dentition on healthy eating index scores and nutrient intakes in a nationally representative sample of older adults. *Journal of Public Health Dentistry*. 2009 Fall, 69(4), pp. 207-16.
- [6] Smith JM, Sheiham A. How dental conditions handicap the elderly. *Community Dentistry & Oral Epidemiology*. 1979 December, 7(6), pp. 305-10.
- [7] Starr JM, Hall R. 2010, Predictors and correlates of edentulism in the healthy older people. *Current Opinion in Clinical Nutrition & Metabolic Care*. 2010 January, 13(1), pp. 19-23.
- [8] Jang JH, Park YD, Kim JH, Kim EJ. Clinical predictors related to oral health-related quality of life (OHRQoL) in Korean elderly for visiting oral healthcare. *Indian Journal of Science & Technology*. 2015 October, 8(25), Available from:<http://dx.doi.org/10.17485/ijst/2015/v8i25/80276>.
- [9] Pace CC, McCullough GH. The association between oral microorganisms and aspiration pneumonia in the institutionalized elderly: review and recommendation. *Dysphagia*. 2010 December, 25(4), pp.307-22.
- [10] National Institute of Dental and Craniofacial Research. The invisible barrier: literacy and its relationship with oral health. *Journal of Public Health Dentistry*. 2005 September, 65(3),pp. 174-82.
- [11] John MT, Slade GD, Szentpetery AS. Oral health related quality of life in patients treated with fixed removable and complete dentures 1 month and 6 to 12 months after treatment. *The International journal of Prosthodontics*. 2004 September, 17(5), pp. 503-11.
- [12] Kwon MH, Choi HS. Impacting factors on oral health status of the community among the elderly the 6th Korea National Health and Nutrition Examination. *Indian Journal of Science & Technology*. 2016 May, 9(20), Available from:<http://dx.doi.org/10.17485/ijst/2016/v9i20/94688>.
- [13] Horowitz AM, Kleinman DV. Oral health literacy: the new imperative to better oral health. *Dental Clinic of North America*.2008 April, 52(2), pp. 333-44.
- [14] Lee JY, Rozier RG, LeeSYD, Bender D, Ruiz RE. Development of a word recognition instrument to test health literacy in dentistry: TheREALD-30_a brief communication. *Journal of Public Health Dentistry*. 2007 Spring, 67(2), pp. 94-8.
- [15] Davis TC, Michielutte R, Askov EN, Williams MV, Weiss BD. Practical assessment of adult literacy in health care. *Health Education & Behavior*. 1998 October, 25(5), pp. 613-24.
- [16] Alexander RE. Readability of published dental educational materials. *The Journal of the American Dental Association*. 2000 July, 131(7), pp. 937-42.
- [17] Richmond S, Chestnutt I, Brown B. 2007, The relationship of medical and dental factors to perceived oral and general health. *Community Dentistry & Oral Epidemiology*. 2007 April, 35(2), pp. 89-97.

- [18] Ju HJ, Oh HW, Kim JY, Lee HS. A cross-section study on oral health literacy and its influencing factors among adults: I. verbal oral health literacy. *Journal of Korean of Oral Health*. 2012 June, 36(2), pp. 97-105.
- [19] Davis TC, Crouch MA, Long SW, Jackson RH, Bates P, George RB, Bairnsfather LE. Rapid assessment of literacy levels of adult primary care patients. *Family Medicine*. 1991 June, 23(6), pp. 433-35.
- [20] Slide GD. Derivation and validation of a short-form oral health impact profile. *Community Dentistry & Oral Epidemiology*. 1997 August, 25(4), pp. 284-90.
- [21] Hwang TY. Understanding health literacy: Implications for medicine and public health. Academy press: Seoul, 2010.
- [22] Jones M, Lee JY, Rozier RG. Oral health literacy among adult patients seeking dental care. *The Journal of American Dental Association*. 2007 September, 138(9), pp. 1199-1208.
- [23] Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association. Health literacy- Report of the council on scientific affairs. *The Journal of the American Medical Association*. 1999 February, 281(6), pp. 552-57.
- [24] Zini A, Sgan-Cohen HD. The effect of oral health on quality of life in an underprivileged homebound and non-homebound elderly population in Jerusalem. *Journal of the American Geriatrics Society*. 2008 January, 56(1), pp. 99-104.,
- [25] Lee HS, Kim CM. Effects of oral health impact profile (OHIP) on depression and quality of life among community-dwelling Korean elderly persons. *Journal of Korean Academy of Community Health Nursing*. 2012 March, 23(3), pp. 338-46.
- [26] Back JU. The effect of oral health on total health and quality of life between Korean and Japanese. *Korean Public Health Research*. 2012 February, 38(1), pp. 81-98.



ISSN
0975-6299

Fetal Transverse Cerebellar Diameter Measurement for Prediction of Gestational Age in Second Trimester and to Derive its Nomogram in Indian Population

Dr.S. Arun Kumar*, Associate Professor, Department of Radiology, Karpagam Faculty of Medical Science and Research, Coimbatore.

Dr.P.S. Sangeetha Devi, Assistant Professor, Department of Paediatrics.

Abstract---

Aims and Objective:

- 1) To determine a correlation between the foetal transverse cerebellar diameter (TCD) and the gestational age as determined by the last menstrual period and other sonographic parameters like biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL) in healthy women with uncomplicated pregnancy between the 15th week of gestation and term.
- 2) To derive nomogram for estimating the gestational age of the foetus from ultrasonographically measured transverse cerebellar diameter in Indian population.
- 3) To derive TCD/AC ratio in second and third trimester in Indian population since its independent parameter in assessing the fetal growth abnormality.

Materials and Methods:

Hardware: GE Voluson P8.

Methods: Hospital based prospective study.

152 healthy pregnant patient included in the study who underwent obstetric sonography in Department of Radiology, Karpagam Faculty of medical science and research, Coimbatore.

Transverse cerebellar diameter is obtained in the axial plane in the cerebellar view i.e with a slight rotation of the transducer approximately 300 from the conventional thalamic plane where the biparietal diameter is measured using the cavum septi pellucidi, third ventricle and thalami as landmarks. In this plane posterior fossa with cerebellum is visualized. The cisterna magna is just posterior to the cerebellum. This plane provides the widest transcerebellar diameter. Gestational age for the measured TCD is obtained from the reference chart "Predicted menstrual age for transverse cerebellar diameter of 14 mm to 56 mm" by Hill et.al., in his study "Transverse cerebellar diameter as a predictor of menstrual age" in 1990.

TCD/AC ratio was calculated according to the following formula:

TCD/AC ratio (%): $\text{TCD (mm)} / \text{AC (mm)} \times 100$.

Conclusion:

TCD positively correlated with clinical gestational age, BPD, HC, AC and FL by 79.9%, 77.6%, 82%, 81.2% and 83.4% respectively. Nomogram of the TCD shows that there is a linear relationship between the cerebellar growth and gestational age, but in Indian population it is slightly smaller than universally accepted nomogram by Hill et al. TCD/AC ratio was fairly constant in second trimester with value of 14.22 +/- 2SD. So TCD can be used as a reliable parameter for determination of gestational age.

*Corresponding Author

Special Issue on "Medical Science"

I. INTRODUCTION

Obstetric sonography plays an important role in the accurate determination of intrauterine gestational age. Knowledge of gestational age is important in following ways¹:

- 1) To anticipate normal spontaneous delivery or to plan elective delivery.
- 2) To consider invasive procedures such as chorionic villus sampling, genetic amniocentesis and in interpretation of biochemical tests such as maternal serum alpha-fetoprotein screening.
- 3) To evaluate the foetal growth.
- 4) Gestational age influence the management decision if the foetus is diagnosed with anomaly. So all important clinical decisions are influenced by the gestational age.

Before the advent of sonography gestational age was calculated with the help of i) menstrual history. ii) physical examination of the uterine size. ii) X ray estimation of gestation age ossification center development. But these parameters have high variability.¹

The last two decades have seen a tremendous progress in application of ultrasound as a diagnostic modality revolutionizing the management towards better care. This is particularly due to its non-invasive, non-ionizing nature and easy availability besides its cost effectiveness leading to wider acceptability. There is no reported risk of ionizing radiation as in radiography,² or any other known biological or embryotoxic effect.

Sonographic measurement of foetal biparietal diameter is a well accepted predictor of gestational age.^{3,4} However there is a high variability in the calculated gestational age which increases as pregnancy progresses with maximum difference approximating 3.6 weeks in the third trimester.^{5,6} The estimation of gestational age from parameters like the BPD, HC, AC, and FL have variability ranging from 25 – 30 % (7). There are conditions like oligohydramnios, multiple gestation, breech presentation and intrauterine growth restriction (IUGR) that can alter the shape of the foetal skull which in turn can affect the BPD and increase the variability.⁸ Multiple gestations and IUGR can also affect the abdominal and femoral measurement.

The present study is being undertaken to measure the transverse cerebellar diameter (TCD) to validate it as a additional morphological measurement of foetal growth with less variability. The cerebellum and posterior fossa are aligned perpendicular to the plane of maximum extrinsic compression. Hence they are able to withstand deformation by extrinsic pressure than the parietal bones² and can be a more accurate parameter for the determination of gestational age.

II. AIMS AND OBJECTIVE

1. To determine a correlation between the foetal transverse cerebellar diameter and the gestational age as determined by the last menstrual period and other sonographic parameters like biparietal diameter, head circumference, abdominal circumference and femur length in healthy women with uncomplicated pregnancy between the 15th to 24th week of gestation.
2. To derive nomogram for estimating the gestational age of the foetus from ultrasonographically measured transverse cerebellar diameter in Indian population.
3. To derive TCD/AC ratio in second and third trimester in Indian population since its independent parameter in assessing the fetal growth abnormality.

III. INCLUSION AND EXCLUSION CRITERIA

Inclusion Criteria

Healthy women with uncomplicated pregnancy between the 15th to 24th week of gestation .

Exclusion Criteria

- 1) Unknown or inaccurate date of last menstrual period.
- 2) Irregular menstrual cycles.
- 3) Oligohydramnios.
- 4) Polyhydramnios.
- 5) Diabetic mother.
- 6) Pregnancy induced hypertension.
- 7) Pre eclampsia.
- 8) Dolichocephalic skull.

- 9) Multiple gestation.
- 10) Fetal chromosomal abnormalities.
- 11) Fetal anomalies.
- 12) Intrauterine growth restriction.
- 13) Any other known maternal and foetal abnormality.

IV. MATERIALS AND METHODS

Hardware: GE Voluson P8.

Methods

Hospital based prospective study.

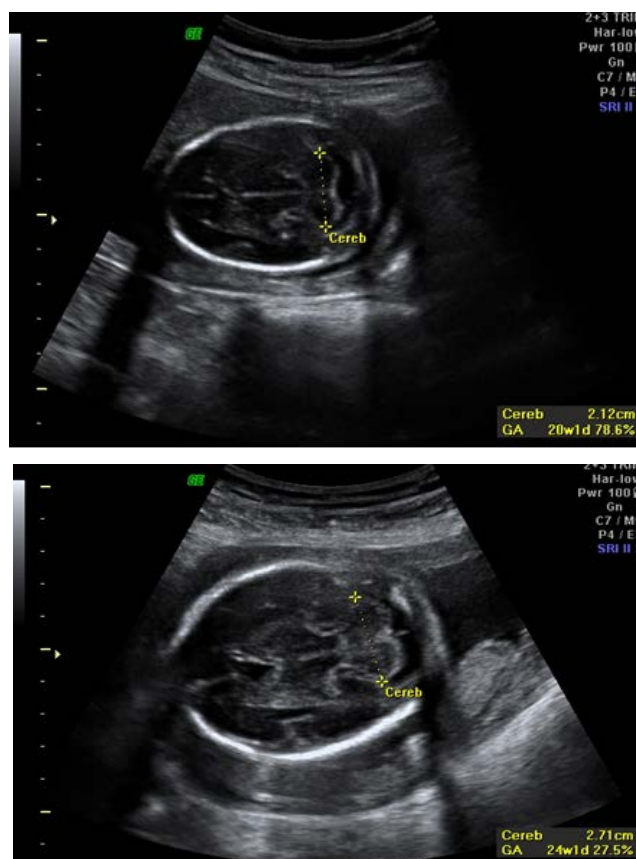
152 healthy pregnant patient included in the study who underwent obstetric sonography in Department of Radiology, Karpagam Faculty of medical science and research, Coimbatore.

Transverse cerebellar diameter is obtained in the axial plane in the cerebellar view i.e with a slight rotation of the transducer approximately 30° from the conventional thalamic plane where the biparietal diameter is measured using the cavum septi pellucidi, third ventricle and thalami as landmarks. In this plane posterior fossa with cerebellum is visualized. The cisterna magna is just posterior to the cerebellum. This plane provides the widest transcerebellar diameter.

Gestational age for the measured TCD is obtained from the reference chart "Predicted menstrual age for transverse cerebellar diameter of 14 mm to 56 mm" by Hill *et.al.*, in his study "Transverse cerebellar diameter as a predictor of menstrual age" in 1990.

TCD/AC ratio was calculated according to the following formula:

TCD/AC ratio (%): TCD (mm)/AC (mm) x 100



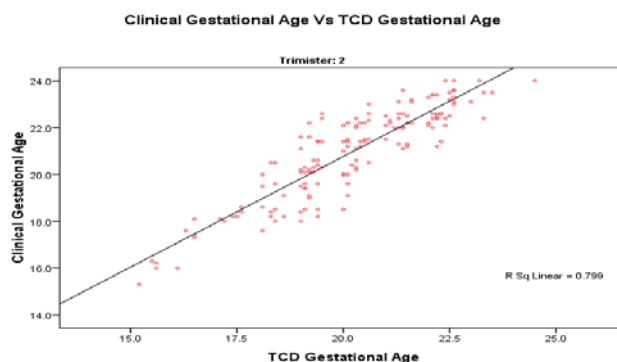
The caliper on the edge of the cerebellar hemisphere demonstrates the method to obtain transcerebellar diameter.

V. RESULTS

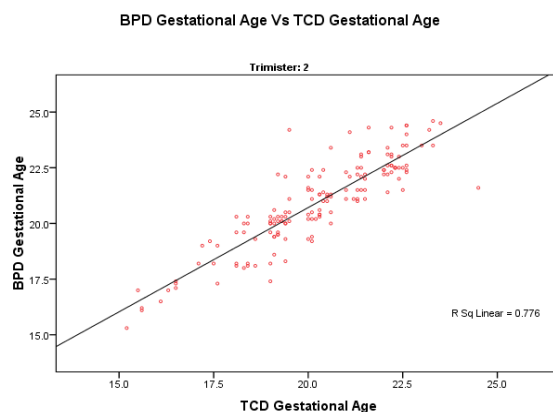
The age of 152 patient included in the study was in the range of 19 to 35years with the mean age of 26.2 years.

Second Trimester Correlation

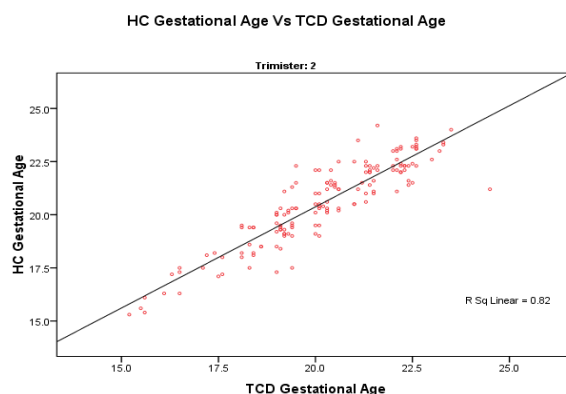
GRAPH NO. 1 A scatter diagram showing the correlation and regression analysis of the TCD with CGA in second trimester. Here TCD is correlated with CGA by 79.9%.



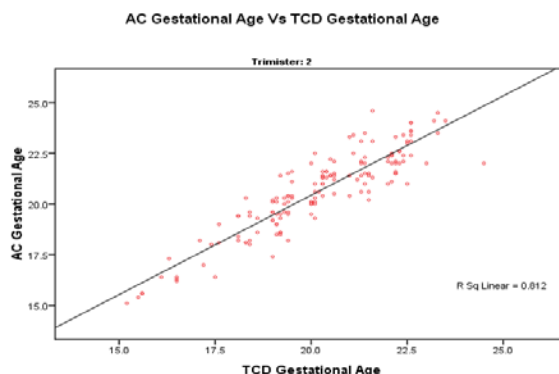
GRAPH NO. 2 A scatter diagram showing the correlation and regression analysis of the TCD with BPD in second trimester. Here TCD is correlated with BPD by 77.6 %.



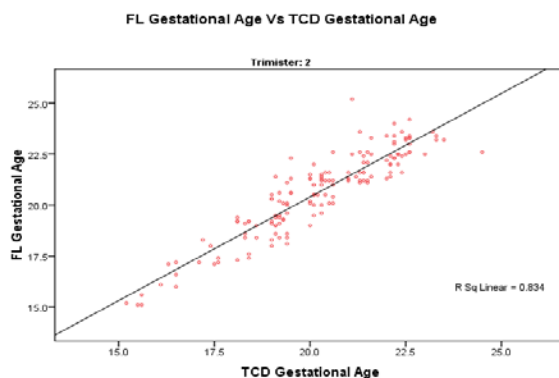
GRAPH NO. 3 A scatter diagram showing the correlation and regression analysis of the TCD with HC in second trimester. Here TCD is correlated with HC by 82 %.



GRAPH NO. 4 A scatter diagram showing the correlation and regression analysis of the TCD with AC in second trimester. Here TCD is correlated with AC by 81 %.



GRAPH NO. 5 A scatter diagram showing the correlation and regression analysis of the TCD with FL in second trimester. Here TCD is correlated with FL by 83.4 %.



TCD is correlated with Clinical GA, BPD, HC, AC and FL in second trimester by 79.9%, 77.6%, 82%, 81.2% and 83.4% respectively.

Table 1: Correlation Co-Efficient of TCD with CGA, BPD, HC, AC and FL in Second Trimester

Combination Of Parameters	Pearson's Correlation Co-Efficient (r)				Significance	
TCD VS CGA	0.894				P<0.001	
TCD VS BPD	0.881				P<0.001	
TCD VS HC	0.906				P<0.001	
TCD VS AC	0.901				P<0.001	
TCD VS FL	0.913				P<0.001	

The above table shows the association between the foetal measurements and TCD. The correlation was best for TCD vs FL (r : 0.913) and least for TCD vs BPD (r : 0.881). All the correlations were statistically significant.

Table 2: Correlation Co-Efficient of CGA with BPD, HC, AC, FL and TCD in Second Trimesters:

Parameters	Pearson's Correlation Co-Efficient (r)				Significance	
CGA VS BPD	0.898				P<0.001	
CGA VS HC	0.919				P<0.001	
CGA VS AC	0.921				P<0.001	
CGA VS FL	0.920				P<0.001	
CGA VS TCD	0.894				P<0.001	

This table shows the association between the foetal measurements and CGA. The correlation was best for CGA vs AC ($r : 0.921$). and least for CGA vs TCD ($r : 0.894$). All the correlations were statistically significant.

TCD/AC Ratio

TCD/AC remains fairly constant, between 15th-24th weeks of gestation with value of $13.87 \pm 2SD$ (SD: 0.95). There was a strong linear relationship between TCD and AC.

Nomogram

TCD (mm)	Gestational age (in weeks)	TCD (mm)	Gestational age (in weeks)
14	15.2	22	20.5
15	15.5	23	21.2
16	16.3	24	21.9
17	17.1	25	22.4
18	17.7	26	23.2
19	18.3	27	23.9
20	19.1	28	24.5
21	19.8		

VI. DISCUSSION

Accurate gestational dating is of paramount importance and the cornerstone for management of pregnancies. Methods to date pregnancies should be simple and straightforward, in all gestational ages. Accurate and easily reproducible sonographic foetal biometric parameters for gestational dating are clinically important for the optimal obstetric management of pregnancies. This is especially true in determining timing of a variety of gestational tests, assessing adequacy of growth and timing of delivery for the optimal obstetric outcome.

In this prospective study of 152 healthy women with uncomplicated pregnancy a correlation is suggested between the gestational age and TCD. A linear relationship was found during the second trimester between the cerebellar growth measured in mm (millimeters) and the gestational age in weeks. This relationship of foetal cerebellar growth and gestational age is statistically significant. In the present study the correlation of TCD with other foetal biometric parameters such as BPD, HC, AC and FL were statistically significant with the P value of 0.881, 0.906, 0.901 and 0.913 respectively. TCD also correlate with the clinical gestational age with statistically significant P value of 0.894.

From a biological perspective cerebellum is not liable to change in form and size because of dense surrounding petrous ridges and occipital bone. This is at variance with several other biometric parameters, especially abdominal circumference, which may be drastically altered by extremes of fetal growth. Hence TCD can be eminently used where it is not possible or difficult to measure BPD or in cases where there are variations in size and shape of foetal head.

TCD/AC ratio was assessed with an idea of its uses as a parameter for foetal growth abnormalities. The foetal TCD / AC ratio is a gestational age independent method of assessing foetal growth. TCD/AC ratio greater than the cut off value would be antenatally diagnosed as IUGR. TCD/AC ratio can be used as an independent method for antenatal diagnosis of IUGR especially in pregnancy with uncertain gestational age^{10,11}

TCD has also been measured to predict mean gestational age in different ethnic groups. Foetal TCD is not independent of ethnic origin of patient. Nomogram for TCD can be developed for different countries and races to predict gestational age for a particular ethnic population. In our study, all the patients were of Indian origin and the normogram for predicting gestational age from TCD was obtained. The values were compared with a study conducted by Hill *et al.*⁹ and it was observed that the values reported in our study are slightly smaller. This is probably due to the difference in the ethnic origin of patients.

VII. CONCLUSION

- 1) TCD positively correlated with BPD, HC, AC and FL.
- 2) Nomogram of the TCD shows that there is a linear relationship between the cerebellar growth and gestational age.

- 3) Nomogram obtained from fetal TCD in Indian population is slightly smaller than universally accepted nomogram by Hill et al.
- 4) TCD/AC ratio was $13.87 \pm 2SD$
- 5) TCD can be used as a reliable parameter for determination of gestational age.

The results of present study show that additional small improvements in accurate gestational dating can be achieved by incorporating the results of TCD with some combination of other fetal biometric parameters, including BPD, HC, AC and FL. Nevertheless, the best combination of biometric measurements remains to be determined. We recommend that TCD be used as an important sonographic biometric parameter for accurate prediction of GA.

REFERENCES

- [1] Peter W. Callen, (1994). *Ultrasonography in obstetrics and gynecology*, 3rd edition, W. B. Saunders company, Philadelphia.
- [2] Mahony, B. S., Callen, P. and Filly, A. R., (1985). The distal femoral epiphysal ossification center in the assessment of third trimester menstrual age: sonographic identification and measurement, *Radiology*, 155, 201-204.
- [3] Campbell, S. (1968). An improved method of fetal cephalometry by ultrasound, *J Obstet Gynaecol Brit Cweth*, 75, 568-576.
- [4] Kurtz, A. B. et. al., (1980). Analysis of biparietal diameter as an accurate indicator of gestational age, *JCU*, 8, 319-326.
- [5] Sabbagha, R. E. and Hughey, M., (1978). Standardization of sonar cephalometry and gestational age. *Obstet Gynecol*, 52, 402-406.
- [6] Hadlock, F. P. et. al., (1982). Fetal biparietal diameter: a critical re-evaluation of the relation to menstrual age using realtime ultrasound, *JUM*, 1, 97-104.
- [7] Hadlock, F. P. et. al., (1983). Computer assisted analysis of fetal age in the third trimester using multiple fetal growth parameters, *JUM*, 11, 313-316.
- [8] Richard D. Mcleary, Lawrence R. Kuhns and Mason Barr Jr., (1984). Ultrasonography of the fetal cerebellum, *Radiology*, 151, 439-442.
- [9] Hill, L. M., Guzick D. and Fries J., (1990). Transverse cerebellar diameter as a predictor of menstrual age, *Obstet Gynecol*, 75, 983.
- [10] Meyer, W. J. et. al., (1993). The fetal transverse cerebellar diameter / abdominal circumference ratio: a gestational age – independent method of assessing fetal size, *J Ultrasound Med*, 12, 7, 379-382.
- [11] Meyer et. al., (1994). Ultrasonographic detection of abnormal fetal growth with the gestational age independent transverse cerebellar diameter / abdominal circumference ratio, *Am J Obstet gynecol*, 171, 4, 1057-1063.



ISSN
0975-6299

A Strategic Approach to Medical Technology System to Improve Life Quality after Salpingo-Oophorectomy

Seong-Ran Lee*, Department of Medical Information, Kongju National University, Korea. E-mail:leesr@kongju.ac.kr

Abstract---

Background/Objectives: The supply of mediating technology system is only solution of the problem of ovarian cancer after salpingectomy. The research is to explore a strategic approach of technology to enhance life after oophorectomy.

Methods/Statistical analysis: Members investigated of 64 participants who were composed of people with mediating technology, while the normal members of 64 participants were composed of people without mediating technology system. The power of t test was performed to find out the effect of pre and post mediating technology achievement of body condition rate by the modeling technology. The design of medical technology system is construction of medical technology system, intermittent phase etc.

Findings: The socio demographic variables of elementary contents are next contents. The proportion of unmarried participants (23.4%) of group investigated were a lower rate than the proportion(28.1%) of normal members. The participants's sex was analyzed. Male with 46.9% in the group investigated showed a higher rate than female with 43.8% in the normal people. While female of 53.1% in the test people was observed less than female with 56.3% in the normal members. Contents described in main text are the difference of body habits by mediating technology system after salpingo-oophorectomy in table 2. For soybean intake, the mean point(72.28 ± 2.91) of members investigated which have eaten soybean of post-connection of mediating technology system statistically significantly higher than the mean point(57.08 ± 2.05) of members investigated pre-connection of mediating technology ($t = -4.27$, $p = .000$). Moreover, it indicates the pre and post of body quality by application of mediating technology system (Figure 2). The data achieved appeared significantly higher rate in the group observed than the normal group, even the days passed 30 days of post-connection of mediating technology.

Improvements/Applications: A positive contents of above will play an important role in the establishment of future medical system and data that provides invaluable insights in the effect of a physical condition.

Keywords--- Strategic Approach, Medical Technology, Life Quality, Salpingo-oophorectomy, Soybean, Insight.

**Corresponding Author*

Special Issue on "Medical Science"

I. INTRODUCTION

Ovarian cancer is the first of mortality rate among female genitalia in South Korea. Salpingo-oophorectomy is the operative dissection of both ovaries and right or left ovary^{1,2,3}. Ovarian cancer can not know early condition which appear their symptoms because their body responses are not felt. The first method of ovarian cancer is operation. Ovarian cancer is the sixth most typical tumor form of cancer in women. Early symptoms are often absent or associated with other problems; thus early detection is uncommon. When the ovaries are dissected, a female is at a five times more disease of stroke or myocardial infarction^{4,5}. Salpingo-oophorectomy is factor related to the an increased risk of osteoporosis and bone fractures. Therefore, the enhancement of life quality through the development of clinical information system is important information technology which can provide to oophorectomy population.. Therefore, this paper is to find out a strategic approach of medical technology system to enhance life quality after salpingo-oophorectomy^{6,7}.

The incidence of ovarian cancer can find when parts in one ovary or right and left ovaries are out of function. Although every ages of women are easy to appear the morbidity rate of ovarian cancer, approximately 92% of female observed with the disease are over 50 years old, and almost illnesses appear in female over 60 years old, according to National Statistical Center. Additionally, the majority of ovarian cancer were in situ (27.8%) or local (52.4%) stage. As noted in above. The National Statistical Center reports that there are much more than 32,172 recent ovarian cancer and about 183,465 mortalities from female ovarian cancer in the U.K. in 2015.

Additionally, According to this situation, it occurred from 2010 to 2015, 2.4% of female observed now will be indicated illness with ovarian cancer at this environment during women lifecycle. The total six-year associated with proportion of life existence since 2005^{8,9,10}

This research tries to implement a management control system to raise the performance of a experiment with the objective to achieve to the entire success toward a special strategy for ovarian cancer. Information was collected from the major problems in order to detect the key characteristics of life habits where a change of treatment is needed^{11,12,13}. The system was established the strategies to be followed and defined information management indicators that allowed monitor and validate the implementation of the strategies through various plans.

The system were developed to understand the effect that has the control system in the management of the positive results observed in the analysis of results. In order to maintain the strategies, it was necessary to develop technology system to check the system status.

Therefore, the supply of mediating technology of information system is only solution of the problem of ovarian cancer and the best way that can enhance body status to patients with ovarian cancer after salpingo-oophorectomy. The research is needed to explore the development of experimental technology to improve body status after operation. Thus, this paper is to develop a strategic approach to medical technology system to improve life quality after salpingo-oophorectomy. A positive results will play an important role in the establishment of future medical system and data that provides invaluable insights in the usability of every medical environment.

II. MATERIALS AND METHODS

A. Predictive Modeling Technology

The design of medical technology system is as follows. 1) planning phase : construction of medical technology system 2) intermittent phase : input, stratege, process, analysis, application 3) final phase : verifying study, impact, usability of system in Figure 1.

B. Materials

The data were achieved through fill out the paper of form structured and interview from January 11 to March 31, 2016.

It has time to fill out this survey. Members investigated of 64 people who were consisted of members with mediating technology, while the normal members of 64 people were consisted of people without mediating technology.

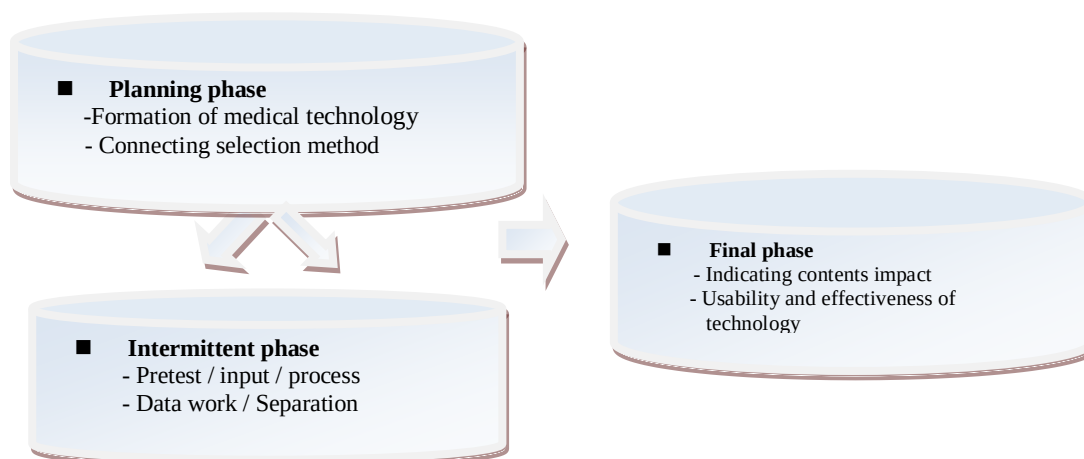


Figure 1: Construction of Predictive Modeling Technology

C. Methods

Sociodemography variables of elementary contents were separated through number value. The power of t test was performed to find out the effect of pre and post mediating technology achievement of body habit rate by the modeling technology.

Achieved contents were separated life quality in participants with ovarian cancer using SPSS 18.0.

III. RESULTS

A. Socio Demographic Variables of Elementary Contents

The sociodemographic variables of elementary contents are next contents. The proportion of unmarried participants(23.4%) of group investigated were a lower rate than the proportion(28.1%) of normal members.. The participants's sex was analyzed. Male with 46.9% in the group investigated showed a higher rate than female with 43.8% in the normal people.

While female of 53.1% in the test people was observed less than female with 56.3% in the normal members.

Table 1: Sociodemographic Variables of Elementary Contents

Items	Exp	Cont	X ²
	Number (percent)	Number (percent)	
Marital status			
Unmarried	15(23.4)	18(28.1)	5.7
Married	49(76.6)	46(71.9)	
Sex			
Gentleman	30(46.9)	28(43.8)	7.2
Lady	34(53.1)	36(56.3)	
Age			
<40	5(7.8)	10(15.6)	12.6
41-50	11(17.2)	23(35.9)	
51-60	23(35.9)	14(21.9)	
≥61	25(39.1)	17(26.6)	
Monthly income			
≤99	16(25.0)	10(15.6)	8.4
100-200	9(14.1)	12(18.8)	
201-299	18(28.1)	23(35.9)	
≥300	21(32.8)	19(29.7)	
Education			
Under middle	17(26.6)	16(25.0)	6.3
Highschool	26(40.6)	20(31.3)	
Over university	21(32.8)	28(43.8)	
Total	64(100.0)	64(100.0)	

B. Difference of Body Habits by Mediating Technology System

Contents described below are the difference of body habits by mediating technology system after salpingo-oophorectomy in table 2.

For soybean intake, the mean point(72.28 ± 2.91) of members investigated which have eaten soybean of post-connection of mediating technology system statistically significantly higher than the mean point(57.08 ± 2.05) of members investigated pre-connection of mediating technology($t = -4.27, p = .000$).

Table 2: Difference of Body Habits by Mediating Technology

Variables	Pre	Post	t	P
	Mean $\pm$ S.D	Mean $\pm$ S.D		
Vitamin intake	52.67 $\pm$ 1.35	78.30 $\pm$ 1.49	-6.25	.041
Exercise	47.42 $\pm$ 0.64	63.72 $\pm$ 0.58	-3.79	.028
Stress	76.25 $\pm$ 2.92	64.18 $\pm$ 1.92	6.84	.417
Hypertension	64.74 $\pm$ 1.56	49.34 $\pm$ 0.71	1.25	.163
Smoking	42.17 $\pm$ 0.32	27.56 $\pm$ 0.35	3.57	.147
Alcohol	69.35 $\pm$ 2.47	46.09 $\pm$ 1.62	7.18	.002
Vegetable	53.91 $\pm$ 1.52	75.15 $\pm$ 0.85	-1.63	.000
Cholesterol	75.54 $\pm$ 1.38	62.39 $\pm$ 2.17	2.30	.147
DM	52.72 $\pm$ 2.19	56.29 $\pm$ 1.28	-1.37	.519
Soybean	57.08 $\pm$ 2.05	72.28 $\pm$ 2.91	-4.27	.000
Carrot intake	41.37 $\pm$ 1.78	63.74 $\pm$ 1.93	-2.94	.000
Onion	54.17 $\pm$ 0.27	70.51 $\pm$ 2.36	-4.52	.000
Screening	52.23 $\pm$ 1.64	75.28 $\pm$ 1.47	1.33	.000
Acupressure	35.18 $\pm$ 1.49	52.16 $\pm$ 1.83	-2.48	.000
Tomato	52.72 $\pm$ 0.62	59.63 $\pm$ 2.37	-4.12	.429
Garlic	42.39 $\pm$ 2.52	57.38 $\pm$ 0.63	-2.52	.003

C. Pre and Post of Life Quality by Mediating Technology

As below, it indicates the pre and post of body quality by application of mediating technology system (Figure 2). The data achieved appeared significantly higher rate in the group observed than the normal group, even the days passed 30 days of post-connection of mediating technology.

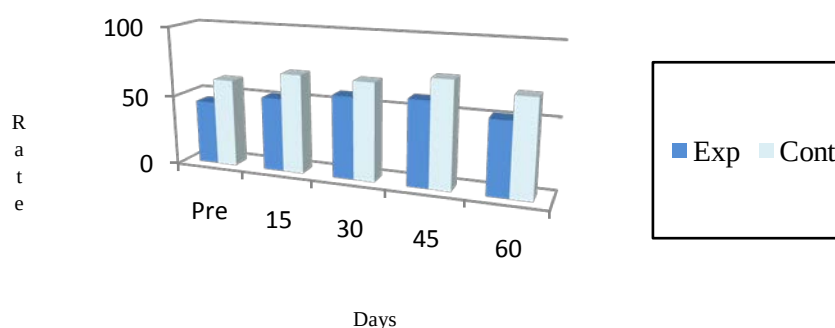


Figure 2: Pre and Post of Body Quality by Mediating Technology

IV. DISCUSSION

The paper is to explore the usability of medical technology to enhance body quality after salpingo-oophorectomy. The conclusions of this research are as next contents. Positive increase of body quality of ovarian patients after surgery who has eaten soybean diminished the symptoms of body illnesses. The achieved data was similar with the previous researches on the vaginal cancer^{14,15}. This study indicated that participants with ovarian cancer should be focused on mediating technology to prevent the observed disease

related to the ovarian cancer. From contents on the data obtained, it expects that this may be used an effective data for using and connecting a medical technology for enhancing body quality.

In addition, systematic studies should be established continually in order to prove results of this study. The present work appeared that body habit rate of mediating technology was increased from 62.8% to 73.1% by the mediating technology system, which is similar to data conducted from previous contents.^{16,17,18,19}

However, it indicated that the mediating technology is not persisted for 4 weeks of time. Accordingly, in order to persist the mediating technology, it is very important to perform regular training.

V. CONCLUSION

The research is to observe a strategic approach to medical technology system to enhance body quality after salpingo-oophorectomy. For soybean intake, the mean point(72.28 ± 2.91) of members investigated which have eaten soybean after connection of mediating technology statistically significantly more than the mean point(57.08 ± 2.05) of members indicated before connection of mediating technology($t = -4.27, p = .000$). Thus, a positive content will play an important role in the establishment of future medical environment and faith that provides invaluable insights in the effect of every science parts.

ACKNOWLEDGMENT

I want to appreciate about the efforts of people who had experienced for research to enhance body quality after salpingo-oophorectomy. The modeling technology will be useful data for treatment of ovarian patients.

REFERENCES

- [1] Saad, A. F. Hu. W. Sood, A. Ovarian Cancer. *Horm Cancer*. 2010
- [2] Yurkovetsky, Zoya, Development of A Multimarker Assay for Early Detection of Ovarian Cancer. *Journal of Clinical Oncology*. 2010, 28(13), pp. 2159-2166
- [3] Zhang Z, Bast R.C. Yu. Y, Three Biomarkers Identified from Proteomic Analysis for the Detection of Early Stage. *Ovarian Cancer*. 2004, 64(1), pp. 5882-5990
- [4] Carney, M. E. Lancaster, J. M. Ford C, A Population-base of Care for Ovarian Cancer Who is Seen By A Gynecologic Oncologist and Who is not. *Gynecol Oncol*. 2002, 84(1), pp. 36-41
- [5] Lee. S. R, The effect of an integrated information system adoption for performance ability improvement in hypertensive patients. *IJSEIA*. 2014, 18(1), pp. 435-442
- [6] Petri A. L., Simonsen, A. H. Hagdall, F. Pedersen, A. T., Hartwell, D., Fung, E.T, Biomarker Panels in Urine and Serum for Ovarian Cancer Diagnosis. *Protemic Clin, App*. 2010, 4(3), pp. 304-314
- [7] Hardie E. M. Hansen B. D. and Carroll G. S. Behavior after ovariohysterectomy in the dog; What's normal?. *App Anim Behav Sci* 2007 51(1), pp. 111-128
- [8] Hedlund C. S. Surgery of the reproductive and genital systems, In : Small Animal Surgery. 1st ed. St. Louis : Mosby-Year Book Inc, 2007 pp. 517-574
- [9] Holton L. Pawson P. Nolan A. Reid J. Scott E. M. Development of a behavior-based scale to measure acute pain in dogs. *Vet. Rec*. 2001 148(1), pp. 225-226
- [10] Jakeways M.S, Mitchell V. Hashim I. A. Chadwick S. J. Shenkin A, Green C. J. Carli F. Metabolic and inflammatory responses after open or laparoscopic cholecystectomy, *Br. J. Surg*. 81(1), pp. 127-131
- [11] Lee. S. R, Short-Term impact analysis of a clinical information system adoption on relieving menstrual distress, *IJBSBT*. 2014, 6(2), pp. 61-68
- [12] Marcovich R. Williams A. L. Seifman B. D. Wolf J. S. A canine model to assess the biochemical stress response to laparoscopic and open surgery, *J Endourol*. 2001 15(1). pp. 1005-1008.
- [13] Mastrocinque S. Fantoni D. T. A comparison of preoperative tramadol and morphine for the control of early postoperative pain in canine ovariohysterectomy. *Vet Anesth Analg*. 2003, 30(1) pp. 220-228.
- [14] Chanoit G. P. Lefebvre H. P. Orcel. K. Laroute V. Toutain P. L. and Braun J. P. Use of plasma creatine kinase pharmacokinetics to estimate the amount of exercise-induced muscle damage in beagles *Am J Vet Res*. 2001, 62(1), pp. 1375-1380.
- [15] Fingland R. B. Ovariohysterectomy in Current techniques in small animal surgery, 4th ed. Baltimore : Williams & Wilkins. 2008 pp. 489-496.
- [16] Hancock R. B. Lanz O. I. Waldron D. R. Duncan R. B. Broadstone R. V. Hendrix P. K. Comparison of postoperative pain after ovariohysterectomy by harmonic scalpel-assisted laparoscopy compared with median celiotomy and ligation in dogs. *Vet Surg*. 2005, 34(1), pp. 273-282

- [17] Lee S. R, The model development and empirical application for the alleviation of low back pain, The 5th International Conference Ubiquitous Computing and Multimedia Application, *Indonesia*. 2014, 6(1), pp. 19-22.
- [18] Su J. L. Da Y. J. Hyun J. N. Su J. K. Myeong H. Y. Young J. J. Won S. B. Keon C. L. Dong Y. L. The effects of squat exercises on the space between the knees of persons with genu-varum. *Indian Journal of Science and Technology*. 2016, 9(26), pp. 110-120.
- [19] Hee J. K. Smoking cessation and relapse among smoking cessation scholarship beneficiaries. *Indian Journal of Science and Technology*. 2016, 9(26), pp.132-138.



ISSN
0975-6299

Comparison of Shoulder Ranges of Motion during Nordic Pole Walking and General Walking in the Elderly

Suzy Kim, MS, Department of Physical Therapy, Emergency Medical Rehabilitation, Kangwon National University, 346 Hwangjo-riDogye-eupSamcheok-siKangwon-Do, Korea. E-mail:suzyeli@naver.com

Jemyung Shim*, PhD, Department of Physical Therapy, College of Health and Science, Kangwon National University, 346 Hwangjo-riDogye-eupSamcheok-siKangwon-Do, Korea. E-mail:sjm7897@hanmail.net

Sungjoong Kim, PhD, Department of Physical Therapy, College of Health and Science, Kangwon National University, 346 Hwangjo-riDogye-eupSamcheok-siKangwon-Do, Korea. E-mail:lymphkim@kangwon.ac.kr

Seung Namkoong, PhD, Department of Physical Therapy, College of Health and Science, Kangwon National University, 346 Hwangjo-riDogye-eupSamcheok-siKangwon-Do, Korea. E-mail:seungnk@kangwon.ac.kr

Hyolyun Roh, PhD, Department of Physical Therapy, College of Health and Science, Kangwon National University, 346 Hwangjo-riDogye-eupSamcheok-siKangwon-Do, Korea. E-mail:withtry@kangwon.ac.kr

Abstract---

Background/Objectives: This study purpose was to find the effect of Nordic pole walking on range of upper extremity in the old person compared to those of general walking exercise.

Methods/Statistical analysis: The subject who were 65 years of age or older and 27 were randomized into 2 groups with nordic walking group (N=13) and general walking group (N=14). Testing was done pre-and after 6 weeks walking exercise intervention to determine range of motion(ROM) at the shoulder joint. Active ROM at shoulder joint was measured using goniometer. Paired t-test compared the variables change between baseline-and after 6 weeks in nordic and general walking group.

Findings: We compared the changes pre and post-test the Nordic walking and the general walking. There were significant differences in all the actions (flexion, extension, abduction, external and internal rotation) pre and post-test the exercise in the Nordic pole walking group ($p<.05$). However, statistically significant differences were not found in actions in the general walking group ($p>.05$). The results suggest that the pole walking had positive effects on the upper limb muscles to subsequently increase the joint working ranges of the upper limbs.

Improvements/Applications: Range of motion at shoulder joint improved 6-week of Nordic waking exercise for elderly.

Keywords--- Nordic Pole WALKING, General Walking, Elderly, Gait, Shoulder Range of Motion.

* Corresponding Author

I. INTRODUCTION

As interest in personal well ageing has increased, Korean communities are now providing programs for preventing chronic disorders and promoting the health of the elderly¹. Such health programs for the elderly include walking exercise to reduce risk factors of metabolic syndrome^{2,3,4} and fall prevention programs for preventing falling and improving the muscular strength of the elderly using balance and resistance exercise⁵. Walking exercise is an appropriate type of aerobic exercise for elderly because it involves less risk of musculoskeletal system injury⁶.

Regular walking exercise prevents a decline in the basal metabolic rate⁷ and is effective in maintaining elderly individuals' gait ability⁸.

Nordic pole walking is a type of walking exercise with poles in both hands, including rhythmical movements of the upper limbs while the poles touch the front ground and then the arms stretch out posteriorly⁹.

The walking exercise increases exercise's effects throughout the entire body as well as the lower limbs by raising muscular activity in the upper body, and it is effective for backaches and arthritis among the elderly by sharing the load on the spine and lower limb joints¹⁰.

In addition, it is demonstrated that the exercise intensity of the upper limbs of Nordic pole walking is higher than that of general walking¹¹. During general walking, the arms only show natural movements, not large ones, while moving back and forth.

Although Nordic pole walking leads to increased muscular activity and movements in the upper limbs, there have been few studies specifying the degrees of increase in the joint working range. In this context, this study purpose was to confirm the effects of Nordic pole walking on the range of the upper limbs in the elderly compared to those of general walking exercise.

II. SUBJECTS AND METHODS

A. Subjects

Among the elderly in Gangwon-do whose were at least 65 years old and who accessed facilities and institutions to the elderly, 27 people served as the subjects after they actively consented to participating in this study.

The subjects were able to communicate, understand what the questionnaire said, walk at least 30 meters independently, and grasp the Nordic poles without difficulty. Meanwhile, those who had disorders in the nervous system or the musculoskeletal system or diseases of at least moderate degrees were excluded from this study.

Prior to the start of this study, we get consent from Kangwon National University (KWNUIRB-2015-07-001-002).

This study goes after guideline on Helsinki Declaration. And the Nordic pole walking group's average age was 71.31 ± 4.39 years, average height was 157.38 ± 3.10 cm, and average weight was 59.27 ± 8.80 kg. The general walking group's average was 74.21 ± 4.59 years, average height was 158.00 ± 7.97 cm, and average weight was 62.24 ± 9.84 kg. (Table 1)

Table 1: Demographic and Clinical Characteristics of Study Participants Included in the Two Difference Groups

		Nordic(N=13)	General(N=14)
Gender(%)	Male	5(38.46)	2(14.29)
	Female	8(61.54)	12(85.71)
Age(years)		71.31 ± 4.39	74.21 ± 4.59
Height(cm)		157.38 ± 8.10	158.00 ± 7.97
Weight(kg)		59.27 ± 8.80	62.24 ± 9.84

All values are mean $\pm$ SD

B. Instrument and Intervention

The Nordic walking and the general walking consisted in a warm-up, major exercise, and warm-down. The subjects underwent the 50-minute training three times a week for six weeks. For the general walking, the warm-up exercise was foot and ankle rolling smoothly in the order of the toes, the soles, and the heels while the subjects stood for 10 minutes.

The main exercise was general walking on the track of a playground for 30 minutes; the subjects underwent the walking exercise while their heart rates maintained 60~80%¹². The warm-down consisted of a weight-support exercise on both feet for 10 minutes, a breathing exercise, and chest stretching. During the Nordic pole walking, the warm-up and the warm-down were similar to those of the general walking, except the subjects grasped the poles.

The main exercise was 30-minute walking forward, using the Nordic poles.(figure 1) We measured the joint working range of the shoulder joints in flexion, extension, abduction, internal and external rotation, using the method presented by Vizniak¹³ and Clarkson¹⁴.

We used a goniometer for measurement when the subjects actively performed motion ranges using their muscular strength.



Figure 1: Nordic Pole Walking

C. Data Analysis

Statistical analysis was performed using SPSS for Windows version 19.0. We used for means and standard deviations for quantitative data. The paired t-test was used to compare the results pre and post in Nordic pole walking group and General walking group for statistical significance level, α was selected as 0.05 for all results.

III. RESULTS

We compared changes pre and post-test in the Nordic walking and the general walking. There were significant differences in all the motions (flexion, extension, abduction, internal and external rotation) pre and post the exercise in the Nordic pole walking group ($p < .05$). However, no statistically significant differences were found in the motions in the general walking group ($p > .05$), except for external rotation in the left shoulder ($p < .05$)(Table 2).

Table 2: Results of Paired T-Test Comparing Nordic and General Walking Groups' Range of Motion of the Shoulder Joint (Flexion, Extension, Abduction, Internal Rotation, External Rotation)

		Nordic(N=13)	General(N=14)
Flexion	pre	160.00±14.31	163.14±17.56
	post	168.00±11.23	167.07±12.83
	<i>t</i>	-3.95	-1.80
	<i>p</i>	.00‡	.09
Flexion	pre	159.85±10.38	167.43±9.75
	post	167.62±9.95	170.07±9.71
	<i>t</i>	-4.66	-1.23
	<i>p</i>	.00‡	.24
Extention	pre	39.77±5.39	39.57±9.47
	post	45.15±5.89	42.29±9.35
	<i>t</i>	-3.80	-2.06
	<i>p</i>	.00‡	.06
Extention	pre	39.23±11.57	40.64±11.41
	post	43.23±8.20	42.93±10.71
	<i>t</i>	-2.23	-1.82
	<i>p</i>	.05†	.09
Abduction	pre	165.54±8.20	169.71±8.30
	post	171.54±5.61	171.21±7.33
	<i>t</i>	-4.94	-1.22
	<i>p</i>	.00‡	.24
Abduction	pre	163.92±11.09	168.29±9.58
	post	170.08±6.69	171.64±6.05
	<i>t</i>	-2.85	-2.15
	<i>p</i>	.01‡	.05
Internal rotation	pre	34.31±6.33	34.21±9.02
	post	38.15±5.60	35.21±9.44
	<i>t</i>	-4.09	-.93
	<i>p</i>	.00‡	.37
Internal rotation	pre	29.00±6.24	32.86±11.59
	post	33.31±6.50	33.00±11.75
	<i>t</i>	-4.57	-.26
	<i>p</i>	.00‡	.80
External rotation	pre	39.77±6.07	40.50±8.87
	post	42.69±7.69	42.50±9.14
	<i>t</i>	-2.29	-2.81
	<i>p</i>	.04†	.01†
External rotation	pre	45.85±11.73	43.71±8.77
	post	53.15±10.25	45.36±8.99
	<i>t</i>	-3.67	-1.46
	<i>p</i>	.00‡	.17

IV. DISCUSSION

This study goal was to identify changes in the joint working range of the upper limbs before and after Nordic pole walking and general walking. The incipient angles of flexion, extension, and abduction of the shoulder joints in all the subjects were not included in the normal range, but their joint working ranges did not restrict their daily movements. The internal and external rotation angles, however, were only half of the normal ones. The elderly frequently undergo flexion, extension, and abduction of their shoulder joints when they take things from shelves, put their hands on the floor, and stuff their hands in the back pockets, while they infrequently engage in shoulder joint rotation in their daily lives. This may reduce the angle of the internal and external rotation of the shoulder joints.

However, the Nordic pole walking group showed significant improved in flexion, extension, abduction, internal and external rotation after six-week. The results suggest that the pole walking had positive effects on the upper limb muscles to subsequently increase the joint working ranges of the upper limbs, when compared to studies in which pole walking rather than general walking reduced the muscular activity of the lower limbs but increased that of the upper limbs by up to 15%^{15,11}. As a study of changes in skin temperature after 60-minute Nordic pole walking reported that subjects showed an increased skin temperature in the upper limbs, the increased use of the upper limbs may be connected to increases in skin temperature, joint working range, and muscular activity¹⁶. In conclusion, Nordic pole walking may increase the use of the upper limbs, leading to the positive effect of an increase in the joint working range of the upper limbs of the elderly. In add, this study call for something to identify the effects of Nordic pole walking on the overall health and quality of life of elderly individuals.

REFERENCES

- [1] Yun J W. Study on the relation between leisure activity and leisure satisfaction of the elderly and successful aging. *Master's thesis, University of Seoul*, 2014.
- [2] Ki-Jun G. The effects of walking exercise program on metabolic syndrome factors in elderly women. *Physical Education Reserch*, 2014, 10(1), pp. 81-94.
- [3] Gui-Nam K. Effect of Walking Program on Body Composition and the Factor of Metabolic Syndrome in Obese Middle Aged Women. *Master's thesis, International University of Korea*, 2010.
- [4] Kyungmi K, Jinseop K, Jiheon H, Jaeho Y, Dongyeop L. A comparative study on stair walk and stepper strengthening exercise influence on the thigh muscle activation of university students. *Indian journal of Science & Technology*, 2015, 26(8), 1-5.
- [5] Su-Hee C, Jae-Heon L, Hwa-Young C, Il-Bok K, Mo-Kyung K, Hyun-Young L. The Effects of Trunk Stabilization Exercise Using Swiss Ball and Core Stabilization Exercise on Balance and Gait in Elderly Women. *Journal of the Korean Society of Physical Medicine*, 2012, 7(1), 49-58.
- [6] Colbert L H, Hootman J M, Macera C A. Physical activity-related injuries in walkers and runners in the aerobics center longitudinal study. *Clinical journal of sport medicine*, 2000, 10(4), 259-63.
- [7] Kungsun C. The Effects of the Walking Exercise program on body composition, Basal Metabolic Rate and Life Satisfaction of elderly Women in Rural Areas. *Master's thesis, Korea National University of Transportation*, 2012.
- [8] Kawanabe K, Kawashima A, Sashimoto I, Takeda T, Sato Y, Iwamoto J. Effect of whole-body vibration exercise and muscle strengthening, balance, and walking exercises on walking ability in the elderly. *The Keio journal of medicine*, 2007, 56(1), 28-33.
- [9] Santos L, Fernandez-Rio J. Nordic walking: a simple lifetime physical activity for every student. *Journal of physical education, recreation & dance*, 2013, 84(3), 26-9.
- [10] Porcari J P, Hendrickson T L, Walter P R, Terry L, Walsko G. The physiological responses to walking with and without power poles™ on treadmill exercise. *Research quarterly for exercise and sport*, 1997, 68(2), 161-66.
- [11] Sugiyama K, Kawamura M, Tomita H, Katamoto S. Oxygen uptake, heart rate, perceived exertion, and integrated electromyogram of the lower and upper extremities during level and nordic walking on a treadmill. *Journal of physiological anthropology*, 2013, 32(1), 1-9.
- [12] Resnick B. A seven step approach to starting an exercise program for older adults. *Patient education and counseling*, 2000, 39(2), 243-52.
- [13] Vizniak N A. Quick reference evidence based physical assessment, 3rd Ed. *Professional Health Systems, Burnaby*, 2008.
- [14] Clarkson H M. Joint motion and function assessment: A research based practical guide. *Lippincott Williams & Wilkins, Philadelphia*, 2005.
- [15] Foissac M J, Berthollet R, Seux J, Belli A, Millet GY. Effects of hiking pole inertia on energy and muscular costs during uphill walking. *Medicine and science in sports and exercise*, 2008, 40(6), 1-9.
- [16] Suzy K, Jemyung S, Hwanhee K. Comparing skin temperatures between Nordic walking and general walking for 60 minutes. *Indian journal of Science & Technology*, 2015, 27(8), 1-6.



ISSN
0975-6299

The Effects of Task-Oriented Activities on Weight Support by the Paretic Side in Stroke Patients

Sung-Ryoung Ma, Assistant Professor, Department of Occupational Therapy, Shinsung University, Daehak-ro, Jeongmi-myeon, Dangjin-si, Chungcheongnam-do, 318-01, Republic of Korea. E-mail: masung77@hanmail.net

Jong-Bae Choi*, Department of Occupational Therapy, Kyung Hee University Medical center, 23 Kyungheedaero, Dongdaemun-gu, Seoul, Republic of Korea. E-mail: cjb3798@naver.com

Jong-Eun Yang, Occupational therapist, Bethesda Hospital Rehabilitation Center, 1623 Bongyeongro, Suwonsi Yeongtong-gu, Gyeonggi-do, Republic of Korea. E-mail: solution1225@naver.com

Abstract---

Background/Objectives: The purpose of this study was to investigate what influence the task-oriented activities on weight support for the stroke patients with hemiplegia.

Methods/Statistical Analysis: A total of 30 patients with stroke patients participated. Subjects were randomly divided into 15 patients in a task-oriented activities group and 15 patients in a simple repetitive balance training group both therapy was applied for 30mins in a day and 3times in a week for 4 weeks. The MTD balance system was used to evaluate weight support by paretic side in stroke patients. To compare the treatments, we used paired t-test and independent sample t-test.

Findings: The task-oriented activities group and simple repetitive balance activities group showed statically significant differences before and after all of the posture. The task-oriented activities group showed a more significant difference compared with the simple repetitive balance training group when standing up from a chair and stretching the impaired arm.

Improvements/Applications: The task-oriented activities on a paretic side for 4 weeks had an effect on weight support after stroke patients with hemiplegia.

Keywords--- Stroke, Task Oriented Activities, Weight Support, Paretic side, Hemiplegia.

* Corresponding Author

I. INTRODUCTION

Stroke is caused by interruption of the cerebral blood supply or cerebral hemorrhage¹. According to Taub et al. (2002), movement function, sensory capacity, and exercise ability on the paretic side deteriorate due to stroke, resulting in compensatory overuse of the non-paretic side². Falls in stroke patients due to impaired balance ability result in both physical injury and fear of recurrence, and lead to self-limitation of physical activities^{3,4}. Neuro developmental treatment, proprioceptive neuromuscular facilitation, constraint-induced exercise treatment, and dynamic observation training have been used to enable recovery of balance ability and function in stroke patients.

This task-oriented approach involves actively challenging patients to learn problem-solving techniques based on functional tasks, rather than repetitive practice of normal movement patterns⁵. In a study of stroke patients using this task-oriented approach, a stretching task resulted in improved balance ability⁶. Kim et al. reported that task-oriented training showed statistically significant differences in trunk control capacity, balance, and walking ability in stroke patients⁷. Park and Bae reported that task-oriented activities significantly improved balance ability and occupational performance measures⁴. However, prior reports are mostly single-case studies involving task-oriented activities in a treatment room environment that patients are unlikely to encounter in real life. Therefore, the purpose of study provide activities related to common-life situations, and to investigate the effect of weight support for the paretic side, also develop effective treatment to improve function in stroke patients.

II. LITERATURE REVIEW

This study aims to investigate what influence the task-oriented activities on weight support by the paretic side in stroke patients. Carr and Spheherd reported that task-oriented activity is a more effective treatment for stroke, as it offers a variety of functional activities to the patient, and aids in the performance of real-life movements⁵. The task-oriented training in this study did not use simple repetitive tasks as in previous studies, but offered a selection of tasks that were closely related to real-life activities and the actual home environment so that the subjects could perform self-care when they returned to their home or society. The findings of this study are as follows.

First, there were significant differences in both control and experimental groups for all 4 activities used to measure body weight support before and after the study. The task-oriented activities group and simple repetitive balance activities group were both effective in increasing weight support on the hemiplegic side, but the experimental group showed greater improvement than the control group, suggesting that task-oriented training is more effective. Gerardin(2000) reported that performance of intervention methods appropriate for functional capability and applicable to real-life situations may aid concentration during the task and activate the cerebral cortex, thus motivating the patient⁸.

Second, the experimental group showed statistically significant improvement in weight support on the paretic side when standing up from a chair ($p<0.05$) and when stretching the impaired arm ($p<0.01$), compared with the control group. This result corresponds to previous reports that task-oriented programs had significant positive effects compared with treatments based on repetition of simple motions⁴. Moreover, standing up from the chair, filling the cup with water, and hanging the washed laundry corresponded to previous reports involving standing up from a sitting, in which the hip and knee joint change from a bent to a resting position; in the stage shortly after standing, the extensor muscles of the hip and knee help maintain balance ability⁹.

To summarize, task-oriented training applied to the experimental group included purposeful activities, and showed improvements in weight support on the hemiplegic side for some motions, compared with the results for simple, repetitive balance activities.

III. PROPOSED WORK

A. Experimental Subjects

The experiment was conducted in B hospital of Gyeonggi Province, South Korea. Thirty patients diagnosed with stroke for at least 6 months were randomly allocated between 2 groups. The study was conducted from February to April 2015, with the following inclusion criteria:

- 1) Diagnosed with cerebral hemorrhage or cerebral infarction for more than 6 months.
- 2) Score of at least 24 points on the Korean mini-mental state examination (MMSE-K), with no difficulty
- 3) Comprehending instructions or communicating.
- 4) Capable of walking more than 10 m without supportive devices.
- 5) Without joint deformity, musculoskeletal pain, fractures, or hemianopsia.
- 6) Patient (or guardian) fully comprehends the object of this study and agrees to participate.

B. Evaluation Tools

MTD Balance System

The MTD balance system (Germany) was used to evaluate left and right balance ability. Static standing, 30° knee-bend posture, standing up from a chair, and stretching the impaired arm were evaluated, and weight support by the paretic side (%) during the 4 movements was measured.

The system measures center of gravity calculated for the percentage body weight. The evaluation details are as follows.

- 1) Measure left and right weight bearing in static standing position with eyes open for 10 seconds.
- 2) Measure left and right weight bearing, maintained for 10 seconds with knees bent at 30°.
- 3) Measure left and right weight bearing for 10 seconds while the seated subject stands up from a chair.
- 4) Measure left and right weight bearing for 5 seconds, with the paretic arm stretched to the side.

C. Intervention Program

The patients were divided into control groups and experimental groups (15/group); the experiment was conducted 3 times weekly, 30 minutes per session, for 4 weeks. The experimental group was given task-oriented activities, and the control group a simple repetitive balance activity. 5 task-oriented activities (as shown in table1) that were meaningful and possible were chosen for the experimental group based on meetings with subjects, and selected from among standardized tasks suggested by the Assessment of Motor and Process Skills (AMPS); these activities are often encountered and applied in real-life situations. The activities were each performed for 5 minutes, with a 1-minute rest period between tasks. The tasks were initiated at the patient's discretion, and the speed, intensity, and difficulty were gradually increased with the patient's agreement over the 4 weeks of the experiment.

The control group performed simple repetitive balance activities, with treatment tools including a balance board and trampoline.

The intervention schedule was identical to that of the experimental group.

Table 1: Task-oriented Training

Task	Training methods
Fill a cup with water from the refrigerator	From a standing position 3 m away, go to the refrigerator and open it using the impaired and normal hand, take the water bottle in the refrigerator and walk 3 m to the table. Pour water into the cup and return the bottle to the refrigerator.
Clean the window	In a standing position, use a prepared spray to clean an indicated mark on the window, holding a wipe with one or both hands. Move toward the side of impairment while cleaning the window.
Hang the washed and dried laundry	From a standing position, go to the washing machine and bend down to take the laundry using the normal or impaired hand, and hang the laundry on a drying rack 2 m away.
Move an object while walking	Use both hands to hold a tray with a plastic cup on it, and walk, being careful not to drop the tray. For a patient whose upper limb is rigid or otherwise difficult to use, the therapist may support the injured upper limb while the patient is walking.
Go up and down the stairs	Go up and down stairs with steps 16-cm high, one by one. Patients with impaired balance may hold the rail. As the experiment proceeds, walk alternately up and down one step, and hold the rail less frequently, if possible.

D. Statistical Processing

The data were statistically processed using SPSS 18.0 for Windows. Data analysis showed a normal distribution for all variables. Four weeks after the experiment, a t-test was performed to compare the balance ability of affected side and non-affected side, and independent sample t-testing was performed to compare the difference between the control and experimental groups. For statistical significance, α was set to 0.05.

E. Results

General Features of the Task Oriented Activities Group

The general features of the task oriented activities group are shown in table 2. There was no statistical difference between the 2 groups ($p>0.05$).

Table 2: Task-Oriented Training

	Division	Task-oriented training group(n=15)	Simple repetitive balance activities group (n=15)
Gender (persons)	Man	8(53.3%)	10(66.7%)
	Women	7(46.7%)	5(33.3%)
Brain injury type	Hemorrhage	10(66.7)	8(53.3)
	Infarction	5(33.3)	7(46.7)
Paretic side	Left	8(55.3)	9(60.0)
	Right	7(46.7)	6(40.0)
Average age		46.73 $\pm$ 15.19	50.35 $\pm$ 18.44
Average disease period (month)		30.53 $\pm$ 20.84	32.68 $\pm$ 19.72

Comparison of Results Before and After the Experiments

1) Comparison of results before and after the intervention in the task-oriented training group

In the experimental group, the weight support distribution in the static standing posture changed from 39.93 $\pm$ 4.38% to 48.93 $\pm$ 5.18% on the hemiplegic side ($p>0.001$), from 40.33 $\pm$ 6.49% to 44.26 $\pm$ 5.76% in the 30° knee-bend posture ($p>0.01$), from 38.20 $\pm$ 5.60% to 43.46 $\pm$ 4.42% when standing up from a chair ($p>0.01$), and from 57.93 $\pm$ 4.44 to 62.73 $\pm$ 4.78 when stretching the impaired arm ($p>0.001$). All of the postures displayed statistically significant differences for weight support on the hemiplegic side as shown in table 3.

Table 3: Comparison of Results Before and After the Intervention

	Task-oriented training group		Simple repetitive balance activities group	
	Pre-test	Post-test	Pre-test	Post-test
Static standing posture	39.93 (4.63)	48.93 (5.18)***	42.86 (4.29)	45.60 (4.45)***
30° knee-bend posture	40.33 (6.49)	44.26 (5.76)**	41.40 (5.91)	44.06 (6.35)*
standing up from a chair	38.20 (5.60)	43.46 (4.42)***	40.46 (5.04)	42.86 (5.16)*
stretching the impaired arm	57.93 (4.44)	62.73 (4.78)***	57.73 (4.60)	60.46 (4.47)***

The values are mean (standard deviation), MTD(%), * $p<0.05$, ** $p<0.01$, *** $p<0.001$ by paired t -test

2) Comparison of results before and after the experiments in the simple repetitive balance activities group.

In the control group, the weight bearing distribution in the static standing posture changed from 42.86 $\pm$ 4.29% to 45.60 $\pm$ 4.45% on the hemiplegic side ($p>0.01$), from 41.40 $\pm$ 5.91% to 44.06 $\pm$ 6.35% in the 30° knee-bend posture ($p>0.05$), from 40.46 $\pm$ 5.04% to 42.86 $\pm$ 5.16% when standing up from a chair ($p>0.05$), and from 57.73 $\pm$ 4.60 to 60.46 $\pm$ 4.77 when stretching the impaired arm ($p>0.001$). All of the postures displayed statistically significant differences for weight support on the hemiplegic side as shown in table 4.

Table 4: Comparison of Results between the Two Groups

	Task-oriented activities group (Mean $\pm$ SD)	Simple repetitive balance activities group (Mean $\pm$ SD)	t
Static standing posture	2.66 $\pm$ 3.90	2.73 $\pm$ 1.62	-0.61
30° knee-bend posture	4.06 $\pm$ 6.77	2.66 $\pm$ 3.90	0.693
standing up from a chair	5.26 $\pm$ 2.18	2.40 $\pm$ 3.41	2.736*
stretching the impaired arm	4.80 $\pm$ 2.54	2.73 $\pm$ 1.27	2.813**

The values are mean, MTD(%), * $p<0.05$, ** $p<0.01$, *** $p<0.001$ by paired independent t -test

3) Comparison of results between the two groups

A comparison of control and experimental groups showed statistically significant differences for 2 activities; the experimental group increased $5.26 \pm 2.18\%$ and the control group $2.40 \pm 3.41\%$ when standing up from a chair ($p < 0.05$); the experimental group also increased $4.80 \pm 2.54\%$ and the control group 2.73 ± 1.27 when stretching the impaired arm ($p < 0.01$). However, there was no statistical difference for static standing posture and 3° knee-bend posture.

IV. CONCLUSION

This study aims to investigate the influence of task-oriented activities on body weight support on the hemiplegic side by allocating stroke patients to a group performing task-oriented training and another group performing simple, repetitive balance activity.

From February to April of 2015, the experiment was conducted by dividing 30 subjects into two groups in B hospital in the Gyeonggi-do Province, which the task-oriented activity, consisting total of 5 tasks, was conducted 3 times weekly for 4 weeks. MTD balance system was used to measure weight support, which static standing up, 30-degree knee bending posture, standing up from a chair, and stretching the impaired arm was evaluated. The results are as follows.

First, the weight support on the hemiplegic side showed a important difference between control and experimental groups for all 4 activities.

Second, the experimental group showed a more important difference compared with the control group when standing up from a chair and stretching the impaired arm.

The research suggested that task-oriented training, in comparison with simple repetitive balance activity, was more effective in improving weight support on the hemiplegic side for some stroke patients. Future studies require a greater number of experimental subjects to determine the mechanism of effect of task-oriented training, as well as a longer duration for the experimental period, to enable development of an effective treatment approach to improve function in stroke patients.

REFERENCES

- [1] Sims N R, Muyderman, H. Mitochondria, oxidative metabolism and cell death in stroke. *Biochimica et Biophysica Acta (BBA)-Molecular Basis of Disease*, 2010 January, 1802(1), pp. 80-91.
- [2] Taub E, Uswatte G, Elbert T. New treatments in neurorehabilitation founded on basic research. *Nature Reviews Neuroscience*, 2002 March, (3), pp. 228-36.
- [3] Watson S C, Chipchase L S, Mackintosh S. Balance, fear of falling, pain and gait aid use by low care older people: pilot study. *Australasian Journal on Ageing*, 2004 June, 23(2), pp. 77-81.
- [4] Park S J, Bae S Y. The effects of task-oriented activities on ADL performance, balance and satisfaction in chronic stroke patients. *The Journal of Korea Society of Occupational Therapy*. 2012 May, 20(2), pp. 1-11.
- [5] Bang Y S. The effects of task-oriented activities on cognitive function and performance of activities of daily living in stroke patients. *The Journal of Korea Society of Occupational Therapy*. 2007 December, 15(3), pp. 49-61.
- [6] Dean C M, Richards C L, Malouin F. Task-related circuit training improves performance of locomotor tasks in chronic stroke: a randomized, controlled pilot trial. *Archives of physical medicine and rehabilitation*, 2000 April, 81(4), pp. 409-417.
- [7] Kim B H. The effects of task-oriented training for trunk control ability, balance and gait after stroke. *Sahmyook University Master thesis*. 2009
- [8] Gerardin E, Sirigu A, Lehericy S, Poline J B, Gaymard B, Marsault C, Le Bihan D. Partially overlapping neural networks for real and imagined hand movements. *Cerebral cortex*, 2000, 10(11), pp. 1093-1104.
- [9] Park J, Woo Y K, Park S Y. Effects of sit-to-stand training on unstable surface on balance in subject with stroke. *Korean Research Society of Physical Therapy*, 2013 June, pp. 01-08



ISSN
0975-6299

The Comparison of the Upper Limb Muscle Activity According to Shoulder Angle with the Push Up Plus Exercise

Shin-Hye Baek, Department of Physical Therapy, Sunmoon University, Chung-Nam, Korea. E-mail:baek3135@naver.com

Eun-Sil Mun, Department of Physical Therapy, Sunmoon University, Chung-Nam, Korea. E-mail:dptn27@naver.com

Jin-Seop Kim, Department of Physical Therapy, Sunmoon University, Chung-Nam, Korea.
E-mail:skylove3373@sunmoon.ac.kr

Ji-Heon Hong, Department of Physical Therapy, Sunmoon University, Chung-Nam, Korea. E-mail:hgh1020@sunmoon.ac.kr

Jae-Ho Yu, Department of Physical Therapy, Sunmoon University, Chung-Nam, Korea. E-mail:naresa@sunmoon.ac.kr

Dong-Yeop Lee*, Department of Physical Therapy, Sunmoon University, Chung-Nam, Korea. E-mail:leedy@sunmoon.ac.kr

Abstract---

Background/Objectives: The purpose of this study is investigating the difference in muscular activity of shoulder muscle depending on the shoulder angle and height of pelvic limb.

Methods/Statistical analysis: The subject consisted of 20 healthy adult male and 10 healthy female excluding the ones with shoulder-related injury. The shoulder angle was set to 70°, 90°, and 110° according to the height of legs and the height of legs was set to 0cm, 50cm, and 80cm. The experiment was conducted in random order. The statistical analysis used repeated ANOVA.

Findings: According to the experiment result, the muscular activity of serratus anterior muscle, pectoralis major muscle, and upper trapezius muscle increased as shoulder angle increased. According to the result of this study, serratus anterior muscle, pectoralis major muscle, and upper trapezius muscle showed significant difference in muscular activity between 70° and 90° and between 70° and 110°, but 90° and 110° did not show significant difference. Improvements/Applications: Therefore, performing push-up plus by adjusting the height of the leg to healthy adults with weak shoulder muscle was effective.

Keywords--- Push Up Plus, Shoulder Angle, Lower Limb Height, Muscle Activity.

* Corresponding Author

I. INTRODUCTION

People experience much discomfort of diseases related with a shoulder for all ages. The shoulder joint is multi-axial, and is composed of a complex structure, and is dependent on muscles and ligaments than bones for supporting, stability and intactness of a shoulder as a spheroid articulation. The contact surface of spheroid articulation is low and has a narrow stability and those who have a functional problems caused by unstable shoulder joint suffer from the spheroid articulation ¹. The shoulder joint is working in association with the movement of the shoulder blades to produce a large range of motion of the shoulder, the movement of the shoulder joint is a stable movement of the shoulder bone, because action needs to be united with the shoulder bones ². The exercise called push-up plus to strengthen the muscles around the shoulder for the shoulder bone to make a stable movement. The purpose of the push-up plus exercise is to stabilize the shoulder joint, and this push-up plus does not bend the elbow joint compare with the ordinary push-up and add the motion of moving in or out the shoulder bone ³. Push-up plus exercise is developed by the representative push-up exercise among the closed chain motion ⁴. Therefore, The previous study recommended the push-up plus exercise as an effective closed chain motion to strengthen the serratus anterior muscle to stabilize the shoulder bone ¹. The closed chain movement is to stabilize the joint and the push-up plus exercise combining push-up with closed chain movement is helpful to stabilize the muscles on the shoulder bones ⁵. In addition, the push-up plus exercise influences on rotator cuff of the shoulder joint and is helpful to stabilize the motion of the shoulder joint ⁶. Push-up plus exercise is effective for stabilizing the spine by strengthening the abdomen as well as the shoulder ². Also, shoulder joint changed by abduction angle of scapular ⁷. Winging scapular is caused by the weakening of the muscle around the shoulder bone ⁸. Main problem of winging scapular is the weakened serratus anterior muscle and trapezius muscle ⁹. Strengthening serratus anterior muscle in doing push-up exercise is to prevent winging scapular, and to prevent leaning forward of the shoulder bone ¹⁰, and to increase the muscle activity of serratus anterior muscle by applying push-up plus exercise for the ordinary adults with problems of functioning or distortion of shoulder bones ³. To increase the additional muscle activity, when doing push-up plus exercise on the stable supporting surface and on the unstable surface, the research showed that increasing the muscle activity of serratus anterior muscle on the unstable supporting surface is more effective ¹¹. In addition when lifting the leg higher in a push-up position, the muscle activity of the shoulder muscle was increased ¹². Lifting the leg on a higher position is helpful to increase the proprioceptive sense of arms and the muscle activity of serratus anterior muscle by loading the weight to the arms ¹³. Push-up plus exercise is effective to the female and male adults that the articulation of the shoulder bone is not correct ¹⁴. On the basis of the above previous study, height adjustment of legs in doing push-up plus exercise was combined and the changes of angles of arms have been added for accurate measure. By changing the angle of the shoulders and the height of legs following the unstable surface of arms, how push-up plus exercise suggests the strengthening the muscle of arms and the effective angle of arms and the height of legs in trapezius muscle, serratus anterior muscle and pectoralis major muscle for the adults having problems of unstable shoulder joint by weakening the muscle around the shoulder, and the problems of unstable articulation of the shoulder bone, and informing push-up plus exercise on the effect of stabilization of the shoulder bone..

II. MATERIALS AND METHODS

This study has been conducted since June 21st 2015 under the approval of the Ethics Committee. The participants are a healthy 20 males and 10 females of a student of S university with no previous damage of the shoulder joint and elbow joint. Before conducting the experiments, the agreements from the participants have been obtained in advance. The method of exercise was informed to the participants by the previous practice and the features of the participants are shown in table 1. To add the unstable supporting surface, a balance pad (TOCU, GTG 400200, Germany, 2010) was used and to see the muscle activity of the muscles of shoulder (serratus anterior muscle, trapezius muscle and pectoralis major muscle), EMG (Zero WIRE EMG, EMG OQUS100, Italy, 2009) was used in this experiment. The EMG mounting position of each muscle is shown in Table 2. Orthopedic physical therapy table (Ntech, GTR-2000, Korea, 2011) was used, to adjust the alignment of the body of the participant and to confirm the height of the legs is increased as the figure, a digital protractor (Digital absolute + axis, 12-1027, USA, 2012) for the angle of the shoulder was used (Figure 1). Before the experiment day, the participants confirm if the motion is correct by doing push-up plus exercise. Experiments were conducted at random, and one motion was performed per day. The pad balance was used to provide the unstable supporting surface to all participants and the angle of the shoulder was measured by

using a digital protractor. In addition, a shoulder, a coxal articulation and a malleolus were aligned straight in line. The angle of the shoulder for the first push-up plus motion was set as 70° (Figure 2), and the angle of the shoulder for the second push-up plus motion was set as 90° (Figure 3), and the angle of the shoulder for the third push-up plus motion was set as 110° (Figure 4). The height of a hip and legs from the ground for each exercise motion with 70° was 45 cm and the height of a foot is 0 cm. The height of a hip with 90° of a ground is 45 cm, and the height of a foot was 50 cm, and the height of a hip from a ground with 110° is 65 cm and the height of a foot was 80 cm. The average value is calculated considering the height of participants with a different body structure, and the angle of the shoulder is the same and the shoulder, coxal articulation and malleolus were to be aligned in line. The neck was to bend when performing every bend. To measure the speed of push-up plus exercise, metronome was used (BPM 40, Beats 4). The repeated ANOVA was conducted to compare the average value of the muscle activity according to the angle, and the angle of arms were classified as 70°, 90°, and 110° in this study. In addition, the analysis of the research result was statistically conducted by using SPSS/PC ver.22.0 for windows program (IBM SPSS Statistics22). The muscle activity showed %MVIC, and the statistical significant level was established as $p < .05$.

Table 1: General Characteristics of the Participants (n=30)

	male(n=20)	female(n=10)
age	19.55 ± 1.70	19.40 ± 0.84
height(cm)	176.2 ± 6.35	160.1 ± 6.02
weight(kg)	72.9 ± 11.96	58.2 ± 7.45

mean±SD

Table 2: The EMG Mounting Position of Each Muscle

Muscle	Pad attaching position
Upper trapezius	C7 SP between the center of the scapula and acromion
Pectoralis major	Under the direction of the diagonal clavicle 2cm
Serratus anterior	Latissimus dorsi on the bottom edge inside the border scapula

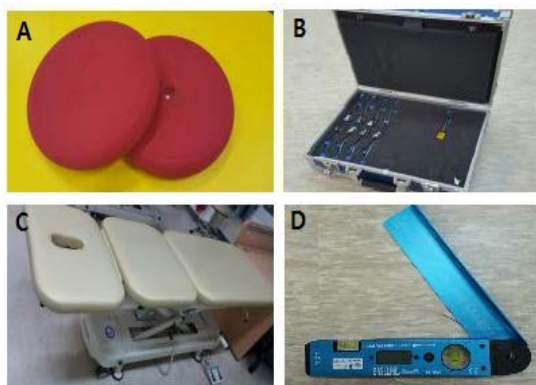


Figure 1: A. Balance Pad, B. Surface EMG, C. Orthopedic Physical Therapy Table, D. Digital Protractor



Figure 2: Push Up Plus Exercise of Shoulder Angle 70°



Figure 3: Push Up Plus Exercise of Shoulder Angle 90°



Figure 4: Push Up Plus Exercise of Shoulder Angle 110°

III. RESULT

In the table 3 shows the comparison of muscle activity among serratus anterior muscle, trapezius muscle and pectoralis major muscle according to the angles. The muscle activity of trapezius muscle showed meaningful difference when comparing the angle between 70° and 90°, and between 70° and 110° (Figure 6). When comparing the muscle activity of serratus anterior muscle, meaningful difference was shown in the angle between 70° and 90°, and between 70° and 110° (Figure 7). In addition, When comparing the muscle activity of pectoralis major muscle, meaningful difference was shown in the angle between 70° and 90°, and between 70° and 110° (Figure 8).

Table 3: Comparison of Changing Shoulder Angle According to the Muscle Activity in Upper Trapezius, Serratus Anterior, Pectoralis Major. unit: %MVC

	Upper trapezius	Pectoralis major	Serratus anterior
70°	18.54±4.30	18.55±5.44	26.07±8.75
90°	101.95±4.13	101.90±3.39	101.75±3.74
110°	102.79±4.44	103.46±5.70	109.14±36.70
F	.000	.000	.000
mean±SD, *p<.05			

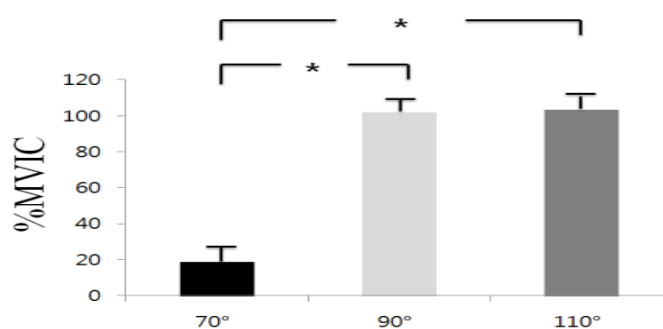


Figure 5: Comparison of Upper Trapezius Muscle Activity According to the Shoulder Angle.

*p<.05 (%MVIC)

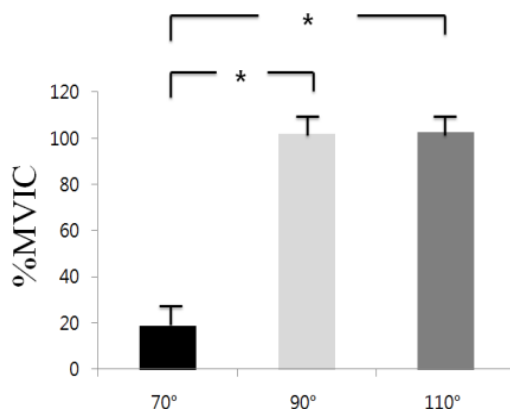


Figure 6: Comparison of Serratus Anterior Muscle Activity According to the Shoulder Angle.

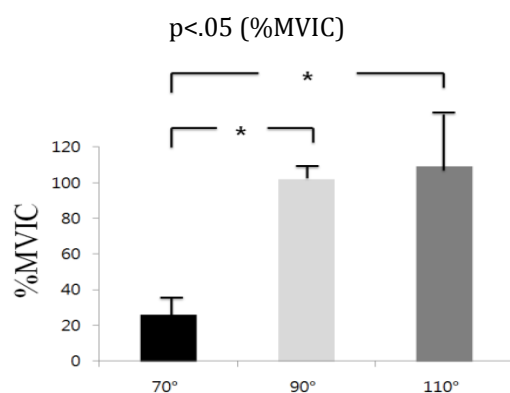


Figure 7: Comparison of Pectoralis Major Muscle Activity According to the Shoulder Angle.

*p<.05 (%MVIC)

IV. DISCUSSION

This study is to review how the muscle activity of trapezius muscle, serratus anterior muscle and pectoralis major muscle are influenced by the height of legs as the angle of the shoulder is increased. The studies on push-up plus regarding knees or using a gym ball were abundant, however, the studies on the muscle activity of push-up plus exercise around the shoulder adjusting the angle of the shoulder or the height of the legs. In this study, a balance pad was used and push-up plus exercise was performed comparing the muscle activity of trapezius muscle, serratus anterior muscle and pectoralis major muscle. One of the previous studies showed that performing push-up plus on the unstable supporting surface is more effective than on the stable supporting surface ¹⁵. The unstable supporting surface was added to motivate the muscle activity. The muscles strengthened in the previous push-up plus exercise were trapezius muscle, serratus anterior muscle and pectoralis major muscle and winging scapular might be caused when those muscles are weakened ¹³. The reason that trapezius muscle, pectoralis major muscle and serratus anterior muscle was decided is because trapezius muscle is related with the muscle above the shoulder bone and as seen in the study, the shoulder bone is turned upward when the shoulder was bent. Therefore, as the angle of the shoulder in trapezius muscle, the muscle activity in performing push-up plus is influenced. Pectoralis major muscle helps to concentrate on the shoulder and hold out the shoulder bone and the shape of the shoulder became round ¹⁶. It shows the concentrating motion. As the bending angle of the shoulder in pectoralis major muscle is increased, the concentrating motion is shown and the muscle activity on pectoralis major muscle is larger. Serratus anterior muscle is a muscle related with a shoulder and push-up plus motion to repeat holding out and letting in of the shoulder bone and because the motion of serratus anterior muscle is related with the shoulder bone, the muscle activity of trapezius muscle, pectoralis major muscle and serratus anterior muscle is influenced in performing push-up plus. Twenty males and ten females were participated in this study. The proportion of males is larger than that of females. The exercise shown in this study is required for

the muscle and so the muscle condition of males can be more reviewed and in case of females, performing the exercise relatively in an inaccurate way, and so the proportion of males became larger. In addition, the muscle activity around the shoulder bone by adjusting the height of legs is reviewed and specifically the bending angle of the shoulder to raise legs is set to 70°, 90° and 110°. The angle of 70° is the basic posture of this study for the basic push-up exercise. The angle 90° makes the body and the ground in line and proper weight around the shoulder is given. To provide the 20° of regular distinctiveness, the angle 110° was applied. The angle of the shoulder is set as 70°, 90° and 110° to all participants and made the bones of the arm, head, coxal articulation and malleolus were aligned in line. Participants were selected at random among people who have not been damaged the shoulder and so the heights of the participants were various, and the experiment was conducted according to the height of the legs by the differentiation of the length of arms and legs. The height of legs were set as 0cm, 30cm and 60cm each to perform push-up and a box was used for the 30cm and Bobath table was used for 60cm. As a result, the meaningful difference in muscle activity of serratus anterior muscle and deltoid muscle was shown. Therefore, the result of this study on each muscle activity is influenced by the bending angle of the shoulder to 70°, 90° and 110° and adjusting the height of legs also influence the muscle activity of serratus anterior muscle. The previous study measured the muscle activity of the right shoulder in performing push-up plus and reviewed the difference of muscle activity when lifting the leg on the same side and the opposite side ¹⁷. As a result, when lifting the leg on the opposite side, meaningful difference of muscle activity in trapezius muscle, serratus anterior muscle and pectoralis major muscle was shown. Therefore, the result of this study, meaningful difference in three muscles by performing push-up plus exercise with lifting the legs is shown. In addition, if a leg lifts, the weight is loaded to the shoulder and the gravity is moved to the front and so the muscle activity is increased. The previous study showed meaningful difference in serratus anterior muscle and pectoralis major muscle is shown in the study on muscle activity of the shoulder in performing push-up plus exercise by bending or extending a neck, and the muscle activity on pectoralis major muscle when bending a neck was high ^{17, 19}. This can be explained that the meaningful difference on muscle activity of pectoralis major muscle with bending a neck. The meaningful difference in the angle of 70° and 90°, and 70° and 110° was shown in this study. However, meaningful difference in the angle of 90° and 110° was not found. The height of the leg with the angle of 70° was 0cm, because the leg is not lifted, and the height is 50cm in the angle of 90°, and the height of the leg with the angle of 110° was 80cm. The difference of the average height in the angle of 70° and 90° was 50cm, and that of the angle of 70° and 110° was 80cm. However, the difference of the average height of the leg in the angle of 90° and 110° was 30cm. Even if the angle of 70° and the other two angles shows a big difference, but the difference in the angle of 90° and 110° was small compared with the angle of 70°. Through this study, the increase of shoulder bending angle, height of the leg, weight of a shoulder in performing push-up plus have the same meaning. The reason that the weight of a shoulder increases is because the body and the ground is parallel. However in the angle of 110°, the angle of the ground and the body became larger than 0°, and the gravity of the center is moved in front and the weight of loading influences on the muscle. Therefore, the muscle activity of all shoulder muscles in the shoulder angle of 110° showed the highest condition.

V. CONCLUSION

The purpose of this study is to confirm the muscle activity of the upper body by the height of the leg and the bending angle from the ground in performing push-up plus exercise, and to confirm the muscle activity of trapezius muscle, serratus anterior muscle and pectoralis major muscle related with the muscle around the shoulder bone by each angle and the height of the leg. When the height of the leg by increasing the angle of muscle is increased, the muscle activity (%MVIC) of all muscles was increased. The three muscles, trapezius muscle, serratus anterior muscle and pectoralis major muscle showed a meaningful difference in the angle between 70° and 90°, and between 70° and 110°. Therefore, performing push-up plus by adjusting the height of the leg to healthy adults with weak shoulder muscle was effective.

REFERENCES

- [1] Newmann DA. Kinesiology of the musculoskeletal system. 2nd edn. Mosby Elsevier. Missouri, 2010.
- [2] Kim GY, Kin SH. Effects of push-ups plus sling exercise on muscle activation and cross-sectional area of the multifidus muscle in patients with low back pain. *Journal of Physical Therapy Science*. 2013 Dec, 25 (12), pp.1575-8.
- [3] Kibler WB, Sciascia A, Wilkes T. Scapular dyskinesia and its relation to shoulder injury. *Journal of the American Academy of Orthopaedic Surgeons*. 2012 June, 20 (6), 364-72.

- [4] Daisuke U, Yanjinsuren B, Rie N, Masaaki S. Effect of various hand position widths on scapular stabilizing muscles during the push-up plus exercise in healthy people. *Journal of Physical Therapy Science*. 2015 Aug, 27 (8), pp. 2573-6.
- [5] Cho SH, Baek IH, Ju YC, Cho MJ, Choi MY, Jung DH. Effect of the Push-up Plus (PUP) Exercise at Different Shoulder Rotation Angles on Shoulder Muscle Activities. *Journal of Physical Therapy Science*. 2014 Nov, 26 (11), pp. 1737-40.
- [6] Park SY, Yoo WG. Differential activation of parts of the serratus anterior muscle during push-up variations on stable and unstable bases of support. *J Electromyogr Kinesiol*. 2011 Oct, 21 (5), pp. 861-7.
- [7] Hong YT, Lee DY, You JH, Kim JS, Hong JH. Changes in the subacromial space according to the angle of shoulder abduction. *Indian Journal of Science and Technology*. 2015 Oct, 8 (25), pp. 1-6.
- [8] Choi SH, Lee BH. Clinical usefulness of shoulder stability exercises for middle-aged women. *Journal of Physical Therapy Science*. 2013 Oct, 25 (10), pp.1243-6.
- [9] Rodrigo CDA, Rodrigo DA, Helga TT, Jaqueline M, Anamaria SDO. Shoulder muscular activity during isometric three-point kneeling exercise on stable and unstable surfaces. *Journal of Applied Biomechanics*. 2011 Aug, 27 (3), pp. 192-6.
- [10] Park SY, Yoo WG. Differential activation of parts of the serratus anterior muscle during push-up variations on stable and unstable bases of support. *J Electromyogr Kinesiol*. 2011 Oct, 21 (5), pp. 861-7.
- [11] Park KM, Cynn HS, Yi CH, Kwon OY. Effect of isometric horizontal abduction on pectoralis major and serratus anterior EMG activity during three exercises in subjects with scapular winging. *J Electromyogr Kinesiol*. 2013 Apr, 23 (2), pp. 462-8.
- [12] Jung J, Kim M, Lee S. The effect of push-up exercise with different lower limb heights on the trunk and the shoulder stabilizing muscles. *Journal of Physical Therapy Science*. 2012 Feb, 24 (2), 617-9.
- [13] Yoo WG. Effect of Exercise Speed and Isokinetic feedback on the middle and lower Serratus anterior muscles during push-up exercises. *Journal of Physical Therapy Science*. 2014 May, 26(5), pp. 645-6.
- [14] Dannelly BD, Otey SC, Croy T, Harrison B, Rynders CA, Hertel JN, Weltman A. The effectiveness of traditional and sling exercise strength training in women. *J Strength Cond Res*. 2011 Feb, 25 (2), pp. 464-1.
- [15] Kim JS, Lee DY. A effect of the shoulder stabilizer muscle activity during a push-up plus on a different condition surface. *Journal of digital policy & management*. 2012 Jan, 10 (1), pp. 399-405.
- [16] Lee SY, Han JT, Park MC, Lee MH, Shim JM. Comparison of shoulder stabilizer muscle activations during push up plus exercise by with cervical flexion and extension. *Journal of Physical Therapy Science*. 2011 Jan, 23 (1), pp. 111-3.
- [17] Cho SH. Comparative analysis of the right shoulder's muscle activity when lifting ipsilateral and contralateral legs during the push up plus exercise. *Korean society for precision engineering*. 2015 Aug, 32 (8), pp. 749-54.
- [18] Yu JH, Hong JH, Kim JS, Kim SJ, Shim DS, Lim JE, Lee DY. Influence of head posture on trunk muscle activation during prone bridging exercis. *Indian Journal of Science and Technology*. 2015 April, 8 (S7), pp. 423-27.



ISSN
0975-6299

Meaning of Recovery of Drug Addicts: Focus Group Study

Gyun-Young Kang, Dept. of Nursing, Kyungdong University, 815 Gyeonhwon-ro, Munmak-eup, Wonju-si, Gangwon-do, Korea. E-mail:mental74@kduniv.ac.kr

Youn-Sil Kim*, Dept. of Nursing, Doowon Technical University, 51 Gwaneumdang-gil, Juksan-yeon, Anseong-si, Gyeonggi-do, Korea. E-mail:sil0218@doowon.ac.kr

Se-Jin Ju, Dept. of Nursing, Namseoul University, 21 Maeju-ri, Seongwan-eup, Seobuk-gu, Cheonan-city, Choongnam, Korea. E-mail:lovepdd@nsu.ac.kr

Abstract---

Background/Objectives: This study is a qualitative research conducted to explore the meaning of recovery of drug addicts in the use of focus group interview

Methods/Statistical analysis: Subjects in the study were 14 patients under medical treatment and custody in the organization N. Data have been collected from two groups where seven members belonged to each group in January, 2015, by performing focus group interview for two sessions on each group. Open coding by Strauss & Corbin was utilized for data analysis categorizing the significant areas.

Findings: According to the results of the study, three categories and six sub-categories were derived. Meaning of recovery of drug addicts was shown by looking at reality from the past, overcoming the extreme obstacles, and preparing for the future.

Improvements/Applications: Therefore, this study is intended to contribute to seek for nursing approach in maintaining and managing recovery with positive interaction with family members and society through the meaning of recovery of drug addicts.

Keywords--- Drug Addicts, Recovery, Meaning, Focus Group, Qualitative Research.

* Corresponding Author

I. INTRODUCTION

A. *Necessity of Research*

Drug addiction has been causing serious social issues beyond the personal destruction including health conditions, career, family, and interpersonal relationship. According to the statistical investigation of drug from Public Prosecutor's Office in Korea ¹, the number of members who controlled drug users was 9,174 in 2011, 9,255 in 2012, 9,764 in 2013, and 9,742 in 2014. Therefore, it has been decreased by 2.0% compared to the previous year. However, there has been overall increasing trend on them ¹. Drug crime coefficient represents a value on the number of drug users exposed per a hundred thousand population. If this value was over twenty, it has been known that control was not feasible through penalty or treatment due to accelerated spreading ². Korea has been representing a value higher than twenty since 1999 ². Therefore, Korea is not safe from drug.

Drug addiction not only harms physical and mental health of individuals but also causes family-related and social issues. In addition, it is developed into problems including economic loss and crime ³. Korea is currently implementing nationally executed policies including the treatment in care and custody, treatment protection, and probation to eradicate drug users. Treatment in care and custody is to accept physically and mentally disabled people and drug addicts in the facility providing the security with treatment, and treatment protection is to make drug users overcome physical and mental dependence on drugs and prevent re-occurrence to restore them as a healthy member in society as a part of hospitalized treatment and out-patient treatment ⁴. Probation is to detain offenders in the correctional facilities making them lead a normal social life instead of restricting them while correcting offensive and delinquent behaviors through guidance, supervision, and support from probation officers and preventing re-occurrence as a part of criminal and institutional policy ⁴. However, in spite of nationally executed policies, the re-occurrence rate of drug users has reached to about 40% since 2005 representing how serious addiction turned out to be ⁵. Therefore, drug addiction that represents high re-occurrence rate is in dire need of treatment intervention for helping drug addicts recover as a member of society through treatment and rehabilitation procedures.

There has not been any treatment rehabilitation policy for drug users in the correctional facility. According to Park ⁶, mild drug users have been detained with smugglers or drug suppliers and exposed to a chance for them to be a smuggler or drug supplier during the period when they were detained. Hereupon, treatment and rehabilitation program is urgently required to prevent re-occurrence of drug users.

Most of the studies in dealing with drug users have been conducted on policies for treatment of drug users, measures for promoting the rehabilitation and treatment, and plans for making them restore as a member of society ^{7,8,9}. In addition, there were studies in dealing with experience of recovery of drug addicts through narcotic anonymous meeting ¹⁰, experience of recovery of drug addicts ¹¹, and experience of recovery of drug addicts in local community ³. However, there have not been previous studies that explored how meaningful recovery was in the perspective of drug addicts.

For the treatment and rehabilitation of drug addicts, understanding on drug addiction is required in advance. Therefore, it is required to identify how drug addicts have lived their lives and what it means to recover for them through their stories. In order to understand how they re-organize the experience of live and the meaning of recovery, qualitative research is required. Qualitative research method is to find the meaning and structure of life of participants with researcher together.

Especially, focus group makes it convenient to deal with reality a researcher intends to understand through interaction with others and also to acquire rich amount of data on experience that is difficult to observe such as drug addiction in a short amount of time. In addition, focus group makes it possible to identify the experience in diverse perspectives and views through interaction among group members ^{12,13}. Therefore, it is anticipated to deeply understand the recovery of drug addicts through focus group interview.

There have been only few studies in dealing with drug addicts conducted by focus group. Therefore, it is very meaningful to conduct a study that confirms the meaning of recovery of drug addicts. This study has been conducted to explore how drug addicts re-organize the recovery in the experience of their lives and create the meaning of recovery. The objective of this study is to identify the meaning of recovery of drug addicts in a qualitative research method. Specific research problem is, "What does it mean to recover for drug addicts?"

II. RESEARCH METHODS

A. Research Design

This study is a qualitative research conducted to identify the meaning of drug addicts in the use of focus group interview.

B. Subjects in the Study and Ethical Consideration

This study has been conducted on 14 male adults who agreed to voluntarily participate in this research by understanding the objective of study among those who were detained under custody for treatment due to drug addiction in the organization N located in the city of G. Considering ethical issues of participants, we have specifically explained the objective and methods of the study and promised to use data only for the purpose of the research and to abolish them after completing the study. In addition, we have guaranteed the non-disclosure of rights and data that were to be used in anonymous as participants had a right to withdraw from participation in the research anytime if they wanted to and acquired their signature on the agreement form. Names of participants suggested in the result of research were named from A to N for the issue of anonymity.

C. Data Collection

Each focus group was comprised of seven members to collect data, and focus group interview has been conducted on each group for two sessions in January 12th and 19th, 2015. We have promised for non-disclosure of data to participants asking for their agreement and recording the procedures of group interview.

About two hours have been consumed for discussion that was proceeded until no new statement about the meaning of recovery was acquired from each of the participants any more. Research questions became clarified according to the principles of questions suggested in the focus group research method while configuring research inquiries and proceeding focus group interview (Table 1).

Table 1: Sample Focus Group Questions

Introductory Question
Please feel free to provide your thought about drugs (narcotic).
Transition Question
Please provide us your thought about recovery.
Key Questions
How do you feel if you 'recover'?
What does it mean to recover to you?
When do you think recovery starts?
How do you lead your life from now on?
Ending Questions
I will briefly summarize our discussion. Has it been well summarized?
Do you have anything to say more?

D. Data Analysis

As for data analysis, recorded resources were transcribed in the language of participants while utilizing open coding by Strauss & Corbin ¹⁴ to find meaning parts and categorize them. I, as a researcher, have repeatedly read the transcribed copies focusing on the data. I have identified each topic exploring the correlation among topics, establishing main and sub-categories, and classifying/recording the parts of conversation in each category based on sub-categories. While proceeding these procedures, researchers have made an effort to maintain accuracy through continuous review and discussion.

E. Rigidity of Research

The evaluation of rigidity of this study was carried out based on Guba and Lincoln's ¹⁵ evaluative criteria composed of truth-value, applicability, consistency, and neutrality suggested. Truth-value represented the result of analysis on the meaning of recovery among drug addicts and confirmed whether they were consistent with their experience.

Applicability was to collect data in-depth until statement of participants was repeated without providing new statement. Consistency has been reviewed and evaluated in terms of procedures and results of the research by two professors in the department of mental nursing and also nurses for addiction psychiatric nurses and also a professor in the department of nurse who wrote a dissertation for doctoral degree.

In addition, we have consciously made an effort for subjectivity of a researcher not to influence on the results of the study for neutrality, and research team has held a regular meeting for data analysis to maintain neutrality.

III. RESULTS

According to the results of analyzing the meaning of recovery among 14 drug addicts who participated in this study, three categories and six sub-categories were derived. Participants in this study turned out to find the meaning in their inner world and seek for the meaning of recovery in the relationship with social supporting system.

The meaning of recovery among drug addicts turned out to be 'looking at reality from the past,' 'overcoming the extreme obstacles,' and 'preparing for the future' (Table 2).

Table 2: Meaning of Recovery of Drug Addicts

Categories	Theme Clusters
Looking at reality from the past	Me seen through the life as an addict Overcoming the trap of karma
Overcoming the extreme obstacles	Frustration Hope and longing on precious others
Preparing for the future	Live independently Way to recover

A. *Looking at Reality from the Past*

The first category, 'Looking at reality from the past,' means to confront themselves as a drug addict through the experience and recognize social influential factors. Participants were aware of how serious addiction was and also that they needed to be disconnected from drug addicts. Drug addicts expressed to look at reality from the past through 'me seen through the life as an addict' and 'overcoming the trap of karma.'

Me Seen Through the Life as an Addict

Participants turned out to realize how they were weak through a life as an addict. In addition, they were afraid of drug while realizing how they were devastated due to drug and also lived for drug due to switched priority in life.

I imagine how I or those around me might be the same when I am released from the jail to society instead of looking at me for using drug. I tried to something to stay out of it. I need to persevere if I feel the pain. However, my weakness is the drug. I always say to myself that this will be the last time. However, drug might be calling me instead at some point (A)

I am frustrated for not being able to stay out of this situation but repeat the same things (B, D, N).

I am anxious and insecure if I am out of meth just like we are out of rice or side dishes at home. Then, I know what I am getting myself into, but I keep repeating them. This is not my life, but the life of drug. I feel like I live to use drug (E).

I have never stayed at home for more than three days. However, I keep rationalizing myself. This was the reason why I stayed at home. This is not to life for my live but for drug (F).

As I am addicted, drug becomes the number one priority over the remaining time. I keep postponing what I am supposed to do but use drug first (G).

I realize that I keep using the drugs as I used it since I was so tired. Conclusion is that I have been wasting my time even if I knew it (omitted). About a couple of years ago, my family had a hope and tried to help me. However, as I continued using drugs after time passed by, they lost their expectation and only asked me to live well. This was what they said to me (I).

Overcoming the Trap of Karma

Participants indicated that relationship with those who they became acquainted with because of drugs was the reason why they were trapped in vicious cycle and unable to stay out of drug. Therefore, they expressed that overcoming the trap in interpersonal relationship that they originally regarded as a part of loyalty was one way to recover. They were aware of how they needed to be disconnected with interpersonal relationship and keep a distance with them.

There is this connection among people with drugs. If I am disconnected with people, I am unable to score drugs. Therefore, there is a high chance for me to quit drugs (D).

This time, I never meet anyone except for my families when others visit. I do not want others to know that I am here. I will keep a distance with them when I am released (G).

When I am released, people wait in the front holding weeds or meth on their hands. At that time, I thought it was a part of loyalty. However, I tried to keep a distance with people I was connected from the past (K).

As I kept on using drugs, I became acquainted with many people. As I became acquainted with them, I was in a deep trap. The reason why we cannot stay out of drugs easily is because of what we have around us (L).

B. Overcoming the Extreme Obstacles

The second category, 'Overcoming the extreme obstacles,' is to realize how frustrated they are in with an extreme experience in their lives motivating them to recover.

Family members turned out to realize how the second category was an important element for drug addicts to recover. In addition, participants indicated that they realized their realities through an indirect experience of death of their friends.

Drug addicts expressed to overcome the extreme obstacles with 'frustration' and 'hope and longing on previous others.'

Frustration

Participants turned out to realize how direct and indirect experience was an extreme of life due to drugs. What they felt in such an extreme in their lives was frustration that motivated them to recover. Frustration was represented as an ardent attitude on willing to do something at the risk of their lives.

As soon as I used drugs, I thought that everything was over. As time passed by, there was nothing I got from addiction.

As soon as I used them... I am frustrated to quit them at the risk of my life (B).

I wanted to live well, but my life was ruined at some point. My friend died out of drugs, and committing a suicide from drug does not sound strange (C).

I believe that I am motivated to quit drugs with frustration (D).

When I looked around, they lost their teeth and hair and died due to liver cirrhosis. Now, I am losing my teeth and hair. I was motivated to change by looking at others who died in this way (E).

I am frustrated enough to quit drugs at this time since there might be no more change for me to go back to family except for this time. I kept on telling myself to quit in the past but have never been this frustrated (F).

I am willing to die if I cannot stay out of drugs. I need to find something if I stay away from drugs. (Omitted). I am the king if I have many drugs. I thought that I would be able to live like a king. However, I do not want to die as a king of drugs. I do not want to succumb to a shot of drug (L).

Hope and Longing on Precious Others

Participants turned out to make up their minds to change for their family by realizing how precious they were and have hope on them. Family was whom they were sorry for and also a promise to make.

There were no ones who were hurt except for family or relatives. I want to find a job that can help family. I have been making an effort for it, but it was not easy (A).

I want to have babies and marry. I also want to share with those in pain (B).

As my mother was left alone and became incapable of doing works, I realized that I needed to support my mother. She has been living to support me. I am sorry for my family (C).

This time, I had my mind made up for my precious family (E).

Those with family might be easy to stop using drugs than people like me. I might stop using drugs since I would be sorry for them (J).

My father became bankrupt because of gambling. Therefore, I might not have anything to do after I am released, so I keep using drugs. If I had family, I would have been better (K).

C. Preparing for the Future

The third category, 'Preparing for the future,' indicated that participants turned out to seek for a meaning of recovery in a diverse and broad range from them to others and social institutions to recover from drugs. Participants were aware of how they needed to overcome drugs by themselves, and making up their mind was the starting point for them to recover. In addition, they also indicated that warm glances from society and social institutional support for drug addicts and their family members were required. Drug addicts turned out to express the preparation for the future with 'independent living' and 'way to recover.'

Living Independently

Participants turned out to have a will to find a way to live without relying on their family members by themselves.

I am sad that I have been wasting my time. I have a goal to live independently without relying on my family members (I).

I had an older sister as the one and only family member. She lives in Malaysia, and I need to live on my own. (Omitted). Recovery might be relevant as I take step by step to make a whole bridge and pass the brook. I try to do it on my own without relying on others (J).

It takes more than making up my mind to quit drugs. However, I cannot tell this to others. I need to control them (N).

Way to Recovery

Participants turned out to regard resolution as a starting point for recovery, and it included a modeling procedure of others who recovered from drug addiction. In addition, they indicated that they might be able to recover and be treated not as a criminal but as an addict if they were supported with heart-warming attitude and encouragement in society.

I believe that making up one's mind or realizing how drug was a bad thing is a part of recovery process. There are people who live well off after they are released from here. About one or two people out of ten.. I would like to know how they live and how they quit drugs. I would like to do the same thing (C).

People treat me as a criminal if they know I used drugs. However, I am an addict instead of a criminal. We need this attitude. (Omitted). We need policies for taking care of us, changing us, helping family, and putting us all together (D).

As I live a repeated life, I realize how I would have been able to quit for a year if I stayed away from drugs for a year.

Then, I quit drug for two years this time. I believe that recovery is to make this time for staying away from drugs. Making up my mind for refraining and staying away from drugs is the recovery to me (L).

It is like a homework. I make up my mind for homework, and this is how recovery starts. There are drug fighting organization and NA meeting in Korea. However, it is still very difficult if I attend them. I hope that there are systems for helping us recover in social policies (M).

It is not important for us to stay away from drugs for one, two, or three years. What is important is for others to recognize how we have been away from drugs for three years and also how 'we lived our lives well enough.' I believe that this is the start of recovery. When I came here, I realized how they called us as a patient. Whether we are treated as a patient or criminal.. Criminal is a bad person, but patient is the one who can be cured (J).

IV. DISCUSSION

The objective of this study is to identify the meaning of recovery of drug addicts and accurately and deeply understand their life experience. The meaning of recovery among drug addicts turned out to be derived as 'looking at reality from the past,' 'overcoming the extreme obstacles,' and 'preparing for the future.'

First of all, 'looking at reality from the past' is explained that addicts look at their lives, identify the causal factors, and find solutions. In other words, it can be interpreted that participants objectively look at their lives, understand themselves, and pursue a desire to stay free from causal factors in the relationship with others related to drugs. This category is explained that drug addicts confront the reality through their lives in the past and recover by disconnecting with interpersonal relationship they built in regard of drugs. According to the result of study by Baek ³, a topic of 'disconnecting the relationship with people' related with drugs was derived. Therefore, the same result was represented with this study. Hereupon, people around drug addicts are of an important existence to stop using drugs and eventually recover from them. In addition, Koski ¹⁶ has insisted that sincere enlightenment, cognitive-emotional changes, confirmative turning point with insight, internal conflict-solving, and confrontation of reality were of a way to recover from addict.

Participants were willing to change and recover by reflecting themselves as '*drugs were calling themselves (A)*' and '*they were living for the remaining lives for drugs (F)*.' It seems that continuous education and rehabilitation are required for internal changes, re-establishment of identity, and positive interaction for expanding the perspective of viewing the reality from the past among drug addicts.

The second category, 'overcoming the extreme obstacles,' confirmed that frustration felt in the dead end in life served as a motivation, and support from environment such as family was of an important meaning for recovery. In other words, frustration in the extreme obstacles might be a turning point to recover, and precious others including family members are of an important meaning for recovery including responsibility and longing that influenced on their recovery. In addition, they were aware of how necessary changes were required as they were concerned with their health conditions as other died from drugs. Koski et al. ¹⁷ insisted that changing factors influencing on recovery from addiction included, first of all, tiring out of drugs in regard of diseases or deaths of others as well as concern with their health conditions, secondly, family factors related to the relationship with others or family members, third, love factors related to spouse, friends, and lovers, fourth, self-dependent group or experiencing the extreme, fifth, social results in dealing with legal or financial issues and changes in divorce or residence, sixth, recognition of the God or religion, and, seventh, support from friends. McIntosha ¹⁸ indicated that continuous motivation was required for them to maintain the recovered conditions. Aforementioned results in the previous studies ^{17,18} were interpreted in the same context with the results of this study.

The third concept, 'preparing for the future,' confirmed that addicts and also social-institutional factors influenced on the recovery. Koski ¹⁷ indicated that self-control was the most important element to suspend problematic behaviors and also that internal changes and correction on self-recognition influenced on recovery ^{19,20}. Margaret ²¹ insisted that stopping drugs might be of a motivation by finding goals from social structure, physical goals, and also identity. It is required to support and aid them for finding social, physical, and identity-related goals for synchronization and also to provide social policies for education and rehabilitation in continuous and stepwise manner. There are Korean Association Against Drug Abuse as a private group for providing drug preventing business and also Narcotic Anonymous.

Participants indicated, '*They treated us a criminal when they know we used drugs (D)*,' and '*Whether we are treated as a criminal or patient... Criminal is a bad person, but patient is the one who can be cured (J)*.' Hereupon, they insisted that changes from social perspective were required. In addition, support and encouragement by saying, 'You work hard and live well,' and warm glances were confirmed to be a required element for them. Koski et al. ¹⁷ indicted the love and support from friends were elements that influenced on recovery. Therefore, it is required for drug addicts to experience interaction with others and social support. It is recommended to provide various continuous and stepwise systems so that drug addicts detained in the facility can maintain cognitive-emotional changes such as resolution and perform it.

According to aforementioned results of the study, recovery was to confront reality through the past and prepare for the future to stay away from extreme obstacles among participants. They recognized how recovery was much more than quitting the drugs. In other words, recovery was a stepwise procedure as indicated, '*Recovery might be relevant as I take step by step to make a whole bridge and pass the brook. I try to*

do it on my own without relying on others (J).' Therefore, recovery is of a course of existence instead of final destination or goals and proceeded in unique and individual routes ²².

At last, it was confirmed that they experienced physical, mental, and social pain due to drug addiction but tried to recover from them with internal power, reliance, family, and social supporting system. In the previous studies, drug addicts recognized how interacting with others everyday was of a correct route to recover ³. Therefore, it is required to identify how drug addicts are able to maintain the recovered conditions and make an efficient approach in the nursing field by understanding the management of recovery of them.

In addition, nurses are required to not only provide the development, education, and support for helping drug addicts but also participate in all the courses for subjects. Nurses are recommended to provide a fundamental service for them to find true identity in every moment when they confront themselves, experience extreme obstacles, and prepare for the future.

V. CONCLUSION AND SUGGESTIONS

This study has been conducted to identify the meaning of recovery among drug addicts by using focus group. According to the results of the study, the meaning of recovery among drug addicts was to confront reality, overcome extreme obstacles, and prepare for the future. Recovery among drug addicts included frustrated enlightenment of lives, confrontation of reality, family, and social support as an important factor. Results of this study are meaningful in that they provided important foundation for development of rehabilitation program for making nurses stay with drug addicts and help their rehabilitation and returning to the society through the meaning of recovery.

Following suggestions are made according to the results of the study. First of all, this study has been conducted on drug addicts detained in the facility for custody of treatment. An expanded follow-up research is recommended in dealing with experience of recovery on drug addicts who maintain the recovered conditions at local community based on results of this study. Secondly, this study has been conducted on male drug addicts. Understanding on recovery of female drug addicts is require in the future.

ACKNOWLEDGMENT

Funding for this paper was provided by Namseoul University.

REFERENCES

- [1] Supreme Prosecutors Office republic of Korea.
http://spo.go.kr/spo/major/drug/data/drugbbs01.jsp?mode=view&article_no=589345&pager.offset=0&board_no=4&stype. Date accessed: 01/07/2016
- [2] Korean Association Against Abuse. drugs and crime facts.
http://pr.drugfree.or.kr/information/index.html?contentsNum=2&category=DRUG_2&headNum=&seq=2189&tpage=4. Date accessed: 01/07/2016.
- [3] Baik H. U., Han I. Y., The Recovery Experience of Drug Addicts in a Community - The Regeneration in the Real World. *Mental Health & Social Work*. 2014, 42(3), pp. 151-177.
- [4] National Law Information Center. MEDICAL TREATMENT AND CUSTODY ACT.
<http://www.law.go.kr/main.html>. Date accessed: 25/07/2016.
- [5] Nam, S. M., An effective measures for Prevention of the spread of Drugs and crime. *Correction review*. 2014, 64, pp. 33-57.
- [6] Kang, E. Y., Sin S. M., A Study on the Drug Treatment and Rehabilitation Programmes in Prison. *Korean criminological review*. 2012, 7, 1-302.
- [7] Kang I W, A Study on the Plan for Activation of Treatment Protection Act toward Domestic Drug Offenders, 2012. Hansung university, master's thesis, Seoul.
- [8] Cho H K. A Study on Rehabilitation in Society Support Plan of Drug Offender, 2006. Kwangwoon university, master's thesis, Seoul.
- [9] Korean Institute of Criminology. A study to activate cooperation between criminal system and health care system for drug offender treatment. Crime phenomenon and criminal justice policy in Korea: Seoul. 2005.
- [10] Choi E M. Analysis of Drug Dependents' Recovery Experiences through NA Self-Help Meetings, 2011. PyeongTaek University, master's thesis, Gyeonggi.
- [11] Yoon H J, A study of the recovery experience from drug dependence : focused on human becoming

- approach, 2013. Sungkyunkwan University, doctor's thesis, Seoul.
- [12] Kreuger, R. A., Focus groups; A practical guide for applied research (2nd ed.). Thousand Oaks, CA: Sage Publications.: 1994.
- [13] Morgan, D. L., Focus groups as qualitative research (2nd ed.). Thousand Oaks, CS: Sage Publications.: 1997.
- [14] Strauss, A., Cobin, J., Basics of qualitative research: technique and procedures for developing grounded theory. New York: Sage Publications, INC.: 1998
- [15] Guba, E., Lincoln, Y. S., Effective evaluation: Improving the usefulness of evaluation results through responsive and naturalistic approaches. San Francisco, CA: Jossey-Bass. 1981.
- [16] Koski A. J., Turning points in addiction careers: five case studies. *Journal of substance misuse*. 1997, 3, pp. 226-233.
- [17] Koski A. J., Fact of influencing recovery from different addictions. *Addiction Research*. 1999, 7(6), pp 469.
- [18] McIntosha, J., Mckeganey, N., Addicts' narratives of recovery from drug use: constructing a non-addict identity. *Social Science & Medicine*. 50(10), pp. 1501-1510.
- [19] Banonis, B. The lived experience of recovering from addiction: A phenomenological study. *Nursing Science Quarterly*. 1989, 2, 37-43.
- [20] Kearney, M., Reclaiming normal life: Mother's stages of recovery from drug use. *Journal of Obstetric, Gynecologic & Neonatal Nursing*. 25, pp. 761-768.
- [21] Margaret, H. K., Truthful self-nurturing: A grounded formal theory of women's addiction recovery. *Qualitative health Research*. 1998, 8(4), pp. 495-512.
- [22] Jacobson, N., Greenley, D., What is recovery? A conceptual model and explication. *Psychiatric Services*. 52(4), pp. 482-485.



ISSN
0975-6299

Evaluation of the Image Quality on Computed Tomography

Kwanghyun Chang, Department of Diagnostic Image, Samsung Seoul Hospital, 81, Irwon-ro, Gangnam-gu, Seoul, chang6014/06351, Korea. E-mail:002abbakh@gmail.com

Joonkoo Choi*, Department of Radiological Science, Graduate School of Health Science, Far East University, 76-32, Daehak-gil, Gamgok-myeon, Eumsung-gun, Chungcheongbuk-do, c3792/27601, Korea. E-mail:rslaser@hanmail.net

Ghajung Kim, Department of Radiological Science, Graduate School of Health Science, Far East University, 76-32, Daehak-gil, Gamgok-myeon, Eumsung-gun, Chungcheongbuk-do, c3792/27601, Korea. E-mail:ghajung@naver.com

Joongseok Go, Department of Radiology, Seoul National University Bundang Hospital, 82, Gumi-ro 173neon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, go1122/13620, Korea. E-mail:snuhgo@hanmail.net

Seunggi Kim, Department of Radiology, Senam University Myongji Hospital 55, Hwasu-ro 14beon-gil, Deogyang-gu, Goyang-si, Gyeonggi-do, mj98015/10475, Korea. E-mail:cocuncap@naver.com

Sinyoung Yu, Department of Radiology, Seoul Sung-sim Hospital, 82, 259 Wansan-ro, Dondaemun-gu, Seoul, sy4643/02488, Korea. E-mail:ryusinyoung@gmail.com

Abstract---

Background/Objectives: The purpose of phantom image test is to evaluate the image quality. Therefore, it is investigated that whether several phantoms are available for QC by comparison and measurement of phantoms.

Methods/Statistical Analysis: In this study, 4 CT scanners were used, LightSpeed VCT(GE healthcare, USA), Brilliance iCT, Brilliance 64(philips medical system, Netherlands), Somatom Definition Flash, Somatom Definition AS(Siemens healthcare, Germany), Aquilion 64 (Toshiba medical system, Japan) and 3 phantoms were used, AAPM CT performance phantom (model 76-140, ACR phantom(model #438, gammexrmi, USA) and catphan phantom (600, USA). Phantom images were obtained from each CT scanners by axial scan.

Findings: There was no significant difference in measurement results for 3 phantoms about common evaluation items (slice thickness, uniformity, high contrast resolution, low contrast resolution, CT number evaluation). The intent of study is to allow users to use other phantoms, not AAPM phantom selected as a standard phantom by "The rules on the installation and operation of special medical equipment".

Improvements/Applications: It is considered to do quality control with proper phantom depend on necessary quality control items because exceptional phantoms have own characteristic quality control items.

Keywords--- CT QA & QC, AAPM, ACR, Catphan.

* Corresponding Author

Special Issue on "Medical Science"

I. INTRODUCTION

As Computed Tomography has the huge part of frequency of use and importance portion for image medical science, it is visualized 2 or 3 dimension to internal organs of human body using.

X-ray and used to widespread for finding various lesions which are difficult diagnosis by general X-ray examination^{1,2}. CT products X-ray and measures the radiation dose after penetrating subject, and processed the reconstruction not reflected direct projection result because of the reconstruction equipment with 2 dimension following location information. This reconstructed processing could cause various problems and represent incorrectly to attenuated degree of original subject³⁻⁷.

II. LITERATURE REVIEW

In present, the cases of CT express various organs and vessel structure with small details in human body. To inspect and measure regularly for correct expression of these structures is a matter of course. The quality of CT image depend on how clear and exact represent tiny structure and the important factors of image quality have CT number accuracy expressed material attenuation degree, spatial resolution, low contrast resolution, noise characteristic, artifact and radiation dose⁸⁻¹¹.

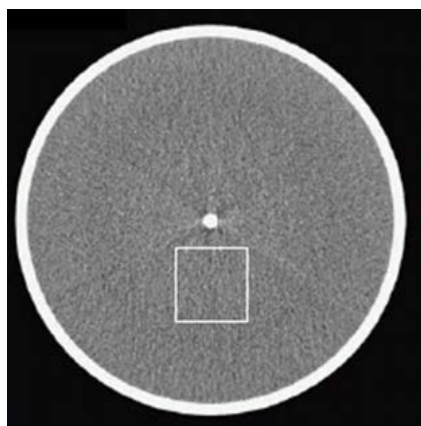
As the evaluation to the decision factors of image quality, phantom image examination purposes to proper evaluation for picture image quality¹¹⁻¹³.

In Korea, it is legislated the Ministry of Health and Welfare in Table 5 "The regulation of installation and management for special medical equipment" and controlled quality management and image examination of CT. However, it just use AAPM phantom for measurement that chosen standard phantom when the regulation was legislated.

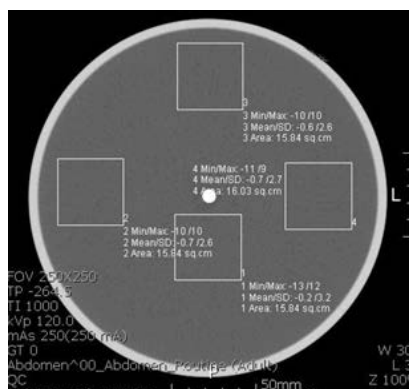
III. PROPOSED WORK

CT scanners for the study are used total 4 equipment with Light Speed VCT (GE healthcare, USA), Brilliance iCT, Brilliance 64(philips medical system, netherlands), Somatom Definition Flash, Somatom Definition AS (siemens healthcare, germany) and Aquilion 64 (toshiba medical system, japan) and total 3 phantoms with AAPM CT performance phantom (model 76-140), ACR phantom (model #438, gammexrmi, USA) and catphan phantom for the measurement. It is acquired images by axial scanning with all phantoms among manufacture equipment, and exposure condition is 120 kVp, 250 mA, scan time 1 sec and 10 mm slice thickness which required the 2013 years article in present "The regulation of installation and management for special medical equipment", excepted C company equipment, 12mm slice thickness that is the closest to 10mm slice thickness is used. Scan FOV is 50cm, display FOV is 25 cm, and single slice conventional scan and standard reconstruction algorithm are examined.

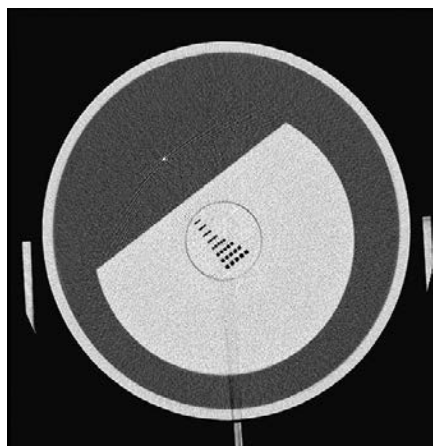
In each phantom, measurable items are measured and compared. Next are measurement images among phantoms as shown in Figure 1, Figure 2, Figure 3.



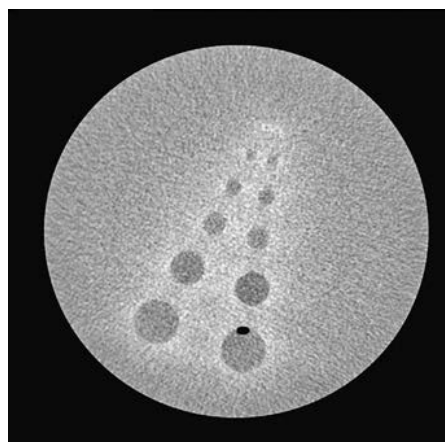
Attenuated Coefficient of Water, Noise Measurement



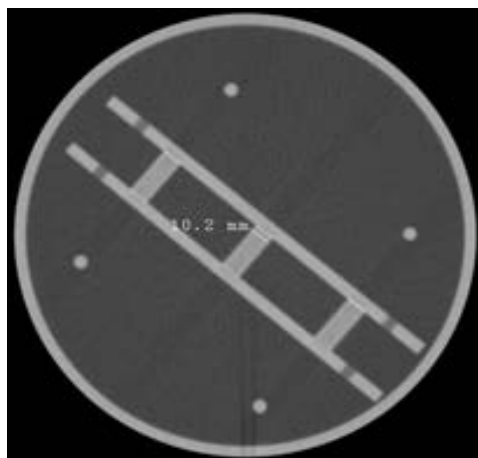
Uniformity Measurement



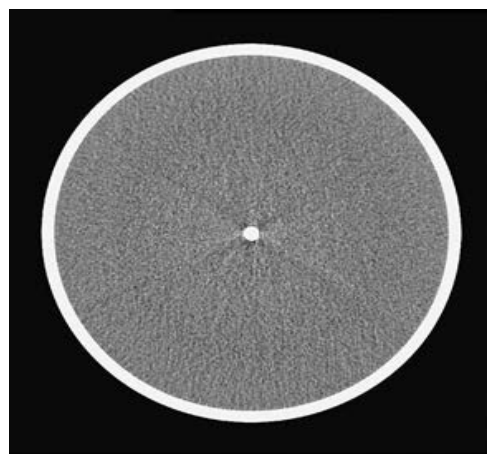
High Contrast Resolution



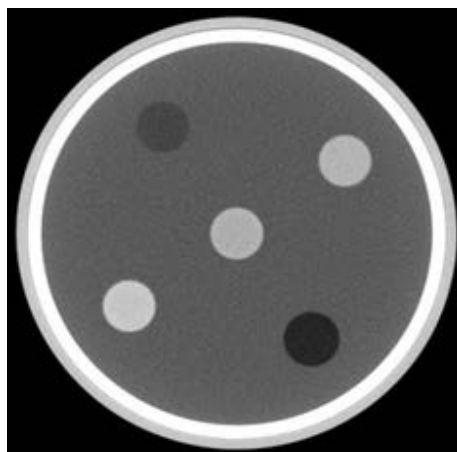
Low Contrast Resolution



Slice Thickness

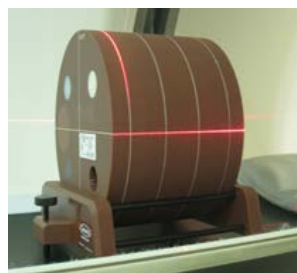
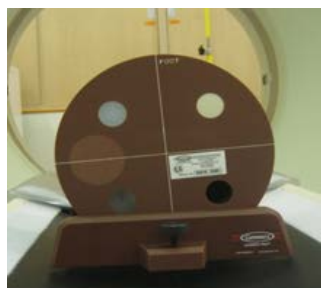


Artifacts

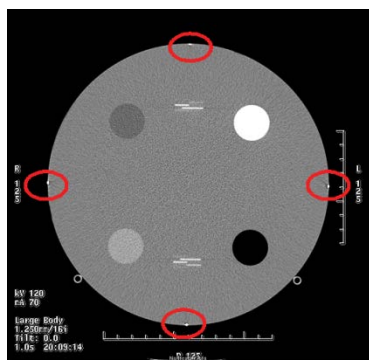


CT Number of Linearity

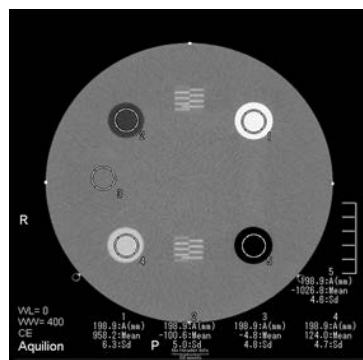
Figure 1: AAPM Quality Control Images



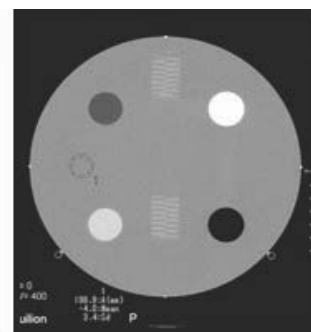
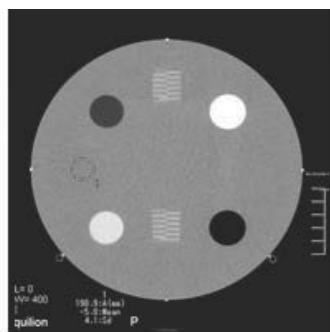
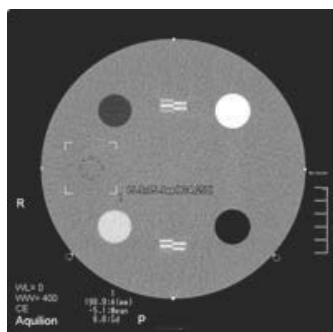
phantom positioning



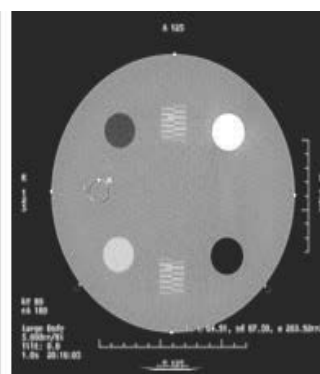
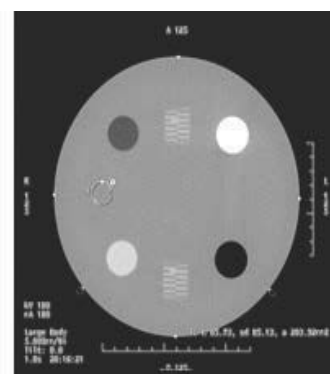
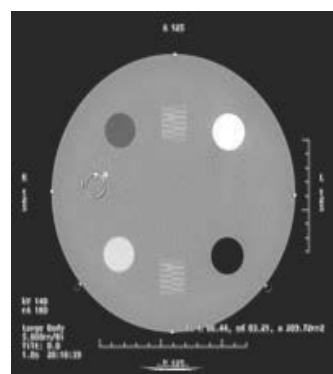
phantom positioning results



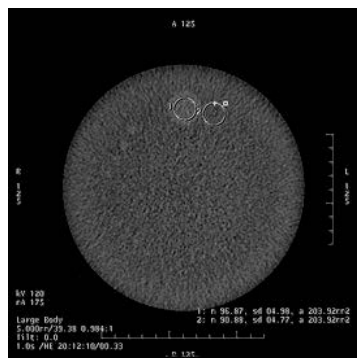
CT number calibration



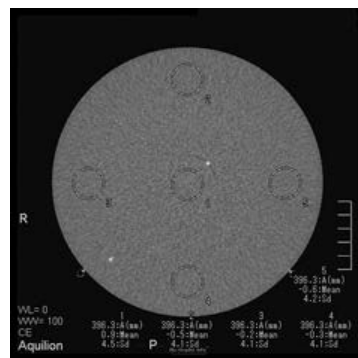
Slice Thickness 3,5,7mm



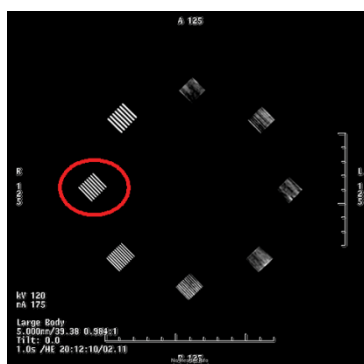
Slice Thickness 80, 100, 120 kVp



low contrast resolution



uniformity

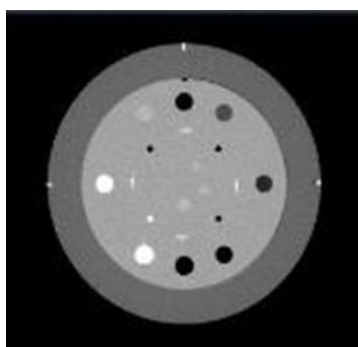


High Contrast Resolution

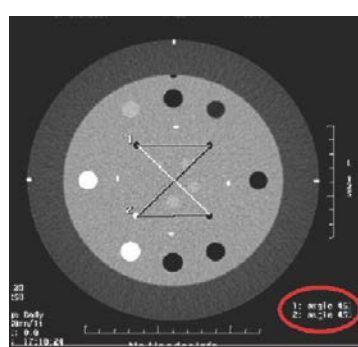
Figure 2: ACR Quality Control Images



positioning



Correct Positioning Image



Circular Symmetry & Spatial Linearity of Pixel Size Verification

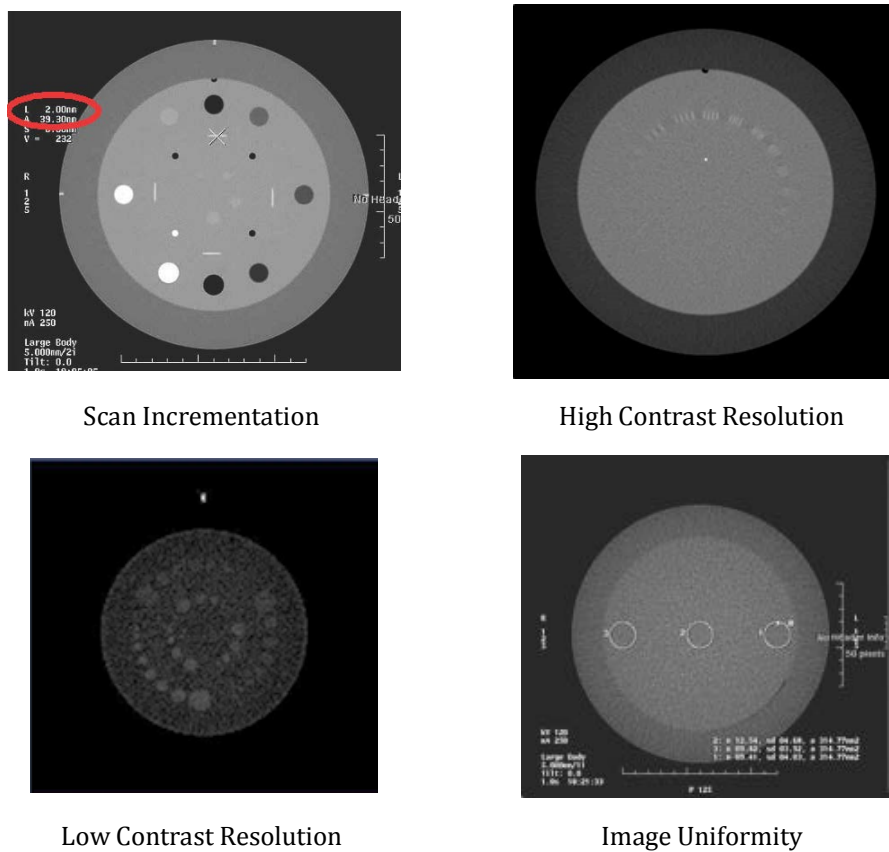


Figure 3: Catphan Quality Control Images

IV. CONCLUSION

To compare the result after the extraction of common articles for measured three different phantoms, it could set four common articles. Those are slice thickness, uniformity, spatial resolution and low contrast resolution. For those articles, it compare and analysis each CT equipment.

1) slice thickness

The measured images by each phantom are followed in figure 4.

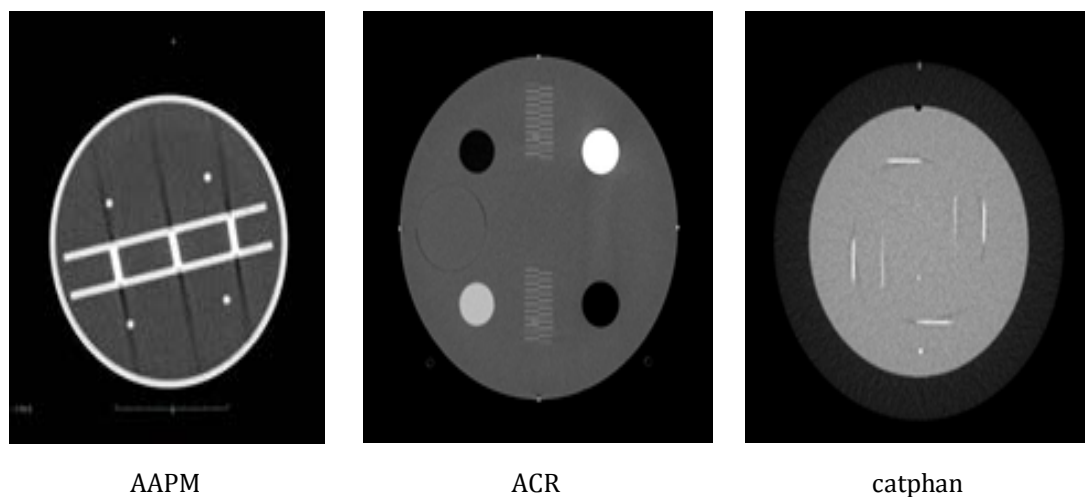


Figure 4: Slice Thickness

Table 1: Slice Thickness Measurement Results

manufacturer	unit : mm		
	AAPM	ACR	catphan
A	10	10	10
B	10	10	10
C	12	10.5	11.5
D(64)	10	10	10
D(128)	10	10	10

As shown in table 1, each phantom are measured to 10mm slice thickness all, but excepted C company case, it is resulted 12mm because 10mm slice thickness couldn't be measured. Those are measured 12.0, 10.5 and 11.5 mm separately.

2) uniformity

The measured images by each phantom are followed in figure 5.

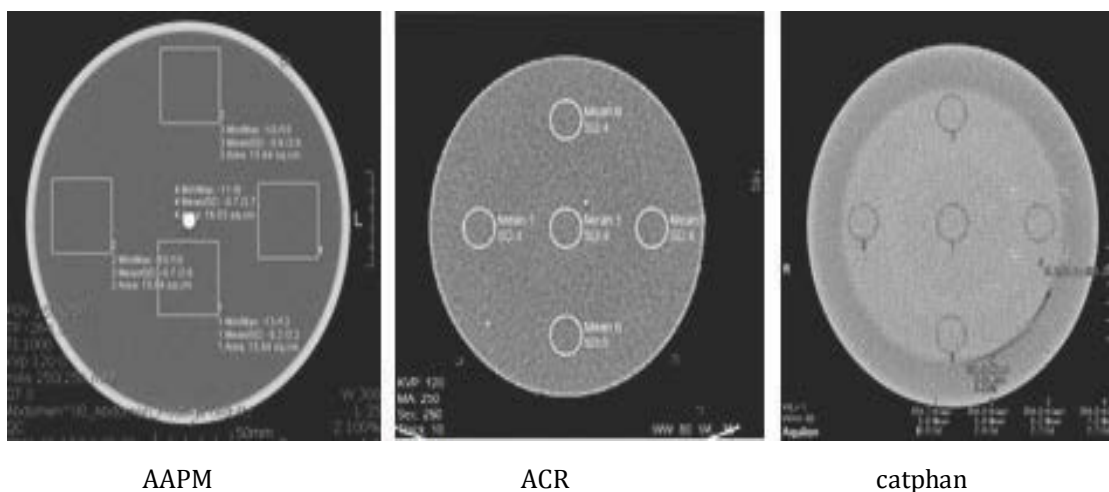


Figure 5: Uniformity

Table 2: Uniformity Thickness Measurement Results

manufacturer	unit : <HU			
	AAPM	ACR	catphan	p
A	0.5	0.7	4.6	0.72
B	0.9	2.7	4.8	0.47
C	0.8	4.5	1.7	0.22
D(64)	3.3	0.9	2.6	0.21
D(128)	1.8	1.4	4.7	0.43
SD	± 1.6	± 1.8	± 1.1	
p	0.67	0.79	0.92	

p = ANOVA test

Uniformity is as shown in table 2 no correlation because all measurement values are various. It is considered different deviation because measured ROI setting and phantom materials are different. Even if measurement values are different, it is all satisfied with standard of suitability.

3) high contrast resolution

The measured images by each phantom are followed in figure 6.

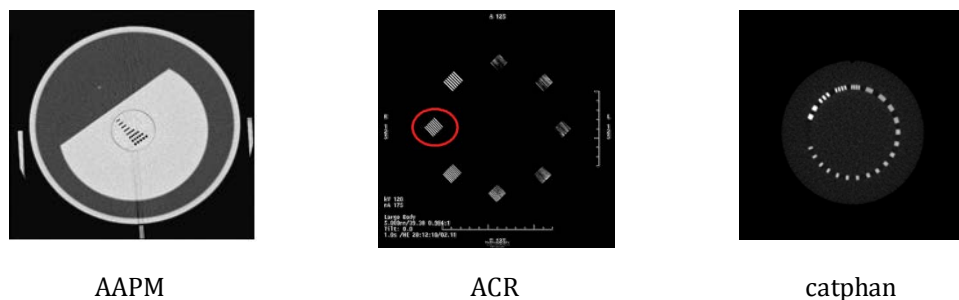


Figure 6: High Contrast Resolution

Table 3: High Contrast Resolution Measurement Results

unit : line pair/mm

manufacturer	AAPM (mm)	ACR	catphan	p
A	1	7	6.6	0.03
B	1	7	6.4	0.01
C	1	7	6.2	0.04
D(64)	1	6	6.5	0.01
D(128)	1	6	6.6	0.01
SD	± 0.12	± 0.38	± 0.22	
p**	0.02	0.04	0.02	

p = ANOVA test, between ACR & catphan, p** = ANOVA test

All is included standard of permission, it has no difference. However, in case of AAPM, it is not possible to compare because hole size express to measurement value in table 3.

4) Low contrast resolution

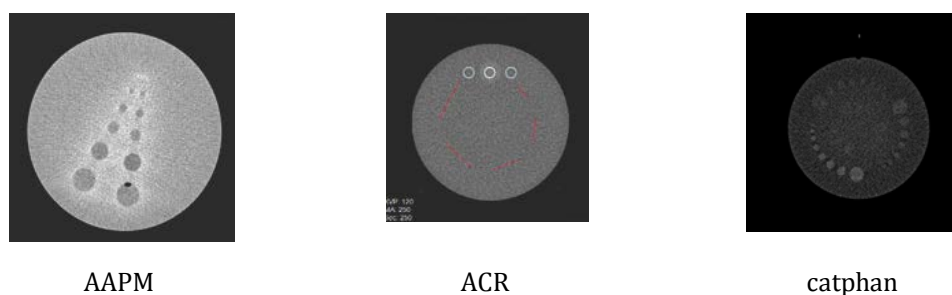


Figure 7: Low Contrast Resolution

All is included standard of permission, it has no difference. However, in case of catphan, it is not possible to compare because it is used to tool of region detectivity measurement as shown figure 7 and table 4.

Table 4: Low Contrast Resolution Measurement Results

unit : mm

manufacturer	AAPM	ACR	catphan	p
A	6.4	4	-	0.01
B	6.4	5	-	0.03
C	6.4	6	-	0
D(64)	6.4	4	-	0.03
D(128)	6.4	4	-	0.03
SD	± 0.0	± 1.3		
p**	0.01	0.04		

p = ANOVA test, between AAPM & ACR, p** = ANOVA test

5) CT number

The measured images by each phantom are followed in figure 8.

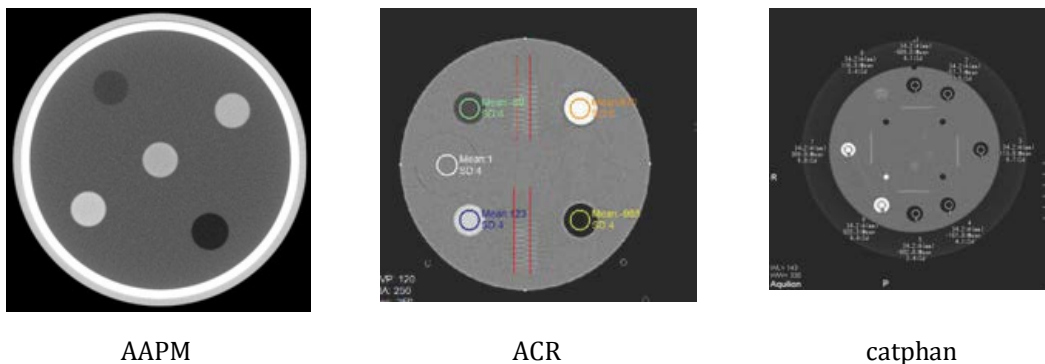


Figure 8: CT Number

Because each phantom composition are all different, it could not done objective comparison, but it could be possible to the measurement following each phantom standard, and the results are all appropriated as shown each other table 5, table 6, table 7.

Table 5: AAPM CT Number Measurement Results

	polystyrene	polyethylene	nylon	polycarbonate	acrylic
A	-26.2	-63.7	91.7	102.8	126.5
B	-20.4	-55.7	97.6	105.8	129.7
C	-32.3	-72.8	91.5	98.7	127.2
D(64)	-39.3	-41.61	90.69	90.28	116.83
D(128)	-38.38	-38.65	97	99.63	124.7
SD	± 7.43	± 17.27	± 4.71	± 2.82	± 3.19
P	0.04	0.07	0.03	0.04	0.03

unit : HU

p = ANOVA test

Table 6: ACR CT Number Measurement Results

	air	polyethylene	water	acrylic	bone
A	-984.98	-88.91	0.71	123.47	870.24
B	-1008.9	-97.1	-2.1	126.36	917.63
C	-1028.19	-103.32	-3.33	119.24	954.17
D(64)	-983.53	-91.59	3.32	122.36	910.87
D(128)	-984.36	-91.14	3.32	123.75	916.02
SD	± 21.69	± 11.91	± 4.58	± 3.52	± 30.06
P	0.04	0.02	0.03	0.04	0.07

unit : HU

p = ANOVA test

Table 7: Catphan CT Number Measurement Results

	air(6CW)	Air(0CW)	PMP	LDPE	polystyrene	acrylic	delrin	teflon
reference	-1000	-1000	-200	-100	-35	120	340	990
A	-983.8	-979	-200	-100	-35	120	340	906.3
B	-986.7	-951.1	-179.6	-86.7	-31.4	128	287	871.3
C	-992.6	-989	-187.8	-113.9	-57.7	116.9	309.9	920.3
D(64)	-987.1	-985.5	-187.9	-98.1	-43	114.2	332	925.5
D(128)	-989.8	-988	-186.3	-96.7	-40.8	118.5	353.2	971

unit : HU

p = ANOVA test

6) The measurement articles and many others

The measured each other values by phantoms are followed in table 8, table 9.

Table 8: AAPM Measurement Results

	CT number of water (HU)	distance (mm)	Angle (o)	Noise (HU)
A	-1.2	0.05	0	3.9
B	0.6	-1.1	-2	4
C	-1.6	-0.3	0.9	4.4
D(64)	-1.56	-1	1	4.13
D(128)	0.08	-1	0	4.43
SD	± 1.62	± 0.83	± 0.21	± 0.39
P	0.04	0.04	0.03	0.04

p = ANOVA test

Table 9: Catphan Measurement Results

	FWHA (mm)	alignment	circular symmetry	angle symmetry
A	2.55	good	good	good
B	2.42	good	good	good
C	3	good	good	good
D(64)	2.2	good	good	good
D(128)	5.5	good	good	good

V. DISCUSSION

In present, diagnosis equipment for human body are a wide variety, those are often used in medical fields. For the correct examination of diagnosis equipment, it must be expected to quality management for equipment characteristic. Specially, the quality management of CT which is important to image examination must be expected to regular quality control. In Korea, even though it has the regulation and been the management by medical institutions, most of them have no private quality control program and put it to other inspection company for the charge practically. This kind of act is far from the purpose that fields do quality control, and adjust image quality directly and management steadily.

As this study, even if measured by using AAPM, ACR and catphan phantoms, it has no difference to main articles such as slice thickness, uniformity, spatial resolution, low contrast resolution and CT number evaluation. It is considered to have meaning to strength the basis to use phantoms except in AAPM phantom which is decided to standard by "The regulation of installation and management for special medical equipment" in Korea.

CT has status very important portion of image examination in modern medical science. It is very important issue to correct reconstruction of detector. It is very meaningful work to perform quality control to check proper reconstruction with regular measurement. In Korea, it had been managed as set the Ministry of Health and Welfare "the regulation of safety management of diagnosis radiation production equipment" and then has been managed to image quality control in earnest by "The regulation of installation and management for special medical equipment" in 2003. However, it had wistfulness because used phantom was just designated AAPM phantom from trial initial to 2013 in present. Therefore, in this study, it is considered the usefulness of the image quality evaluation with various phantoms compared typical phantom performance of CT.

In slice thickness evaluation, it is measured 10mm of all 5 sorts CT of AAPM, ACR and catphan, and confirmed no measurement difference of 12mm scanned image of one CT. In uniformity, it could be known that all equipment within ± 5 HU status under measurement error range. In spatial resolution, the case of AAPM could not be the comparison with other phantoms because hole size is shown measurement value, but it is confirmed no difference of measured values by other phantom separately. In low contrast, the case of AAPM is macroscopic evaluation, for ACR, it is the result using software, and catphan case could not be compared in accordance with a little bit different evaluation items, but if it set standard differently for each phantom, it is consider that to perform quality control management has no problem. For the evaluation of CT number, it could not be compared one by one for different material of phantom, but it has no problem with measurement using any phantoms because measured values are all under allowable error.

It is considered to do quality control with proper phantom depend on necessary quality control items because exceptional phantoms have own characteristic quality control items. In the future, it should be use

various phantoms for the measurement phantom images of special medical equipment in Korea, and it should do wide range quality control with proper selection for each phantom standard level.

REFERENCES

- [1] Hong SS, Lee JW, Seo JB, Jung JE, Choi J, Kweon DC. Evaluation of image quality and radiation dose by adaptive statistical iterative reconstruction technique level for chest CT examination. *RadiatProt Dosimetry*. Epub 2013 May 22, 2013;157(2):163-71. doi: 10.1093/rpd/nct127.
- [2] Richard S, Husarik DB, Yadava G, Murphy SN, Samei E. Towards task-based assessment of CT performance: system and object MTF across different reconstruction algorithms. *Med Phys*. 2012 Jul;39(7), 4115-22
- [3] In-Gyu you, Cheong-hwan Lim, Young-CheolJoo. A Study on the of Justification of Low Dose Chest Computed Tomography during Health Examinations. *Indian Journal of Science and Technology*, 2015 January Vol 8(S1), 231-235
- [4] Friedman SN, Fung GS, Siewerdsen JH, Tsui BM. A simple approach to measure computed tomography (CT) modulation transfer function (MTF) and noise-power spectrum (NPS) using the American College of Radiology (ACR) accreditation phantom. *Med Phys*. 2013 May;40(5):051907
- [5] M. Anto Bennet, Resmi R. Nair, V. Mahalakshmi G. Janakiraman. Performance and Analysis of Ground-Glass Pattern Detection in Lung Disease based on High-Resolution Computed Tomography. *Indian Journal of Science and Technology*, 2016 January Vol 9(2), DOI: 10.17485/ijst/2016/v9i2/ 71285
- [6] Nam-Gil Choi, Jae-Bok Han, Jong-Nam Song, Wok Kim, Myo-Young Jung, Ho-JinSeong. The Research on the Volume of Artificial Structure by the Change of Scan Parameter in CT Inspection. *Indian Journal of Science and Technology*, 2016 July Vol 9(25), DOI: 10.17485/ijst/2016/v9i25/ 97200
- [7] McCollough CH, Bruesewitz MR, McNitt-Gray MF, Bush K, Ruckdeschel T, Payne JT, Brink JA, Zeman RK; American College of Radiology. The phantom portion of the American College of Radiology (ACR) computed tomography (CT) accreditation program: practical tips, artifact examples, and pitfalls to avoid. *Med Phys*. 2004 Sep;31(9):2423-42
- [8] Zhang D, Cagnon CH, Villablanca JP, McCollough CH, Cody DD, Zankl M, Demarco JJ, McNitt-Gray MF. Estimating peak skin and eye lens dose from neuroperfusion examinations: use of Monte Carlo based simulations and comparisons to CTDIvol, AAPM Report No. 111, and ImpACT dosimetry tool values. *Med Phys*. 2013 Sep;40(9):091901
- [9] Hippelinen E, Nikkinen P, Ihalainen T, Uusi-Simola J, Savolainen S. Personal radiation doses in PET/CT facility: measurements vs. calculations. *RadiatProt Dosimetry*. 2008;132(1):57-63
- [10] Cody DD, Mahesh M. AAPM/RSNA physics tutorial for residents: Technologic advances in multidetector CT with a focus on cardiac imaging. *Radiographics*. 2007 Nov-Dec;27(6):1829-37
- [11] Schneiders NJ, Bushong SC. A precise CT phantom alignment procedure. *Med Phys*. 1980 Sep-Oct;7(5):549-50. PubMed PMID: 7421765.
- [12] Schneiders NJ, Bushong SC. CT quality assurance: computer assisted slice thickness determination. *Med Phys*. 1980 Jan-Feb;7(1):61-3
- [13] Brunner CC, Kyprianou IS. Material-specific transfer function model and SNR in CT. *Phys Med Biol*. 2013 Oct 21;58(20):7447-61



ISSN
0975-6299

The Effect of Inhaling Aromas on the Quality of Sleep and Fatigue of Three Shift Working Nurses

Min-Sook Seo, Dept. of Nursing, Chung-Ang University, Seoul, Korea. E-mail:placebo72@hanmail.net
Dahye Park*, Dept. of Nursing, Semyung University, Jecheon, Korea. E-mail:caunurse@gmail.com

Abstract---

Background/Objectives: In this study, the purpose is to apply aromatic inhalation therapy to nurses working three shifts who experienced work overload as well as sleep lack and chronic fatigue in order to inspect the outcomes of aroma on the fatigue and irregular sleep pattern of the registered nurses.

Methods/Statistical Analysis: As quasi-experiment study on the non-equivalent control group, this study were collected from June 1st, 2013 to July 15th, 2013 on the experimental group of 30 registered nurses and the control group of 30 registered nurses who work shifts at C University hospital in Seoul. This study analyzed using descriptive statistics, X²-test and Independent t-test by use of SPSS WIN 18.0, a statistics program.

Findings: This study recognizes the impacts of aromatic inhalation therapy on level of fatigue and the quality of sleep of working three shifts nurses; the experimental group getting aromatic inhalation therapy enjoyed quality sleep while feeling less fatigue. It is assumed that the aromatic inhalation therapy can be requested, as interventions, to working three- shifts nurses to improve their sleep while reducing fatigue. In addition, this study makes a recommendation for further studies on the selecting of aroma oil, on the way of interventions based on the individual general characteristics of the working three shifts nurses and the various wards they work at.

Improvements/Applications: It is also recommended that sleep programs is developed that can help manage the variables identified in this study and that follow-up studies are conducted to verify the model.

Keywords--- Aromatic Inhalation Therapy, Nurses, Three shifts, Sleep, Fatigue.

* Corresponding Author

I. INTRODUCTION

Change in sudden life cycles due to the shift system can be a threatening factor to the individual life and health of nurses under the medical situations, where tension and risks exist, which are characteristics of nursing profession¹. In addition, nurses need to have enough sleep to work properly at night. However, it is difficult for them to sleep well due to the change in biological rhythms, caused by the shift work².

Sleep is the easiest thing that can be done to gain a positive effect for relieving the fatigue of nurses³.

The specific purposes were as follows. In this regard, this study analyzes the effect of aroma oil inhalation therapy, including orange, lavender, roman and chamomile on the fatigue the sleep quality of nurses who are bound to do three shifts. In this regard, this study analyzes the effect of aroma oil inhalation therapy, including orange, lavender, roman and chamomile on the fatigue of nurses who are bound to do three shifts.

II. MATERIALS AND METHODS

A. Design

This study employed a nonequivalent control group pre-test & post-test design: Quasi-experimental design.

B. Participants and General Procedures

This study data were collected from June 1st, to June 15th, 2013. Participants were selected from nurses who work shifts at C University hospital in Seoul. The subjects of this study were on the experimental group of 30 registered nurses and the control group of 30 registered nurses. Self-reported questionnaires were used. To maintain consistency, researchers and assistants were required to understand the research method, the research procedure, and the questions being used before starting the study. Subjects were capable of three shifts working, and communicating at a level where they could participate in a survey and understand the purpose of this study. For the study, we selected nurses who did not have olfactory dysfunction and respiratory diseases, not taking certain medications like sleeping pills, as the subjects.

In pretest, the experimental and control groups were researched in the method way concerning their general characteristics, the level of fatigue, and the quality of sleep; the experimental group began aromatic inhalation therapy when they start working night shift on their pillows by dropping aroma oil every day for two weeks before going to bed. In post-test, the level of fatigue and the quality of sleep were measured on the experimental and control groups.

C. Ethical Considerations

This study conformed to the ethical principles of the Declaration of Helsinki. This study was approved by the Ethics Review Committee and the approval number is IRB-C2013059(1019). All participants were given some small token of thanks.

D. Data Analysis

Using a significance level of 0.5, an 80% power, and an effect size of 0.8, the size of the sample using G-power 3.1.2 revealed that the sample needed is 26.

Thus, we took the sample of 30 subjects, and 60 subjects were analyzed. This study analyzed using SPSS version 18.0 programs.

The X²-test and Independent t-test were used to determine the significance of differences before and after group therapy. The significance level was Cronbach as $\alpha = 0.05$.

E. Instrument

Quality of Sleep

Quality of sleep is a self-reported scale developed by Lee HyeRyun(2005). It contains 28 items measuring 6 factor of dimensions: Insufficient sleep(12 items), After recovery sleep(4 items), Difficulty in falling asleep(4 items), Difficulty in lying awake(3 items), the Sleep satisfaction(3 items), Difficulty in maintaining sleep(2 items).

Fatigue

Fatigue is a self-reported scale developed by Industrial Fatigue Research Society, Japan Society for Occupational Health(Aoyama, 1988).

This tool is a self-report scale that consists of 30 multiple-choice items, each of which is scored on a 3-point Likert-type scale ranging from never(0 point) to always(2 points), with higher score indicating better fatigue.

III. RESULTS

1) Demographic Characteristics of the Participants.

As for the age ranges, those who under the age of 30 were the majority with 71.7% (N=43), and those who over the age of 30 accounted for 28.3% (N=17).

In terms of work departments, intensive care unit (ICU) was 63.3%(N=38) and general ward was 36.7% (N= 22) The marriage status was that single status was 41.7%(N=45), and married status was 25% (N=15), while the final education background was that 35% of subjects (N= 21), were two-year college graduates, 41.7 %(N=25) were four-year college or university graduates, and 23.3% ((N=24) were graduates with over a master's degree or students in graduate course. A total of 43.3% subjects did not have any religion (N=36), In terms of the clinical experience, over five years(N=36, 60%) was the majority, while a total of 78.3%(N=47) had sleep disturbance.

The analytical results on the homogeneity in the verification of groups (experimental group and contrast group) according to the general characteristics, conducted at the significant level 5%, demonstrate that there was no significant difference in these two groups.

Table 1: Homogeneity Test for General Characteristics between Two Groups

Characteristics	Categories	Experimental group n=30(%)	Control group n=30(%)	χ^2	p
Age	>30	19(63.3)	24(80)	3.831	0.147
	<=30	11(36.7)	6(20)		
Work departments	ICU	14(46.7)	24(80)	7.182	0.028
	General ward	16(53.3)	6(20)		
Marriage	single	21(70)	24(80)	0.800	0.371
	Married	9(30)	6(20)		
Education background	College	13(43.3)	8(26.7)	3.436	0.179
	University	9(30)	16(53.3)		
	over a master	8(26.7)	6(20)		
Religion	Buddhism	7(23.3)	5(16.7)	1.221	0.748
	Christian	5(16.7)	7(23.3)		
	Catholic	4(13.3)	6(20)		
	No	14(46.7)	12(40)		
Clinical experience	< 5 years	8(26.7)	16(53.3)	43.333	0.543
	<= 5 years	22(73.3)	14(46.7)		
Sleep disturbance	Yes	8(26.7)	5(16.7)	0.884	0.347
	No	22(73.3)	25(83.3)		

2) Difference of sleep between two groups

There were statistically significant differences in the scores of experimental group ($t = -3.937$, $p = 0.000$). Experimental group will have a better sleep than the control group.

Table 2: Difference of Sleep between Two Groups (N=60)

Characteristics	Pretest	Posttest	Difference	t	p
Experimental group	1.82±0.40	2.27±0.50	-0.46±0.12	-3.937	.000
Control group	2.08±0.47	2.09±0.87	-0.01±0.16		

Table 3: Difference of Sleep in Measured Variables of Experimental and Control Group(N=60)

Characteristics	Categories	Experimental group n=30(%)	Control group n=30(%)	χ^2	p
Insufficient sleep	Pretest	1.41±0.36	1.56±0.42	-3.113	0.003
	Posttest	1.79±0.56	1.61±0.46		
	Difference	-0.38±0.12	-0.05±0.11		
After recovery sleep	Pretest	2.47±0.75	2.68±0.71	-1.859	0.068
	Posttest	2.79±0.59	2.73±0.62		
	Difference	-0.32±0.17	-0.05±0.17		
Difficulty in falling asleep	Pretest	1.63±0.44	2.00±0.71	-4.447	0.000
	Posttest	2.24±0.61	2.03±0.71		
	Difference	-0.61±0.14	-0.03±0.18		
Difficulty in lying awake	Pretest	2.03±0.57	2.60±0.71	-4.201	0.000
	Posttest	2.73±0.71	2.48±0.68		
	Difference	-0.70±0.17	0.12±0.18		
Sleep satisfaction	Pretest	2.54±0.70	2.88±0.68	-2.261	0.028
	Posttest	2.92±0.59	2.84±0.52		
	Difference	-0.38±0.17	0.04±0.16		
Difficulty in maintaining sleep	Pretest	1.88±0.58	2.20±0.83	-3.351	0.001
	Posttest	2.52±0.86	2.10±0.76		
	Difference	-0.64±0.19	0.10±0.20		

3) Difference of fatigue between two groups

There were statistically significant differences in the scores of experimental group ($t = -2.367$, $p = 0.021$). Experimental group will feel less fatigue than the control group.

Table 4: Difference of Fatigue between Two Groups (N=60)

Characteristics	Pretest	Posttest	Difference	t	p
Experimental group	5.66±1.50	4.49±0.87	1.17±0.32	-2.366	0.021
Control group	5.63±1.53	5.17±1.32	0.46±0.37		

Table 5: Difference of Fatigue in Measured Variables between Two Groups (N=60)

Characteristics	Categories	Experimental group n=30(%)	Control group n=30(%)	χ^2	p
Physical symptom	Pretest	5.66±1.50	2.15±0.47	-2.718	0.009
	Posttest	4.49±0.87	2.03±0.52		
	Difference	1.17±0.32	0.12±0.13		
Sensory nerve symptom	Pretest	1.63±0.50	1.64±0.57	-2.572	0.013
	Posttest	1.28±0.22	1.51±0.44		
	Difference	0.35±0.10	0.13±0.13		
Mentally symptom	Pretest	1.91±0.52	1.84±0.62	-1.112	0.271
	Posttest	1.49±0.43	1.63±0.50		
	Difference	0.42±0.12	0.21±0.15		

IV. DISCUSSION

The aroma oil inhalation therapy was applied to the nurses who did three shifts for two weeks. The study results exhibit that the change in scores of the contrast group is appeared to be lower than those of the experimental group in comparison with the quality score of sleep, showing a statistically significant difference in two groups. This reveals that the aroma oil inhalation therapy is effective in improving the sleep quality of experiments.

The findings are consistent with those of previous studies regarding the effect of the aroma oil inhalation therapy on sleep. The inhalation of Aroma for night shift nurses enhanced the quality of sleep and reduced fatigue⁴. Along the same line, oil blended with lemon, lavender, and Sandalwood was put beneath the pillows

of the subjects after having been soaked to the gauze, which was applied to the night shift nurses. The results exhibit that the score and sleep quality increased and the observable symptoms of fatigue decreased ².

The previous research by Yun ⁴ revealed the same effect of the aroma oil inhalation therapy as this study. However, this research increased the sample number from 17 to 30, and used the Roman Chamomile, instead of the Sandalwood, which had been frequently used in existing studies to prove the new effect of Aroma. This study was conducted by the Quasi-experiment based on the nonequivalent control group pre-test & post-test design.

The research Sakamoto et al. ⁵, examined the effect of jasmine oil and lavender oil on the increase in efficiency at work. In this study, the study results demonstrate that the efficiency in Lavender oil, which has the sedation effect, was higher than in Jasmine oil. The research of Hirokawa et al. ⁶, applied the aroma oil inhalation therapy to the subjects by making them fall asleep while opening the bottle of the Lavender oil for five days. They reported that the quality of sleep had improved and difficulty in falling asleep had decreased in this experiment.

They reported that the quality of sleep had improved and difficulty in falling asleep had decreased in this experiment. As shown above, the overall results of previous studies reveal that the intervention by using the oil inhalation therapy would be effective in improving the quality of sleep, though it might be difficult to compare the effects of different aroma oils because the sorts of essential oils, and blending methods and periods, used in each study, were different. Therefore, this study identified that the intervention of the oil inhalation therapy for the nurses who do three shifts is effective in improving sleep quality and relieving fatigue. It is expected that the findings of this study will help nurses with three shifts improve the quality of their sleep and relieve their fatigue through the development and application of the intervention.

V. CONCLUSION

This study is subject to the Quasi-experimental research based on the nonequivalent control group pre-test & post-test, attempted to verify the effect of the aroma oil inhalation therapy on sleep quality and fatigue targeting the nurses with three shifts. The study results reveal that aroma oil inhalation therapies that apply the mixed oils of orange, lavender, and Roman Chamomile to the nurses with three shifts, was effective in improving sleep and relieving fatigue. Therefore, we can give suggestion to conduct specific research on the selection of aroma oils, intervention methods, and periods, in view of various nursing units where nurses do three shifts and individual characteristics, as the case may be. In addition, on account that self-report is liable to bring about Hawthorne effect, it is suggested that methods to measure objectively such as Polysomnography and Liquid teak profile should be examined along with the self-report.

REFERENCES

- [1] Kho H, Kim M Y, Kwon Y S, Kim C N, Park K M, Park J S, Park Y S, Park C J, Lee K H, Lee B S, Shin Y H, Lee E J. The Fatigue Experience of Shift Work Nurses, *Korean Society of public Health Nursing*, 2004, 18(1), pp. 103-118.
- [2] Park S H, Park K S, Ko Y J, Lee B Y, Yang H S, Park H J, Woo Y H, Lee J Y, Park D H. The effect of Aroma inhalation Therapy on Fatigue and Sleep in Nurse Shift Workers, *Journal of East-West nursing research*, 2012, 18(2), pp. 66-73.
- [3] Gaba D M, Haward S K. Fatigue among clinicians and the safety of patients, *New England Journal of Medicine*, 2002. 346, pp. 1249-1255.
- [4] Yun S H. The Effect of Aroma Inhalation on sleep and Fatigue in Night Shift Nurse, Yonsei university. 2008.
- [5] Sakamoto R, Minoura K, Usui A, Ishizuka Y, Kanba S. Effectiveness of aroma on work efficiency: Lavender aroma during recesses prevents deterioration of work performance, *Chemical series*. 2005, 30, pp. 683-691. doi: 10.1093/chemse/bji061
- [6] Hirokawa K, Nishimoto T, Taniguchi T. Effect of lavender aroma on sleep quality in healthy Japanese students 1, *Perceptual and Motor Skills*, 2012, 114(1), pp. 111-122. doi: 10.2466/13.15.PMS.114.1.111-122



ISSN
0975-6299

Evaluation of Rectal Dose According to Body Mass Index (BMI) Using the Adjacent Organs and Belly Board

Shim Jae-Goo, Dept. Daegu Health College, Korea. E-mail:sg2428@dhc.ac.kr

Jung Hong-Ryang*, Dept. of Health Care, Hanseo University, Korea. E-mail:hrjung@hanseo.ac.kr

Abstract---

This study analyzed the set-up error by the difference in body mass index (BMI) and applied the error to the existing treatment plan to compare the BMI determined dose for the small intestines and bladder in colorectal cancer to study the usability of belly board. Twelve patients received radiation therapy before or after surgery after being diagnosed with colorectal cancer between August 2014 and July 2015. They were divided into two groups based on BMI (high BMI, ≥ 24 kg/m²; low BMI, or < 24 kg/m²) and each group was sub classified on the use/non-use of belly board (Group 1, belly board and low BMI; Group 2, no belly board and low BMI; Group 3, belly board and high BMI; Group 4, no belly board and high BMI). For Group 1, the volume of bladder V_{10} did not change with V_{20} 2.13 $\pm$ 0.83 cc, V_{30} 3.66 $\pm$ 2.99 cc, and V_{40} 4.53 $\pm$ 3.45 cc. The volume of the small bowel V_{10} was 1.11 $\pm$ 1.30 cc with V_{20} 2.19 $\pm$ 1.82 cc, V_{30} 2.55 $\pm$ 2.25 cc, and V_{40} 2.75 $\pm$ 2.55 cc (Group 2). In Group 3, V_{10} did not change with V_{20} 11.73 $\pm$ 14.94 cc, V_{30} 15.08 $\pm$ 19.78 cc, and V_{40} 19.40 $\pm$ 23.92 cc, while the volume of small bowel V_{10} was 1.19 $\pm$ 1.82 cc, V_{20} 16.22 $\pm$ 24.36 cc, V_{30} 17.67 $\pm$ 25.30 cc, and V_{40} 18.49 $\pm$ 26.37 cc. In Group 4, V_{10} did not change with V_{20} 8.08 $\pm$ 9.12 cc, V_{30} 15.45 $\pm$ 7.63 cc, and V_{40} 19.53 $\pm$ 9.61 cc, while the volume of small bowel V_{10} was 0.73 $\pm$ 0.86 cc, V_{20} 7.13 $\pm$ 5.38 cc, V_{30} 15.26 $\pm$ 14.97 cc, and V_{40} 10.77 $\pm$ 7.92 cc. The volume of bladder V_{10} did not change with 0.39 $\pm$ 0.68 cc, V_{20} 12.33 $\pm$ 9.98 cc, V_{30} 18.03 $\pm$ 8.79 cc, and V_{40} 21.55 $\pm$ 8.12cc, while the volume of small bowel, V_{10} was 18.38 $\pm$ 17.00 cc, V_{20} 11.45 $\pm$ 1.69 cc, V_{30} 23.67 $\pm$ 20.79 cc, and V_{40} 36.17 $\pm$ 31.70 cc.

Keywords--- Radiotherapy, Rectal Ca, BMI.

** Corresponding Author*

Special Issue on "Medical Science"

I. INTRODUCTION

According to the World Health Organization, 35% of adults are overweight with 10% of these obese individuals being men and 14% being women [1]. Obesity increases the risks of breast, colorectal, endometrial, renal cell, esophageal, and pancreatic cancer [2-5].

Gastric cancer is the most common cancer for both men and women in Korea followed by colorectal cancer (CRC). In 2010, according to the Korean Cancer Prevalence Report, there were 7,645 CRC-related deaths in Korea. CRC is the fourth most lethal cancer related to obesity after lung, hepatic and gastric cancers [6]. Elsewhere,, it is the fourth most prevalent cancer globally, with 800,000 people diagnosed annually [7]. The prevalence of CRC is likely related to the widespread adoption of a westernized diet and the consequent increase in the prevalence of obesity, which has contributed to the increases in various metabolic syndromes, diabetes, cardiovascular diseases, and cancer.

Body mass index (BMI) is one of the indices of obesity. BMI correlates height and weight, and is used to evaluate the health-related risks of patients. It is related to body fat in adults. It is calculated by dividing weight in kg by the square of height in meters (kg/m^2). The standard of obesity varies from country to country; a BMI $\geq 25 \text{ kg/m}^2$ and $\geq 30 \text{ kg/m}^2$ is considered overweight and obese, respectively, in Asia. The Korean Society for the Study of Obesity classifies BMI $\leq 18.5 \text{ kg/m}^2$ as underweight, $18.5\text{-}22.9 \text{ kg/m}^2$ as normal weight, 23 kg/m^2 as overweight, 24 kg/m^2 as risk of obesity, $25\text{-}30 \text{ kg/m}^2$ as minor obesity, $30\text{-}35 \text{ kg/m}^2$ as severe obesity, and $\geq 35 \text{ kg/m}^2$ as extreme obesity. The number of Korean adults who are considered overweight has more than doubled in 6 years from 13.9% in to 30.6% in 2001, coincident with the rapid socioeconomic development of the country [8].

Obesity is a risk factor of colorectal cancer. However, little is known concerning dose assessment of the small intestines and bladder, which are the internal organs adjacent to the rectum, according to BMI when CRC patients receive radiotherapy [9][10].

Most colorectal cancer patients receive radiotherapy positioned stomach-down, so radiation may not target the tumor and interfere with the treatment when geometric consistency is not achieved due to improper position of patients by body weight or breathing. Therefore, rectal cancer patients receiving radiotherapy are required to minimize movement using a belly board for accurate positioning according to the use of ostomy. Many studies have already discussed the use of the belly board while CRC patients lie stomach-down to expand the bladder during radiotherapy [11]. The belly board is used only for patients who are wearing an ostomy. Obese patients who are not wearing an ostomy may not maintain the right position as their lower belly moves due to breathing during radiotherapy. Prior studies have discussed positioning of CRC patients during radiotherapy according to BMI and the use of belly board; obese patients can adopt improper positions regardless of the use of an ostomy and the use of belly board can reduce the error [12].

However, there is no information regarding the difference in dosage on the surrounding small intestines and bladder during radiotherapy for CRC in case of positioning errors due to differences in BMI.

This study analyzed the setup error according to different BMI values and applied the error to the existing treatment plan to compare the dose on the small bowel and bladder during radiotherapy for CRC according to BMI. The aim was to study the usability of the belly board.

II. MATERIALS AND METHODS

A. Materials

The study involved 12 patients who received radiotherapy before or after surgery after they were diagnosed with CRC at a general hospital in Seoul between August 2014 and July 2015. The patients were divided into two groups based on BMI (≥ 24 and $< 24 \text{ kg/m}^2$). Each group was comprised of two subgroups based on the use or non-use of the belly board. In total, there were four groups with three individuals per group: Group 1, belly board and BMI $< 24 \text{ kg/m}^2$; Group 2, no belly board and BMI $< 24 \text{ kg/m}^2$; Group 3, belly board and BMI $\geq 24 \text{ kg/m}^2$; and Group 4, no belly board and BMI $\geq 24 \text{ kg/m}^2$.

B. Method

To evaluate patient position-related errors during simulated therapy, 58 images were taken after the patient was positioned in the therapy room. The bladder was expanded by withholding urination for 2 hours before the position simulation for radiotherapy. Patients maintained a prone position during examination

using a High Advantage computed tomography (CT) device 16 channel (GE, USA) to obtain three-dimensional information needed for a treatment plan. The CT scans had a sectional thickness of 5 mm and pitch of 1.35 degrees. Sixty images were acquired for each patient. The scan range for the simulation was 5 mm from the lumbar spine level 4 to the perineum. To establish an accurate treatment plan and for dosage analysis, Pinnacle ver. 9.0 software (Phillips, Andover, MA, USA) was used to examine the images transmitted using Digital Imaging and Communications in Medicine (DICOM).

The target volume of the transmitted image or the gross tumor volume included all tumors observed in the radiological view according to the International Commission on Radiation Units Report 50. It included the pelvic lymph node, except for the external iliac lymph node. The planning target volume was applied with a 1.5 cm margin to the clinical target volume and the prescription dose was set at 97-103%. The upper boundary of each irradiation was the joint between lumbar spine level 4 and the pelvis, and the lower boundary was the bottom of the obturator foramen or over 3 cm to the bottom of the tumor. The left and right boundaries of the irradiation were 1.5 cm from the sides of pelvic cavity.

The treatment was planned by applying a planning target volume (PTV) to the transmitted images and the radiotherapy equipment applied multi collimators using a LINAC 21EX (Varian, USA) that consisted of a total of 120 leaves including 40 5-mm leaves and 20 10-mm leaves. When needed for an even distribution of dosage, the optimized radiotherapy plan was established using the universal wedge or enhanced dynamic wedge (EDW). The energy applied was one 10 MV ray for each of the left and right beam, and the 4 MV ray for the rear irradiation zone. Total dosage was 44 Gy for 22 sessions of 2 Gy a day with 40% weight on the rear beam and 30% weight on each of the side beams.

C. Analysis

A total of 58 anteroposterior and lateral images taken during the simulated positioning and the electronic portal imaging device for accurate positioning before radiotherapy were utilized to analyze the mean and standard deviation values of the X, Y and Z axes of each patient. Error analysis of the axes of each patient was done at least twice to evaluate the position of the image taken before the first therapy and after more than 10 sessions of radiotherapy using the images saved on the patient information system. When the error on the position was large, standard deviations were calculated for the images including those taken until the position matched the initial position. The center point was moved as much as the error and a new treatment was planned by moving the previous CT image as much as the error using full term for RTP. Based on this, the minimum dosage, maximum dosage, mean dosage and standard deviation of Groups 1-4 were compared to analyze the difference in dosage on normal tissues and tumors, and to classify the critical organs of small intestines and bladder into V_{10} , V_{20} , V_{30} , and V_{40} in case of errors.

The difference compared to the previous treatment plan was comparatively analyzed by measuring volume and dosage (Fig. 1).

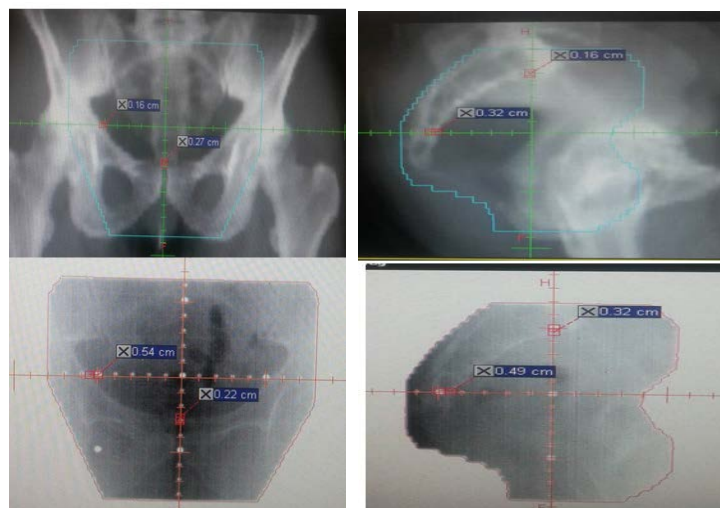


Figure 1: Set-Up Errors of AP&LAT (EPID)

III. RESULTS

The mean and standard deviation of the X, Y, and Z axes of the 12 patients are summarized in (Table 1). The mean and standard deviation of the 12 patients' X, Y, and Z axes were $1.5 \pm 0.5\text{mm}$, $1.8 \pm 0.2\text{mm}$, and $1.3 \pm 0.2\text{mm}$ for (Group 1), $2.0 \pm 0.5\text{mm}$, $1.0 \pm 0.5\text{mm}$, and $2.2 \pm 0.2\text{mm}$ for (Group 2), $2.0 \pm 0.1\text{mm}$, $1.0 \pm 0.5\text{mm}$, and $2.5 \pm 0.5\text{mm}$ for (Group 3), and $1.5 \pm 0.5\text{mm}$, $2.5 \pm 1.0\text{mm}$, for $3.0 \pm 1.0\text{mm}$ (Group 4). As a result of this, colorectal cancer patients with high BMI showed higher mean and standard deviation for the error of position of patients.

Table 1: Difference of BMI each Group and the Error and SD

	(unit : mm)			
	Group 1	Group 2	Group 3	Group 4
X	$1.5 \pm 0.5\text{mm}$	$2.0 \pm 0.6\text{mm}$	$2.0 \pm 0.2\text{mm}$	$1.5 \pm 0.5\text{mm}$
Y	$1.8 \pm 0.2\text{mm}$	$1.0 \pm 0.4\text{mm}$	$1.0 \pm 0.5\text{mm}$	$2.5 \pm 1.0\text{mm}$
Z	$1.3 \pm 0.2\text{mm}$	$1.0 \pm 0.5\text{mm}$	$2.5 \pm 0.5\text{mm}$	$3.0 \pm 1.0\text{mm}$

Group 1 = using belly board and under BMI 24

Group 2 = not using belly board and under BMI 24

Group 3 = using belly board and BMI 24 or over Group 4 = not using belly board and BMI 24 or over.

The volume of bladder V_{10} did not change with V_{20} $2.13 \pm 0.83\text{cc}$, V_{30} $3.66 \pm 2.99\text{cc}$ and V_{40} $4.53 \pm 3.45\text{cc}$ (Group 1). Also, the volume of small intestines V_{10} was $1.11 \pm 1.30\text{cc}$ with V_{20} $2.19 \pm 1.82\text{cc}$, V_{30} $2.55 \pm 2.25\text{cc}$ and V_{40} $2.75 \pm 2.55\text{cc}$ (Group 2).

The volume of bladder V_{10} didn't change with V_{20} $11.73 \pm 14.94\text{cc}$, V_{30} $15.08 \pm 19.78\text{cc}$ and V_{40} $19.40 \pm 23.92\text{cc}$ while the volume of small intestines V_{10} was $1.19 \pm 1.82\text{cc}$, V_{20} $16.22 \pm 24.36\text{cc}$, V_{30} $17.67 \pm 25.30\text{cc}$ and V_{40} $18.49 \pm 26.37\text{cc}$ (Group 3). The volume of bladder V_{10} did not change with V_{20} $8.08 \pm 9.12\text{cc}$, V_{30} $15.45 \pm 7.63\text{cc}$ and V_{40} $19.53 \pm 9.61\text{cc}$ while the volume of small intestines V_{10} was $0.73 \pm 0.86\text{cc}$, V_{20} $7.13 \pm 5.38\text{cc}$, V_{30} $15.26 \pm 14.97\text{cc}$ and V_{40} $10.77 \pm 7.92\text{cc}$ (Group 4) (Table 2).

The volume of bladder V_{10} did not change with $0.39 \pm 0.68\text{cc}$, V_{20} $12.33 \pm 9.98\text{cc}$, V_{30} $18.03 \pm 8.79\text{cc}$ and V_{40} $21.55 \pm 8.12\text{cc}$ while the volume of small intestines V_{10} was $18.38 \pm 17.00\text{cc}$, V_{20} $11.45 \pm 1.69\text{cc}$, V_{30} $23.67 \pm 20.79\text{cc}$ and V_{40} $36.17 \pm 31.70\text{cc}$ (Table 3).

Table 2: Comparison of Bladder Volume According to Difference of Each Group

	(unit : cc)			
OARs	Bladder			
Volume	V_{10}	V_{20}	V_{30}	V_{40}
Group 1	0	2.13 ± 0.83	3.66 ± 2.99	4.53 ± 3.45
Group 2	0	11.73 ± 14.94	15.08 ± 19.78	19.40 ± 23.92
Group 3	0	8.08 ± 9.12	15.45 ± 7.63	19.53 ± 9.61
Group 4	0.39 ± 0.68	12.33 ± 9.98	18.03 ± 8.79	21.55 ± 8.12

Table 3: Comparison of Small Bowel Volume According to Difference of Each Group

	(unit : cc)			
OARs	Small Bowel			
Volume	V_{10}	V_{20}	V_{30}	V_{40}
Group 1	1.11 ± 1.30	2.19 ± 1.82	2.55 ± 2.25	2.75 ± 2.55
Group 2	1.19 ± 1.82	16.22 ± 24.36	17.67 ± 25.30	18.49 ± 26.37
Group 3	0.73 ± 0.86	7.13 ± 5.38	15.26 ± 14.97	10.77 ± 7.92
Group 4	18.38 ± 17.00	11.45 ± 1.69	23.67 ± 20.79	36.17 ± 31.70

As a result the patients who had high BMI and did not use the belly board showed high dosage on the bladder and small intestines which are the normal organs close to the rectum.

IV. DISCUSSION

This study investigated the correlation between the error in the position of CRC patients during radiotherapy and BMI. The control group of patients with high BMI showed high position error. Another study also showed that the error in position increased by the difference in BMI in case of the radiotherapy of prostatic cancer patients using CT [13]. Several other studies mentioned that the only way to reduce the position error in relation to BMI in the case of radiotherapy of head and neck cancer patients and lung cancer patients is to use an appropriate fixture [14, 15].

A recent study on the correlation between position during radiotherapy and BMI showed that higher BMI increased the error in the position of endometrial cancer patients during radiotherapy and the error in the X, Y and Z axes more than doubled for the patients with high BMI compared to the patients with normal BMI [16]. As a way to reduce positioning error, the authors suggested the use of alpha cradle and Vac-loc bags to fix the patients in place. It was considered that only the use of such fixtures can reduce the error. This study discussed the error that occurs during radiotherapy of CRC patients.

Generally, obesity is denoted by a BMI of 23 kg/m². However, the present results of analysis of position error of CRC patients, repositioning by altering the method of positioning according to the patients BMI.

For patients whose BMI is higher than 24 kg/m², the belly board should not be used just for patients with an ostomy. This is based on results with rectal cancer patients with ostomy, for whom the belly board minimizes movement, allowing optimum position without unnecessary dose on normal tissues during radiotherapy. This is important, since patients with a BMI ≥ 24 kg/m² can move their bodies significantly when breathing.

One limitation of this study is that the images from the treatment could not be checked daily and that the number of images taken and the number of target group were limited. The other limitation is the small number of subjects, which obviated statistical analysis.

The significance of this study is that it observed the position of rectal cancer patients and assessed the dose on the normal organs of small intestines and bladder in regard to BMI.

REFERENCES

- [1] Mathers C, Stevens G, Mascarenhas M, "Global health risks: mortality and burden of disease attributable to selected major risks" Geneva, World Health Organization, 2009
- [2] Marmot M, Atinmo T, Byers T, Chen J, Hirohata T, Jackson A, "Food, nutrition, physical activity, and the prevention of cancer: a global perspective" American Institute for Cancer Research, 2007
- [3] Doyle SL, Donohoe CL, Lysaght J, Reynolds JV, "Visceral obesity, metabolic syndrome, insulin resistance and cancer", *Proc Nutr Soc*, vol.7, pp. 181-9, 2012
- [4] Bianchini F, Kaaks R, Vainio H, "Overweight, obesity, and cancer risk" *Lancet Oncol*, vol.3, pp. 565-74, 2002
- [5] Kitahara CM, Berndt SI, de Gonzalez AB, Coleman HG, Schoen RE, Hayes RB, "Prospective investigation of body mass index, colorectal adenoma, and colorectal cancer in the prostate, lung, colorectal, and ovarian cancer screening trial" *J Clin Oncol*, vol.31, pp. 2450-9, 2013
- [6] Jung KW, Won YJ, Kong HJ, Oh CM, Seo HG, "Cancer statistics in Korea: incidence, mortality, survival and prevalence in 2010". *Cancer Research*, vol.45, pp. 1-14, 2013
- [7] Jemal, "Cancer statistics, 2008," *CA Cancer J Clinical*, vol.58, pp.71-96, 2008
- [8] Kim DM, Ahn CW, Nam SY, "Prevalence of obesity in Korea" *Obes Rev*, vol.6, pp.117-21, 2005
- [9] Meyerhardt JA, Giovannucci EL, Holmes MD, Chan AT, Chan JA, Colditz GA, "Physical activity and survival after colorectal cancer diagnosis" *J Clin Oncol* vol.24, pp.3527-34, 2006
- [10] Simkens LH, Koopman M, Mol L, Veldhuis GJ, "Influence of body mass index on outcome in advanced colorectal cancer patients receiving chemotherapy with or without targeted therapy" *Europe J Cancer*, vol.47, pp.2560-7, 2011
- [11] S.M. Yoon, "Postoperative adjuvant fluorouracil based chemotherapy combined with RT for rectal cancer," *Journal Korean Soc Ther Radiol Oncol*, vol.23, S150, 2005
- [12] J.G Shim, H.R Jung, J.M Seo, B.S Park, J.Y Jang, C.H Lim, "Analysis of Body Mass Index on Set Up Errors Rectal Cancer in Radiotherapy" *Cancer in Radiotherapy* journal contents, vol 10, pp.412-8, 2013
- [13] Wong "Potential for higher treatment failure in obese patients Correlation of elevated body mass index and increased daily prostate deviations from the radiation beam isocenters in an analysis of

- 1,465 computed tomographic images" Radiation Oncology Biological Physics, vol 75, No.49, e55, 2009
- [14] Johansen "Set-up errors in patients undergoing IGRT (image guided radiation treatment). Relationship to body mass index and weight loss," Acta Oncology vol.47, e1458, 2008
- [15] Santanam "Estimation of setup uncertainty using planar and MVCT imaging for gynecologic malignancies" Journal of Radiation Oncology Biological Physics, vol.71, e1517, 2008
- [16] Lingareddy "Palliative reirradiation for recurrent rectal cancer" Journal of Radiation Oncology Biological Physics, vol.38, pp.785-90, 1997



ISSN
0975-6299

Imaging Radiation Dose Reduction with Adaptive Statistical Iterative Reconstruction in Brain CT

Yoonjeong Kim, Dept. of Radiological Science, Hanseo University, Korea. E-mail:apfltmzl@naver.com

Danbi Lee, Dept. of Radiological Science, Hanseo University, Korea. E-mail:ekfrlcjs@naver.com

Ino Yu, Dept. of Radiological Science, Hanseo University, Korea. E-mail:xjvnska@naver.com

Su Chul Han, Dept. of Radiological Science, Hanseo University, Korea. E-mail:calmhan81@gmail.com

Hong-Ryang Jung, Dept. of Radiological Science, Hanseo University, Korea. E-mail:hrjung@hanseo.ac.kr

Cheong-Hwan Lim* Dept. of Radiological Science, Hanseo University, Korea. E-mail:lch116@hanseo.ac.kr

Abstract---

Background/Objectives: Patient doses were compared and analyzed depending on the application of FBP (Filtered Back Projection) and ASIR (Adaptive Statistical Iterative Reconstruction Algorithm).

Methods/Statistical analysis: A64-MDCT Optima TM CT 660 system was used for imaging. For quantitative analysis, images containing both sides of orbit and basal ganglia were obtained. After setting a 40~45 mm² area as Region Of Interest (ROI), the average CT number was measured. A statistical program, SPSS 22.0 was used for the calculations, and ANOVA, Kruskal-Wallis, and paired-t tests were performed after the normality and equivalence tests.

Findings: For quantitative analysis, a comparison of SNR of each scan type was carried out. From the Kruskal-Wallis test, the SNR of Axial scan was 0.13 ± 0.67 , and the SNR of Helical scan was 0.12 ± 0.64 . There was a significant difference for the Axial scan values ($\chi^2=12.54$, $p<0.05$), but there was no corresponding significant difference for those from the Helical scan ($\chi^2=0.49$, $p>0.05$). When ASIR was applied in the axial scan, the value of CT DIvol decreased by 21.46 mGy (47.8%) at maximum. The value of DLP decreased by 343.42 mGy·cm (47.8%) at maximum. When ASIR was applied in the helical scan, the value of CT DIvol decreased by 18.52 mGy (49.9%) at maximum and the value of DLP decreased by 328.92 mGy·cm (49.9%) at maximum.

Improvements/Applications: This study could confirm a dose reduction through applying FBP and ASIR algorithm for each scan type in brain CT imaging.

Keywords--- FBP (Filtered Back Projection), ASIR (Adaptive Statistical Iterative Reconstruction Algorithm), Dose Reduction.

* Corresponding Author

Special Issue on "Medical Science"

I. INTRODUCTION

With the current advances in medical technology and further near-term advances, the average life span may indeed reach 100 years. As people have a greater interest in health management for a better quality of life, the number of patients visiting the hospitals and clinics for primary or follow-up care has been increasing¹. With these increased visits, the number of CT tests being performed is also increasing, and this includes brain CT tests². With increased CT use per patient, the exposure dose that a patient receives is also increasing. It is known that exposure dose from a CT test is more than that from a general X-ray test. In addition, to obtain a better image in a CT test, there has been a trend of exposure doses becoming higher. All those factors have led to an average patient receiving higher doses of radiation from CT scans.^{3, 4}

To decrease exposure during medical procedures, various methods are now being devised. Of these, examples include using a noise reduction filter or utilizing Body Mass Index (BMI) measures to adjust exposure dosage⁵.

Recently, Adaptive Statistical Iterative Reconstruction Algorithm (ASIR), a method to reduce exposure dose while minimizing the degradation of image was introduced^{2, 6-10}. For the study on exposure dose reduction in a brain CT scan, this study compared and analyzed exposure dose depending on the application of Filtered Back Projection (FBP) and Adaptive Statistical Iterative Reconstruction Algorithm (ASIR) according to scan type.

II. MATERIALS AND METHODS

The equipment involved the 64-MDCT Optima™ CT660 (GE Healthcare, Chicago, IL, USA) used in scanning for this study, and the test conditions were as follows (Table 1). As for the object of a scan, it was used the head phantom that (Cardinal Health, Dublin, OH, USA) made up of body tissue material (figure 1a).

Table 1: Exposure Conditions of this Study

Material	Head phantom	
Unit	Optima™ CT 660 (64-MDCT)	
Detector	2D	
Coverage(mm)		
Scan type	Axial	Helical
Thickness(mm)	5/20	5/5
kVp	120	120
mA	115	200
Rotation Time	2	1
Pitch	-	0.969:1
DFOV(mm)	240	
Algorithm	FBP/ASIR	FBP/ASIR

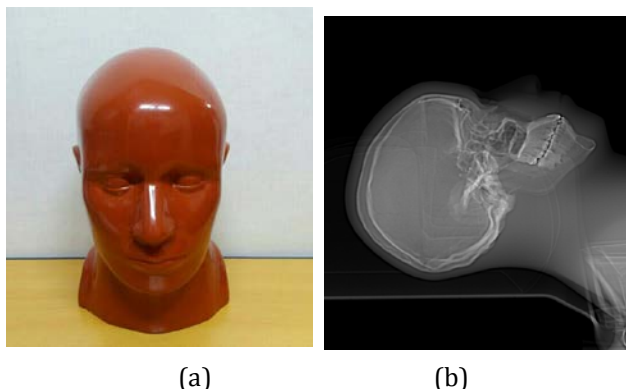


Figure 1: Head Phantom (a) and Scout Image of Head Phantom in CT (b)

With Supra Orbitomeatal Line (SOML) of the head phantom as an origin, and after fixing it vertically to the brain fixation device on the table, the scan range was set from skull base to vertex by scanning scout image (120kV, 10mA) for the criteria (figure 1b). The FBP and ASIR algorithm were applied for image acquisition for each scan type. In case of ASIR, the scan was carried out by applying a 10%~50% of change. After image acquisition, to reduce errors, data was acquired by 5 times of iterative measurements.

For quantitative analysis, the image containing both sides of orbit and basal ganglia was used. By setting the range of 40~45 mm² area as Region Of Interest (ROI), the average of CT number was measured. Noise was defined as standard deviation (SD) of CT number ROI, and with this, the Signal to Noise Ratio (SNR) parameter was calculated.

For the measurement of exposure dose, Dose Length Product (DLP) and CT dose index (CTDI_{vol}) values provided in the equipment were used. CTDI_{vol} is CTDI at the axle of scanning, and the formula to obtain the value in consideration of exposure fluctuation at the Z axle is as follows⁸:

1. $CTDI_{vol} = CTDI_W \times NT / I$
 2. $DLP = CTDI_{vol} \times \text{length (cm)}$
- I: the distance of table movement per each rotation of spiral CT
- NT: the total thickness of beam during the acquisition of image
- CTDI_W: $1/3 CTDI_{(center)} + 2/3 CTDI_{(surface)}$

All data was recorded as average $\pm$ standard deviation, and for statistical analysis, in each position, CT number (HU), Noise (SD), and Signal-to-Noise Ratio (SNR) values were obtained and evaluated. As a statistical program, SPSS 22.0 (SPSS Inc., Chicago, IL, USA) was used, and ANOVA Test, Kruskal-Wallis test, and paired-t test were used after normality test and equivalence test. Confidence level (CI) used was 95%, and for level of significance, p value was set to be less than 0.05.

III. RESULTS

In the evaluation of noise, the average value of noise in orbit and basal ganglia, the region of interest, were measured as 4.68 $\pm$ 0.54 at FBP, 3.90 $\pm$ 0.83 at 10%, 3.91 $\pm$ 0.34 at 20%, 3.89 $\pm$ 0.62 at 30%, 3.65 $\pm$ 0.43 at 40%, and 4.14 $\pm$ 0.72 at 50% for the Axial scan.

Correspondingly, the average value of noise was measured as 5.30 $\pm$ 0.63 at FBP, 4.32 $\pm$ 0.57 at 10%, 4.45 $\pm$ 0.58 at 20%, 4.26 $\pm$ 0.90 at 30%, 4.05 $\pm$ 0.55 at 40%, and 4.30 $\pm$ 0.64 at 50% for the helical scan. As a result of analyzing FBP and each % of ASIR for the axial and helical scans, the significance probabilities were below 0.001 (p<0.05), making the difference values significant. It was confirmed that image noise was significantly low when ASIR was applied rather than FBP (Table 2).

For quantitative analysis, comparison evaluation for SNR of each scan type was carried out. From the Kruskal-Wallis test, SNR of Axial scan was 0.13 $\pm$ 0.67, and SNR of Helical scan was 0.12 $\pm$ 0.64. There was a significant difference in Axial scan ($\chi^2=12.54$, p<0.05), but there was no significant difference in Helical scan ($\chi^2=0.49$, p>0.05) for this measure (Table 3).

Table 2: Quantitative Analysis of Noise

	Scan type	
	Axial (Average $\pm$ SD)	Helical (Average $\pm$ SD)
FBP (0%)	4.68 $\pm$ 0.54	5.30 $\pm$ 0.63
10%-ASIR	3.90 $\pm$ 0.83	4.32 $\pm$ 0.57
20%-ASIR	3.91 $\pm$ 0.34	4.45 $\pm$ 0.58
30%-ASIR	3.89 $\pm$ 0.62	4.26 $\pm$ 0.90
40%-ASIR	3.65 $\pm$ 0.43	4.05 $\pm$ 0.55
50%-ASIR	4.14 $\pm$ 0.72	4.30 $\pm$ 0.64
p-value	0.001 (<0.05)	0.001 (<0.05)

Table 3: Quantitative Analysis of SNR

Scan type	Average $\pm$ SD	χ^2	p
Axial	0.13 $\pm$ 0.67	12.54	0.028
Helical	0.12 $\pm$ 0.64	0.49	0.992

In axial scan, as a result of dose evaluation, the CTDI_{vol} value was measured as 41.14 $\pm$ 0.02 mGy at FBP, 37.56 $\pm$ 0.03mGy at 10%, 32.22 $\pm$ 0.04 mGy at 20%, 28.62 $\pm$ 0.02mGy at 30%, 25.04 $\pm$ 0.03mGy at 40%, and 19.68 $\pm$ 0.02mGy at 50% for and the DLP value was measured as 658.23 $\pm$ 0.36 mGy·cm at FBP, 601 $\pm$ 0.48mGy·cm at 10%, 515.14 $\pm$ 0.55mGy·cm at 20%, 457.9 $\pm$ 0.40mGy·cm at 30%, 400.66 $\pm$ 0.60mGy·cm at 40%, and 314.81 $\pm$ 0.38mGy·cm at 50%. In the helical scan, CTDI_{vol} value was measured as 36.99 $\pm$ 0.02 mGy at FBP, 33.27 $\pm$ 0.02mGy at 10%, 29.57 $\pm$ 0.03 mGy at 20%, 25.86 $\pm$ 0.02 mGy at 30%, 22.17 $\pm$ 0.02 mGy at 40%, and 18.47 $\pm$ 0.01 mGy at 50% for and the DLP value was measured as 657.02 $\pm$ 0.36 mGy·cm at FBP, 590.93 $\pm$ 0.18 mGy·cm at 10%, 525.18 $\pm$ 0.56 mGy·cm at 20%, 459.42 $\pm$ 0.42 mGy·cm at 30%, 393.85 $\pm$ 0.36 mGy·cm at 40%, and 328.1 $\pm$ 0.33 mGy·cm at 50%(figure 2).

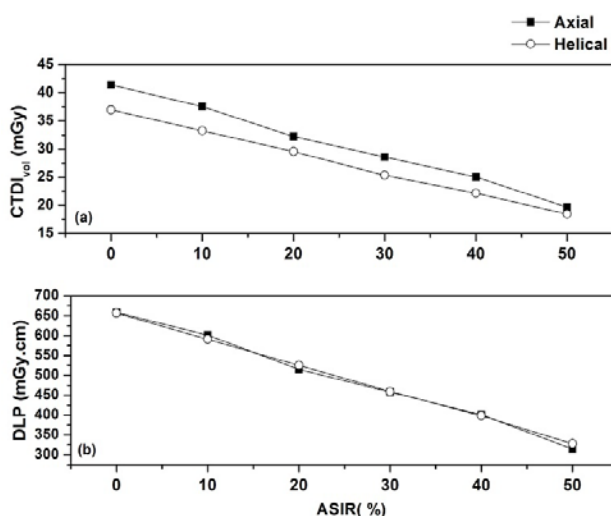


Figure 2: Comparison of Dose Between Axial Scan and Helical Scan, According to ASIR (%) and 0% Means FBP Application. (a) CTDI_{vol}, (b) DLP

When ASIR was applied in the axial scan, the value of CTDI_{vol} decreased by 21.46 mGy (47.8%) at maximum and it of DLP decreased by 343.42 mGy·cm (47.8%) at maximum. When ASIR was applied in the helical scan, the value of CTDI_{vol} decreased by 18.52 mGy (49.9%) at maximum and it of DLP decreased by 328.92 mGy·cm (49.9%) at maximum.

IV. DISCUSSION & CONCLUSION

ASIR algorithm is not an existing method of algorithm application but a method to iteratively reconstruct image statistically. Its application allowed a dose decrease, while enabling generating images of diagnostic value¹. Recently as the range and importance of the clinical application of MDCT in brain-nervous system diagnosis have increased, the interest in exposure doses in the test has also increased, and various researches to reduce radiation exposure are being reported^{1,2,7,8,11,12,13}.

Voronaet al.⁷ reported a decrease in average CTDI by 22.1% and DLP by 23.9% through applying 20% of ASIR in brain CT imaging for 20 pediatric patients. As a result, Kilic et al.⁶ measured the dose of 149 adult patients in a brain CT test, and it was reported that CTDI of cerebrum and occipital fossa decreased by 31% and by 35%, respectively, and DLP decreased by 31% while the quality of image did not change significantly. On the other hand, this study and that of Janget al.¹ carried out exposure dose reduction by ASIR for Head phantom instead of actual patients. In case of Kim et al. study, dose was measured by differentiating the level

of ASIR for axial scan and helical scan. As a result, it could be confirmed that CTDI decreased by 47.8% and by 49.9% at maximum, and DLP decreased by 47.8% and 49.9%, respectively, at maximum. Even in this study, as the doses were measured by differentiating the levels of the ASIR for the phantom, there was significance in results since CTDI and DLP, a measure of radiation, decreased by 47.8% and by 49.9% at maximum in the Axial scan, and CTDI and DLP in Helical scan decreased by 49.9% and 49.9% at maximum, respectively.

Besides a brain CT test, in a cardiovascular system CT imaging test, Fliceket al.¹⁴ decreased the doses by 50% as a result of reconstructing the images through applying 40% of ASIR for patients and was able to reconstruct the images without a significant change in the quality of image. Also, Bradyet al.¹⁵ reported that in a chest and abdominopelvic cavity CT by applying 40% of ASIR, they decreased the doses by 72% and 64%, respectively, at maximum. From the research by Jang et al.², when they applied 50% of ASIR for phantoms in brain CT images, the noise levels of the central and peripheral parts decreased by 46.9%, 48.2%, 43.2%, and 47.9%, respectively, as these changes were also statistically significant. In the image noise analysis of this study, as the noise of the images decreased statistically by 22% and 23%, respectively, in the Axial and Helical scans by applying ASIR, it was a desirable outcome. However, in case of the axial scan, since significant differences were shown at the 50% points, it could be confirmed that when applying ASIR beyond a certain level, it can be undesirable. In cardiovascular system contrast CT imaging study, as a result of applying ASIR with different levels such as 0%, 20%, 40%, 60%, 80%, and 100%, Leipsicet al.¹³ reported that only images applied with 40% and 60% of ASIR showed significant enhancement diagnostically. Also, in a chest CT imaging study, as a result of applying 70% of ASIR to 23 patients, Singh S et al.¹² reported that the diagnostic data could not be obtained due to the degraded quality of the images. It is possible to apply ASIR from 10% to 100% levels and if too much ASIR is applied, the noise becomes too small, and the images start to look artificial and begin to lose diagnostic value¹. On whether the applied ASIR can be increased to 100% is appropriate for diagnosis or not, it has not actually yet been established. Actual users prefer a 30% or 40% level for ASIR, which reduces the noise while providing the same diagnosis data when compared to the image not altered ¹¹.

The limitation of this study is that the experiments were performed only with a phantom head, and as such, clinical results could not be obtained, and a small amount of data was obtained from each experiment. In addition, since the evaluation of image was only composed of quantitative evaluations such as dose, SNR, and noise, etc., it is not known whether the images were valuable for diagnosis. In the future, if a study is performed with actual patients, the data yield will be greater. As this study could confirm dose reduction through applying FBP and ASIR algorithm for each scan type in brain CT, it is judged that excessive application of ASIR can result in image artifacts, and selecting an appropriate level of ASIR is important.

REFERENCES

- [1] JangHyunchul, Kim Hyunju, and Cho Jaewhan.Dose evaluation according to the application of ASIR in Heart CT test, *Korea Contents Academy Journal*.2011, 11(5)
- [2] Jang Hyunchul, Kim Hyunju, Cho Jaewhan.Image Noise Evaluation and Exposure Dose Analysis of Brain CT Using ASIR,*Korea Radiation Academy Journal*.2012, 6(5).
- [3] ChoiNam-Gil, HanJae-Bok, Kim Song Wok, JungMyo-Young, SeongHo-Jin. The Research on the Volume of Artificial Structure by the Change of Scan Parameter in CT Inspection, *Indian Journal of Science and Technology*.2016, 9(25).
- [4] MamathaH.,Shamasundar N.M.,Bharathi M.B.,Prasanna L.C. Variation of ostiomeatal complex and its applied anatomy: a CT scan study, *Indian Journal of Science and Technology*, 2010, 3(8).
- [5] Kim Hyunju.A Study on the Appropriate Radiation Dose Criteria according to BMI Index in CT test for the Assessment of Abdominal Body Fat.Soonchunhyang University dissertation (Ph. D). 2015.
- [6] Jang Hyunchul.Usefulness of Adaptive Statistical Iterative Reconstruction Method in Cardiovascular CT Test.*Soonchunhyang University*. 2010.
- [7] Vorona G.A.,Zuccolib G., Sutcavageb T. The Use of Adaptive Statistical Iterative Reconstruction in Pediatric Head CT: A Feasibility Study. *American Journal of Neuroradiology*. 2012.
- [8] KilicaK., ErbasG.,GuryildirimaM.Lowering the Dose in Head CT Using Adaptive Statistical Iterative Reconstruction. *American Journal of Neuroradiology*. 2011,32, pp.1578-1582.
- [9] MillerJanet Cochrane.,PhilD.Iterative Image Reconstruction Method (ASIR): Lowering CT Radiation Dose and Improving Image Quality.*MGH*, 2009.
- [10] Ko SJ, Kang SS. Optimization of Exposure Parameters in Brain Computed Tomography, *Journal of Korea*

- an Society of Radiological science*.2010,33(4),pp.355-362.
- [11] Alvin C Silva, Holly J Lawder, Amy Hara.Innovations in CT dose reduction strategy: application of the adaptive statistical iterative reconstruction algorithm. *American Journal of Neuroradiology*.2010, 194 (1), pp.191-199.
 - [12] Singh S, Kalra MK, Gilman MD.Adaptive statistical iterative reconstruction technique for radiation dose reduction in chest CT: a pilot study, *Radiology*.2011,259, pp.565-573.
 - [13] Leipsic J, Labounty TM, Heilbron B.Adaptive statistical iterative reconstruction: assessment of image noise and image quality in coronary CT angiography. *American Journal of Neuroradiology*.2010, 195, pp. 649-654.
 - [14] Flicek KT, Hara AK, Silva AC.Reducing the radiation dose for CT colonography using adaptive statistical iterative reconstruction: A pilot study.*American Journal of Neuroradiology*.2010, 195, pp.126-131.
 - [15] Brady SL, Moore BM, Yee BS.Pediatric CT: implementation of ASIR for substantial radiation dose reduction while maintaining pre-ASIR image noise.*Radiology*.2014,270, pp.223-231.



ISSN
0975-6299

The Study of Psychological Factors Analysis on Elderly with EEG in Hospital

Mi-Hyun Jung, Dept. Emergency Medical Technology, Kangwon National University, Korea. E-mail:wjdaigus15@daum.net

Tae-Young Moon, Dept. Emergency Medical Technology, Kangwon National University, Korea.
E-mail:dems05@kangwon.ac.kr

Jee-Hee Kim, Dept. Emergency Medical Technology, Kangwon National University, Korea. E-mail:kjh1962@hanmail.net

Byung-Jun Cho*, Dept. Emergency Medical Technology, Kangwon National University, Korea. E-mail:cho6451@gmail.com

Abstract---

Background/Objectives: The purpose of this study is to investigate the longer life span in women. This study focused on the understanding of psychology in the elderly women using EEG for health promotion.

Methods/Statistical analysis: The subjects were thirty elderly women over 65 years old in geriatric care hospital and signed up with the informed consent and they were divided into normal 10 elderly group, 10 exercise elderly group and 10 hospital elderly group. Brain wave was measured by 'power spectrum analysis' of Tele Scan program. The background EEG appeared in left and right asymmetry in the area of theta wave and alpha wave.

Findings: This is indicated in the mental problems associated with depression. This indicates a higher level of depression in the hospitalized elderly women more than normal elderly women and exercise elderly women. Therefore the hypothesis was received in that background EEG would be different in each group.

Improvements/Applications: This study will provide the basic data of psychological factor solutions for the elderly with EEG in various clinical fields.

Keywords--- Electroencephalography(EEG), Psychology, Elderly.

* Corresponding Author

I. INTRODUCTION

UN defined that any society in a certain country whose proportion of the population aged 65 and over is greater than 7%~14%, 14%~20%, or over 20% is called "aging society", "aged society", and "super-aged society", respectively[1]. As the modern medicine is advanced and the level of dietary life is improved, the average life expectancy increases and the death rate decreases, changing the world into an aging society. UN is prospecting in the World Population Prospects that the aging rate of world major developed countries will increase 1.4~1.6 times by 2040 compared to 2010, and BRICs (Brazil, Russia, India and China) will reach 1.4~3.0 times [2]. In the case of Korea, the ratio of seniors aged 65 and over in total population of 2013 covered 12.2%, which has continuously been increased from 3.1% in 1970 and will reach 24.3% in 2030 and to 37.4% by 2050. In particular, the ratio of the super-aged population with the age of 85 and over was 0.9% in 2013, and will increase to 2.5% in 2030 and become 7.7% by 2050. Even compared to international countries, the aging rate and the old-age sustenance rate in Korea was previously lower than developed countries, but it seems to climb up next to Japan in the two rates in 2040[1]. In regard to the period during which the ratio of the old population increasing from 7% to 14%, France took 115 years, US 75 years, UK 47 years and Japan 24 years, whereas, Korea will take 18 years [1]. The Organization for Economic Co-operation and Development (OECD) predicts[3] that Korea will be the 'fastest country in the world within 50 years' among member countries, mentioning that the aging speed of Korea cannot be found ever in the history.

The increase in the old population will have effects on various fields, including society, economy and health care, and the aged are expected to trigger not a few problems in our society as they will increasingly have a higher portion of the domestic population. The issue of health care among many problems resulted from the increase of the old population is likely to be the most serious problem together with economic loss and social burden. Another point to be reviewed with an increasing number of the old population that the medical use by the aged is more than the medical use by the young. The survey on the use of medical resources conducted by the Statistics Korea in 2003 reported that the scale of the medical use by the aged people showed 362 out of 1,000, which is twice the value than the medical use by the whole average people with 158 out of 1,000, and the per-capita duration of treatment was 8.5 days, which is longer than the young with 5.8 days. The old people visiting an emergency medical care center need more time and treatment to be cured than the young ones, and show higher hospitalization rate and death rate, covering more medical care cost[4].

Likewise, the issues on the increasing number of old patients are the crucially considered parts in medical service institution and emergency medical care center in the near future. A lot of precedent studies mentioned that, with the prolonged average life, many senior people have a greater tendency to live with senile diseases and various disorders[5], and most old people are reported to experience depression, an emotional problem, caused by aged-impaired health problems[6]. However, old people's depression is still underestimated in clinical field, or their diagnoses are sometimes missing, consequently giving medically inattentive management services, which are activating as such a higher death risk that the issue should be designated as a main case to be treated [7].

The human thought and behavior are controlled by the brain function, and the function varies according to the activity of many brain nerves. The ways to check neurological changes of the brain are positron emission tomography imaging (PET imaging), single-photon emission computed tomography (SPECT), and Functional magnetic resonance imaging (fMRI) and electroencephalography (EEG). EEG was first used by Hans Berger in 1929, and recently used for the diagnosis of brain activity and brain dysfunction, such as convulsive disease, brain tumor, psychiatric disease, etc. in a clinical point [8]. In comparison to other brain imaging research methods, EEG not only directly shows the functional change of the cerebrum by the noninvasive way, but also has an economic merit by providing various and useful information with just a short-timed examination. The brain measurement has been recognized as a way of objectively interpreting brain functions compared to paper test [9]. Furthermore, it can classify human emotional condition by using EEG. In the study of correlation between emotion and EEG, Kang[10] reported that EEG is appropriate to measure central nervous activity, especially the activity level of the cerebral cortex, and it can most promptly check the functional condition of the cerebral activity with the frequency content which is induced from the electrode. In this sense, EEG is the source that can figure out the variation of the brain activity which changes swiftly in temporal and spatial ways [11], and it is the test method that uses noninvasive method which gives no effect on human body and secures objective feasibility on a neuro physiological base and evaluates the

brain function, taking its position in that EEG is still being used as an excellent test device in the basic research[12]. In the precedent study regarding the EEG on the elderly, Kang et al.[12] carried out a comparative analysis on the brain activation between general old people and demented old people with respect to a concentration training program using a computer, and Lee [11] implemented a research on the effect of computer-assisted cognitive rehabilitation training and balance exercise on cognition: visual perception, hand function, balance and EEG in the elderly. Sung[13] conducted comparative study on EEG between the young group at the average age of 35 and the old group of 72 in the study of quantitative EEG and low resolution electromagnetic tomography (sLORETA) according to normal aging. In existing researches, likewise, the specific studies including aging process or Alzheimer's disease was undergone, and the study of correlation between EEG change by aging and exercise and brain activation has been continuously implemented, but there are still unclear points on which difference EEG shows in terms of the depression in the general old and the hospitalized old[14].

Thus, this study attempts to measure and compare the EEG of the general old, the hospitalized old and the regularly-exercised old, apprehend psychological characteristics, and finally provide a basic resource for the improvement of the life quality of the old people and their health promotion.

II. MATERIALS AND METHODS

This research included 30 senior participants who are hospitalized in the hospital for the elderly and who are attending the college for the elderly, and randomly assigned them into 10 hospitalized people, 10 normal old people, and 10 people who are regularly exercising 30 minutes a day, 3 times a week, except for those who were influenced by the EEG measurement during the test, showing some physical changes including nictation and ophthalmodonesis. All participants were fully learned about the purpose and the method of the research in order for them to be totally understood of the test contents, and voluntarily agreed with the process. The general characteristics of the participants were as follows. The general old people's age was 71.30 ± 4.62 , height was 157.40 ± 4.48 cm, weight was 57.20 ± 5.29 kg and body fat was 23.07 ± 2.69 kg/m² on average; and as for the hospitalized group, the age was 72.00 ± 6.09 세, height was 157.30 ± 5.60 cm, weight was 57.50 ± 5.17 kg and body fat was 23.30 ± 2.49 kg/m² respectively on average. The group of old people who are regularly exercising showed their average physical data with the age of 69.70 ± 4.19 , the height of 154.60 ± 4.20 cm, the weight of 54.35 ± 4.93 kg and the body fate of 22.81 ± 2.69 kg/m² <Table 3>. There was no statistically significant difference among three groups in age, height, weight and body fat ($p > .05$). This research applied Poly G-I (LAXTHA Inc., Korea) which is a computerized polygraph system to measure brain wave, and measured the background EEG in 8 parts of the head surface as a way of monopolar derivation.

The 8 electrodes were attached to the left frontal parietal lobe (Fp1), the right frontal parietal lob (Fp2), the left frontal lobe (F3), the right frontal lobe (F4), the left temporal lobe (T3), the right temporal lobe (T4), the left parietal lobe (P3), the right parietal lobe (P4) one by one based on the International 10/20 electrode system. Added to that, one ground electrode was placed to the back of the left earlobe, and one reference electrode was attached to the back of the right earlobe, thus adding 10 electrodes in total, and EEG was measured for 3 minutes <Pic. 1>. The electrode used was a ground typed disc electrode plated by the gold, and a foreign body was first removed from the head surface by using an alcohol swab to minimize contact resistance before being attached. The electrode was placed by the support of the EEG-dedicated glue (Elefix Z-401CE, Japan), and was fixed on the head surface by using gauze.

An examiner who measured EEG (attachment of electrode, use of measurement device and application of the analysis program) was trained by an EEG measurement professional before experiment, underwent a preliminary experiment course in which the examiner was trained on repeated measurement process, and officially participated in the experiment. In the laboratory which is not disturbed by noise, the examinee sat on a cozy chair with backrest, and got electrodes attached to his or her head surface. To secure a measurement reliability, the same examiner attached electrodes, managed a measurement device, minimized the movement of body and head, and made the participant close his or her eyes and stay calm for 3 minutes in order to minimize noise mix caused by the eye movement. The examinee was also required not to do chewing action or talk during the examination. The data of the study were compared in the time span of 60 ~ 120 seconds, excluding first and last 60 seconds which could be influenced by environment.

The EEG data were collected by using the real time analysis program (TeleScan).

The mean and the standard deviation were produced in the physical characteristics and variable measurement data, and One-way ANOVA was applied to verify the mean difference. Tukey was applied for the post-hoc test in order to verify the difference by each group, and the statistical significance level of measurement values was set as $p < .05$.

Table 1: Baseline Characteristics of the Patients

	Normal elder	In Hospital	Activity elder	<i>p</i>
Age (year)	71.30±4.62	72.00±6.09	69.70±4.19	.584
Wight (kg)	57.20±5.29	57.50±5.17	54.35±4.93	.332
Hight (cm)	157.40±4.48	157.30±5.60	154.60±4.20	.348
BMI(kg/m ²)	23.07±2.69	23.30±2.49	22.81±2.69	.894

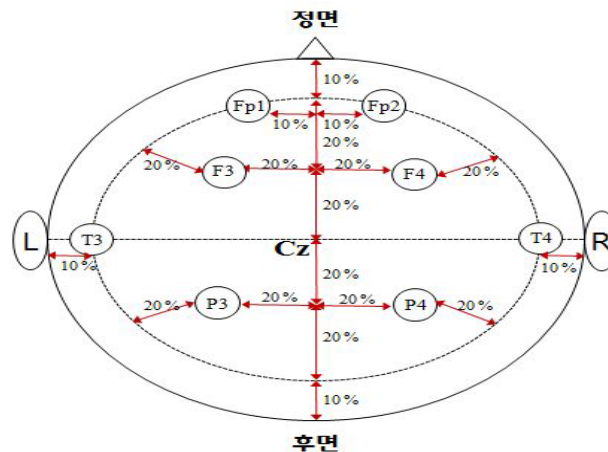
* $p < .05$ 

Figure 1: EEG 8 Electrode Pade Place

III. RESULTS

The inter-group comparison test of relative theta power by area in the group of the general old people, the hospitalized old people and the exercising old people is as follows. <Table 3><Fig. 2>

The significant difference was found in Fp1, F3, F4, T3 and P3 areas ($p < .05$), and no difference was found in Fp2, T4 and P4 areas. The Tukey post-hoc test result showed a significant difference between the exercising group and the hospitalized group, and between the general group and the hospitalized group ($p < .05$). The inter-group comparison test of relative alpha power by area in the group of the general old people, the hospitalized old people and the exercising old people is as follows. <Table 4><Pic. 3> The significant difference was found in T4 ($p < .05$), and no difference in Fp1, Fp2, F3, F4, T3, P3 and P4. The Tukey post-hoc test result presented a significant difference between the exercising group and the hospitalized group.

Table 2: Relative Theta Power in Group

Item	Normal elder	In Hospital	Activity elder	F	<i>p</i>
Fp1	.207±.090	.222±.114	.380±.154	6.126	.006*
Fp2	.208±.108	.233±.121	.328±.146	2.484	.102
F3	.162±.082	.236±.116	.366±.162	6.912	.004*
F4	.157±.078	.220±.108	.282±.123	3.601	.041*
T3	.166±.076	.202±.109	.370±.165	7.977	.002*
T4	.148±.089	.169±.081	.270±.190	2.526	.099
P3	.152±.071	.171±.110	.312±.192	4.231	.025*
P4	.168±.088	.208±.137	.309±.177	2.749	.082

* $p < .05$

Table 3: Relative Alpha Power in Group

Item	Normal elder	In Hospital	Activity elder	F	p
Fp1	.373±.154	.383±.167	.293±.150	1.067	.358
Fp2	.373±.152	.414±.179	.308±.133	1.176	.324
F3	.408±.195	.402±.145	.312±.110	1.229	.308
F4	.412±.177	.403±.158	.300±.123	1.622	.216
T3	.393±.150	.357±.142	.250±.128	2.786	.079
T4	.320±.151	.360±.184	.184±.137	3.372	.049*
P3	.416±.155	.497±.183	.346±.172	1.962	.160
P4	.420±.177	.506±.216	.312±.194	2.440	.106

IV. DISCUSSION

The studies dealing with psychological issues on the depression of the existing senior people have demonstrated the survey research styles through subjective survey scales. So this study attempted to investigate the depressive disposition of the old people through EEG, considering that more diverse aspects of researches on senior depression are needed.

For this reason, in the consideration of difference by each old group found in the theta wave and the alpha wave through the EEG test, the relative alpha power showed no significant difference in the areas of Fp1, Fp2, F3, F4, T3, P3 and P4, but displayed decrease in the T4 area in the hospitalized group. The alpha wave appears in a stable and comfortable state, and it is likely to be recorded very clearly in the parietal area and the occipital area and faintly in the frontal area. The time when the stable alpha wave is activated is the time when one is in the calm state with eyes closed, but when staring at something with eyes open or in the emotional upset, the alpha wave was deactivated. Moreover, in the case of mental disorders, such as depression, schizophrenia and emotional disturbance, etc., the alpha wave is reported to become a serious bilateral asymmetry[15]. In the study of EEG by Heller and Nitschke[16], the frontal lobe and the occipital lobe in the depressed senior people showed an abnormal alpha wave asymmetry, displaying the alpha wave decrease more in the right part than the left part in the occipital lobe [17].

In comparison with the study by Davidson[18], in which he demonstrated that if the alpha wave asymmetry is found in F4 or in T4, a temporary control disability appears in emotion or impulse, the study suggests that the asymmetrical decrease of T4 in the hospitalized group implies that the hospitalized people have tendency of depression and emotion control disorder. The inter-group relative theta power showed no significant difference in Fp2, T4 and P4, but displayed significant difference in Fp1, F3, F4, T3 and P3. This result can be understood in the same context with Le [11] in his study of EEG of the major depressive patients that the theta wave is supposed to amplify its activity in both sides of the temporal lobe through depression and anxiety disorder; and it is also in consonance with the study by Tranel et al.[19] that if the condition of severe depression continues for a long span of time, the activity of the left frontal lobe sharply declines, approaching to the theta wave, the slower wave, not to the alpha wave. This can signify that the function of the left frontal lobe, which guides emotion and action to the direction of getting attention and reward, gradually decreased; on the contrary, the function of the right frontal lobe, which is in charge of a delicate tendency toward recession, in other words, very vulnerable nature to frustration, has increasingly been enhanced in disposition. On this basis, this study suggests that the asymmetrical increase of the theta wave in the areas of Fp1, F3, F4, T3 and P3 of the hospitalized group indicates the chronic depression.

The current study of EEG on depressive disorders mainly focused on an Alpha wave oriented research in the study by So[20]. However, old people's depression mainly covers a chronic depression, so the opinion of the theta wave is still in need of further study in the future, and further studies are required with more subjects. Personal characteristics of the subjects were not considered in this study, so another difference can be emerged by their lifestyles due to the nature of an EEG test. Moreover, in the research process, the subjects were limited to a certain group of female senior citizens who lived in a metropolitan city, so some differences by the regional characteristics can be produced; thus the result may not be expanded to entire old female citizens in the country. In addition, the study has a high possibility to set aside some of test results regarding the patients who were currently undergoing so severe depressive disorders or serious comorbid anxiety that they would show difficulty participating in the test, consequently quitting the experiment. Further to that, lots

of EEG measurement outputs from many subjects are needed to produce reliable results, but this study faced the limit of work forces and costs.

REFERENCES

- [1] Statistics Korea(2009). www.kostat.go.kr , Population and Household, retrieved August, 2016.
- [2] United Nations. World Population Prospects, 2012.
- [3] Statistics Korea (2014). www.kostat.go.kr , Population census. Retrieved August, 2016.
- [4] Sanders AB(1992). Care of the elderly in the emergency department : where do we stand?. *Ann Emerg Med*, 21: 792-795.
- [5] Park, S.A., Kim, I.S., Lee, H.W., Kim, K.C. (2011). Effect of Aroma Hand Massage on Sleep Disturbance and Depression in Hospitalized Elderly Patients. *Korean J Oriental Physiology & Pathology*, 25(2), 365-372.
- [6] Jung, J.H., Ha, J.W., Kim, B.K.(2012). The Current Status about Sleep Disorder in the Journal of Oriental Neuropsychiatry for Evidence Based Medicine. *J Oriental Neuropsychology*, 23(4), 11-36. DOI : 10.7231/jon.2012.23.4.011
- [7] Büla, C. J., Wietlisbach, V., Burnand, B., & Yersin, B. (2001). Depressive symptoms as a predictor of 6 month outcomes and services utilization in elderly medical patients. *Archives Internal Medicine*, 161(21), 2609-2615.
- [8] Cooper, R., Osselton J.W., Shaw J.C.(1980). *EEG Technology*, 3rd ed. London Butterworth, 265-270.
- [9] Lee, I.H., Kim, Y.H., Kim, I.S.(1997). *Neurophysiology*. Seoul:Jihaksa.
- [10] Kang, S.Y., Kim, M.K., Ryu, H.W. (2013). Influence of the Concentration of Lavender Oil on Brain Activity. *Kor J Aesthet Cosmetol* 11(6), 1099-1107.
- [11] Lee, J.S., Jung K.H., Park, S.H., Lee, S.H. (2006). Power spectral analysis of resting EEG in unmedicated major depressive disorder. *Korean Society for Depression & Manic Depressive Illness*, 4(2), 56-61.
- [12] Kang, W, K., Kang, M. H., Yang, J.L., Ku, E.J., Kim, S.K(2009). The Comparison of EEG Activity by Computer Assisted Cognitive Rehabilitation Program in the Normal Elderly and the Elderly With Dementia. *J of the Korean Society of Occupational Therapy*, 17(3), 1-13.
- [13] Sung, K.A., Lee, S.H., Kim, S.R. (2011). Age Differences of Quantitative Electroencephalography and Current Source Density. *J Korean Neuropsychiatric Association*, 50(5), 401-408.
- [14] Kwak Y.T.(2006). EEG Coherence in Controls, Mild Cognitive Impairment and Different Stage of Alzheimer's Disease. *J Korean Neurol Assoc*, 24(1), 38-46.
- [15] Henriques J.B., Davidson RJ(1991). Left frontal hypoactivation in depression. *J Abnorm Psychol*, 100, 535-545.
- [16] Heller W, Nitschke J(1998). The puzzle of regional brain activity in depression and anxiety: The importance of subtypes and comorbidity. *Cognition and Emotion*, 12, 421-447.
- [17] Tranel, D., Bechara, A., Denburg, N.L (2002). Asymmetric Functional Roles of Right and Left Ventromedial Prefrontal Cortices in Social Conduct, Decision-Making, and Emotional Processing. *Cortex*, 38(4), 589-612. [http://dx.doi.org/10.1016/S0010-9452\(08\)70024-8](http://dx.doi.org/10.1016/S0010-9452(08)70024-8)
- [18] Davidson R.J., Ekman P., Saron C., Senulis R, Friesen W.V.(1990). Approach-withdrawal and cerebral asymmetry: Emotional expression and brain physiology I. *Journal of Personality and Social Psychology*, 58(2), 330-341. <http://dx.doi.org/10.1037/0022-3514.58.2.330>
- [19] Tranel, D., Bechara, A., Denburg, N.L (2002). Asymmetric Functional Roles of Right and Left Ventromedial Prefrontal Cortices in Social Conduct, Decision-Making, and Emotional Processing. *Cortex*, 38(4), 589-612. [http://dx.doi.org/10.1016/S0010-9452\(08\)70024-8](http://dx.doi.org/10.1016/S0010-9452(08)70024-8)
- [20] So, Y.S., Lee, J.S., Eom, S.H., Jun, J.Y., Oh, D.Y. (2008). Influence of Comorbid Anxiety Disorder on Electroencephalographic Asymmetries in Major Depressive Patients : A Preliminary Study. *Korean Academy Anxiety Disorder*, 4(2), 127-134.



ISSN
0975-6299

The Effect of Hospital Nurses' Emotional Labor on Turnover Intention with Focus on the Mediating Effect of Burnout

Kyoung Eun Kim*, Dept. of Child Welfare, Namseoul University, Cheonan-City, Korea. E-mail:leejay48@chol.net

Abstract---

Background/Objectives: This study explored the structural relationship among nurses' emotional labor, job burnout, and turnover intention in Korea and investigated the mediating effect of burnout.

Methods/Statistical Analysis: A total of 210 nurses in Korea participated in this study. Descriptive statistics for all study variables were computed. To examine the hypothesized model structural equation modeling (SEM) was used. Data were analyzed with SPSS and AMOS programs.

Findings: The results indicate that nurses' emotional labor is related to job burnout and turnover intention and job burnout is related to turnover intention. Emotional labor had a significant positive direct effect on their burnout and also an indirect effect on their turnover intent via emotional burnout.

Improvements/Applications: This study provides guidelines for interventions aimed at preventing or reducing the turnover rates of nurses.

Keywords--- Nurse, Emotional Labor, Job Burnout, Turnover Intention.

* Corresponding Author

I. INTRODUCTION

According to a Hospital Nurses Association's report in 2014, nurses' turnover rate in Korea was 13.9 percent, with the turnover increasing to 29 percent among nurses with less than a year of experience.¹ The average turnover rate for workers in general in Korea was 4.7 percent in 2014; such nurses' turnover rate was a little high. Nurses' turnover is defined as the number of nurses that have quit within a year, in relation to the total number of nurses.² Nurses' turnover is in line with a nursing shortage. Nurses' turnover raised a major problem for health care services concerning the cost and quality of healthcare.³ Nurses' intention to quit or turnover causes unstable situations which trigger negative consequences on the quality of services provided. This phenomenon may jeopardize patients' health or safety.⁴ Also, many previous studies reported the association between nursing turnover and shortages.⁴ Given the shortage of nurses and the importance of health care quality, understanding the antecedents of the intentions for nurses' turnover is of great importance.

Factors influencing turn over intention have been identified. Many kinds of research have shown that the intention of turn overcomes from factors like leader's support, job commitment, and job satisfaction.^{5, 6} Other researchers classified three main dimensions affecting turnover intention⁷: (1) personal, (2) work-related, and (3) environmental. The decision to leave the job or the decision to quit tends to be the consequence of a process of these underlying causes. Therefore, the integrative correlation among nurses' personal variable, work-related variable, and their turnover intention should be explored.

On the personal factor, emotional labor, occupational stress, and burnout are reported to be notable determinants of career-change intentions.^{8,9} Emotional labor refers to efforts made to modulate the expression of one's emotions to meet the expectations of customers.¹⁰ These expectations are based on display rules or norms about appropriate emotional expressions for specific situations.¹¹ The literature shows emotional job demands is positively associated with turnover intention¹² Emotional labor occurs when one should express an emotion different from what is felt by the person in reality. Emotional disharmony caused by emotional labor worsens the condition of a person performing emotional labor. If a problem caused by emotional labor is not properly handled, the person concerned shows severe stress, anger, hostility, and emotional burnout, and the person may have a mental disease and commit suicide in a serious case.¹³ The work role of nurses involves a great deal of emotional work as nurses may suppress negative emotions and enact positive emotions on a day-to-day basis.¹⁴ Therefore, nurses' emotional labor can have negative health consequences¹¹ and is a significant predictor of burnout¹⁵ and turnover intention.

On the work-related factor, job burnout refers to emotional exhaustion, dehumanization, and the decline of self-accomplishment suffered by mainly organization members performing interpersonal relations work.¹⁶ Nurses experience emotional fatigue and job burnout as they are exposed to too much stress through relations with various occupational groups including patients, guardians, doctors, and administrative workers. Burnout has been associated with organizational outcomes; Burnout results in increased intention to leave or quit, negative work attitudes, and lower levels of performance^{12,17} as well as with physiological and affective outcomes.¹⁶ Nurses experiencing job burnout have been evaluated to cause the change in jobs, productivity decline, and the reduction of job satisfaction, which could negatively affect organizational efficiency.¹⁸ To prevent nurses' burnout is critical not only for retaining nurses but also for improving their well-being and the quality of patient care.¹⁹

Although emotional exhaustion is the essence of job burnout, the job burnout literature has rarely considered emotional work demands as predictors of burnout. As a job stress phenomenon, burnout may play a mediating role between the external job demands and work-related outcomes. As nurses' positive conviction on nursing decreases, it is hard to handle their role effectively, due to job burnout.²⁰ Given that group burnout can be caused by diffusion to other people within a group, when job burnout is caused to a person within the group due to its high infectiousness, coping with nurses' job burnout related to emotional labor and workplace violence can prevent nurses' change of job, and help the improvement of nurses' job satisfaction.²¹

Thus, this study aims to examine a model linking nurses' emotional labor and job burnout to turnover intention. Based on previous studies, nurses' emotional labor and job burnout is assumed to affect turnover intention. Also, job burnout functions as a mediating variable explaining turnover intention (Figure 1).

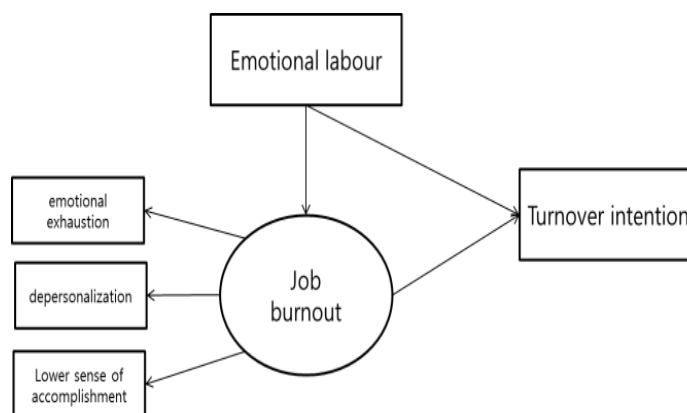


Figure 1: Hypothesized Model

II. METHODS

A. Study Design

To analyze the integrative relationship between emotional labor and job burnout, turnover intention among hospital nurses, a cross-sectional research design was used.

B. Participants

Participants were 229 hospital nurses. The data was collected via structural questionnaires gathered by who agreed to participate in the study, and 210 of them were analyzed except for 19 incomplete questionnaires.

C. Measurements

Emotional Labor

To measure emotional labor, the Korean Emotional Labor Scale was used, which developed by Jang²². Emotional labor includes induction and repression of emotion to keep an outward appearance for others²³. The Korean Emotion Labor Scale measured the level nurses reported that their emotional understanding and emotional displays were regulated by their jobs²². This scale was composed of 26 items. All items were measured on a five-point. The Cronbach's α was 0.94.

Job Burnout

Maslach Burnout Inventory (MBI) was used to measure nurses' job burnout²⁴; MBI was composed of 3 subscales (e.g. emotional exhaustion, depersonalization, and diminished personal accomplishment)²⁴. Emotional exhaustion subscale was composed of nine items (e.g. "I feel emotionally drained from my work"). Depersonalization subscale comprised five items (e.g. "I've become more callous toward people since I took this job"). Diminished personal accomplishment subscale comprised eight items (e.g. "I feel exhilarated after working closely with my customers"). Respondents rated each item on a 5-point. Higher scores represent higher levels of job burnout. The Cronbach's α was 0.92.

Turnover Intention

To measure nurse's turnover intention, The Turnover Intentions Scale was used, which was revised on the basis of Becker²⁵. This scale was composed of 6 items (e.g. "I plan on leaving my job within the next year", "I have been actively looking for other jobs"). Respondents rated each item on a 5-point. Higher scores indicate higher turnover intention. The Cronbach's α was 0.76.

D. Data Analysis

Descriptive statistics were conducted. The hypothesized model and alternative model was tested by structural equation modeling (SEM). To evaluate the fit of structural models to the data, the standard chi-square index of statistical fit, the root mean square error of approximation (RMSEA), Tucker-Lewis index (TLI) and Comparative Fit Index (CFI) were used. RMSEA values below .06 show a close fit to the data²⁶, whereas TLI and CFI values greater than .90, and preferably greater than .95, are considered adequate support for the fit of a model to data²⁶. Standardized parameter estimates were reported. The model was

estimated along with direct, indirect, and total effects, and a formal test of mediation was conducted. Statistical Package for the Social Sciences (Version 18.0) and the Analysis of Moment Structures statistical software programs (Version 18.0) were used for data analysis.

III. RESULTS

A. Participants Characteristics

Table 1 shows the characteristics of the study participants. The mean age of nurses was 30.95 ± 6.91 years. Regarding the proportion of gender, 97.1% of participants were female and 2.9% of participants were male. Educational background was as follows: Diploma 137 nurses (65.6%); Bachelor, 68 nurses (32.5%); and more than graduate school, 4 nurses (1.90%). Regarding the marital status, 134 nurses (63.8%) were single.

Table 1: General Characteristics (N=186)

Variable	Category	n(%), Mean $\pm$ SD
Age		30.95 $\pm$ 6.91
Gender	Male	6(2.9)
	Female	204(97.1)
Educational background	Diploma(3 years)	137(65.6)
	Bachelor (4 years)	68(32.5)
	$\geq$ Graduate school	4(1.9)
Marital state	Single	134(63.8)
	Married	76(36.2)
Department	Ward	117(55.7)
	Outpatient	26(12.4)
	Intensive care unit	4(1.9)
	The Others	63(30.0)
Income	< 2 million won	22(10.9)
	2 ~ 2.5 million won	127 (63.2)
	2.5 ~ 3.5 million won	43 (21.4)
	> 3.5 million won	9(4.5)
Alcohol drink	Nearly not	70(33.3)
	< Once per week	68(32.4)
	Once per week	41(19.5)
	2~3 times per week	23(11.0)
	$\geq$ 4 times per week	8(3.8)

B. Descriptive Statistics for Variables

Descriptive statistics for emotional labor, turnover intention, emotional exhaustion depersonalization, lower sense of personal accomplishment are shown in Table 2. The level of emotional labor is $2.69 \pm .31$ point (ranging 1-4) and the level of turnover intention is $3.27 \pm .55$ point (ranging 1-5). Job burnout includes 3 subscales. The level of emotional exhaustion is $2.95 \pm .66$ (ranging 1-5). The level of depersonalization is $2.41 \pm .76$ (ranging 1-5). The level of lower sense of personal accomplishment is $2.44 \pm .68$ (ranging 1-5).

Table 2: Mean and Standard Deviations of Variables

Variable	Category	Mean $\pm$ SD
Emotional labor (1~4)		2.69 $\pm$.31
Turnover intention (1~5)		3.27 $\pm$.55
Job burnout (1~5)	Emotional exhaustion	2.95 $\pm$.66
	Depersonalization	2.41 $\pm$.76
	Lower sense of accomplishment	2.44 $\pm$.68

Correlations among main variables are shown in Table 3. Nurse's emotional labor was positively related with job burnout ($r = .44, p < .001$) and its subscales (emotional exhaustion, $r = .46, p < .001$; depersonalization, $r = .43, p < .001$; lower sense of personal accomplishment, $r = .29, p < .001$) and turnover intention ($r = .21, p < .001$). Also, job burnout ($r = .46, p < .001$) and its subscales (emotional exhaustion, $r = .52, p < .001$; depersonalization, $r = .42, p < .001$; lower sense of personal accomplishment, $r = .27, p < .001$) were positively related with nurse's turnover intention.

Table 3: Correlation Among Main Variables

	1	2	3	4	5	6
1	1					
2	.21**	1				
3	.44***	.46***	1			
4	.46***	.52***	.90***	1		
5	.43***	.42***	.88***	.70***	1	
6	.29***	.27***	.89***	.65***	.73***	1

** $p < .01$, *** $p < .001$

1: emotional labor, 2: turnover intention, 3: Job burnout, 4: emotional exhaustion, 5: depersonalization, 6: lower sense of personal accomplishment

C. Model Fitness

To test the hypothesized model, structural equation modeling (SEM) techniques were employed. Table 4 indicates the summarized results for the alternative and hypothesized models. The initial analysis of the hypothesized model revealed moderate fit to the data ($\chi^2 = 17.76$, $df = 3$, $p = 0.00$, CFI = 0.97, TLI = 0.96, RMSEA = 0.15). Except for the path from the perceived nurse's emotional labor to turnover intention, other specified paths were significant. This result provided initial support for the model. To improve the model fit, we explored a competing model (full mediation model) which did not have a direct path from the emotional labor to turnover intention within the model. A competitive model (see Figure 2), based on theoretical reasoning, suggesting an indirect effect of nurse's emotional labor on turnover intention²⁷, did not have a correlation between the emotional labor and turnover intention within the hypothesized model. The alternative model resulted in an adequate fit to the data ($\chi^2 = 18.43$, $df = 4$, $p = .01$, CFI = .97, TLI = .96, RMSEA = 0.10) and all paths in alternative model were significant (see table 4).

Table 4: Regression Weights of Alternative Model (final model)

	Estimate(unstandardized)	Estimate(standardized)	SE	CR
Emotional labor → job burnout	1.00	.48***	.14	7.28
job burnout → turnover intention	.47	.54***	.06	7.63

*** $p < .001$, SE=Standard error, CR=composite reliability.

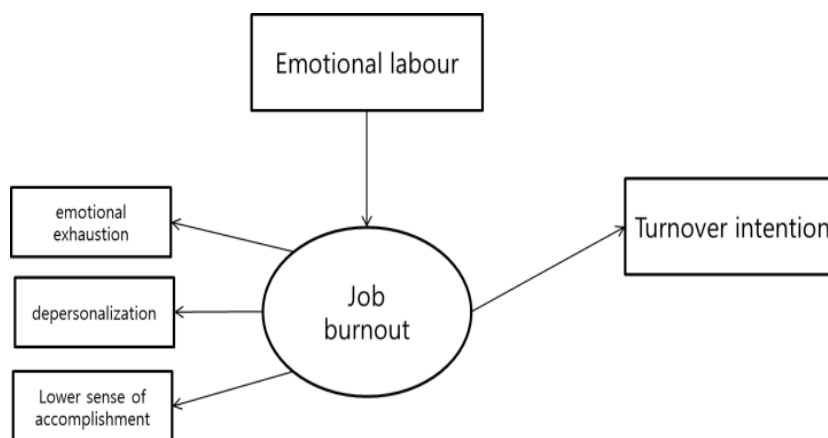


Figure 2: Alternative Model

Comparing the hypothesized model with the alternative model ($\Delta \chi^2_{df=1} = .66$, $p > .05$), the alternative model resulted in a better fit to the data (see Table 5). This result indicated that the alternative model fit the data well. The final model accounted for 30 % of the variance in turnover intend ($R^2 = .24$, $p < .001$). The estimates of the direct, indirect, and total effects of emotional labor on turnover intend via emotional burnout have been displayed in Table 6.

Table 5: Model Fitness Index for Hypothesized Model and Alternative Model

Model	χ^2	df	p	TLI	CFI	RMSEA	$\Delta\chi^2$
Hypothesized model	17.76	3	0.10	0.97	.96	0.15	-
Alternative model (Full mediation model)	18.00	4	0.00	0.97	0.96	0.13	.66

Table 6: Standarized Direct and Indirect Effect

	direct effect	indirect effect	total effect
Emotional labor → job burnout	.48***		.48***
Emotional labor → turnover intention		.26**	.26**
job burnout → turnover intention	.55***		.55***

p<.01, *p<.001

Emotional labor had a significant positive direct effect on their burnout ($\beta = .48$, $p < .001$) and also the indirect effect on their turnover intend via emotional burnout ($\beta = .26$, $p < .05$). Emotional burnout had a significant direct effect on their burnout ($\beta = .55$, $p < .001$). Thus, nurses with higher emotional labor had more burn out in work, and then nurses with higher burn out had more turnover intention.

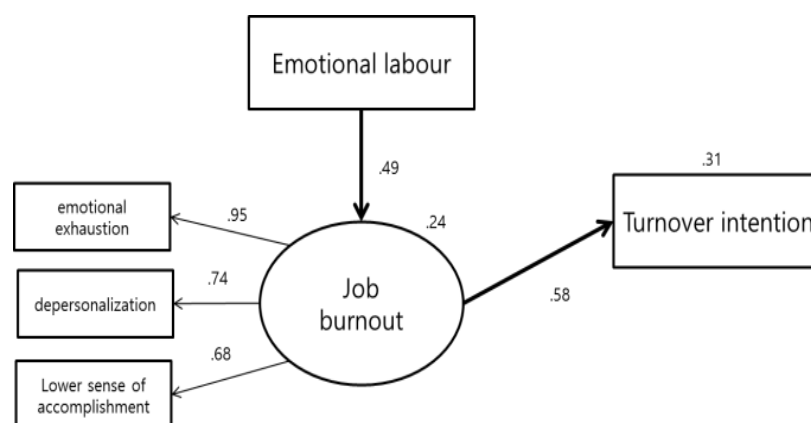


Figure 3: Final Model

IV. DISCUSSION

This study was to determine whether nurses' emotional labor predicted turnover intention and to investigate the mediating effect of job burnout. First, the findings indicate that nurses' emotional labor and burnout are significant predictors of nurses' turnover intention. This result is consistent with previous studies indicating the positive relationship between an employer's emotional labor and turnover intention.^{8,9,18} Nurses' emotional labor may occur when they feel disharmony between their actually experienced emotional state for effective job performance or adaptation to an organization and the emotional expressions required by an organization's emotional expression norm.²⁷ Nurses have to cope with various emotional experiences in a variety of work settings and handle them effectively. Thus, nurses must hide their rejection or disgust in order to perform their tasks and to express "a caring face" simultaneously²⁸. Moreover, the stereotype about nurses is a burden to them because a common social representation regards the nurse as caring, loving, and emphasized with patients.²⁹ Because of these reasons, nurses should induce and suppress their emotion to meet patient needs even though they don't want to. For nurses, higher emotional control is needed to maintain positive relations with a patient in various times and situations. Considering that this stressful emotional labor causes the nurse's turnover intention, educational and support programs to minimize nurses' emotional labor and regulate their emotion effectively should be provided.

As predicted, nurses' job burnout was related with their turnover intention. Not only were nurses' emotional exhaustion but also depersonalization and a lower sense of personal accomplishment were significantly related to turnover intention, which is consistent with previous research on the area of nurses' turnover.^{5,6,8,9} As job burnout was found to be particularly strongly associated to work overload, lack of

social support, and role stress³⁰, job burnout could be reduced or prevented by decreasing the nurses' workload and strengthening nurses' social support. Nurses' turnover intention was directly associated with nurses' job quitting and job rotation; moreover, changes in nurse staff could the lower the effectiveness of team-based care in hospital³¹ and thus ultimately affect the quality of patient care. These results reconfirmed the need to develop an intervention program to prevent nurses' emotional burnout and to promote their self-esteem and self-efficacy concerning their job.

Second, the findings investigate the mediating effect of the job burnout in the relationship between nurses' emotional labor and turnover intention. Nurses' emotional labor indirectly influenced nurses' turnover intention via job burnout. This result was partly consistent with that of previous studies,^{9,21} which underlined the importance of nurses' burnout in work. Even though nurses have higher emotional labor they don't quit their job if they get a strong support from their colleagues and supervisors and if they experience a higher sense of personal accomplishment. In turn, nurses with higher emotional labor may easily quit their job if they don't get support from their hospital staff, along with any accomplishment or pride. Nurses' job burnout works as a buffer in turnover intention. To prevent or reduce nurses' burnout, it is necessary to take a deep interest in the quality of the interpersonal relationship in a hospital. Social support from the hospital staff can be significantly helpful in reducing and preventing emotional exhaustion and depersonalization.³⁰ Also, guidelines and policies to improve nurses' competence and efficacy as a nurse should be developed in health care settings. If nurses get the proper reward and personal accomplishment, they could carry out their task effectively even in emotionally adverse situations. Also, our findings warrant further analysis to investigate the mediating effect of the hospital environment (e.g., organizational culture) and the quality of collegial relationships in the relationship among nurses' emotional labor, burnout, and turnover intention.

To conclude, our study not only confirmed the relationships among nurses' emotional labor, burnout, and turnover intention but also shed light upon the mediating effect of job burnout in the relationship between nurses' emotional labor and turnover intention, providing meaningful recommendations for nurses' management.

REFERENCES

- [1] Korea's nurses walking away from careers that are too tough, <http://koreajoongangdaily.joins.com/news/article/article.aspx?aid=3009081&cloc=etc%7Cjad%7Cgooglenews>. accessed: 01/01/2015.
- [2] Sellgren S, Ekvall G, Tomson G. Nursing staff turnover: Does leadership matter? *Leadership in Health Services*, 2007, 20, pp. 169-183.
- [3] Stone PW, Tourangeau AE, Duffield CM, Hughes F, Jones CB, O'Brien-Pallas L, Shamian J. Evidence of nurse working conditions: a global perspective. *Policy, Politics, and Nursing Practice*, 2003, 4(2), pp. 120-130
- [4] Flinkman M, Leino-Kilpi H, Salanterä S. Nurses' intention to leave the profession: Integrative review. *Journal of Advanced Nursing*, 2010, 66(7), pp. 1422-1434. <http://dx.doi.org/10.1111/j.1365-2648.2010.05322.x>, PMID:20497270
- [5] Chiu C K, Chien SC, Lin PC, Hsiao YC. Understanding hospital employee job stress and turnover intentions in a practical setting: The moderating role of locus of control. *Journal of Management Development*, 2005, 24, pp. 837-855.
- [6] Price LJ. Reflections on the determinants of voluntary turnover. *International Journal of Manpower*, 2001, 22, pp. 600-624.
- [7] Beehr TA. The process of retirement: A review and recommendations for future investigation. *Personnel Psychology*, 1986, 39, pp. 31-55. <http://dx.doi.org/10.1111/j.1744-6570.1986.tb00573.x>
- [8] Chau S L, Dahling J J, Levy P E, Diefendorff J M. A predictive study of emotional labor and turnover. *Journal of Organizational Behavior*, 2009, 30(8), pp. 1151-1163.
- [9] Jourdain G, Chenevert D. Job demands—Resources, burnout and intention to leave the nursing profession: A questionnaire survey. *International Journal of Nursing Studies*, 2010, 47, pp. 709-722.
- [10] Wharton A S, Erickson R J. The consequences of caring: Exploring the links between women's job and family emotion work. *Sociological Quarterly*, 1995, 36(2), pp. 273-296.
- [11] Schaubroeck J, Jones J R. Antecedents of workplace emotional labor dimensions and moderators of their effects on physical symptoms. *Journal of Organizational Behavior*, 2000, 21, pp. 163-183.
- [12] Lee RT, Ashforth BE. A meta-analytic examination of the correlates of the three dimensions of job burnout. *Journal of Applied Psychology*, 1996, 81(2), pp. 123-133.

- [13] Hankyore Newspaper. Retrieved Dec. 4, 2013, from, <http://www.hani.co.kr/arti/culture/book/614054.html>
- [14] Mann S, Cowburn J. Emotional labour and stress within mental health nursing. *Journal of Psychiatric and Mental Health Nursing*, 2005, 12, pp. 154–162.
- [15] Brotheridge CM, Grandey AA. Emotional Labor and Burnout: Comparing Two Perspectives of “People Work”. *Journal of Vocational Behavior*, 2002, 60, pp. 17–39
- [16] Maslach C. *Burnout: The cost of caring*. Englewood Cliffs, NJ: Prentice-Hall, 1982.
- [17] Cameron S J, Horsburgh M E, Armstrong-Stassen M. Job satisfaction, propensity to leave, and burnout in RNs and RNAs: A multivariate perspective. *Canadian Journal of Nursing Administration*, 1994, 7(3), pp. 43–64.
- [18] Maslach C, Schaufeli WB, Leiter MP. Job burnout. *Annual Review of Psychology*, 2001, 52, pp. 397–422.
- [19] Aiken LH, Clarke SP, Sloane DM, Sochalski J, Silber JH. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA*. 2002;288(16), pp. 1987–1993.
- [20] Kim JR, Suh SR, Shin JW. Work stress and fatigue among medical insurance review nurses, *Korean Journal of Health Education and Promotion*, 2009, 26(4), pp. 63–70.
- [21] Kim YH, Choi JH, Kim KE. The impact of job overload, relationship with senior on nurses’ intention to quit their jobs - mediating role of emotional exhaust-*Journal of Korean Academy of nursing administration*, 2009, 15(3), pp. 372–381.
- [22] Jang S J. *The development of Korean Emotional Labor Scale*. The 51st Conference of the Korean Society of Occupational and Environmental Medicine, 2013, November, pp. 461–463.
- [23] Smith P, Gray B. Reassessing the concept of emotional labour in student nurse education: role of link lecturers and mentors in a time of change. *Nurse Education Today*, 2001, 21, pp. 230–237.
- [24] Maslach C, Jackson S. *MBI: Maslach Burnout Inventory, manual research edition*. University of California, Palo Alto, CA. 1986.
- [25] Becker TE. Foci and bases of commitment: Are they distinctions worth making? *Academy of Management Journal*, 1992, 35(1), pp. 232–244. <http://dx.doi.org/10.2307/256481>
- [26] Kim CH, Yang SS, Kim YJ, Son, YJ, You MA, Song JE. A Structural Equation Model of Nurses’ Turnover Intention. *Journal of Korean Academy of Nursing Administration*, 2009, 15(4), pp. 550–562.
- [27] Hochschild A. *The managed heart*. Berkeley: University of California Press. 1983.
- [28] Meerabau E. Be good, sweet maid and let who can be clever: a counter reformation in English nursing education? *International Journal of Nursing Studies*, 2004, 41, pp. 285–292.
- [29] James N. Care=organization+ physical labour+ emotional labour. *Sociology of Health and Sickness*, 1992, 14(4), pp. 488–509.
- [30] Schaufeli WB. *Burnout*. Donker, Rotterdam. 1990.
- [31] Hassmiller SB, Cozine M. Addressing the nurse shortage to improve the quality of patient care. *Health Affairs*, 2006, 25(1), pp. 268–274.



ISSN
0975-6299

A Study on the Influencing Factors of Mental Health in Female College Students Focusing on Self-Esteem and Smartphone Addiction

Je Woo Choi, Dept. of Dental Technology.

GeumSook Oh*, Dept. of Nursing, Chungbuk Health & Science University, South Korea. E-mail:ohgs@chsu.ac.kr

Abstract---

Background/Objectives: The aim of this study is to provide a basis for the development of nursing interventions, to improve mental health of female college students by identifying the extent of self-esteem and smartphone addiction affecting the mental health of the group, and by clarifying the relationships between the self-esteem, smartphone addiction and mental health of female college students.

Methods/Statistical Analysis: From November 12 to 24, 2015, 337 students were selected from G, C, and M city, and all of them filled out a questionnaire for data collection of this study.

Findings: Within subjects, there appeared to be pure correlations between the smartphone addiction and mental health ($r=.486$, $p<.01$) and between the self-esteem and mental health ($r=-.458$, $p<.01$), respectively. The stepwise multiple regression analysis showed that the smartphone addiction and self-esteem had the explanatory power of each 23.5% and 20.7% to the mental health.

Keywords--- Female College Student, Self-Esteem, Smartphone Addiction, Mental Health.

* Corresponding Author

I. INTRODUCTION

A. Purpose

College students in their early adulthood have developmental tasks to build meaningful interpersonal relationship[1], and until mid 90's most after-class activities included circle activity or hanging out with friends, but after mid-late 90's internet mediated virtual activities such as games, chatting, and community activities are continuously increasing[2]. Recently many conversation is done via messengers or SNS, so without smartphone, students struggle, feel alienated. Smartphone-dependent behaviors are increasing, thus there are growing concern toward smartphone addiction. Severe social problem related to addiction include not only the direct influence to the body of harmful effect, but also creates various problems such as financial problem due to excessive charges, psychopathological problem such as withdrawal symptoms, troubles daily tasks or academic activities, violation against law due to false use, and language destruction[3]. Addiction rate in case of smartphone is higher in college student group(36.3%) compare to middle school student(25.1%), high school student(29.1%), and adult(29.3)%[4]. Thus this study holds a meaning to conduct a research on smartphone addiction on female college student where addiction problem is most serious and smartphone addiction rates are highest among the college students overall.

Meanwhile Lee[5] adverts that smartphone addiction is related to self-esteem. And also whether he/she uses smartphone or not, one who can control their use of smartphone has higher self-esteem in positive attitude then person who can't[6], [7]. Also Jahoda(1963)'s mental health primarily judges level of health about individuals, judges positive attitude toward self, integration of characteristics, and secondarily judges health status to instant human behavior to characteristic and circumstances, which are individual autonomy, reality perception, environmental mastery[8]. Thus mental health values problems requiring empirical thinking between relationship of individuals and their circumstances.

This study was performed to further the current knowledge of the self-esteem and smartphone addiction and to clarify its negative effects on the mental health of college students.

B. Focus

- 1) Identify the relationships between the extent of self-esteem, smartphone addiction and mental health of female college students.
- 2) Identify the self-esteem and smartphone addiction affecting the mental health of female college students, respectively.

II. MATERIALS AND METHODS

A. Subjects

Subjects were sampled from cities K, C, and M districts by convenience sampling. 400 questionnaires were distributed for the survey in consideration of dropout rates. Among them, 33 out of 370 copies were collected, and total of 337 female college students who are literate, able to communicate and who agreed to participate in the study were selected. We collected data from November 12 to 24 in 2015.

B. Tools

The questionnaire is composed of 67 items; demographics & smartphone utilization 10 items, smartphone addiction 15 items, self-esteem 10 items, mental health 32 items.

Smartphone Addiction (Smartphone Addiction Proneness Scale)

Smartphone Addiction Proneness Scale developed by National Information Society Agency(NIA)[9] in 2011 was used. The survey contained a total 15 questions on a 5-point Likert scale(1 point indicating 'not at all' and 5 points indicating 'very much so'), which were distributed four subcategories; daily life disability, withdrawal, tolerance, loss of control. The higher total score was designed to mean the higher smartphone addiction.

Self-Esteem

To measure this construct, we used the self-esteem scale developed by Rosenberg in 1965[10] and later translated by Jeon[11]. The survey contained a total 10 questions on a 5-point Likert scale(1 point indicating 'not at all' and 5 points indicating 'very much so'). The higher total score, the higher the self-esteem is indicated. Negatively asked questions were calculated in reverse order.

Mental Health

To measure the mental health, we extracted and practiced Depression, Anxiety, Impulsiveness, Aggression from Neurosis factor from A tool of NEO-PAS personality inventory of adolescents developed by Kim, An(2006)[12],

validated by Kim, Hong, & In(2006).[12]. The survey contained a total 32 questions on a 5-point Likert scale(1 point indicating 'not at all' and 5 points indicating 'very much so'), which were distributed four subcategories; depression, anxiety, impulsiveness, aggression. The higher total score was designed to represent lower mental health.

C. Data Analysis

Statistical analysis was performed using the SPSS Win 20.0 program with a significance level set at $p < 0.05$. The extents of smartphone addiction, self-esteem and mental health were analyzed using descriptive statistics.

The relationships between the smartphone addiction or self-esteem and mental health of female college students were identified by using the Pearson's correlation coefficient. Stepwise multiple regression was performed to clarify influential subordinate factor of the smartphone addiction and self-esteem in the mental health of them.

III. RESULTS

A. General Characteristics of Female College Students

Table 1 reports the general characteristics of female college students. Age groups had the highest percentage of in 10s(70.3%). The mobile device types was smartphone(99.1%), use duration was less than 2year(78.9%). The use time showed more than 3hour per day(64.1%), 1-6hour per weekday(79.2%), and 1-6hour per weekend(69.7%). The monthly use rate was 4-80.000(71.8%), phone use motivation was Broad communication with around people(49.9%), main use function was SNS(53.7%). Their use satisfaction showed very good(30.0%) and good(54.3%).

Table 1: Demographic Characteristics of Study Participants(N=337)

Characteristic	Categories	N(%)
Age(year)	Teenager	237(70.3)
	Twenty	95(28.2)
	Thirty	5(1.5)
Mobile device types	General phone	1(0.3)
	Smartphone	334(99.1)
	Tablet pc, i-pad	2(0.6)
Use duration	<1year	121(35.9)
	<1-2 year	145(43.0)
	≥3year	71(21.1)
Use time(day)	<1 hour	5(1.5)
	<1-2hour	37(11.0)
	<2-3hour	79(23.4)
	≥3hour	216(64.1)
Use time(weekday)	1-6hour	267(79.2)
	7-12hour	53(15.7)
	13-18hour	13(3.9)
	19-24hour	4(1.2)
Use time(weekend)	1-6hour	235(69.7)
	7-12hour	76(22.64)
	13-18hour	22(6.5)
	19-24hour	4(1.2)
Monthly use rate	20.000won	1(0.3)
	2-40.000won	48(14.2)
	4-60.000won	116(34.4)
	6-80.000won	126(37.4)
	≥100.000won	46(13.6)
Phone use motivation	Latest trends	47(13.9)
	Various news search	101(30.0)
	Business and academic help	21(6.2)
	Broad communication with around people	168(49.9)
Main use function	Voice call	12(3.6)
	Text message	15(4.5)
	Internet search	73(21.7)
	Enjoy the music/movies, and watch DMB	46(13.6)
	Games and hobby game entertainment features	10(3.0)
	SNS(KakaoTalk etc.)	181(53.7)
Use satisfaction	Very good	101(30.0)
	Good	183(54.3)
	So so	51(15.1)
	Dissatisfaction	2(0.6)

B. Extents of Smartphone Addiction, Self-Esteem, and Mental Health

Table 2 reports mean scores, standard deviation, and range of variables in female college students. Participants' mean scores for smartphone addiction, self-esteem in the mental health were 43.24(SD=11.18), 34.34(SD=5.78), 75.83(SD=25.96) respectively. Mean score of smartphone addiction was over the moderate level. Self-esteem level indicated similar level. But Mental health was under the moderate score.

Table 2: Mean Scores of Smartphone Addiction, Self-Esteem, and Mental Health

(N=337)

Variable	MD±SD	Range
Smartphone addiction	43.24±11.18	41.98-44.45
Daily life disability	14.12±3.90	13.68-14.53
Withdrawal	11.55±3.62	11.14-11.94
Tolerance	12.27±3.26	11.89-12.62
Loss of control	34.39±5.78	33.77-35.03
Self-esteem	34.34±5.78	33.77-35.03
Mental health	75.83±25.96	73.28-78.37
Depression	16.34±6.62	15.39-16.98
Anxiety	20.88±8.34	20.10-21.68
Impulsiveness	19.93±7.59	17.73-19.23
Aggression	18.67±7.91	71.39-76.48

C. Relationships Between the Smartphone Addiction, Self-Esteem, and Mental Health in Female College Students

Table 3 reports relationships between the smartphone addiction, self-esteem and mental health of female college students. Within correlation between smartphone addiction and subordinate factor of mental health, impulsivity showed highest correlation($r=.474$).

Followed by anxiety, depression, and aggression showing positive correlation to the level of significance. Secondly between correlation of mental health and sub-factors of smartphone addiction showed high correlation between daily life impairment and withdrawal ($r=.440$). Followed by loss of control($r=.411$). Thustotal score of Mental Health with smartphone addiction ($r=.486$) showed high correlation. Self-esteem and mental health ($r=-.458$) showed a negative correlation.

Table 3: Correlation Coefficients of Key Variables

(N=337)

Variables	Daily life disability	Withdrawal	Tolerance	Loss of control	Smartphone addiction	Self-esteem	Depression	Anxiety	Impulsiveness	Aggression	Mental health
Daily life disability	1	.621**	.765**	.679**	.858**	-.160*	.373**	.364**	.445**	.354**	.440**
Withdrawal	.621**	1	.775**	.714**	.889**	-.041	.351**	.398**	.430**	.349**	.440**
Tolerance	.765**	.775**	1	.646**	.913**	-.093	.289**	.308**	.363**	.272**	.362**
Loss of control	.679**	.714**	.646**	1		-.213*	.342**	.371**	.384**	.333**	.411**
Smartphone addiction	.858**	.889**	.913**	.770**	1	-.130	.401**	.428**	.474**	.391**	.486**
Self-esteem	-.160*	-.041	-.093	-.213*	-.130	1	-.575**	-.374**	-.312**	-.328**	-.458**
Depression	.373**	.351**	.289**	.342**	.401**	-.575**	1	.737**	.616**	.659**	.854**
Anxiety	.364**	.398**	.308**	.371**	.428**	-.374**	.737**	1	.659**	.637**	.875**
Impulsiveness	.445**	.430**	.363**	.384**	.474**	-.312**	.616**	.659**	1	.765**	.874**
Aggression	.354**	.349**	.272**	.333**	.391**	-.328**	.659**	.637**	.765**	1	.880**
Mental health	.440**	.440**	.362**	.411**	.486**	-.458**	.854**	.875**	.874**	.880**	1

** $p<.01$. * $p<.05$

D. Smartphone Addiction Affecting the Subordinate Factors of Mental Health in Female College Students

Table 4 reports a multiple regression analysis of the relationship of smartphone addiction and mental health. Smartphone addiction showed 23.7% power of explanation to affecting mental health ($F=134.835$, $p<.001$). Examining smartphone addiction affecting sub-factors of mental health in details, subordinate factors of mental health contributed most by smartphone addiction were depression($F=83.434$, $p<.001$), anxiety($F=97.485$, $p<.001$), impulsiveness($F=126.383$, $p<.001$), aggression($F=78.369$, $p<.001$).

Table 4: Summary of Multiple Regression Analysis Between Smartphone Addiction and Mental Health
(N=337)

Selected Variables	B	β	R ²	Adj. R ²	F
Mental health	1.090	.486***	.237	.235	134.835
Depression	.228	.401***	.161	.159	83.434
Anxiety	.298	.428***	.183	.181	97.485
Impulsiveness	.305	.474***	.225	.223	126.383
Aggression	.259	.391***	.153	.151	78.369

B=unstandardized coefficients; β =standardized coefficients. * $p < .05$, ** $p < .01$, *** $p < .001$

E. Self-Esteem Affecting the Subordinate Factors of Mental Health in Female College Students

Table 5 reports a multiple regression analysis of the relationship of self-esteem and mental health.

Self-esteem has 20.9% power of explanation to the effect on mental health ($F=123.617$, $p < .001$). Examining self-esteem affecting sub-factors of mental health in details, subordinate factors of mental health contributed most by self-esteem were depression ($F=203.773$, $p < .001$), anxiety ($F=86.796$, $p < .001$), impulsiveness ($F=55.006$, $p < .001$), aggression ($F=61.553$, $p < .001$).

Table 5: Summary of Multiple Regression Analysis between Self-Esteem and Mental Health

Selected Variables	B	β	R ²	Adj. R ²	F
Mental health	-2.056	-.458***	.209	.207	123.617
Depression	-.658	-.575***	.330	.328	203.773
Anxiety	-.540	-.374***	.140	.138	86.796
Impulsiveness	-.409	-.312***	.097	.094	55.006
Aggression	-.449	-.328***	.107	.105	61.553

B=unstandardized coefficients; β =standardized coefficients. * $p < .05$, ** $p < .01$, *** $p < .001$

IV. DISCUSSION

This study aimed to clarify the relationships between the smartphone addiction, self-esteem and mental health of female college students, and to identify smartphone addiction and self-esteem affecting the subordinate factors of mental health of them. Answer to the general characteristic of female student for the distribution of smartphone addiction were to make broad communication with surrounding people (49.9%). Comparing this to previous studies [2], [3], [5], female college students value peer relationship within interpersonal relationships, and use smartphone as a tool to maintain this relationships.

In the relationships between the relevant factors of female college student's mental health related self-esteem and smartphone addiction, the self-esteem related mental health was lessor as worse mental health ($r = -.458$, $p = .01$) are lower, and also, smartphone addiction are higher, mental health ($r = .486$, $p = .01$) are higher. This was similar to the findings of researchers who claimed low self-esteem provoked a various physiologic, psychologic, behavioral health problems to college students [2], [7]. And also, subordinate factors of mental health related smartphone addiction in female college students are shown as followed, anxiety, impulsiveness, aggression, depression, in addition to subordinate factors of smartphone addiction related mental health in them are shown as followed, daily life disability, withdrawal, loss of control, and feel that is similar to the finding and interpersonal phobia [2], [3], [5], [7]. And also, It's similar to results of Smartphone addiction and its relations with mental health among nursing students by Im [13].

Thus, active supports of national level are needed for college student to continue their academic activities, modify environmental conditions involving smartphone addiction, thus improve and elevate their mental health and self-esteem [2], [7], [14].

V. CONCLUSION

In the current study, authors confirm the extents of the self-esteem and smartphone addiction affecting the mental health, and their relationships. Based on these results, authors suggest that the effective strategies to reduce smartphone addiction and adaptable care programs promoting the self-esteem and mental health of female college students could be developed. A further in the study, sampling method should be change to generalize the findings random sampling rather than convenience method. We also hope that performs data analysis including demographic variables influencing on the mental health.

REFERENCES

- [1] Kwon, S. M., Psychopathological assessment of Anxiety disorders, *Psychopathology*, vol. 6, no. 1, pp. 35-51, 2003.
- [2] Shin, J. S., A Study on Internet Addiction of the University Students and Communication Anxiety, Unpublished master thesis of Sangji University, 2009.
- [3] Mun, E. Y. and Kim. T. H., The difference of the way of coping with stress and Interpersonal Relationship of the Smartphone addict and Internet addict, *Korea Institute of Youth Facility and Environment Conference*, vol. 2014, no. 1, pp. 75-87, 2014.
- [4] No cut News., 3 people out of 10, "Not live without a mobile phone". 2011. 6. 9.
- [5] Lee, M. S., Smartphone Addiction and Related Social Concerns, Unpublished masters thesis, Yonsei University, 2011.
- [6] Lee, S. Y., The Relationship between Mobile Phone Addiction Psychological Maturity and Academic Achievement of the Middle School Student, Unpublished masters thesis, Chunnam University, 2011.
- [7] Pi, S. J., The Difference in SNS Addiction Possibility, Self-Esteem and Personal Relationships according to SNS Behavior, Unpublished masters thesis, Dankook University, 2013.
- [8] Jahoda, M.(1963). Mental health, *The Encyclopedia of Mental health* vol. 3. Franklin Wotts Inc.
- [9] National Information Society Agency(NIA). Internet addiction diagnostic scale advanced tertiary studies, 2011.
- [10] Rosenberg, M., "Society and adolescent self-image". NJ : Princeton University Press. 1965.
- [11] Jeon, B. J., "Self-Esteem: A test of its measurability", *Studies Yonsei*, 11: 107-129, 1974.
- [12] Kim, D. I. & An, H. E., A Validation Study of NEO Personality Assessment System(NEO-PAS) for Adolescents, *Korea Journal of Youth Counselling*, vol. 14, no. 1, pp. 77-91. 2006.
- [13] Im O. H., Smartphone addiction and its relations with mental health among nursing students, Unpublished masters thesis, Chonbuk University, 2014.
- [14] Han, H.J., The Effects of Smartphone Addiction in Mental Health and Physical Health in College Students, Unpublished doctoral dissertation, Catholic University of Daegu , 2015.



ISSN
0975-6299

A Study of Coil Embolization for Cerebral aneurysm Patients (Around the Coil Amount)

Seunggi Kim, Department of Radiology, Senam University Myongji Hospital 55, Hwasu-ro 14beon-gil, Deogyang-gu, Goyang-si, Gyeonggi-do, mj98015//10475, Korea. E-mail:cocuncap@naver.com

Joonkoo Choi*, Department of Radiological Science, Graduate School of Health Science, Far East University, 76-32, Daehak-gil, Gangok-myeon, Eumsung-gun, Chungcheongbuk-do, c3792/27601, Korea. E-mail:rslaser@hanmail.net

Ghajung Kim, Department of Radiological Science, Graduate School of Health Science, Far East University, 76-32, Daehak-gil, Gangok-myeon, Eumsung-gun, Chungcheongbuk-do, c3792/27601, Korea. E-mail:ghajung@naver.com

Joongseok Go, Department of Radiology, Seoul National University Bundang Hospital, 82, Gumi-ro 173neon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, go1122/13620, Korea. E-mail:snuhgo@hanmail.net

Kwanghyun Chang, Department of Diagnostic Image, Samsung Seoul Hospital, 81, Irwon-ro, Gangnam-gu, Seoul, hang6014/06351, Korea. E-mail:002abbackh@gmail.com

Sinyoung Yu, Department of Radiology, Seoul Sung-sim Hospital, 82, 259 Wansan-ro, Dondaemun-gu, Seoul, sy4643/02488, Korea. E-mail:ryusinyoung@gmail.com

Abstract---

Background/Objectives: The purpose of aneurysm patients treated with coil embolization and provides statistics on the average usage of the aneurysm coil sizes and to help the treatment plan.

Methods/Statistical Analysis: From September 2010 to September 2014 after angiography as the initial target patients treated with coil embolization 277 patients in Gyeonggi M university hospital, it's size by using the volume rendering techniques height, width, depth, divided by the neck size to measure the insurance recognized by comparing the amount according to the size of the coil insurance accepted rules and the evaluation by using the packing density sheet were quantitatively analyzed for the volume of the aneurysm with coil.

Findings: Ruptured aneurysms, un-ruptured aneurysms and packing density with independent samples t-test analysis t is -2.473, p is 0.014 ($p < 0.05$) with un-ruptured aneurysms (32.92 ± 8.98) is ruptured cerebral aneurysm (29.64 ± 12.87) than the overall packing density showed a statistically higher. In addition, correlation between the bivariate correlation analysis aneurysm coil size and the total count was strong linear relationship ($r = 0.795$, $p < 0.01$), this can be said to increase the total amount of the coil is used the larger the aneurysm size. Also found that one meaningless relationship to aneurysm size and packing density are correlated with a smaller increase in aneurysm size packing density ($r = -.473$) But that was a weak correlation between the number of coils used and the total packing density ($r = -.260$, $p < 0.01$). The proportion of the total 277 cases are the result of more than 99% used one case was used in a range of insurance policies and coverage using the number on the coverage meets the criteria according to 49% and the mean aneurysm size, the average of the total number of coil used aneurysm size was used as a 0.83 per 1mm.

Improvements/Applications: Aneurysm size 1mm to use 0.83 on average per coil is considered suitable for use insurance policies to one per 1mm.

Keywords--- Coil Embolization, Cerebral Aneurysm, Packing Density Ratio, Packing Density SHEET, Volume Rendering, Insurance Accepted Rule.

* Corresponding Author

Special Issue on "Medical Science"

I. INTRODUCTION

Cerebral aneurysm refers to a number of causes which are by the major blood vessels that supply blood to the brain blood vessel walls that are very dangerous situation prone to rupture swell as ground cherry disease. How to treat aneurysms are discovered when the aneurysm neck clipping far is that of ligation clips to clamp the neck of the aneurysm through a craniotomy and surgical care or there are treatment options within the aneurysm coiling vessels by puncture of the femoral artery using a micro catheter filled with platinum coil in the aneurysm sac, aneurysm longer able to cut off the blood flow to different endovascular treatment. However, while the amount of the expensive treatment material of the coil increases with increasing coil embolization was leads to an increase in public health costs, accordingly, in november 2008 insurance accepted rules that regulate the amount depending on the size of the coil is used blossomed (November 28, 2008, Notice No. 2008-149) was a limit to the amount coil.

This study is quantitative analysis to measure the height, width, depth, neck size over the TFCA the aneurysm size intended for aneurysm coiling patients in Gyeonggi-do M university hospital 2010.9.1~ 2014.9.30 and as appropriate to fit the insurance regulations by using this evaluating that provides statistics on the average amount of the future coil aneurysms size began the study to help the predict to the treatment plan.

II. LITERATURE REVIEW

Recently, in the treatment of cerebral aneurysms, the weight on endovascular coil embolization is gradually increasing compared to the traditional treatment method of aneurysm neck clipping. Aneurysm coil embolization domestic situation of recent years has seen a very rapid expansion also seems to increase the number of 20% every year, and it is known that the treatment has 5,300 cases in 2011. Compared with the same period of 5700 the number of surgical cases coil embolization was performed in 48% of all aneurysms¹. This statistic is 19% compared to 25% in 2004 and 2003 showed a marked tendency to increase every year, but I think that the alternative surgical treatment, surgery and compared the relative proportions seem a big difference for each institution². On the other hand there is a big advantage of the relative strengths and weaknesses compared to surgery or to avoid critical, craniotomy. Above all, the clinical application of this treatment long-term anatomical outcome is that there is a clear disadvantage does not reach the clipping³.

The results of these treatments may be that recanalization is possible without showed a large difference depending on the aneurysm size, shape, and these disadvantages and additional burden of risk with the coiling overcome this disadvantage. Reducing the recanalization of the aneurysm in various techniques and long-term results for the treatment of larger limitations of wide neck aneurysm of procedure, the indications for surgery are being extended to the development of such a balloon, stent new mechanisms that can prevent, treatment results are also being improved.

III. PROPOSED WORK

A. Research Unit

As shown in figure 1, the angiographic equipment used in this study using GE INNOVA 3131-IQ bi-plane angiography image system equipment.

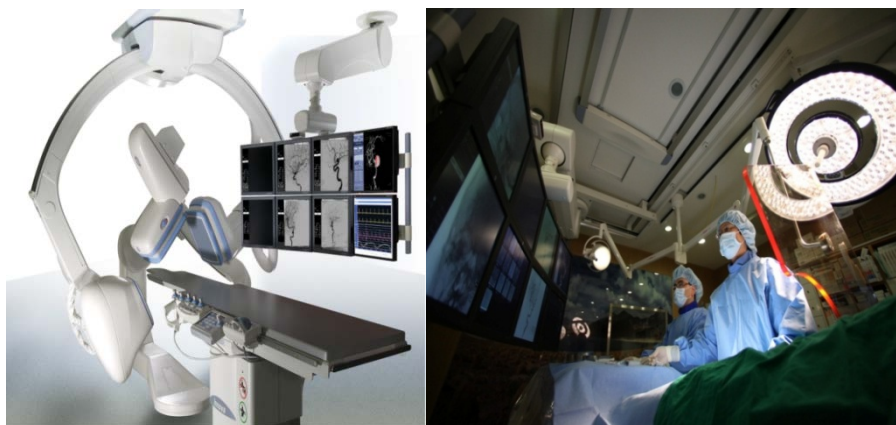


Figure 1: GE INNOVA 3131-IQ Bi-plane Angiography Image System

As shown in figure 2, equipment for image post processing to measure aneurysm size was used as the GE AW 4.6 Volume Share5



Figure 2: GE AW 4.6 Volume Share5 Post Processing System

B. Research Methods

Gyeonggi-do M university hospital admission in patients with a cerebral aneurysm and 3D rotational angiography after the first TFCA, AW 4.6 Volume Share5 post processing system via the 3D reconstruction to check the exact location of the aneurysm and coiling the following to aneurysm size for width, depth, height, neck size for each measurement packing density sheet for use in packing density ratio value⁴⁻⁸ to recognize the patient's age, ruptured or un-ruptured, gender, location, shape, coils of total usage count for was created by insurance accepted suitably used in the rules it was confirmed the presence or absence and evaluated.

C. Image Acquisition Method

As shown in figure 3 and 4, GE INNOVA 3131-IQ bi-plane equipment for use by the patient supine position with the AP and LAT acquisition and 3D rotational angiography and for equipment set-up and inspection after the image is immediately GE AW 4.6 Volume Share5 post processing system automatically transfer to be set It is to obtain the image to reconstruct an image by volume rendering the transferred image to measure the aneurysm size, location and the like.



Bi-plane angiography tube position 3D angiographic tube rotation position

Figure 3: GE INNOVA 3131-IQ Bi-plane 3-D Rotation Angiography Image System

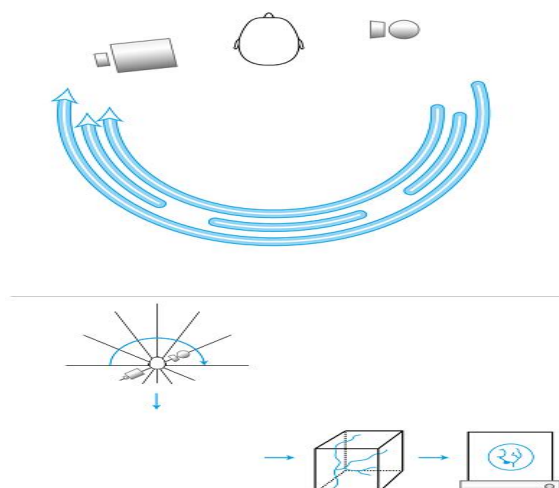


Figure 4: 3-D Rotation Angiographic Image Acquisition Process

D. Aneurysm Size Measurement Method

As shown in figure 5, 3D rotation angiogram to check each of the image(source image) after processing of the GE AW 4.6 Volume Share5 post processing system in by reconstruction the aneurysm is located where the width, depth, height, neck size for each measurement it rounds the most significant size measured by the size indicated.

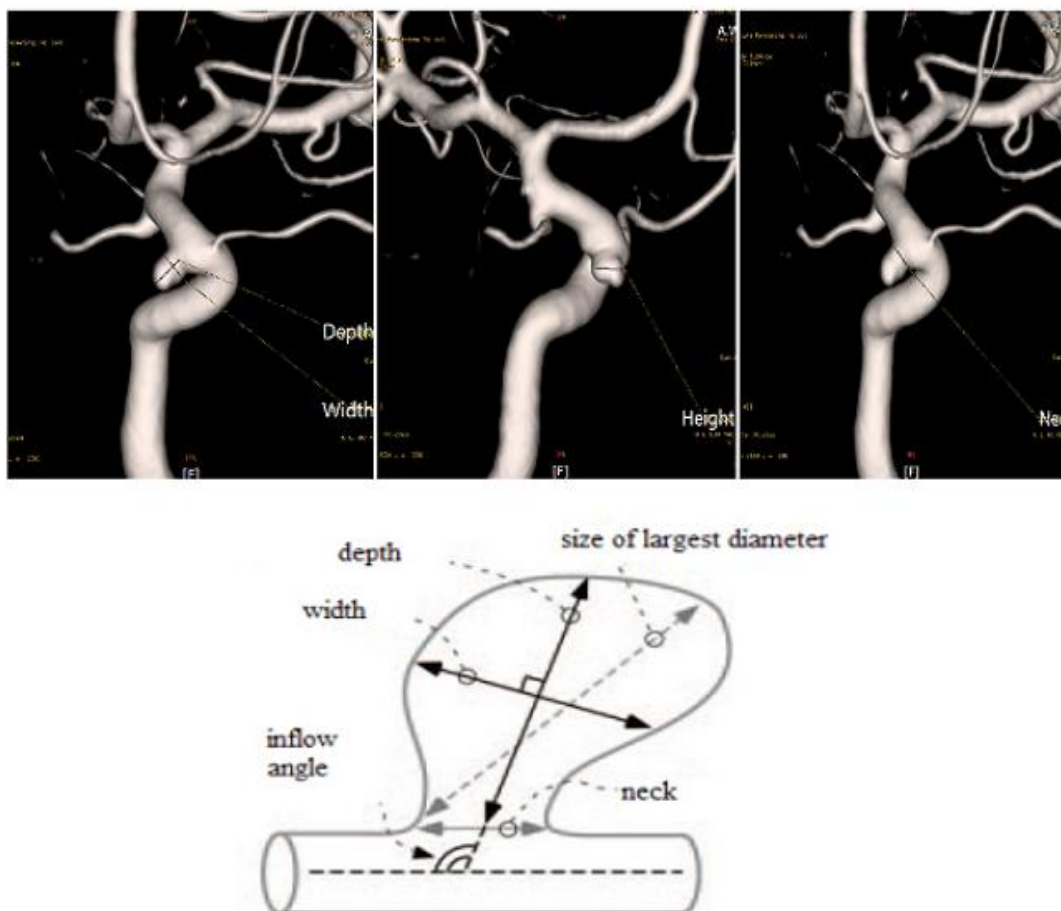


Figure 5: Aneurysms Size Measurement Method by a 3D Reconstructed Image⁹

E. Aneurysm Coiling Method

First, the patient is conscious, and after general anesthesia in anesthesiology, regardless procedure was anesthesia, the neurovascular of the imaging anatomical shape for coiling after equally matched and when the TFCA aneurysm neck and the most visible angle and surrounding normal blood vessels most after made working angle set to that view, which were well separated procedures. The time it took about 3-5 hours, including the time general anesthesia. Treatment method was used to assist with assisted coiling procedure that without assisted coiling and a catheter, wire, stent, balloon, etc. The trial coil is GDC, Target coil (Stryker. USA), TruFill DCS orbit, Orbit Galaxy Xtrasoft coil (Cordman. USA), Hydrosoft, Hypersoft coil (Microvention, USA), Axiom coil (ev3. USA) was being used coiling technical methods were carried out according to the general principles^{10,11}. The results are shown in figure 6 and 7.



Figure 6: The Actual Coil Embolization Procedure



Figure 7: The Actual Coil Embolization was Successfully Performed Before and After Images

F. Aneurysm Packing Density and Volume Measurements

After the width, depth and height in the 3D reconstruction image by using the calculated packing density sheet aneurysm volume obtained, respectively, by substituting the size of the aneurysm coil embolization in the formula calculate the parking density of the coil. The shape of the aneurysm was measured by the oval, rectangular. As shown in figure 8, packing density ratio has been that much better when treatment is to treat the aneurysm coiling or whereby the provided important data to predict the likelihood that the future of recanalization.

Packing Density Calculation Sheet																													
Aneurysm Size (mm)						Aneurysm Volume (cc)					Coil Volume (cc)				% Volume Packing Density														
Neck	Depth	Height	Width	0.000		0.000	0.000	cm	#DIV/o!																				
Coil	OD	shape	Diam								Leng	Volume	Coil	OD	shape	Diam	Leng	Volume	Coil	OD	shape	Diam	Leng	Volume					
Target	0.012				0.000	MCS-18	0.015				0.000	HES-18	0.034				0.000	Presidio18	0.0105									0.000	
Target	0.012				0.000	MCS-18	0.015				0.000	HES-18	0.034				0.000	Presidio18	0.0105									0.000	
Target	0.012				0.000	MCS-18	0.015				0.000	HES-18	0.034				0.000	Presidio18	0.0105									0.000	
Target	0.012				0.000	MCS-18	0.015				0.000	HES-18	0.034				0.000	Presidio18	0.0153									0.000	
Target	0.012				0.000	MCS-18	0.015				0.000	HES-18	0.034				0.000	Presidio18	0.0153									0.000	
Target	0.012				0.000	MCS-18	0.015				0.000	HES-14	0.027				0.000	Presidio18	0.0153									0.000	
Target	0.012				0.000	MCS-18	0.015				0.000	HES-14	0.027				0.000	Detapac	0.0105									0.000	
Target	0.012				0.000	MCS-10	0.0100				0.000	HES-14	0.027				0.000	Detapac	0.0105									0.000	
Target	0.012				0.000	MCS-10	0.0100				0.000	HES-14	0.027				0.000	Detapac	0.0105									0.000	
Target	0.012				0.000	Hypersafe	0.0100				0.000	HES-14	0.027				0.000	Detapac	0.0105									0.000	
GDC-18	0.015				0.000	Hypersafe	0.0100				0.000	HES-10	0.022				0.000	Detapac	0.0105									0.000	
GDC-18	0.015				0.000	Hypersafe	0.0100				0.000	HES-10	0.022				0.000	Detapac	0.0105									0.000	
GDC-18	0.015				0.000	Hyster	0.0100				0.000	HES-10	0.022				0.000	Detapac	0.0105									0.000	
GDC-18	0.015				0.000	Hyster	0.0100				0.000	HES-10	0.022				0.000	Detapac	0.0105									0.000	
GDC-18	0.015				0.000	VFC	0.0110				0.000	HES-10	0.022				0.000	Detapac	0.0100									0.000	
GDC-18	0.015				0.000	VFC	0.0110				0.000	HydroSF	####				0.000	Detapac	0.0100									0.000	
GDC-18	0.015				0.000	VFC	0.0110				0.000	HydroSF	####				0.000	Detapac	0.0100									0.000	
Target	0.010				0.000	MCS-HS	0.0110				0.000	HydroSF	####				0.000	Detapac	0.0100									0.000	
Target	0.010				0.000	MCS-HS	0.0110				0.000	HydroSF	####				0.000	Detapac	0.0100									0.000	
Target	0.010				0.000	MCS-HS	0.0110				0.000	HydroSF	####				0.000	Axiom2	0.0115									0.000	
Target	0.010				0.000	MCS-HS	0.0110				0.000	HydroSF	####				0.000	Axiom3	0.0115									0.000	
Target	0.010				0.000	MCS-HS	0.0110				0.000	HydroSF	####				0.000	Axiom4	0.0125									0.000	
Target	0.010				0.000	MCS-HS	0.0110				0.000	HydroSF	####				0.000	Axiom5	0.0125									0.000	
Target	0.010				0.000	Cosmos	0.0110				0.000	HydroSF	####				0.000	Axiom6	0.0125									0.000	
Target	0.010				0.000	Cosmos	0.0110				0.000	HydroSF	####				0.000	Axiom7	0.0135									0.000	
Target	0.010				0.000	Cosmos	0.0110				0.000	HydroSF	####				0.000	Axiom8	0.0135									0.000	
Target	0.010				0.000	Cosmos	0.012				0.000	GALAXY	0.012				0.000	Axiom9	0.0135									0.000	
Target	0.010				0.000	Cosmos	0.012				0.000	GALAXY	0.012				0.000	Axiom10	0.0135									0.000	
Target	0.010				0.000	Cosmos	0.012				0.000	TruFill	0.012				0.000	Axiom12	0.0145									0.000	
Target	0.010				0.000	Cosmos	0.012				0.000	TruFill	0.012				0.000	Axiom14	0.0145									0.000	
Coil count					0	Coil count					0	Coil count					0	Coil count					0	Coil count					0
Total Coil No.					0																								
Total length					0.0																								

Figure 8: Packing Density Sheet

G. Insurance Accepted Regulations (November 28, 2008, Notice No. 2008-149)

As shown in table 1, as the cost of the main material detachable coil expensive to be used for aneurysm coiling (March 2015 currently priced at approximately ₩ 570,000 won), an increase on november 28, 2008 announced the results in the national cost of medical care with the rise of the total cost of treatment aneurysm size, neck size, were each used to limit the number depending on whether the degree of difficulty. Here, compared to the maximum diameter size and the size of the neck of the aneurysm is highly complex lesions were the size of the neck to notice if the diameter is more than 50% of the maximum wide neck and the neck size is more than 4 mm.

Table 1: Insurance Accepted Coil Number Recognition

Aneurysm size(mm)	Recognized coil number	High difficulty
1	1	1+2
2	2	2+2
3	3	3+2
4	4	4+2
5	5+2	5+2+2
6	6+2	6+2+2
7	7+2	7+2+2
8 More than	8 More than+4	8+4+4

H. Statistical Methods

Statistical analysis methods which are more certain sex incidence in the aneurysm by dividing the genders using a descriptive statistical analysis using SPSS ver. 20 divided into men and women is also the ages 20, 30,

40, 50, 60 divided into units, 70, at least 80 to investigate a specific age for ages that generate a lot. Also recognize the area that generate a lot occurring mainly much, therapy was the separation of the aneurysm size by 1 mm~4 mm, 5 mm~7 mm, at least 8 mm equally separated from the insurance accepted regulations of detachable coil, the neck size of the according to the above were classified according to 4 mm and dome-neck-to-size ratio. Coiling was separated by the case and assisted when implemented alone, packing density ratio is less than the 25% or more in packing density ratio obtained by substituting the width, depth, and height of the aneurysm using a packing density sheet less than 25% for more than 25% of high-density group were divided into low density group. In addition, independent sample t-test with a ruptured aneurysm, un-ruptured aneurysm the packing density ratio was validated by comparison with aneurysm size and the number of coil total use, packing density was between correlation analyses. As a result, the coil was used for verifying whether insurance accepted regulations.

IV. CONCLUSION

By SPSS ver. 20 statistic frequency analysis techniques presented with aneurysms patients who received initial treatment with angiography and a total of 277 people of which 141 people un-ruptured aneurysms, ruptured aneurysms is 136 peoples shown in table 2. Among men 84 (30.3%) women the proportion of women was higher than men with 193 people (69.7%).

Table 2: Male and Female Patients Ratio(n=277)

	The total number of treatment	Rate(%)
Male	84	30.3%
Female	193	69.7%

As shown in table 3, average age was 52.37 years insurance against usage (%)Is 49.06%, the average PD(packing density) (%) 31.32%, the average aneurysm size is 5.92

Table 3: Descriptive Statistics Analysis of Ages, Insurance Against Usage, Packing Density, Aneurysm Size

Variable	min	max	mean	SD
Ages(year)	20	80	52.37	11.59
Insurance against usage(%)	11	133	49.06	18.16
Packing Density(%)	10	99	31.32	11.16
Aneurysm Size(mm)	2	20	5.92	3.05

As shown in table 4, the overall treatment of patients with ruptured aneurysms 136 people, un-ruptured aneurysms 141 people with un-ruptured aneurysms were five.

Table 4: The Division of Un-Ruptured Aneurysms and Ruptured Aneurysms

	The total number of treatment	Rate(%)
Ruptured Aneurysm	136	49.1%
Un ruptured Aneurysm	141	50.9%

As shown in table 5, patient age was the most common treatment classified as ordering 50's was 33.9% 60's (23.8%), 40's (21.3%), 70's (14.1%).

Table 5: The Division of Age, Gender

Age	Male	Female	Sum	Rate(%)
20~29	2	0	2	0.7%
30~39	7	6	13	4.7%
40~49	26	33	59	21.3%
50~59	36	58	94	33.9%
60~69	8	58	66	23.8%
70~79	5	34	39	14.1%
80 More than	0	4	4	1.4%

Analysis of the average age, aneurysm size, classified as packing density, insurance against usage aneurysm size 30's were in the larger 7 mm packing density was highest in 40's to 30's 66.61% insurance against usage is highest with 52.46% as shown in table 6.

Table 6: Average Analysis Per Ages

Ages	N	Size(M $\pm$ SD)	PD %(M $\pm$ SD)	Insurance against usage %(M $\pm$ SD)
20~29	2	4.50 $\pm$ 0.70	34 $\pm$ 00	41.50 $\pm$ 12.02
30~39	13	7.0 $\pm$ 3.85	31.53 $\pm$ 7.25	52.46 $\pm$ 16.80
40~49	59	5.44 $\pm$ 2.76	33.61 $\pm$ 15.16	47.81 $\pm$ 21.64
50~59	94	5.38 $\pm$ 2.47	31.31 $\pm$ 10.13	45.74 $\pm$ 16.86
60~69	66	6.40 $\pm$ 3.27	30.40 $\pm$ 10.38	53.51 $\pm$ 16.83
70~79	39	6.67 $\pm$ 3.63	29.79 $\pm$ 9.10	50.67 $\pm$ 17.52
80More than	4	7.50 $\pm$ 5.19	26.00 $\pm$ 7.25	47.75 $\pm$ 18.46

As shown in table 7, locations of aneurysms classification anterior circulation have accounted for 89.9% of the total 249 people of which most with anterior communicating artery 81 patients (29.2%).

Table 7: Locations of Aneurysms

Location	Number	Rate(%)
Anterior circulation	249	89.9%
Acho-ICA	11	4.0%
ICA bifurcation	2	0.7%
Paraclinoid	57	20.6%
ACA	13	4.7%
A-com ICA	81	29.2%
P-com ICA	46	16.6%
MCA	39	14.1%
Posterior circulation	28	10.1%
PCA	2	0.7%
BT	15	5.4%
PICA	7	2.5%
SCA	4	1.4%

As shown in table 8, the size of aneurysm was classified into 1~4 mm, 5~7 mm, 8 mm or more. As a result, the most common size 5~7(43.7%).

Table 8: The Division of Aneurysms size

Aneurysm Size(mm)	Male	Female	Sum	Rate(%)
1-4	24	77	101	36.5%
5-7	38	83	121	43.7%
8 more than	21	34	55	19.9%

If there is more than insurance regulations recognize the aneurysm neck size belonging to the highly complex in the procedure 4 mm dome to neck and if the rate pertaining to the results of highly complex procedures classified as less than 1.5, accounting for 84.8% of the totals 235 people as shown in table 9.

Table 9: The Division of Aneurysms Neck Size

Neck Size(mm)	Number	Rate(%)
4mm below	220	79.4%
4mm more than	57	20.6%
Dome to neck rate(1.5 below)	235	84.8%

The coil embolization treatment method was separated by simple methods and assisted manner. The results were assisted coiling method has a high degree of difficulty of the surgery patients 166 patients (59.9%) as shown in table 10.

Table 10: The Division of Coil Embolization Treatment Methods

Procedure Method	Pt	Rate(%)
without assisted	111	40.1%
Assisted	166	59.9%

If you separate the packing density that can assess the completeness of the coiling procedure had gender with more than 25% high density is 202 people (72.9%), and showed that women more than men as shown in table 11.

Table 11: The Division of Packing Density

PD(packing density)	Male	Female	Total	Rate(%)
High Density (25% more than)	63	139	202	72.9%
Low Density (25% under)	21	54	75	27.1%

Packing density was classified by gender overall 277 people among them women and 193 patients (69.6%) and men and women was as high as 31.94 percent average woman as shown in table 12.

Table 12: The division of PD and Gender

		N	mean
PD(packing density)	Male	84	29.88
	Female	193	31.94

Ruptured and un-ruptured aneurysm packing density with independent sample t-test results ruptured aneurysm mean is 29.64, and the mean un-ruptured aneurysm is 32.92, $t = -2.473$, $p = 0.014$ ($p < 0.05$) than with un-ruptured aneurysm is ruptured aneurysm the high packing density showed a statistically as shown in table 13.

Table 13: Un-ruptured and Ruptured Aneurysms t-Test Comparison

	Packing Density M $\pm$ SD	t	p
ruptured Aneurysm	29.64 $\pm$ 12.87	-2.473	0.014
Un-ruptured Aneurysm	32.92 $\pm$ 8.98		

In addition, correlation analysis bivariate correlation analysis results showed that aneurysms size and coil defined correlation between the number of total usage ($R = 0.795$, $p < 0.01$) as shown in table 14. Therefore be said that the total amount of the coil used larger the aneurysm size increases and aneurysm size and packing density than the smaller the aneurysm size showed that the correlation between an increase in the packing density ($r = -.473$, $p < 0.01$). But it showed weak coil packing density and the total number of used and correlation ($r = -.260$, $p < 0.01$).

Table 14: Correlation Analysis of the Aneurysm Size, the Total Number of Uses, PD

Variable	r
Size-total number of used	.795 ($p < 0.01$)
PD-size	-.473 ($p < 0.01$)
PD-total number of used	-.260 ($p < 0.01$)

Packing density of 25% or higher were classified as high-density group ruptured and un-ruptured as shown in table 15. As a result, if you have treated more than 25% of high-density groups was more than 118 people with un-ruptured a case of ruptured.

Table 15: The Division of Ruptured or Un-Ruptured Packing Density

R/U	PD(packing density) High Density(25% more than)	PD(packing density) Low Density(25% under)
Un-ruptured	118	23
Ruptured	84	52

The aneurysm size were classified according to the Insurance accepted rule. The results from the 3 mm size, 1 case has been used in excess of the accepted insurance standards.

Insurance accepted rule has to use one per 1 mm in principle. Check the number per 1 mm was used to using the coils result 0.8ea per 1 mm as shown in table 16.

Table 16: Aneurysms Actual Number and Percentage of Recognized Standards and Insurance Per 1 mm

Use aneurysms average number per 1mm	0.83ea
Insurance recognized standards VS Amount used	49%

V. DISCUSSION

Today, there are treatments by minimally invasive in the treatment is for a disease with the development of modern medical science is widely used. The reason is that the results of the treatment are important, but because of a wound that looks out no less important to the outcome of the treatment suffered fearful. So it will be of the method for treating a disease for treatment by minimal invasive reason for many patients selected. The same is true also in the treatment of aneurysms. Surgical methods of surgery than open surgery without cutting the head coil embolization in endovascular treatment that the femoral artery through a tiny scratch of 3-5 mm will be a lot of reasons to increase. Also it represents a surgically and similar treatment as a result of the rapid development of a number of devices have procedures is increasing more and more treatment cases. However, because this is too expensive price of a detachable platinum coil main material of the coil embolization whereby the coil used in prescribed treatment for insurance recognized standards on the basis of the aneurysm size and neck size causes a national increase of total expenses in 2008 it began to limit the number. Whereby the hospital and, most charge a fee for the use of coils used in excess of 100% for patients or conditions occur that hospital to pay the costs. As recent years have strengthened assessment for any costs charged to uninsured patients it was highlighted as a very important issue and using a quantitative analysis of cerebral aneurysm recognized standards for insurance.

This study is based on predicting the number of available coil and quantitative analysis of cerebral aneurysm analyze the usage of the aneurysm size and estimated in accordance with aneurysm size was evaluated whether a good use for the actual usage and insurance accepted standards it was to propose.

Quantitative analysis was total 277 cases had been used appropriately meet the insurance coverage standards to be more than 99% when used in excess of insurance coverage based on only one case of 3 mm in size. In addition, the actual use to look at the descriptive analysis of statistics, the average age is 52.37 years old and total packing density ratio was $31.32 \pm 11.16\%$, and the current default insurance accepted standards of aneurysms 1 mm per coil 0.83ea was used the insurance accepted standards to 100% the number ratio of the coil has been used is 49%.

In this study, there is no problem in used by the insurance clinical standards it can be seen that most suitably used for the criteria. In addition, it is thought that can provide data that can predict in advance the available number of coils in accordance with the approximate aneurysm size.

REFERENCES

- [1] Meyers PM, Schumacher HC, Higashida RT, et al. Reporting standards for endovascular repair of saccular intracranial cerebral aneurysms. *AJNR Am J Neuroradiol* 2010;31:E12-24
- [2] Han MH. Endovascular Treatment of Cerebral Aneurysms. *Korean Journal of Stroke* 2004;6(1):1-8
- [3] Lim Sang-Wook and Lim Cheong-Hwan. A study for the Reproducibility of Detachable Coil used in Cerebral Aneurysm Coil Embolization. *Indian Journal of science and Technology* 2016 June; pp5-6
- [4] Kanabe Y, Sadato, Taki W, Hashimoto N. Endovascular occlusion of intracranial aneurysm with Guglielmi detachable coils: correlation between coil packing density and coil compaction. *Acta Neurochir* 2001;143(5):451-5.
- [5] Sluzewski M, van Rooij WJ, Bescos JO, Slump CH, Wijnalda D. Relation between aneurysm volume, packing, and compaction in 145 cerebral aneurysms treated with coil. *radiology* 2004;231(3):653-8.
- [6] Yagi K, Satoh K, Matsubara S, Nagahiro S. Evaluation of aneurysm stability after endovascular embolization with Guglielmi detachable coils: Correlation between long-term stability and volume embolization. *Neurol Med Chir* 2005;45(11):561-6
- [7] Slob MJ, Sluzewski M, van Rooij WJ. The relation between packing and reopening in coiled intracranial aneurysm: a prospective study. *Neuroradiology* 2005;47(12):942-5
- [8] Ernemann UU, Gronewaller E, Duffner FB, Guervit O, Claassen J, Skalej MD. Influence of Geometric and Hemodynamic parameters on Aneurysm Visualization during Three-Dimensional Rotational

- Angiography: An in Vitro Study. AJNR Am J neuroradiol 2003;24:597-603
- [9] Young Sub Kwon, Factors affecting the durability of coil embolization for intracranial aneurysms. The Master's Thesis submitted to the Department of Medicine, the Graduate School of Yonsei University 2010;5
- [10] Im SH, Han MH, Kwon OK, et al. Endovascular coil embolization of 435 small asymptomatic unruptured intracranial aneurysms: procedural morbidity and patient outcome. AJNR Am J Neuroradiol 2009;30:79-84
- [11] Kwon OK, Kim SH, Kwon BJ, et al. Endovascular treatment of wide-necked aneurysms by using two microcatheters: techniques and outcomes in 25 patient. AJNR Am J Neuroradiol 2005;26:894-900



ISSN
0975-6299

A Study on Setting Expansion and Surface Condition Depending on the Mixed Method and the W/P Ratio for a Type-IV Dental Stones

In-Ho Jeong, Dept. of Dental Technology, Gimcheon University, 214 Daehakro, Gimcheon-si Gyung-sangbuk-do, Korea.
E-mail: jih4611@hanmail.net

Soo-Chul Park* Dept. of Dental Technology, Gimcheon University, 214 Daehakro, Gimcheon-si Gyung-sangbuk-do, Korea.
E-mail: remidios@hanmail.net

Sang-Yong Nam, Dept. of Dental Technology, Daegu health college, Youngsong-ro, bu-gu, Daegu, Korea.
E-mail: namsy28@dhc.ac.kr

Abstract---

Background/Objectives: Selecting one from the dental stones that are selling in the market, we have made 3 specimens and made also another 3 specimens increasing the water mixing ratio to 20% under the same conditions.

Methods/Statistical Analysis: High-strength stones were inserted into the identical size mold that could be measured the setting expansion, and every specimen is measured at half-hour intervals from 30 minutes to 180 minutes, for 24 hours, the setting expansion was measured until the ultimate setting, the setting expansion ratio and the average were illustrated on a graph depending on the production methods for every specimen, and finally the difference of the dental High-strength setting expansion was compared.

Findings: Microscope mount optical camera (HT-004, HIMAX, TAIWAN) with 5.1M Pixels, after measuring the setting expansion of a dental High-strength stones that was made by 6 methods.

- 1) While it showed 0.075%, 0.025% lower than those of the manufacturing company, in VACUUM MIXER.
- 2) When we compared the specimen that was made with the normal water mixing ratio with one that was added water to 20% in a vacuum mixer and hand & vacuum, the setting expansion amount of the specimen that has higher water mixing ratio was reduced, but it was greatly insignificant.
- 3) In addition in the specimen that was added water to 20%, there were more small bubbles than in the specimen that was made with the normal water mixing ratio.
- 4) There was a significant difference in the setting expansion amount for a dental High-strength stones depending on an interaction between time and group ($p < 0.05$).

Improvements/Applications: Even if it is uncomfortable, to use a vacuum mixer or a vacuum investing machine is the best practice to make an ideal cast. So we think the further study would be needed for this for each manufacturing company of gypsum.

Keywords--- Dental High-Strength stones, Hand Mixing, Setting Expansion, Vacuum Investing Machine after Mixing by Hand, Vacuum Mixer.

* Corresponding Author

Special Issue on "Medical Science"

I. INTRODUCTION

A dental gypsum can be classified from type I to type v depending on the production method by the 1988 International Organization Standard (IOC) 6873, which are impression plaster, general plaster, lower expansion High-strength gypsum for both a cast and a die and higher expansion High-strength gypsum for a cast and a die. Of them the impression plaster and the general gypsum can be made with β type Calcium Sulfate hemihydrate, the rest of them can be made with α type Calcium Sulfate hemihydrate. α type Calcium Sulfate hemihydrate has a pillar-shaped crystal of prism form, and its form is more regular than β type Calcium Sulfate hemihydrate and that is a denser, so that it is a small in volume and heavy, and its property of matter is excellent. Therefore, Type III, IV and V gypsum, which are made with α type Calcium Sulfate hemihydrate, is used widely for production of a dental model or a die.

For the physical characteristics of a dental gypsum have been defined by the International Organization for Standardization (ISO), through setting time, setting expansion ratio, compression strength and second development of a fine part. Such features are the physical nature, as fundamental characteristics for a dental gypsum, and there have been conducted a lot of studies for improving such characteristics in the meanwhile.

The materials of a die should have the particular characteristics; the suitability for the impression materials, volume accuracy, reproducibility of acceptable fine part, preciseness, proper setting time, minimal setting expansion, higher compression strength, a node and abrasion resistant, surface hardness, easy of operating and efficiency, non-toxic and flexural strength^{1,2,3,9,10}.

For making prosthetic components, the preciseness of dental materials is required, so it has to be made precisely according with what a manufacturing company suggests. The dental impression compounds can gain an impression in people mouths, during setting, contraction can happen, and a dental cast can be made inserting anhydrite or a dental High-strength plaster into the impression model acquired. The dental High-strength stones is used by mixing with water, and can be expansion during the setting expansion. For getting a detailed dental cast using a dental High-strength stones, it has to be made according with the instruction manual from the manufacturing company. If more water is used than the quantity which the manufacturing company suggests, it is known as the setting expansion amount can be reduced. There are many various method to make a dental cast; a way of mixing by hand, eliminating bubble from a vacuum investing machine after mixing by hand, mixing by a vacuum mixer. Even if there are various production methods, there is few study for it. Selecting one from the dental High-strength stones that are selling in the market, we have made 3 specimens and made also another 3 specimens increasing the water mixing ratio to 20% under the same conditions, so that we compared the surface condition of every specimen using a microscope mount optical camera, and then we tried to use it for making a prosthetic, investigating setting expansion degree.

II. LITERATURE REVIEW

Shen et al¹⁴ reported that if calcium sulfate is added to a gypsum for adjusting setting time and setting extension, the setting time might be reduced. Fraunhofer and Spiers⁸ reduced the setting time adding pottassim chloride in it^{5,10}.

Harcourt and Lautenschlager⁹ added a catalyst and retarder, and observed the setting time depending on the effect of them on the product amount of dihydrate gypsum, through monitoring X-ray diffraction of product amount of dihydrate gypsum⁶.

Combe and Smith⁷.reported the change of setting time and setting expansion depending on adding lignosulfonate, Brukl et al⁶.

Reported the change of setting time and setting expansion depending on the mixed water with the second distilled water, deionization distilled water, sweet water and hard water.

Newman et al¹¹.reported the difference of setting expansion in the gypsum which is mixed mechanically by hand mixing and in a vacuum.^{4,5,8}

Even if there are various production methods, there is few study for it.

III. PROPOSED WORK

The analysis of all the data was performed using SPSS 23.0 for Window Program (SPSS, Chicago, IL, USA). We presented the setting expansion amount between groups on the average and standard deviation, and we conducted the Repeated-Measure ANOVA over time for the same individual as every specimen. The significance level was $p < 0.05$.

As Figure1, the setting extension was increased over time in all 3 methods which mixed with normal water mixing ratio suggested by the manufacturing company, it showed the similar value to the setting extension amount of the manufacturing company in HAND MIXING and HAND & VACUUM INVESTING, while it showed 0.075%, 0.025% lower than those of the manufacturing company, in VACUUM MIXER.

The average value and the standard deviation are for every specimen at half-hour intervals as Table 1; 30min, 60min, 90min, 120min, 150min, 180min for 24hours.

Table 1: Average and Standard Deviation of the Setting Expansion Amount for a dental High-strength Stones

Group		N	M	SD
30min	HAND MIXING 20/100	5	0.064	0.010
	HAND MIXING 24/100	5	0.047	0.004
	VACUUM MIXER 20/100	5	0.056	0.007
	VACUUM MIXER 24/100	5	0.050	0.001
	HAND+VACUUM 20/100	5	0.050	0.003
	HAND+VACUUM 24/100	5	0.048	0.004
60min	HAND MIXING 20/100	5	0.070	0.010
	HAND MIXING 24/100	5	0.053	0.005
	VACUUM MIXER 20/100	5	0.061	0.009
	VACUUM MIXER 24/100	5	0.061	0.001
	HAND+VACUUM 20/100	5	0.060	0.001
	HAND+VACUUM 24/100	5	0.059	0.004
90min	HAND MIXING 20/100	5	0.074	0.013
	HAND MIXING 24/100	5	0.056	0.006
	VACUUM MIXER 20/100	5	0.064	0.008
	VACUUM MIXER 24/100	5	0.063	0.003
	HAND+VACUUM 20/100	5	0.062	0.001
	HAND+VACUUM 24/100	5	0.061	0.005
120min	HAND MIXING 20/100	5	0.077	0.014
	HAND MIXING 24/100	5	0.059	0.006
	VACUUM MIXER 20/100	5	0.065	0.008
	VACUUM MIXER 24/100	5	0.067	0.002
	HAND+VACUUM 20/100	5	0.065	0.002
	HAND+VACUUM 24/100	5	0.065	0.005
150min	HAND MIXING 20/100	5	0.078	0.013
	HAND MIXING 24/100	5	0.061	0.006
	VACUUM MIXER 20/100	5	0.066	0.009
	VACUUM MIXER 24/100	5	0.070	0.001
	HAND+VACUUM 20/100	5	0.067	0.002
	HAND+VACUUM 24/100	5	0.065	0.005
180min	HAND MIXING 20/100	5	0.079	0.013
	HAND MIXING 24/100	5	0.061	0.006
	VACUUM MIXER 20/100	5	0.067	0.009
	VACUUM MIXER 24/100	5	0.070	0.001
	HAND+VACUUM 20/100	5	0.068	0.001
	HAND+VACUUM 24/100	5	0.067	0.005
24hours	HAND MIXING 20/100	5	0.089	0.018
	HAND MIXING 24/100	5	0.071	0.006
	VACUUM MIXER 20/100	5	0.076	0.010
	VACUUM MIXER 24/100	5	0.083	0.006
	HAND+VACUUM 20/100	5	0.081	0.002
	HAND+VACUUM 24/100	5	0.076	0.006

However, when we compared the specimen made with the normal water mixing ratio with one that was added water to 20% in vacuum mixer and hand vacuum, the setting expansion amount of the specimen that has higher water mixing ratio was reduced, but it was greatly insignificant.

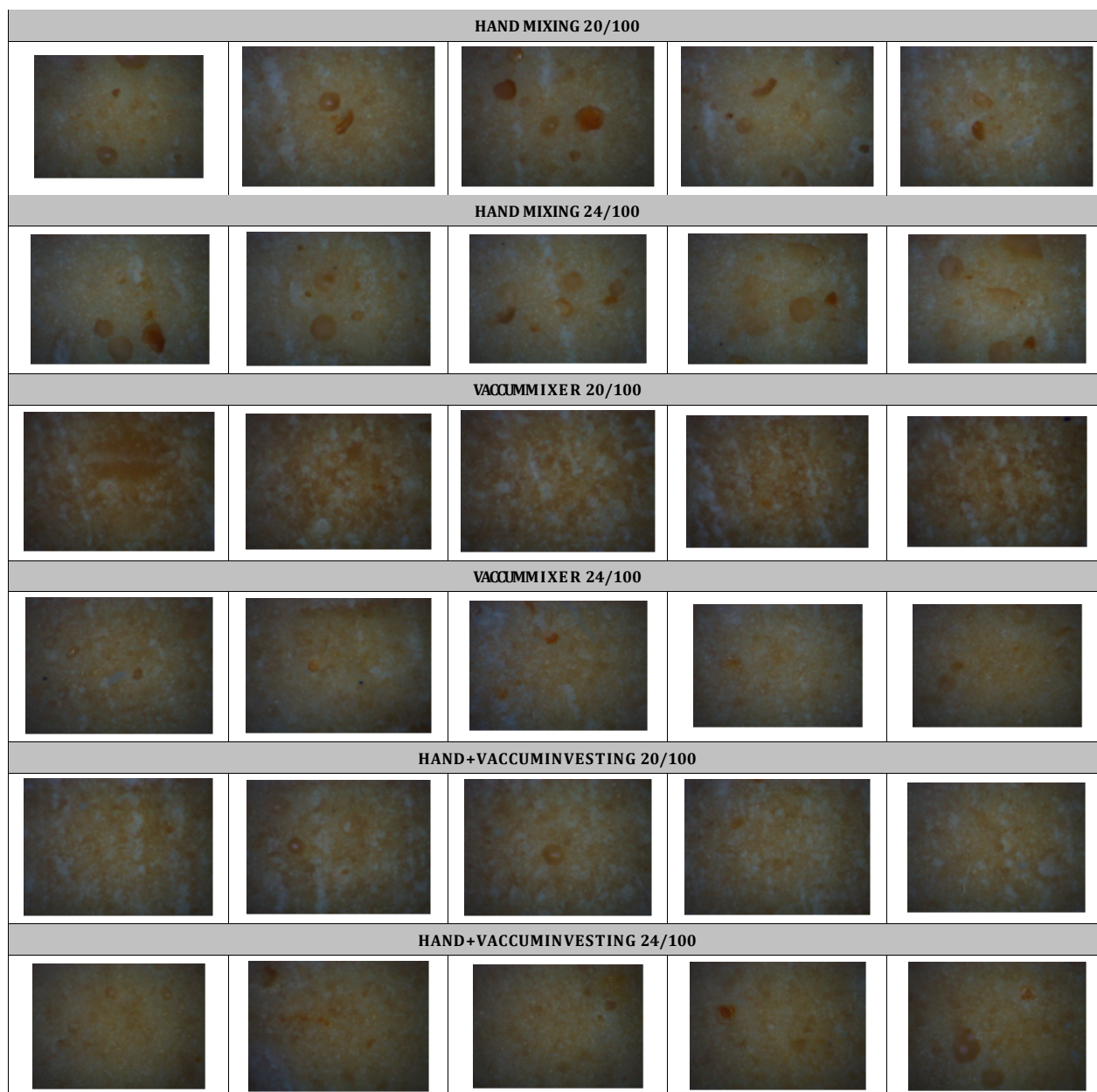


Figure 1: Cross Section for Every Specimen Using an Optical Camera

We observed inside bubble of cross section of the specimens using a microscope mount optical camera in 300 times magnification, which were compared the setting extension amount for a dental High-strength stones<Figure 1>.

As the result, there were a lot of small bubbles and big bubbles in the cross section of a specimen made by hand mixing, while there was difficult to find bubble in the cross section of a specimen made by vacuum mixer and hand & vacuum investing, but it couldn't be said that there was no bubble. In addition in the specimen that was added water to 20%, there were more small bubbles than those in the specimen that was made with the normal water mixing ratio.

Testing hypothesis of the difference between groups in the setting extension amount for a dental High-strength stones is as Table 2.

As the result of analysis, there was a significant difference between the specimen made by hand mixing 20/200 and the specimen made by hand mixing 24/100.

Table 2: Testing Hypothesis of the Difference between Groups in the Setting Expansion Amount for a Dental High-Strength Stones

Group		mean difference	average error	p	confidence interval 95%	
					lower value	higher value
HAND MIXING 20/100	HAND MIXING 24/100	.01751*	.004379	.006	.00398	.03105
	VACUUM MIXER 20/100	.01091	.004379	.166	-.00262	.02445
	VACUUM MIXER 24/100	.00974	.004379	.263	-.00380	.02328
	HAND+VACUUM 20/100	.01120	.004379	.147	-.00234	.02474
	HAND+VACUUM 24/100	.01291	.004379	.068	-.00062	.02645
HAND MIXING 24/100	HAND MIXING 20/100	-.01751*	.004379	.006	-.03105	-.00398
	VACUUM MIXER 20/100	-.00660	.004379	.663	-.02014	.00694
	VACUUM MIXER 24/100	-.00777	.004379	.499	-.02131	.00577
	HAND+VACUUM 20/100	-.00631	.004379	.702	-.01985	.00722
	HAND+VACUUM 24/100	-.00460	.004379	.896	-.01814	.00894
VACUUM MIXER 20/100	HAND MIXING 20/100	-.01091	.004379	.166	-.02445	.00262
	HAND MIXING 24/100	.00660	.004379	.663	-.00694	.02014
	VACUUM MIXER 24/100	-.00117	.004379	1.000	-.01471	.01237
	HAND+VACUUM 20/100	.00029	.004379	1.000	-.01325	.01382
	HAND+VACUUM 24/100	.00200	.004379	.997	-.01154	.01554
VACUUM MIXER 24/100	HAND MIXING 20/100	-.00974	.004379	.263	-.02328	.00380
	HAND MIXING 24/100	.00777	.004379	.499	-.00577	.02131
	VACUUM MIXER 20/100	.00117	.004379	1.000	-.01237	.01471
	HAND+VACUUM 20/100	.00146	.004379	.999	-.01208	.01500
	HAND+VACUUM 24/100	.00317	.004379	.977	-.01037	.01671
HAND+VACUUM 20/100	HAND MIXING 20/100	-.01120	.004379	.147	-.02474	.00234
	HAND MIXING 24/100	.00631	.004379	.702	-.00722	.01985
	VACUUM MIXER 20/100	-.00029	.004379	1.000	-.01382	.01325
	VACUUM MIXER 24/100	-.00146	.004379	.999	-.01500	.01208
	HAND+VACUUM 24/100	.00171	.004379	.999	-.01182	.01525
HAND+VACUUM 24/100	HAND MIXING 20/100	-.01291	.004379	.068	-.02645	.00062
	HAND MIXING 24/100	.00460	.004379	.896	-.00894	.01814
	VACUUM MIXER 20/100	-.00200	.004379	.997	-.01554	.01154
	VACUUM MIXER 24/100	-.00317	.004379	.977	-.01671	.01037
	HAND+VACCUM 20/100	-.00171	.004379	.999	-.01525	.01182

High-strength gypsum at half-hour intervals every 30min, 60min, 90min, 120min, 150min, 180min for 24 hours, and there was a significant difference in the setting expansion amount for a dental High-strength stones depending on an interaction between time and group ($p < 0.05$) in table 3.

Table 3: Multivariate Testing Between Time and Group for the Setting Expansion Amount of a Dental High-Strength Stones

effectiveness		value	F	degree of hypothesis freedom	degree of error freedom	Significance probability
time	Trace of Pillai	.986	224.097	6.000	19.000	.000
	Lamda of Wilks	.014	224.097	6.000	19.000	.000
	Trace of Hotelling	70.768	224.097	6.000	19.000	.000
	the maximum radical of Roy	70.768	224.097	6.000	19.000	.000
time* Group	Trace of Pillai	1.603	1.809	30.000	115.000	.014
	Lamda of Wilks	.087	2.183	30.000	78.000	.003
	Trace of Hotelling	4.323	2.508	30.000	87.000	.000
	the maximum radical of Roy	2.960	11.347	6.000	23.000	.000

IV. CONCLUSION

A dental cast has a demerits which it could be broken often during the prosthesis production process. We used Genus (H. M Korea) as High-strength gypsum for test: we used several way to make a specimen, for example, by hand mixing (N=5), second, after mixing by a vacuum mixer (N=5), third, eliminating bubble from a vacuum investing machine after mixing (N=5), forth, under the same condition, adding the water mixing ratio to 20%, thus we made total 30 specimens of 5 dental High-strength stoness with the identical size.

We inserted High-strength gypsum into a mold with identical size, which it is possible to measure the setting expansion, and measured every specimen every 30 minutes until 180minutes for 24hours, thus we made a graph for the setting extension ratio and the average depending on the production method for every specimen, finally we compared the difference in the setting expansions for a dental High-strength stones. For measurement path of the setting expansion, we used No. 204654 from Mitutoyo Corporation, which was made in Japan.

We measured the surface condition of a specimen of a dental High-strength stones using a microscope mount optical camera (HT-004, HIMAX, TAIWAN) with 5.1M Pixels, after measuring the setting expansion of a dental High-strength stones that was made by 6 methods.

- 1) In the normal water mixing ratio, the setting extension was increased over time in all 3 methods, and it showed the similar value to the setting extension amount of the manufacturing company in HAND MIXING and HAND & VACUUM INVESTING, while it showed 0.075%, 0.025% lower than those of the manufacturing company, in VACUUM MIXER.
- 2) When we compared the specimen that was made with the normal water mixing ratio with one that was added water to 20% in a vacuum mixer and hand & vacuum, the setting expansion amount of the specimen that has higher water mixing ratio was reduced, but it was greatly insignificant.
- 3) As the result, there were a lot of small bubbles and big bobbles in the specimen made by hand mixing, while there was difficult to find bubble in the cross section of a specimen made by vacuum mixer and hand & vacuum investing, but it couldn't be said that there was no bubble.
- 4) As the result, there was a significant difference in the setting expansion amount for a dental Type-IV stones over time every 30min, 60min, 90min, 120min, 150min, 180min for 24hours, and there was a significant difference in the setting expansion amount for a dental Type-IV stones depending on an interaction between time and group ($p < 0.05$).

With the foundation of such results, at present in the service, we often work after setting a dental High-strength stones within 2~3hours, so that even if the detailed prosthetic components are made, it might happen to be eliminated often inner side of Crown while we put the detailed prosthetic components into peoples mouths, so when a dental technician should work after 24hours that is to be the maximum expansion amount which the manufacturing company suggests, the proper prothes is could be made¹². Even if it is uncomfortable, to use a vacuum mixer or a vacuum investing machine is the best practice to make an ideal cast¹³. So we think the further study would be needed for this for each manufacturing company of gypsum.

ACKNOWLEDGMENT

This dissertation research was conducted by the research assignment of Gimcheon University in 2016.

REFERENCES

- [1] Shim YS. Effect of In-office Bleaching Application on the Color, Microhardness and Surface Roughness of Five Esthetic Restorative Materials. *Indian Journal of Science and Technology*. 2015, 8 (S1), pp. 420-425.
- [2] American National Standards Institute/ American Dental Association. Specification 25 for dental gypsum products. 1990.
- [3] Duke P, Moore BK, Andres CJ. Study of the physical properties of type IV gypsum, resin-containing, and epoxy die materials. *J Prosthet Dent*. 2000, 83(4), pp. 466-73.
- [4] Woo HS, Kim SH. A Study on Applying a 3D Printer to Healthcare; Dentistry Area. *Indian Journal of Science and Technology*. 2016, 9 (20).
- [5] Brabant A, Grimonster J, Deschamps R, Van Biervliet L. Comparative study of 4 physical properties of 13 dental stones, "hard" and "extra hard". [In French] *CahProthese*. 1980, 8(32), pp.145-57.

- [6] Brukl CE, McConnell RM, Norling BK, Collard SM. Influence of gauging water composition on dental stone expansion and setting time. *J Prosthet Dent*, 1984, 51(2), pp.218-23.
- [7] Combe EC, Smith DC. Improved stones for the construction of models and dies. *J Dent Res*, 1982, 61(1), pp.808-10.
- [8] Fraunhofer JA, Spiers RR. Accelerated setting of dental stone. *J Prosthet Dent*, 1983, 49(6), pp. 859-60.
- [9] Harcourt JK, Lautenschlager EP. Accelerated and retarded dental plaster setting investigated by x-ray diffraction. *J Dent Res*, 1970, 49(3), pp.502-07.
- [10] Choi E, Han MS, Kwon EJ. Comparative Study on Tensile bond Strength between Heat curing Denture base Resin and Reline Materials. *Indian Journal of Science and Technology*. 2016, 9 (24).
- [11] Newman SM, Crowder JW, Nicholas CA. Gypsum die materials: Setting expansion & relative hardness. *J Tenn Dent Assoc*, 1985, 65(1), pp.35-7.
- [12] Peyton FA, Leibold JP, Ridgley GV. Surface hardness, compressive strength, and abrasion resistance of indirect die stones. *J Prosthet Dent*, 1952, 2(3), pp.381-89.
- [13] Yen TW, Collard SM, King GE. The effects of hollow microsphere fillers on density and impact strength of denture base resins. *J Prosthet Dent*, 1991, 65(1), pp.147-52.
- [14] Shen C, Mohammed H, Kamar A. Effect of K₂SO₄ and CaSO₄ Dihydrate solutions on crystallization and strength of gypsum. *J Dent Res*, 1981, 60(8), pp.1410-17.



ISSN
0975-6299

Study on Effectiveness of Auxiliary Device for Examining Cubital Tunnel Syndrome

Sun-Youl Seo, Department of Radiology, Eulji University, Seongnam, Korea. E-mail:atom@eulji.ac.kr

Man-Seok Han*, Department of Radiology, Kangwon National University, Samcheok, 245-905, Korea.
E-mail:angio7896@naver.com

Yong-Kyun Kim, Department of Radiotechnology, Daewon University, Jecheon, South Korea.
E-mail:kimy66@hanmail.net

Jae-Uk Jang, Dept. of Health Medical Science, Graduate School Kangwon National University Samcheok, Korea, Dept. of Radiation Oncology, Chungnam National University Hospital, Daejeon, Korea. E-mail:linac@cnu.ac.kr

Gab-Jung Kim, Songho College 210, Namsan-ro, Namsan-ri, Hoengseong-gun, Gangwon-do, Republic of Korea.
E-mail:kim69gj@hanmail.net

Woo-Jin Jeon, Department of Radio Technology, National Police Medical Center, Seoul, Korea. E-mail:griffice@gmail.com

Abstract---

Purpose: This study is to fabricate an assistance device that keeps external angle of forearm at 20 degrees in order to evaluate usabilities of assistance devices.

Methods: The study was conducted from 30 males and females. The examination device used for this study were Discovery XR656(GE Healthcare, Kemath, Germany) DR and SOMATOM definition AS+ CT(Computed Tomography). The device was made of foamex (foam PVC). The posture for cubital tunnel view examination requires for patients to bend their elbows more than 60 degrees and turn their forearms 20 degrees externally. The analysis method of cubital tunnel depth(CTD) was to measure the length between the deepest location of groove for ulnar nerve and a line vertical to the line connecting protruding part of medial epicondyle and trochlea medial in order to measure the CTD with and without the assistance device. CTD were measured and compared from VRT images on CT examination of 30 males and females to prove the usability of the assistance device. For statistics, SPSS 18.0 version was used to conduct independent two samples t-test.

Findings: Differences in CTD between the two sexes were nonexistent but, the differences in CTD according to the use of assistance device were 4.63 ± 0.86 mm in temporizing measure, and 6.01 ± 0.27 mm with the assistance device for male. For females, the results were 4.58 ± 0.41 mm in temporizing measure and 5.94 ± 0.58 mm with the assistance device. The results proved that the measured values of CTD are deeper with the use of assistance device. The difference between CTD value from CT of normal person and CTD level measured with X-ray using the assistance device were non existent $P > 0.05$.

Improvements: Use of an assistance device made more accurate and convenient examinations possible compared to examinations without any assistance devices. Use of the assistance device in this study in radiological examinations on Cubital Tunnel Syndrome would provide more accurate and convenient examinations in the future.

Keyword--- Cubital Tunnel Syndrome, Cubital Tunnel Depth, Examination Assistance Device, CT, X-Ray.

* Corresponding Author

I. INTRODUCTION

According to studies conducted in the 1990s, there has been a surprisingly sharp increase in conditions such as carpal tunnel syndrome, cubital tunnel syndrome, thoracic outlet syndrome, and repetitive motion injuries (RMI) such as golfer elbow or tennis elbow, make up to 25% of work-related injuries in the United States^{1,2,3}.

Among these, patients suffering from cubital tunnel syndrome have been increasing in recent years, mainly due to the rise of modern-day occupations that require frequent wrist-bending movement, increased smartphone usage, and their lifestyles. Cubital tunnel syndrome is a disease caused by the lack of blood supply to nerves as the nerves and blood vessels get compressed when bending the arms⁴.

Its symptoms include sensory abnormalities on the fourth and/or the fifth finger and muscle weakness. Almost all reported cases have precedent inducing factors, which can be any of the following factors: nerves under compression due to a narrowed cubital tunnel for whatever reason,^{5,6} nerves under continued tension, nerves under friction due to recurring dislocation or incomplete dislocation,⁷ or ulnar nerve under compression near the elbow joint due to a specific structure^{8,9,10}.

General X-ray inspection as well as diagnostic imaging techniques such as ultrasound, CT, or MRI can be used to diagnose cubital tunnel syndrome. However, ultrasound depends substantially on the technician's diagnostic ability, and CT or MRI is rarely used because of its relatively high cost and long hours. In¹¹ Cubital tunnel view is generally performed as a radioactive image test to examine cubital tunnel.

The cubital tunnel view test is designed to have a frontal view of the ulnar groove when imaged from anterior-posterior view after complete bending of the elbow joint followed by 20° external rotation of the forearm, such that it vertically sees the medial trochlea, and its relationship to the medial epicondyle is well shown. In¹² X-ray can be deployed in various fields of group diagnostic imaging; however, X-ray inspection shows different images depending on the patient's posture and the incident angle of the X-ray, which makes it largely dependent on the radiologist's expertise. Therefore, examination using X-ray can employ auxiliary examination device to reduce its dependency on the radiologists' capabilities and increase its accuracy, repeatability, and patient convenience. Based on the precedent studies on radiological analysis of cubital tunnel, In¹² this study designed an axillary device to minimize dependency of radiological analysis for cubital tunnel on radiologists' competency and evaluates the feasibility of the device while examining the cubital tunnel syndrome.

II. SUBJECTS AND METHODS

A. Subjects

The subjects of the experiment were voluntary participants who agreed to the purpose of this study, and the experiment was conducted at N general hospital in Seoul.

The average age of 30 male participants was 25.33±1.30 years old, and that of 30 female participants was 21.50±0.54, which makes the average age of all subjects 23.80±2.19 years.

In the CT-scan comparison group, the average age of the 30 male participants was 40.85 years old, and that of the 30 females was 45.57, which makes the average age of all subjects 43.21 years.

B. Devices

The medical device used for the examination was Discovery XR656 (GE Healthcare, Kemnath, Germany) DR equipment shown as it. [Fig. 1] and SOMATOM definition AS+ CT equipment, along with the auxiliary device. The auxiliary device consists of a V-shaped arm support with a slope of 20° to maintain the arm angle and the handle, which is adjustable as per the arm length. The material used here is Foamex (PVC foam sheet), which allows transmission of X-rays, is lightweight, and can be manufactured with a density of 0.35–0.9 g/cm³ shown as it. [Fig. 2,3].

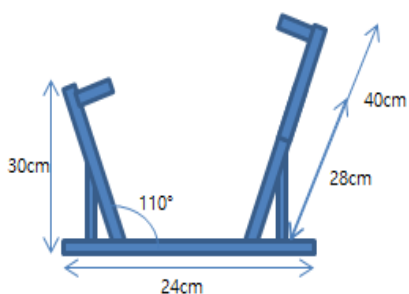
The test was performed once using the auxiliary device and once without using the device, both under the same conditions of 53 kVp, 10 mA, and auto-exposure control.



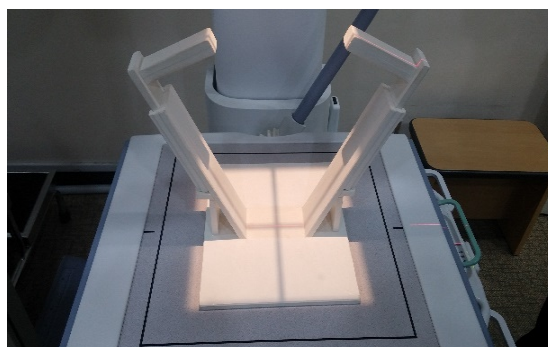
Figure 1: DR X-ray System



Figure 2: CT Scanner



a) Design Assistance device



b) Assistance device the actual

Figure 3: Assistance device for Inspection of Material FOAMEX (foam PVC)

C. Methods

The existing temporizing examination method and the method employing the auxiliary device were used for the test, and the basic posture involves the elbow bent at an angle more than 60° and the arm externally tilted at an angle of 20° shown as it.[Fig. 4,5].CT scan was also performed to obtain accurate physiological information.



Figure 4: Conventional Method



Figure 5: Method with Assistance Device

D. Assessment

The measured cubital tunnel depth (CTD) is the shortest vertical distance from the deepest point in the ulnar nerve groove to the line that connects the highest protruding point in medial trochlear and medial epicondyle, using pi-view (Infinit, Korea) shows it.[Fig. 6].

3D CT scan images extracted through the VRT technique using syn CT 2011A were compared, and the CTD from the extracted 3D images was also measured shows it.[Fig. 7]

Descriptive statistics were used for the test subjects, and an independent two-sample t-test was performed while using the auxiliary device for CTD measurement, while not using the auxiliary device, and for the CT scan, respectively. SPSS 18.0 (SPSS, Chicago, USA) was used for data processing.

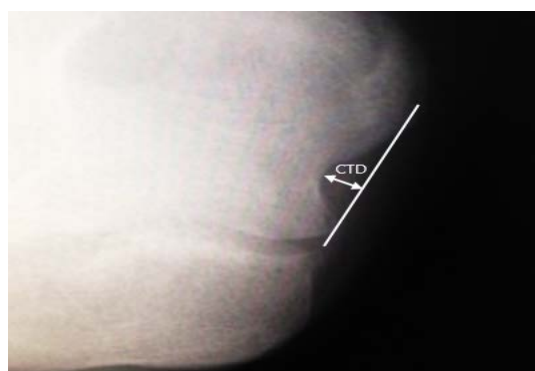


Figure 6: Cubital Tunnel Depth Measured from X-ray



Figure 7: Cubital Tunnel Depth Measured from CT

III. RESULTS

The results shows if there is any difference in the measured CTD depending on the gender. The average CTD of males was 4.63 ± 0.86 mm and that of females was 4.58 ± 0.41 mm when using the temporizing method. On the other hand, the average CTD of males was 6.01 ± 0.27 mm and that of females was 5.94 ± 0.58 mm when using the auxiliary device. No significant difference in the CTD depending on the gender ($p > 0.05$) as shown asit was noted.[Table 1].

Table 1: Cubital Tunnel Depth Analysis According to Gender N=60

Classification	Gender	CTD(mm)	<i>p</i>
Conventional	M	4.63 ± 0.86	0.06
	F	4.58 ± 0.41	
With Assistance device	M	6.01 ± 0.27	0.82
	F	5.94 ± 0.58	

The study also shows if there is any difference in the measured CTD depending on the test method. In male subjects, an average CTD of 4.63 ± 0.86 mm was measured when using the temporizing method and 6.01 ± 0.27 mm when using the auxiliary device. In females, an average CTD of 4.58 ± 0.41 mm was measured when using the temporizing method and 5.94 ± 0.58 mm when using the auxiliary device; the measured CTD was significantly deeper when using the auxiliary device($p < 0.05$) showsit. [Table 2].

Table 2: Cubital Tunnel Depth Analysis of the Test Method N=60

Gender	Classification	CTD(mm)	<i>p</i>
M	Conventional	4.63 ± 0.86	0.01
	With Assistance device	6.01 ± 0.27	
F	Conventional	4.58 ± 0.41	<0.01
	With Assistance device	5.94 ± 0.58	

For normal people, there was no difference between the CTD measured by CT scan and the CTD measured by X-ray aided by the tool ($P > 0.05$) showsit.[Table 3].

Table 3: Comparison of CTD Average between X-Ray and CT by using toolN=60

Gender	Classification	CTD(mm)	<i>p</i>
M	CT	6.17 ± 0.86	0.556
	X-ray (With Assistance device)	6.01 ± 0.27	
F	CT	5.56 ± 0.63	0.190
	X-ray (With Assistance device)	5.94 ± 0.58	

IV. DISCUSSION

Cubital tunnel is a tunnel between the medial epicondyle and olecranon, where the fibers of flexor carpi ulnaris origins in the ulnar groove of the posterioepicondyle is partially covered⁷. Cubital tunnel syndrome is a disease when the nerves get compressed due to the change in the bone structure of this cubital tunnel. To secure the frontal view of the ulnar groove to examine the cubital tunnel syndrome, the cubital tunnel view test is performed to objectively evaluate the shape of the bone structure that composes the cubital tunnel using the cubital tunnel angle and CTD¹². And the development of a new diagnostic test kit for knee ligament injury and an evaluation of its efficacy. It is considered useful as a new supplementary device¹³.

Moreover, when compared to the temporizing method without the auxiliary device, there was a statistically significant difference in the depth for both males and females, resulting in deeper CTD measurement when using the auxiliary device for both males and females. In addition, the CTD measured while using the auxiliary device in this study and the CTD measured from the CT images were not significantly different ($P > 0.05$). Based on this, it is believed that the test using the auxiliary device reveals the anatomical shape of the cubital tunnel closest to its original shape.

Based on these study results, the existing cubital tunnel view test, which largely depends on the radiologist's ability, can be potentially improved by using the designed auxiliary device when fixed at an external angle of 20°, as described above. It can obtain a CTD image closer to its original shape, increase posture stability and patient convenience, and minimize dependency on the radiologist's diagnostic ability.

One limitation of this study is that the participants' age and weight could not be compared due to the limited number of non-patient participants. Besides, the 30 male and 30 female participants for the feasibility test of the auxiliary device and the 30 male and 30 female participants for the CT images were not the same group of people. Owing to the nature of this study, different subjects were examined for the CT scan. The comparison was performed based on the central limit theorem, which states that the number of samples provides an approximate mean value. Comparison of more subjects would further reduce the error.

To overcome these limitations, it is necessary to conduct a survey of a larger group in the future, and studies for confirming abnormal pathology using pathological comparison.

V. CONCLUSION

This study evaluates the effectiveness of the auxiliary device for radiological examination of the cubital tunnel syndrome. The results indicated that a more accurate test can be possible when using the auxiliary device compared to when not using the device. Based on this, if the auxiliary device used in this study can be utilized for radiological examination of the cubital tunnel syndrome in future, a more accurate test can be made possible.

REFERENCES

- [1] Della BJ. Claims incidence of work-related disorders of the upper extremities, Washington State. *Am J Ind Med*, 1998, 25: 245-251
- [2] Gordon NK. Epidemiology of musculoskeletal disorders due to biochemical overload. *Ergonomics*. 1998, 41: 1253-1260
- [3] Robertson CS. Prevalence and predictors of long term work disability due to carpal tunnel syndrome. *Am J Ind*, 1998, 33: 543-550
- [4] HK Kwon, HJ Lee, SK Yim, MS Hahn, BJ Cho, SR Lee. Anatomical Evaluation of Ulnar Nerve according to the Elbow Position. *Korea Medical Citation Index*. 2001, 25, pp. 2
- [5] Kanazawa S, Fujioka H, Kanatani T, Tsunoda M, Saura R, Mizuno K. The relation between cubital tunnel syndrome and the elbow alignment. *Kobe Journal of Medical Sciences*. 1994, 40(5-6), pp. 155-63
- [6] Grana W. Medial epicondylitis and cubital tunnel syndrome in the throwing athlete. *Clin Sports*, 2001, 20(3), pp. 541-8
- [7] JS Yoon, SJ Kim, YH Kim. Ultrasonographic Findings of Ulnar Nerve in the Cubital Tunnel Syndrome. *Korean academy of rehabilitation medicine*. 2002, 26(2), pp. 167-171
- [8] Bozentka DJ. Cubital tunnel syndrome pathophysiology. *Clin Orthop Relat Res*. 1998, 351, pp. 90-4
- [9] Lowe JB, 3rd, Novak CB, Mackinnon SE. Current approach to cubital tunnel syndrome. *Neurosurg Clin* (Amst), 2001, 12(2), 267-84.

- [10] Kleinman WB. Cubital tunnel syndrome. anterior transposition as a logical approach. 2016. DOI: 10.1053/jhsu.1999.0886
- [11] CH Kim, MJ Lee, MS Kang, Ultrasonography of the Elbow Joint. J Korea Orthop US Soc, 2012,1, pp.123-129.
- [12] SH Kim, MS Chung, GH Baek, Radiological Analysis of the Cubital Tunnel. The Journal of the Korean Society for Surgery of the Hand. 2006.
- [13] SY Seo, MS Han, SJ Yoo, MC Jeon, HK Lee, DK Han, IM Yang and GJ Kim. Development of a New Diagnostic Test Kit for Knee Ligament Injury and an Evaluation of its Efficacy. Indian Journal of Science and Technology, 2015 April; Vol 8(S8), 350–355,



ISSN
0975-6299

A Study on Usability of the Shielding Clothing Bismuth During Mammography

Sun-Youl Seo, Dept. of Radiology, Eulji University, Seongnam, Korea. E-mail:atom@eulji.ac.kr

Man-Seok Han*, Department of Radiology, Kangwon National University, Samcheok, Korea. E-mail:angio7896@naver.com

Se-Jong Yoo, Department of Diagnostic Radiology, Konyang University Hospital, Daejeon, Korea.
E-mail:yysj016@hanmail.net

Min-Cheol Jeon, Department of Radiological Technology, Daejeon Health Institute of Technology, Daejeon, Korea.
E-mail:99jmc@daum.net

Hyun-Kuk Lee, Department of Radiology, Eulji University Hospital, Daejeon, Korea. E-mail:lhk@eulji.ac.kr

Su-Jeong Yu, Department of Radiology, The Catholic University of ST. Mary's Hospital Korea Seoul.
E-mail:yangpa518@naver.com

Abstract---

Background /Objectives: this study is to produce a new shielding gear more efficient than pre-existing lead shielding using dose reducing fiber developed with bismuth trioxide from Buffalo, and study its adaptability.

Methods: mammography was conducted with LoradSelenia from HOLOGIC. The phantoms used were Female rando phantom from THE PHANTOM LABORATORY and ACR phantom from GAMMEX RMI. The dosimeters used were the glass dosimeter reader FDG1000 and PLD from CHIYODA TECHNOL. The shielding used to compare and determine the amount of scattered ray in this study were lead shielding gear with a thickness(an equivalent) of 0.25mm from INFAB and a customized bismuth shielding with a thickness of 0.2mm(2 layers of 0.1mm). The conditions were 28kVp, 65mAs for CC view and 30kVp, 85mAs for MLO view. The exposure dose by scattered ray were measured from thyroid, breast on the opposite side and gonad (hereafter called critical organs) without any shieldings for the first experiment, then measured four times each with lead shielding for the next experiment, and measured four times each with bismuth shielding for the third experiment.

Findings: The average dose for each critical organ without shieldings were 985.66 μ Gy, 573.00 μ Gy, with lead shielding, the numbers were 5.66 μ Gy, 4.66 μ Gy, and 31.66 μ Gy, 34,00 μ Gy, with bismuth shielding. Therefore, the lead and bismuth shielding have reduced 99.18% and 94.06% of exposure dose.

Improvements: The new shielding using bismuth is useful in shielding thyroid and gonad considering the mobility of the patient, light weight and thickness of the shielding.

Keywords--- Lead Shielding, Bismuth Shielding, Thyroid, Breast, Gonad, Scattered Ray.

* Corresponding Author

Special Issue on "Medical Science"

I. INTRODUCTION

It is estimated that 16 million new cancer cases will be diagnosed in North America in 2020; this represents a 50% increase in the number of cases from 2002. It is also estimated that 10.3 million patients will die of cancer in the same year¹. In the US, the medical radiation exposure dose per person increased by approximately 5.7 fold: from 0.53 mSv in the early 1980s to 3.0 mSv in 2006². It is speculated that South Korea has the third highest number of computed tomography (CT) instruments among all countries in the Organization for Economic Co-Operation and Development (OECD)^{3,4}. This indicates that people in South Korea are at greater risk of exposure to medical radiation compared with people in other countries. While cancer is caused by genetic and environmental factors, as well as lifestyle habits, radiation is also considered cancer-causing entity. Ionizing radiation is used to treat cancer issues, but it can also affect normal organs in the proximity. According to a report by the International Commission on Radiological Protection (ICRP 103), the weight values for the thyroid gland, gonads, and breasts (hereafter referred to as critical organs) are set relatively higher compared with those for other organs in imaging procedures that use radiation. At present, only the thyroid gland is protected by lead shielding during mammography in medical institutions; however, it is of the highest importance that all critical organs be protected during mammography⁵. Although lead demonstrates desirable machinability and can be cut into a thin sheet, its rate of use is low because of its heavy weight. Furthermore, it is not possible to use separate lead shields for each breast. In addition, for mammography, patients must face the radiologic technologists without clothes on their upper body, and without underwear, this can result in feelings of shame. Additionally, the low temperature in the exam room required by the DR (digital mammography) system can compromise the patient's immune system.

At present, in medical institutions, lead is no longer used to shield against scattered X-rays in mammography due to its inefficiency. In order to improve shielding, we constructed a bismuth trioxide-mixed shield. In the present study, the ability of this new shield to protect the critical organs under mammography was compared against the ability of lead shielding. Accordingly, this study aimed to investigate the shielding effect and utility of the bismuth trioxide-mixed shield in protecting against scattered X-rays from medical radiation^{6,7} and to determine if it could replace lead shielding in mammography.

II. SUBJECTS AND METHODS

A. Equipment

In the present study, a Lorad Selenia unit (HOLOGIC) was used for mammography [Fig. 1]. A female RANDO phantom (THE PHANTOM LABORATORY) and ACR phantom (GAMMEX RMI Inc.) were used as phantoms [Fig. 2, 3]. A molybdenum filter was used for mammography, and a molybdenum target was used for filtration. Dose was measured using a photoluminescence dosimeter (PLD) and an FDG1000 reader (CHIYODA TECHNOL Co.) [Fig. 4]. Surface doses were measured using 0.25-mm lead shielding (INFAB Co.) and 0.2-mm bismuth shielding material fabricated with bismuth from Buffalo Co. [Fig. 5, 6].



Figure 1: HOLOGIC loradSelenia



Figure 2: The Phantom Laboratory Female Rando Phantom



Figure 3: Gammex RMI ACR Phantom



Figure 4: Chiyoda Technol PLD



Figure 5: Apron(INFAB 0.25mmpb)



Figure 6: Shielding Clothing(0.2mm bismuth).

B. Experimental Methods

The new bismuth-based shielding was constructed by taking into account the mean height of Korean women (160 cm). Both convenience of use and patient privacy were considered in its design. This shield was lighter than the existing lead apron and shielded the breast on the unexamined side [Fig. 6].

The lead shielding that had been previously used in clinical practice and the bismuth shielding fabricated in this study were compared by calculating the surface and shielded dose weights of the phantoms. Three PLDs were attached to the thyroid gland, the breast on the unexamined side, and the gonads, respectively, by using an ACR Phantomcom pressed to 4.5 cm and a female RANDO phantom. Imaging was performed on the upper and lower parts of the breasts (cranial caudal [CC] view, 28kVp, 65mAs) and esophoria (mediolateral-oblique [MLO] view, 30kVp, 85mAs) with no shielding, with lead shielding, and with the bismuth shielding. During mammography, patients undergo a total of four imaging procedures, to generate two CC view and two MLO view images. To examine the patients in this study under the same conditions, PLDs were attached to the thyroid gland and the breast on the unexamined side to emulate the cumulative exposure dose that patients would receive during an actual imaging procedure. Therefore, the dose that a PLD at a particular position received comprised the cumulative surface dose from two CC view and two MLO view images.

Before measuring the exposure dose, the pre-value was measured by resetting the glass dosimeter, and the post-value was obtained after exposure to radiation. The Exp. Value was calculated as follows: post-value – pre-value = Exp. Value. Natural background radiation was also measured with a glass dosimeter without exposure to radiation; this value was subtracted from the Exp. Value, to generate the true value. This was considered the critical organ dose for each condition.

III. RESULTS

A. Weight of the Shielding

The lead and bismuth shields weighed 3,200 g and 600 g, respectively.

B. Exposure Doses Without Shielding

The exposure doses were 689 μ Gy, 706 μ Gy and 662 μ Gy (mean dose 685.66 μ Gy) for the thyroid gland and 590 μ Gy, 448 μ Gy and 681 μ Gy (mean dose 573 μ Gy) for the breast on the unexamined side.

In summary, when shielding was not used, the doses to the thyroid gland were higher compared with those to the breast on the unexamined side [Table 1].

Table 1: Dose Value of with and Without Protection (μ Gy)

	Thyroid	Breast
without protection	685.66	573.00
Lead	5.66	4.66
Bismuth	31.33	34.00

C. Exposure Doses with the Lead Shielding

The exposure doses were 5 μ Gy, 6 μ Gy and 6 μ Gy (mean dose 5.66 μ Gy) for the thyroid gland and 5 μ Gy, 6 μ Gy and 3 μ Gy (mean dose 4.66 μ Gy) for the breast on the unexamined side [Table 1].

3.4. Exposure doses with the fabricated bismuth shielding

The exposure doses were 15 μ Gy, 39 μ Gy and 40 μ Gy (mean dose 31.33 μ Gy) for the thyroid gland and 36 μ Gy, 32 μ Gy and 34 μ Gy (mean dose 34.00 μ Gy) for the breast on the unexamined side [Table 1].

IV. DISCUSSION

While the incidence rate of breast cancer in South Korea is relatively lower than that of Western countries^{8,9}, there has been a rapid increase in the number of mammography procedures performed. As a result, anxiety regarding the risk of radiation exposure to patients and guardians during examination has also increased. As it is unavoidable that the patients are exposed to medical radiation, interest in shielding that protects them from this exposure during examination and its significance has grown¹⁰. In the present study, we successfully fabricated bismuth shield, which was then compared with the traditional lead shield. The thickness of the lead shielding (INFAB Co.) was 0.25 mm, whereas the thickness of the fabricated bismuth shielding, which used bismuth from Buffalo Co., was 0.2mm. Therefore, further experiments with shields of equivalent thickness are needed. These further experiments may indicate more accurate shielding effects.

In these experiments, the gonads were excluded, because the detector and the supporting uncovered gonad received very low doses, both before and after shielding.

Although the lead shielding had a higher shielding effect than the bismuth shielding, the difference in dose to the breast on the unexamined side between the two shields was as little as 2.67 μ Gy. Therefore, it was determined that there was no difference in the practical shielding rate between the lead shielding and the bismuth shielding.

V. CONCLUSION

Radiation doses to the breast during mammography were compared on the unexamined side before and after shielding. The lead shielding and the bismuth shielding blocked 99.18% and 94.06% of radiation,

respectively For the breast on the unexamined side, although the shielding rate of the lead shield was higher than that of the bismuth shielding (5.12%), the bismuth shielding (600 g) was approximately 5.3-fold lighter than the lead shielding (3,200g). This allowed much greater movement of the patients and was associated with less repulsion; therefore, it was determined that this new shielding has utility in protecting the thyroid gland and the breast on the unexamined side during mammography

REFERENCES

- [1] SJ Yoo, CS Lim, KR Sim, A study on performance evaluation of Apron by shielding rate and uniformity, J. Korea Saf. Manag. Sci. 2005, 17(1): 103-109
- [2] David A. Schauer, ScD, CHP Otha W. Linton, and MSJ, National Council on Radiation Protection and Measurements Report Shows Substantial Medical Exposure Increase. Radiological Society of North America, Radiology, 2009, 253(2), <<http://radiology.rsna.org/content/253/2/293.full.pdf+html>>
- [3] Whal Lee, Current status of medical radiation exposure and regulation efforts, J. of Korean Medical Assoc; 2011, 54(12): 1248-1252
- [4] SH Kim, YJ Kim, JS Kwak, Development and Radiation Shield effects of Dose Reduction Fiber for Scatter ray in CT Exams, Journal of the Korea Academia- Industrial cooperation Society, 2013, 14(4): 1871-1876
- [5] ICRP, Recommendations of the International Commission on Radiological Protection. Publication 103, Annals of the ICRP, 2007, 137(2-4), Pergamon Press, Oxford
- [6] SJ Yoo, MS Han et al., The Analysis of Exposure Dose Related Factors in Abdominal CT of General Hospitals in Daejeon Area. Indian Journal of Science and Technology, 2015, Vol 8(S1), 492-496.
- [7] SJ Yoo, MS Han et al., Dose assessment in according with the Source to Image receptor Distance (SID) from Digital Chest Radiography. Indian Journal of Science and Technology, 2015, Vol 0, 148-151.
- [8] Kelsey JL "Gammon MD/Epidemiology of breast cancer, Epidemiol Rev 1990, 12:228~40
- [9] Jeongeun Ra, W.S Suh, D.O. Shin et al., Determination of out factors for the Gamma-knife using a Photoluminescence Glass Rod Detector. Medical physics 2007, 18(1), 1226-5829.
- [10] CG. Kim, Measurement dose of dental panoramagraphy using a radiophotoluminescent Glass Rod Detector, The Korea Academia Industrial cooperation journal 2011, 12(6), pp. 2624~2628.



ISSN
0975-6299

A Study on the Ultra Structure of Actinomycosis in Women with IUDs

Mi-Soon Park, Dept. of Pathology, Korea Clinical Laboratory, Seoul, Korea. E-mail:kimpark42000@naver.com
Mi-Hwa Lee, Dept. of Radiology, Kyung-Hee University Hospital, Gang-Dong, Seoul, Korea. E-mail:rjqrndl113@hanmail.net

Byoung-Soo Chang*, Professor, Dept. of Cosmetology, Hanseo University, Chung-nam, Korea.
E-mail:bschang@hanseo.ac.kr

Abstract---

Background/Objectives: To investigate the structure of biofilm and the micro-structural characteristics of anaerobic Gram-positive actinomyces by vaginal examination and microscopic analysis of the secretions from infected patients.

Methods/Statistical analysis: The presence or absence of sulfur granules produced by these bacteria were analyzed using energy dispersive X-ray spectroscopy (INCA, Oxford Ins, UK), and clinical specimens from the patients infected with actinomyces were collected for analysis via scanning electron microscopy (SEM).

Findings: From high resolution scanning electron microscopy (SEM), the surface of hypha-formed biofilm was covered with a substance secreted by the bacteria, and hexagonal sulfur granules were scattered around the mycelium. The formation of the porous biofilm is believed to create the best conditions for bacterial growth and proliferation in the anaerobic state. Granules of 100 - 150 nm in size were observed, and the components were measured by energy dispersive X-ray spectroscopy (EDX). Vaginal smear specimens of squamous intraepithelial cells were observed through optical, electronic, and transmission electron microscopy, and the bacteria were shown to produce an electrolyte salt. The most common of the bacteria is parasitic in the host, and creates major growth of a biofilm that maintains a persistent infection.

Improvements/Applications: Ecosystems of the vagina are affected by a number of different types of microorganisms, pH, and concentration of sugar. These ecosystems can also be affected by hormonal changes, medications, douches, and frequency of sexual intercourse. Thus, it is considered that one should maintain personal hygiene such that the vaginal pH stays slightly acidic, and one should use vaginal cleaning agents with special care, since frequent use is considered to cause hypersensitivity reactions, total destruction of normal bacteria, and a lowering of the vaginal pH.

Keywords--- SEM, TEM, Actinomycosis, Sulfur Granules, Bacterial Vaginosis.

* Corresponding Author

I. INTRODUCTION

Actinomyces belongs to Actinomycetales and grows in diverse directions. It is a non-acid fast anaerobic bacterium that shows PAS(Periodic Acid-Schiff)- and Gram-positive reactions¹. Moreover, this bacterium is opportunistic, existing in the oral cavity and pharynx, ileocaecal, and appendix as filaments with no formation of spores². Actinomyces are the most widely spread mycetoma among the existing bacteria, and are classified according to the arrangement of growing hypha and spores and the structural features of the shape and surface of spores. The bacterium that causes Actinomycosis was identified in the late 19th century, and *actinomyces israelii* has since been shown to be the major pathogen that infects humans. *Actinomyces israelii* is the most common subtype causing disease of the human body and coexists in an anaerobic state in the oral cavity, pharynx, tonsils, gastrointestinal tract, and reproductive system³. Traditionally, actinomycosis appears as a result of an infection in the female reproductive system, and has been shown to be derived from the gastrointestinal system. However, recent actinomycosis in the reproductive system is related to women who use an intrauterine device(IUD)⁴, with 20% of infected woman using such a device. Among infected patients, more than 25% show pelvic infection⁵. Actinomycosis is a chronic suppurative bacterial infection, which was one of the most common diseases prior to the development of antibiotics, however it rarely occurs now. It appears in the head and neck and spreads through the blood stream or tissue directly, causing swelling in the soft tissue of the head, face, and neck, and appears in the chest, lungs, and chest wall. In smear samples of woman with an intrauterine device (IUD), microorganisms similar to actinomyces are commonly found⁶.

II. LITERATURE REVIEW

For approximately 7% of the women with an intrauterine device(IUD), *Actinomyces spp.* appears in smearspecimens⁷. In addition, women who wear the device for a long period of time show infection of the pelvis⁸. Actinomyces infections in the female genital organs are increasing through contact with the perineum, uterine cervix, oral cavity, or anus^{9,10}. This study aimed to investigate the structure of the biofilm and micro-structural characteristics of the bacteria that form as a result of actinomyces in the reproductive organs of women via vaginal examination and visualization of the secretions of actinomycosis using a light microscope. We also aimed to analyze the presence or absence of sulfur granules produced by these bacteria using an energy dispersion spectrum analyzer(EDX).

III. PROPOSED WORK

Materials were selected targeting vaginal examination and the analysis of the vaginal secretions of inflammatory disease patients who had an intrauterine contraceptive device(IUD) for more than one year, and who presented with vaginitis and severe itching in H hospital. This study used clinical material from vaginal examination and secretions that had been confirmed to be infected with Actinomycetes diagnosis by pathology specialists. Patient consent was obtained prior to the test. This study was executed following deliberation approval from the Public Institution of Bioethics Council appointed by the Ministry of Health and welfare (project management number: P01-201405-BS-03).

A. Materials

We collected samples from five female patients who had been diagnosed with intrauterine inflammation and actinomycosis in hospital H, located in Seoul. This study protocol was approved by the Ethics Committee of the Public Health Institutional Review Board, designated by the Ministry of Health and Welfare in Korea.

B. Methods

The samples of epithelial cells were collected from the endocervix and vagina by rotating the Rovers brush™ in a clockwise direction five times, and were subsequently placed in a liquid cytology solution to prevent cell degeneration.

The foreign materials (mucous and RBC) in the speculum were removed by Cell prep®, and a single layer of the samples was smeared on a glass slide.

C. Papanicolaou Staining and Light Microscopy

To distinguish the Actinomycosis from the surrounding cells, the nuclei were stained with Harris hematoxylin solution and discolored using 0.5% hydrochloric acid (Young-Dong, Korea). The cytoplasm was also stained with Orange G-6 and EA-36 (Young-Dong, Korea). The samples were sealed using cover glass to prevent contamination, and actinomycosis was observed under a light microscope (BX51, Olympus, Japan).

D. Scanning Electron Microscopy (SEM)

Actinomycosis samples were pre-fixed and post-fixed in 2.5% paraformaldehyde-glutaraldehyde (4°C, phosphate buffer, pH 7.4) and 1% OsO₄ (4°C, phosphate buffer), respectively, for 2 hours. Fixed samples were washed with phosphate buffered solution (4°C, 0.4 M phosphate buffer, pH 7.4) several times, and then dehydrated in increasing concentrations of ethanol (70%, 80%, 90%, 95%, 100%), which was then substituted with isoamyl acetate. The processed samples were dried in a critical point dryer (Hitachi SCP- II, Japan) and coated with gold at a thickness of 20 nm using an ion coater (JFC-1100, Japan). The samples were observed using a scanning electron microscope (JSM-840 A, Hitachi, Japan) at 20kV.

E. Transmission Electron Microscopy (TEM)

Actinomycosis samples were fixed in 2.5% paraformaldehyde-glutaraldehyde (4°C, phosphate buffer, pH 7.4) for 1 hour, washed twice for 15 minutes with phosphate buffer (4°C, 0.4 M phosphate buffer, pH 7.4), and fixed again with 1% OsO₄ (4°C, phosphate buffer) for 1 hour. The fixed samples were washed twice with the same buffer solution and then dehydrated in increasing concentrations of ethanol, which was substituted with propylene oxide, and then they were embedded in Epon-Araldite solution. Polymerization was performed at 60°C in a vacuum drying oven (Yamato, Japan) for 36 hours. Semi-thin sections were cut from embedded samples using an ultramicrotome (Leica EM UC7, Germany), which were then stained with 1% toluidine blue (1% borax) on a hot plate (60°C) for 2 minutes. The stained sections were washed with distilled water and observed under a light microscope (Olympus CH30, Japan) from low to high magnification. To observe the microstructure of actinomycosis, an ultra-thin section was cut and attached to a copper grid, and then stained with uranyl acetate and lead citrate. This ultra-thin section was observed under a transmission electron microscope (H-7500, Hitachi, Japan) at 100 kV.

F. Energy dispersive spectroscopy (EDX)

Energy dispersive X-ray spectroscopy (INCA, Oxford Ins, UK) was used for the qualitative and quantitative analysis in the vaginal examination and clinical specimens diagnosed as actinomycosis, at an acceleration voltage of 15 kV using the same method as with the scanning electron microscope (SEM) observation.

IV. CONCLUSION

Optical microscopy of the specimens showed that actinomyces colonies were stained dark blue by hematoxylin dye, and many inflammatory cells were concentrated around them as like shown in "Figure 1." The edges of the hypha were observed as if they stick together, and thin radiation filaments appeared projecting from the tangled clump in the center as like shown in "Figure 2."

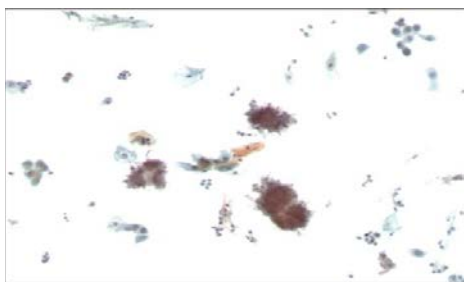


Figure 1: Light Micrograph of Actinomyces spp. Showing the Filamentous and Branching Bacterium. Pap. stain, x100.

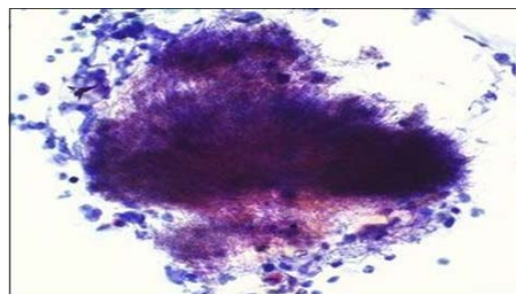


Figure 2: Light Micrograph of Actinomyces spp. Showing the Filamentous Clump. Pap. stain, x400.

Scanning electron microscopy showed that actinomyces were attached to the surface of vaginal speculum epithelial cells with surrounding inflammatory cells, with the mycelium extending in long branches. This

mycelium formed the segment in an elongated state, and branching was not observed as like shown in "Figure 3." High resolution scanning electron microscopy(SEM) showed that the surface of the hypha formed a biofilm covered in a substance secreted by the bacteria, and hexagonal sulfur granules were scattered around the mycelium. These granular materials had a diameter of approximately 100 - 150 nm, and were observed scattered around actinomyces alone or together as like shown in "Figure 4."

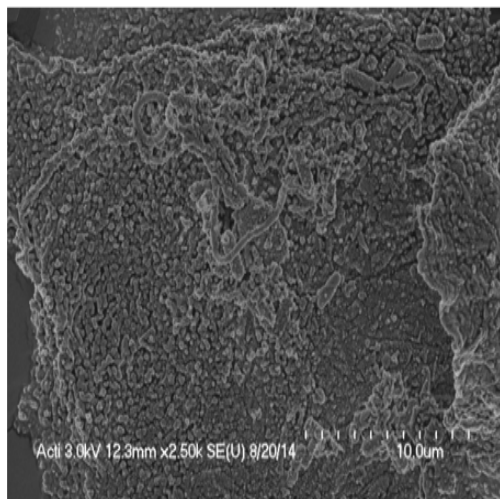


Figure 3: SEM micrograph of Actinomyces biofilm on the epithelial cell surface

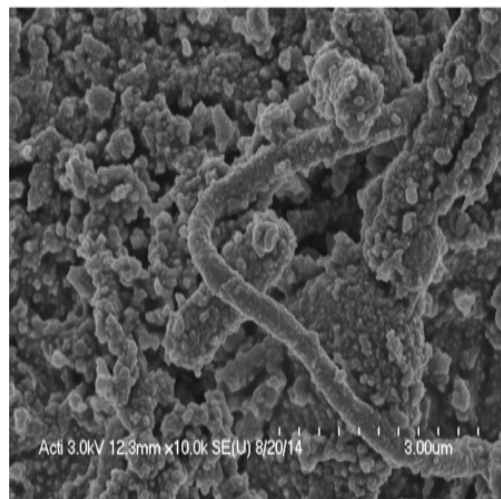


Figure 4: SEM micrograph of Actinomyces biofilm showing substance production and sulfur granules

The surfaces of epithelial cells to which actinomyces were fixed were confirmed to be covered in biofilm, and many pores existed on the surface where sulfur granules were scattered as like shown in "Figure 5,6."

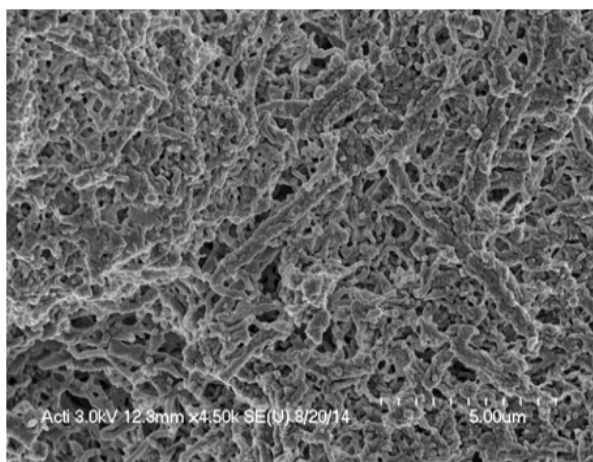


Figure 5: Scanning Electron Micrograph of Actinomyces Biofilm Showing Substance Production and Sulfur Granules

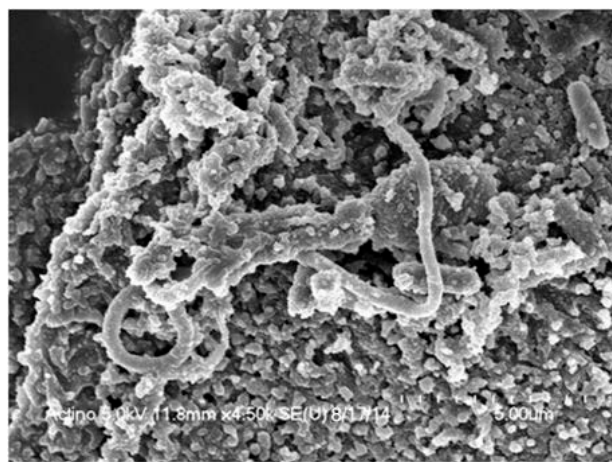


Figure 6: Scanning Electron Micrograph of Actinomyces Biofilm Showing the Hexagonal Crystals Observed Inside and Outside

Energy dispersive X-ray spectroscopy confirmed the existence of granules, composed of carbon(C), nitrogen(N), sodium(Na), and sulfur (S) as like shown in "Figure 7." The sulfur (S) component and accounted for 1.21% among the analyzed elements, which was the highest with the exception of oxygen, which can be exposed to the sample during analysis, copper, which is the supporting membrane component of the specimens, and platinum, which is the coating agent for scanning electron microscopy(SEM) as like shown in "Figure 8."

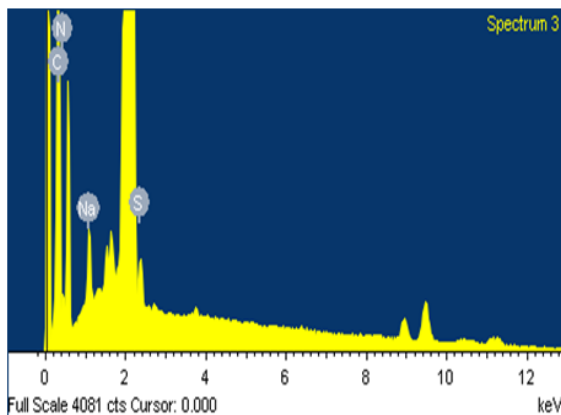


Figure 7: Electron Dispersive X-ray Spectroscopy(EDX) to Analyze the Actinomyces Biofilm Composition

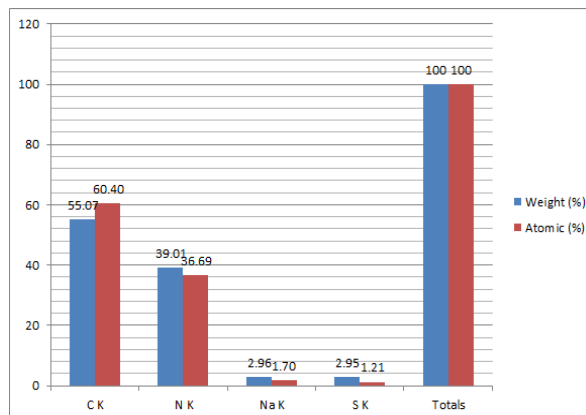


Figure 8: Electron Dispersive X-ray Spectroscopy(EDX) of the Actinomyces Biofilm Composition Showing a Sulfur Element of 1.21%

The actinomyces that were entangled with the inflammatory cells were attached to the surface of these inflammatory cells, forming a biofilm, and cells in bacillary form were observed around the inflammatory cells as like shown in "Figure 9,10" Inflammatory cells that formed lumps with actinomyces were observed to have decomposed or dissolved membranes, a spherical shape, and a diameter of 7 - 8 μm as like shown in "Figure 9"

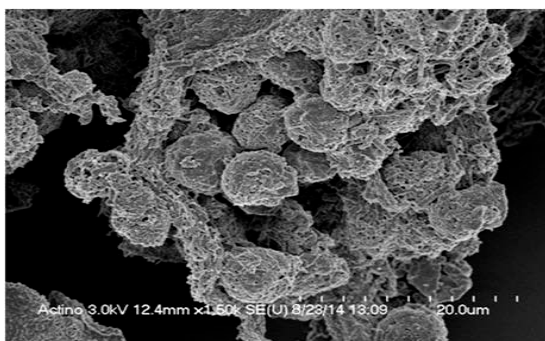


Figure 9: Scanning Electron Micrograph of Actinomyces Clumped with Inflammatory Leucocytes

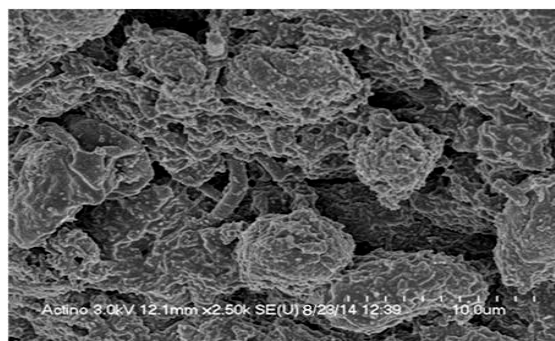


Figure 10: Magnified Scanning Electron Micrograph of figure 9. Actinomyces Observed Inside the Inflammatory Leucocytes and Biofilm

Actinomyces covered the surface of inflammatory cells, forming a biofilm for their division and growth, were attached to inflammatory cells, or connected inflammatory cells to the epithelial cells or bacteria to the inflammatory cells as like shown in "Figure 11, 12."

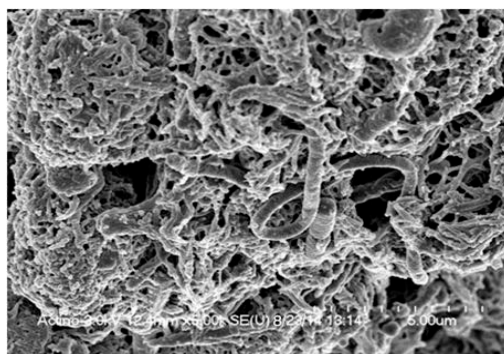


Figure 11: Scanning Electron Micrograph of Actinomyces Biofilm Developed Over a Clump of Inflammatory Leucocytes

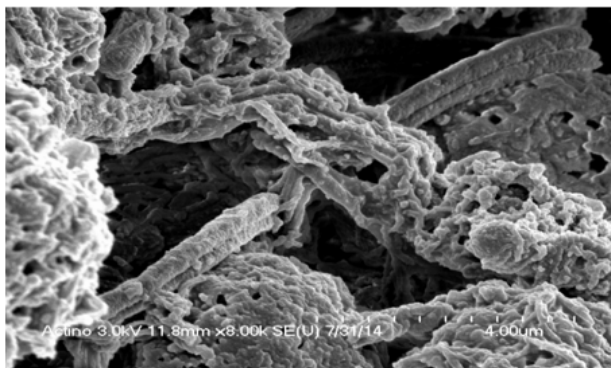


Figure 12: Scanning Electron Micrograph of Actinomyces Showing Linear Elongated Mycelia

Transmission electron microscopy (TEM) showed that the mycelium and spores formed a colony, and that epithelial cells were in close contact as like shown in "Figure 13." In addition, cells that formed lumps with actinomyces had a concentrated or decomposed nucleus, and cell organelle could not be observed as like shown in "Figure 13." In particular, the cytoplasm of the epithelial cells was filled with cornification fibers, and the nuclei of apoptotic inflammatory cells existed. The nuclei that were exposed because the cytoplasm was completely dissolved or decomposed appeared to have a high electron density by the concentration of the nucleus or allow electron density due to fusion of nucleus as like shown in "Figure 14."

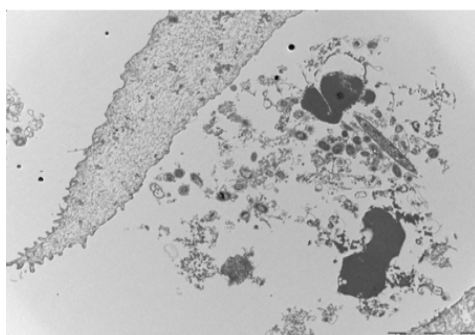


Figure 13: Transmission Electron Micrograph of Actinomyces Sample

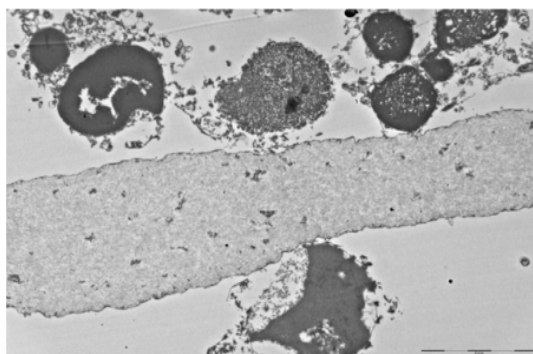


Figure 14: Transmission Electron Micrograph of Actinomyces Sample Showing Exfoliated Epithelial Cells and Naked Nuclei

Colonies of actinomyces under transmission electron microscopy (TEM) occupied an area of approximately $30 \mu\text{m}^2$, and mycelium and spores were distributed densely in a radial shape as like shown in "Figure 15." The mycelium and spores that were cut in various directions appeared to be different sizes, and granules with a high electron density were scattered in the mycelial cytoplasm, which had a spherical shape and a diameter of approximately 50 nm. The spores were in the breakup phase, with some partly germinated as like shown in "Figure 16.", and were filled with amorphous material with a low electron density and fibrous material in the space between the mycelium and the spore as like shown in "Figure 16."

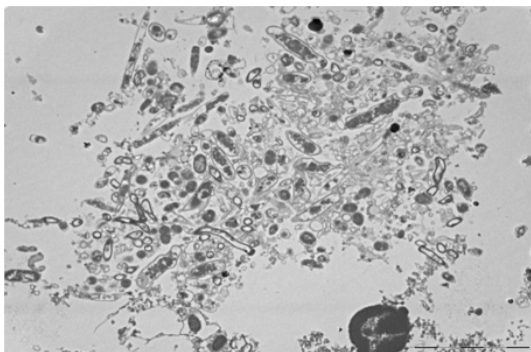


Figure 15: Transmission Electron Micrograph of Actinomyces Colony

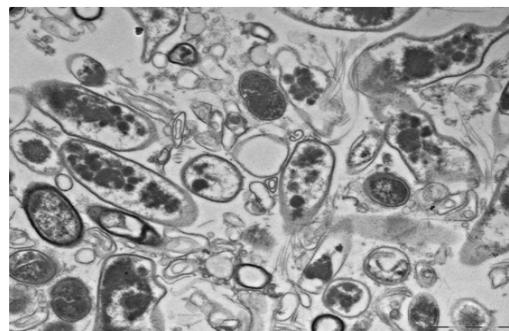


Figure 16: Magnified Transmission Electron Micrograph of Figure 15 Showing Mycelia and Spores

Spores in the breakup phase in high resolution transmission electron microscopy (TEM) were confirmed to form cell walls in the center, and these cell walls appeared to have a low electron density, with a thickness of approximately 30 nm, and the cell walls were observed clearly as like shown in "Figure 17." In addition, the cutting-edge in spores that had germinated formed thick cell walls as like shown in "Figure 18." Spores that stretched straight in transmission electron microscopy had a shorter diameter measuring approximately 0.3 μm as like shown in "Figure 19."

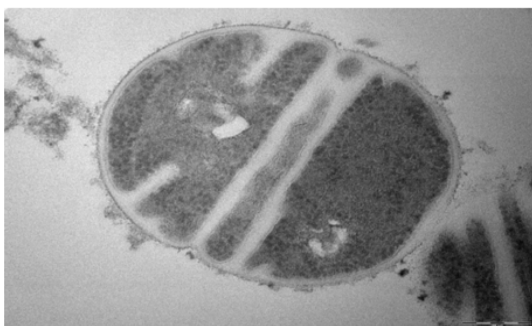


Figure 17: High Magnification Transmission Electron Micrograph of Figure 15 showing a Budding Spore

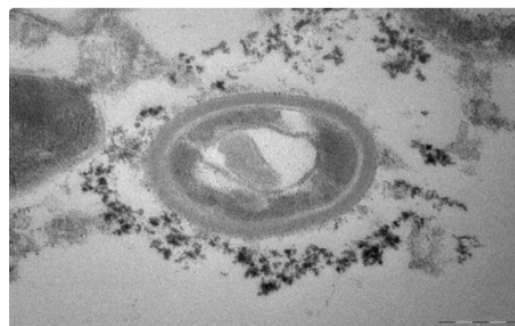


Figure 18: High Magnification Transmission Electron Micrograph of Figure 15 Showing the Spore

In the mycelial cytoplasm, materials with a high electron density were scattered in the cytoplasm, and the cell wall and nuclear membrane were also observed separately by a sharp boundary as like shown in "Figure 19, 20."

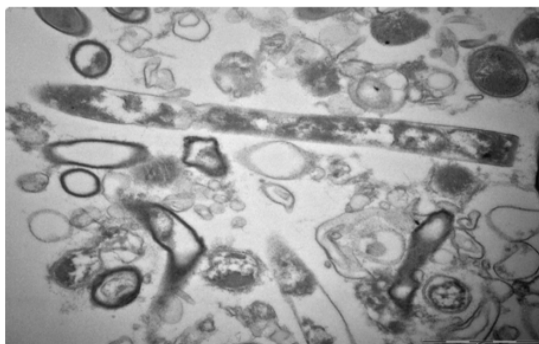


Figure 19: Transmission Electron Micrograph of Actinomyces Colony Showing Linear Elongated Mycelia

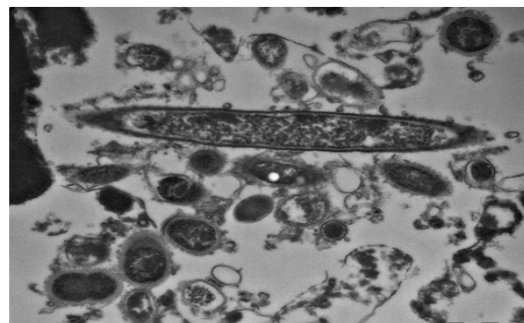


Figure 20: Transmission Electron Micrograph of Actinomyces Colony Showing Linear Elongated Mycelia

On a section of actinomyces specimen, the mycelium became large or showed various irregular shapes as like shown in "Figure 20." The spores of actinomyces in high magnification transmission electron microscopy were covered with biofilm as like shown in "Figure 21, 22." and materials with a low electron density and a mycelium thickness of approximately 40 nm surrounded the entire cell wall of the spores, or were connected to adjacent mycelium or spores as like shown in "Figure 21, 22."

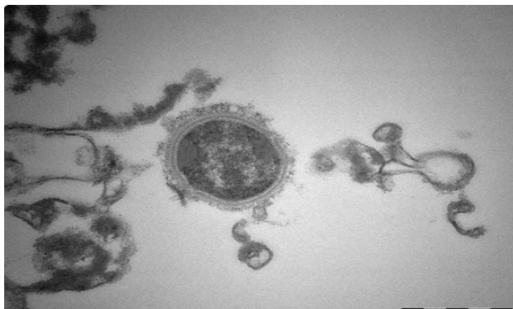


Figure 21: High Magnification Transmission Electron Micrograph of Actinomyces Covered with Biofilm

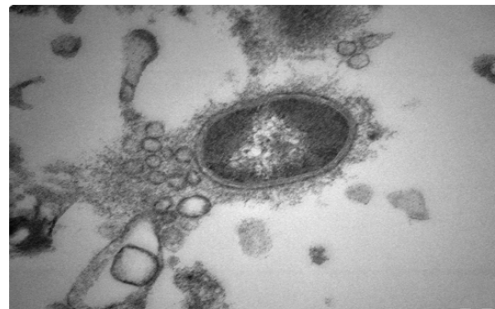


Figure 22: High Magnification Transmission Electron Micrograph of Actinomyces Covered with Biofilm. The Biofilm Interconnected with Adjacent Mycelia and Spores

REFERENCES

- [1] Simpson RS, Read RC. Nocardiosis and actinomycosis. *Medicine*. 2014 January, 42(1), pp. 23-25.
- [2] Sandra M, Oosterhof H, Vandissel JP. Actinomyces and the intrauterine device. *Arch Intern Med*. 1998 June, 158(11), pp.1270.
- [3] Frazili T, Blair D, Riddell S, Kiska D, Nagra S. Actinomycesmeyer infection: Case report and review of the literature. *Journal of Infection*. 2012 October, 65(4), pp. 357-361.
- [4] Kalaichelvan V, Maw AA, Singh K. Actinomyces in cervical smears of women using the intrauterine device in Singapore. *Contraception*. 2006 April, 73(4), pp. 352-355.
- [5] Kayikcioglu F, Akgul MK, Haberal A, Demir F. Actinomyces infection in female genital tract. *European Journal of Obstetrics & Gynecology and Reproductive Biology*. 2005 January, 118(1), pp. 77-80.
- [6] Myer L, Kuhn L, Stein ZA, Wright Jr TC, Denny L. Intravaginal practices, bacterial vaginosis, and women's susceptibility to HIV infection: epidemiological evidence and biological mechanisms. *Lancet Infect Dis*. 2005 December, 5(12), pp.786-794.
- [7] Norrington D, Ruby J, Beck P, Eleazer P. Observations of biofilm growth on human dentin and potential destruction after exposure to antibiotics. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2008 April, 105(4), pp.526-529.
- [8] Westhoff C. IUDs and colonization or infection with Actinomyces. *Contraception*. 2007 June, 75(6), pp.S48-S50.
- [9] Carrillo M, Valdez B, Vargas L, Alvarez L, Schorr M, Zlatev R, Stoytcheva M. In vitro Actinomyces israelii development on IUD copper surfaces. *Contraception*. 2010 March, 81(3), pp.261-264.
- [10] Robert C. Nocardiosis and actinomycosis. *Medicine*. 2009 December, 37(12), pp.657-659.



ISSN
0975-6299

A Study on the Utility of Automatic Exposure Control Function in a Diagnostic Digital Radiography System

Ye-Won Park, Dept. of Health Care, Hanseo University, Seosan, Korea. E-mail: srtpyw@nate.com

Cheong-Hwan Lim*, Dept. of Health Care, Hanseo University, Seosan, Korea. E-mail: lch116@hanseo.ac.kr

Abstract---

Background/Objectives: Diagnostic DR systems may result in an excessive exposure of radiation, since there are no limitations about exposure levels to acquire the required medical images. This study aimed to understand the proper dose of diagnostic DR equipment and to investigate SI when DICOM image was captured and exposure level when it was tested according to automatic exposure control and manual modes.

Methods/Statistical Analysis: Four diagnostic DR systems and a chest phantom were used. DICOM images were captured in the chest PA test and their exposure levels were five times measured using a dosimeter, establishing AEC and manual modes, respectively, during the chest PA test. The SI for captured DICOM images was recorded by establishing an ROI with Image J. The statistical analysis was performed utilizing the Mann-Whitney test.

Findings: Measurements of the diagnostic DR system yielded SI values that differed by manufacturers and ROIs of DICOM images, while AEC and manual modes of the same manufacturer's equipment did not. The exposure level in the AEC mode compared to the manual mode was measured to be lower by 5.7% in S company's equipment, by 49% for the P company, by 2.1% for the G company, and by 187.2% for the C company one. The differences among the four DR systems were statistically significant ($p < .05$). It is suggested to use radiographic tests of outstanding image quality flexibly with lower doses in consideration of the equipment characteristics and patients' physical conditions, recognizing that excellent medical images can be captured with lower doses in the DR system by the manual mode than by AEC.

Improvements/Applications: Since the AEC function in the diagnostic DR system may not capture the medical image at lowest exposure levels, manual modes that take patients' physical conditions into account are thought to contribute in the reduction of doses.

Keywords--- AEC (Automatic Exposure Control), manual, SI(Signal Intensity), EI(Exposure Index), Exposure Dose.

* Corresponding Author

Special Issue on "Medical Science"

I. INTRODUCTION

X-ray tests, which are the basic tools for the diagnosis and treatment of disease, can acquire images digitally and the exposure level for an image capture tends to be increasingly low. Radiation to be used in the medical practices should follow ALARA(As Low As Reasonably Achievable), a defensive principle recommended by International Commission on Radiological Protection (ICRP), to acquire an excellent quality image with the lowest dose.

The factors that affect the image quality of radiography using the DR system vary according to the X-ray tubes to generate X-rays, detectors to capture the medical image, software for processing, up to the monitors. The DR system can be weakened during the process of X-rays passing from the object to the X-ray tube, and it can acquire black and white digital images by the detector according to the X-ray level.^{1,2}

The diagnostic DR system has been improved from early models to realize superior medical images with lower dose levels. Since a variety of elements in film and screen types are influential factors, including test condition, film type, film development temperature, and time, the know-how and skillful techniques of the radiological technologists is essential. Moreover, kVp and mAs in the generating device are important to realize a high quality image.

However, the image-taking conditions of the DR system have not been restricted, due to the detector and the dynamic range which is the characteristic of software for improvement of the DR system, and the impact of kVp and mAs on the image is less than that of the film and screen type system.³

In addition, no correlation has been established between the radiation dose and the "concentration" of the image. automatic exposure control(AEC), which is widely used as the main function in the DR system can control the contrast with post-processing after an image capture.⁴

The AEC function in the DR system utilized to control the radiation dose automatically upon the radiation exposure in the detector is sufficient for an image capture. The goal of the generating device for diagnosis is to capture the best image, maintaining the initial capacity and lowering exposure levels to the patient. Hence, this study aimed to lower unnecessary exposure during radiation tests and to acquire an excellent medical image by comparing the exposure levels in AEC and manual modes, which are superior in a diagnostic DR system. It is time to consider studies that investigate whether the radiation dose be kept low while acquiring a high-quality image at an appropriate exposure level.

II. MATERIALS AND METHODS

A. Test Equipment

The tests were performed with (1) four DR systems made by S, P, G, and C companies that equip the medical institutions; (2) chest phantom(RSD Phantom, Belarus) of a human model; and (3) a dosimeter by Unfors ThinX RAD(Unfors, Sweden) as seen in Fig. 1.



Figure1: Chest Phantom

B. Test Methods

For reproducibility and a consistency of the image, the tests were performed with a human model chest phantom which was balanced both to the left and right while maintaining a posteroanterior(PA) position attached on a wall bucky for position stability. A high kilo voltage, which is widely used in clinical practice,

was used to capture the Digital Imaging and Communications in Medicine (DICOM) image. The test conditions to capture the DICOM image were both the AEC mode to control exposure dose automatically and the manual mode to control it by hand. The exposure dose during the image capture was measured simultaneously.

In the AEC mode, DICOM images of the chest phantom were captured five times by each DR system with the test conditions including chest PA, source image of the receptor distance (SID) at 180 cm, a radiation field of 17×17 inches, and a tube voltage of 125 kVp. With respect to the manual mode, DICOM images in the chest phantom were also captured five times by each DR system with the test conditions including chest PA, a SID of 180 cm, a radiation field of 17×17 inches, a tube voltage of 125 kVp, and a tube current of 3 mAs. During the capture process of each DICOM image, the Unfors ThinX RAD dosimeter was positioned under the right side of the DR detector and the exposure dose was measured as seen in Fig. 1.

C. Image Analysis

DICOM files transmitted by Picture Archiving and Communication System (PACS) were analyzed by Image J (Version 1.49) which is a program for value and image analyses developed by National Institutes of Health (NIH). The ROI was set from each DICOM image by Image J and its SI was measured after establishing five points including L (lung field), LM (lung field margin), M (mediastinum), HS (heart shadow), and D (diaphragm) as displayed in Fig. 2, which refers to the image evaluation points by the Japanese Tuberculosis Association⁵. A Mann-Whitney test was calculated, using SPSS Version 22 for Windows to compare the SI of the DICOM image with the results of exposure levels at a significance level of $p < 0.05$.

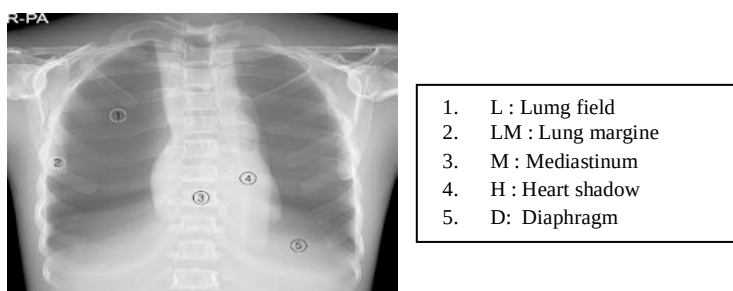


Figure 2: Image of a Chest Phantom

III. RESULTS

A. SI (Signal Intensity)

The measured values of SI in the AEC mode by the diagnostic DR system were 5,663, 1,719, 3,747, and 3,471 μGy for the S, P, G, and C companies, respectively, as in the lung field; 9,642, 2,846, 4,435, and 2,283 μGy for the lung field margin; 12,329, 3,360, 5,042, and 746 μGy in the mediastinum; 12,089, 3,317, 4,918, and 1,136 μGy for the heart shadow; and 9,477, 2,613, 4,526, and 2,136 μGy for the diaphragm. The measured values of SI by each area ROI are displayed in Table 1.

Table 1: Measurement Values of SI by Areas Upon DR and AEC Systems

Manufacture Region	S	P	C	G
L	5663	1719	3471	3747
LM	9642	2846	2283	4435
M	12329	3360	746	5042
H.S	12089	3317	1136	4918
D	9477	2613	2136	4526

L : lung field, LM : lung field margin, M : mediastinum, HS : heart shadow, D : diaphragm

The measured values of SI in the manual mode by the diagnostic DR system were 5,823, 1,718, 3,788, and 3,470 μGy for the S, P, G, and C companies for the lung field; 9,283, 2,579, 4,507, and 2,347 μGy for the lung field margin; 12,386, 3,334, 5,079, and 723 μGy for the mediastinum; 12,304, 3,255, 4,046, and 1,167 μGy for the heart shadow; and 9,417, 2,545, 4,545, and 2,209 μGy for the diaphragm (Table 2). In the same diagnostic DR system, SI values by areas were slightly different: AEC and manual modes ranged at 6%-3.9%, .3%-10.4%, .7%-2.5%, and .1%-3.3%, for the four companies, respectively.

Table 1: Measurement Values of SI by Areas Upon DR and Manual Systems

Region \ Manufacture	S	P	C	G
L	5823	1718	3470	3788
L.M	9283	2579	2347	4507
M	12386	3334	723	5079
H.S	12304	3255	1167	5046
D	9717	2545	2209	4545

B. Exposure Dose

The exposure dose using AEC in each DR system was determined to be 103.4, 64.4, 345.2, and 107.7 μGy for the S, P, C, and G companies, respectively (Table 3).

Table 3: Exposure Dose by DR System and AEC

Unit : μGy				
Region \ Manufacture	S	P	C	G
Exposure dose	103.4 $\pm$ 1.34	64.4 $\pm$ 0.2	345.2 $\pm$ 0.84	107.7 $\pm$ 0.27

In the manual mode of each DR system, the exposure dose was measured to be 109.6, 126.2, 120.2, and 105.5 μGy , in S, P, C, and G companies, respectively (Table 4). For the AEC mode, the values were lower by 5.7% for the S company equipment, 49% in the P company, while higher by 2.1% in the G company and 187.2% in the C company. The exposure levels between AEC and the manual mode in the same DR system were statistically significant for all four types of equipment ($p < 0.05$).

Table 4: Exposure Dose by DR System and Manual

unit : μGy				
Region \ Manufacture	S	P	C	G
Exposure dose	109.6 $\pm$ 1.67	126.2 $\pm$ 0.18	120.2 $\pm$ 0.84	105.5 $\pm$ 1.60

IV. DISCUSSION

The manufacturers of the DR systems provide the index of air kerma (μGy) in the actual detectors where the radiological image is formed, which is called as exposure index (EI).⁶ This is a method to exchange the information on the exposure measured in the detector with the technologists who directly operate the equipment. This represents an indirect index of digital image quality as a supplement and it shows the exposure dose measured in the detector as the ratio of image signal versus the noise level.⁷ Therefore, EI cannot determine accurate effective dose for the patient but it is a minimum standard for radiological technologists to recognize the optimization of that dose.⁸ Checking EI when using AEC functions may lower unnecessary exposure level to the patient. The operator must select the exposure condition to capture an optimum-quality image with the least dose for the patient in radiological tests.

However, setting the optimum radiation dose and change of air kerma upon dose increase should be taken into account, since air kerma cannot always be measured and automatic exposing devices are preferred to manual ones in actual clinical practices.⁴

The DR system's hardware and algorithms to produce an image are environmental factors to that influence the image and exposure dose significantly; however, they cannot be controlled by the radiological technologists. Exposure levels can be lowered to control kVp and mAs considering the patient's physical condition in the test. The operator of the diagnostic DR system may think about capturing an optimum image with an optimum dose using ACE functions during the test, yet, some diagnostic DR systems in the AEC mode show higher exposure levels than in the manual mode. Nevertheless, once these DR systems pass the performance standards of the Korea Institute for Accreditation of Medical Imaging, they will be no problem for clinical use, which does away with worries about unnecessarily increased radiation. The lack of effort to lower effort for the radiation dose by radiological technologists may cause excessive exposure to the patients in the diagnostic DR system.

There were few differences of the DICOM image SI for areas measured by Image J in term of the signals between AEC and manual modes. However, it was confirmed that SI in the same area was measured to be different depending on the manufacturers. This was because of the detector characteristics and different post-processing algorithms of raw data. The final captured images of the DR system were DICOM ones that carried unique characteristics of the manufacturers. The AEC mode is mainly used in the clinical practice due to the convenience of the test, however, SI values of G and C companies in the AEC mode were higher by 2.1 and 187.2%, respectively, than those in the manual mode, which is considered an unnecessary excessive exposure. So, the AEC mode may not be the best way to capture an optimal medical image with an appropriate dose. Manufacturers are required to improve AEC function to capture excellent images at low doses.

Radiological technologists should be well aware of the DR system's characteristics of the DR with regard to the changes of digital imaging devices and their use while resetting optimum radiation conditions to minimize the exposure to the patients without compromising image quality. In addition, they should use it cautiously with a better understanding of AEC and the training about the management of doses should include multiple aspects. When performing quality control of the DR system, the dose measurement items must be included to understand the changes of the dose to the patient by various variables of the device, and such a quality control measure ought to be performed regularly.⁹

The image quality evaluation is the important factor in diagnostic radiology. Quantitative evaluation methods of noise are Signal to Noise Ratio (SNR), Contrast to Noise Ratio (CNR), Noise Power Spectrum (NPS), and so on;¹⁰. Contrast, resolution, etc. have also been used as evaluation tools of the DR image. However, they are insufficient as tools to assess image quality as well as their diagnostic value. It is suggested that a standardized phantom compliant with the DR system should be developed and its regular evaluation for the image should be performed continuously.

V. CONCLUSION

In comparison with the SI values in both AEC and manual modes in the same diagnostic DR system, there was no significant difference between them. It was found that some DR systems showed higher exposure doses in the AEC mode than in the manual mode. The former, which is provided by all DR systems, is convenient in clinical practice while it may not achieve an optimum dose to capture an excellent image. Radiological technologists in clinical practice must recognize the fact that better medical images can be acquired with lower dose levels in the manual mode than in the AEC mode of the diagnostic DR system. They should also use the test methods flexibly to acquire excellent images with lower doses according to ALARA principles while considering the characteristics of the diagnostic DR system in conjunction with the patients' physical conditions. Also, the manufacturers should improve and develop their equipment continuously to acquire excellent images with low exposure doses by performance enhancements and post-processing improvements of AEC functions, which are widely used in clinical practice.

ACKNOWLEDGEMENT

This study was supported by the 2015 Academic Research Support Project of Hanseo University.

REFERENCES

- [1] Ye-Won Park, Cheong-Hwan Lim, Hong-Ryang Jung, Oh-Nam Yang and Chang-Moo Baek. A Study on the Appropriate Inspection Distance of Digital X-Ray Imaging Equipment for Diagnosis. Indian Journal of Science and Technoigy. 2015 April, Vol 8(S8), pp 380-386.
- [2] Seung-WoonJeung, Cheong-Hwan Lim, Young-CheolJoo. A Study on the Work Environment and VDT Syndrome in Radiation Technologists Working in the Area of 3D Processing. Indian Journal of Science and Technoigy. 2015 August, Vol 8(18),1.
- [3] Kwang-Jae Lee, Min-Gi Kim, Jong-Woong Lee, Ho-Cheol Kim. Research for The Environmental Optimization of Dose and Image quality in Digital Radiography. Journal of the Institute of Electronics Engineers of Korea. 2013 Vol. 50(2), pp. 203-209.
- [4] Yang, S., Han, J. B., Choi, N. G., Lee, S. G. The Review of Exposure Index in Digital Radiography and Image Quality. Journal of Radiation Protection and Research. 2013, Vol 38(1), pp. 29-36.
- [5] Choi, J. H., Lim, C.H., Yuxin, H. A Study on Patient Gown in Digital Radiography Examination. Indian Journal of Science and Technology. 2016 June Vol 9(24).
- [6] Shepard, S. J., Wang, J., Flynn, M., Gingold, E., Goldman, L., Krugh, K. Samei, E. An exposure indicator

- for digital radiography. AAPM Task Group 116 (executive summary). Medical physics. 2009, 36(7), 2898-2914.
- [7] Seibert, J. A., & Morin, R. L. The standardized exposure index for digital radiography: an opportunity for optimization of radiation dose to the pediatric population. Pediatric radiology. 2011, Vol 41(5), pp. 573-581.
- [8] Neitzel, Ulrich. The exposure index and its standardization. PHIPILS. 2009.
- [9] EunKyeong Kim. A Study on the State of Setting Irradiation Conditions and Awareness of Dose and Quality Control of Diagnostic Digital Radiography. Korea University. 2011.
- [10] Ki-Won Kim, Jung-Whan Min, Kwang-Yeul Lyu, Jung-Min Kim, Joo-Ah Lee, Jae-Hong Jung, Dong-Chan Sung, Soon-Cheol Park. Comparison Study on CNR and SNR of Thoracic Spine Lateral Radiography. Korean Society of Radiological Science. 2013 Vol. 36(4), pp. 273-280.



ISSN
0975-6299

Research about Contrast Media Volume Injection by Body Mass Index in Cardiac Computer Tomography

Kyoo-Hyung Kim, Dept. of Health Care, Hanseo University, Seosan, Choongnam, Korea. E-mail: kimkh8606@mjh.or.kr
Chung-Hwan Lim*, Dept. of Health Care, Hanseo University, Seosan, Choongnam, Korea. E-mail: lch116@hanseo.ac.kr

Abstract---

Background/Objectives: Even if a little smaller amount of a contrast media is used for cardiac computer tomography(CT) according to patients' BMI, excellent images with a good Hounsfield Unit(HU) value and an acceptable signal-noise ratio(SNR) can be obtained.

Methods/Statistical analysis: The CT equipment used in this study was Light Speed Volume CT 64 channel (GE healthcare, USA). Patients with heart rates of less than 65 were classified into 4 groups according to their BMI and the SNR was measured by injecting different amount of contrast media. Collected materials were analyzed using SPSS Version 23.0 at the significance level of $p < 0.05$.

Findings: By BMI, the measured value was the highest at underweight and the lowest at severely obesity. By contrast media dose, it was the highest at 90 ml and the lowest at 80 ml. Correlations analyses showed statistically significant differences of contrast media dose according to BMI.

Improvements/Applications: It is considered that contrast media dose should be decided considering BMI to minimize side effects of contrast media while acquiring excellent quality SNR.

Keywords--- MDCT, Contrast Side Effect, BMI, SNR, Contrast Media.

* Corresponding Author

I. INTRODUCTION

The current era is an information era in which computer technology has developed rapidly.¹⁾The clinical usage of Computer Tomography (CT) has advanced greatly since its development in 1972.²⁾ The basic principle of CT image composition is to measure the inner structure of the human body from various directions through X-ray penetration and detectors, then reconstruct those cross-sectional images using a computer and finally reconstruct the image in a recording device. It is the device making image of cross-sections of human body using differences of various structures of human body in HU by combining existing X-ray and computer technology. In other words, rotating X-ray tubes are received by detectors, transformed to light and electric signals, reconstructed as a cross-sectional image using mathematical methods in the computer, and then presented on the monitor after image processing.³⁾ Existing CT acquires a single image per rotation but with the development of Multi-Detector Computed Tomography (MDCT) with 320 detector columns, there was revolutionary improvement in speed. As the examination duration is reduced, the clinical application range was expanded enormously.¹⁴⁾ By minimizing artifacts caused by patients' movement, it could secure clinical efficacy as it can examine whole abdomen while the patient holds his breath. By development of CT equipment, it was possible to reduce examination time, to enhance image evaluation capacity by the reduction of slice thickness, and to reconstruct images of bones and blood vessels with three-dimensionally. Therefore, the diagnostic value of CT image increases and examination cases are increasing accordingly. As CT examination time reduces and MDCT rapidly develops in cardiovascular examinations, it is widely used in coronary artery disease diagnosis. When comparing MDCT with Conventional CT, scan speed shortened and diversification of inspection area, as enhancement of diagnosis areas is required, it uses more amount of contrast medium more frequently, and injection speed and pressure increase, accordingly, diverse side effects are shown.⁵⁾ Currently, a non-ionic water-soluble low-osmolality contrast media is used to enhance the safety of patients rather than an ionic contrast media. Because of unexpected side effects of a contrast medium after CT both patients and radiological technologists feel burdens. Additionally, because characteristics of examination, medical institutions may not be able to respond well to the contrast media side effects. Use of an optimal contrast media amount is a very important factor to acquire high quality images with diagnostic value while - at the same time - reducing patients' anxiety and mental stress by reducing the side effects to some extent. Accordingly, this study tried to examine the most optimal amount for a contrast medium by minimizing overuse in relationship to patients' BMI when decisions about contrast medium amounts are made in Cardiac CT routine tests.

II. MATERIALS AND METHODS

A. Research Equipment

Light Speed Volume CT 64 channel (GE healthcare, USA) was used. For Scan Type Cardiac and for Cardiac Mode Snap Shot Segment (Helical) were used respectively. Rotation Time was set at .35sec, Detector coverage at 40.0 mm, slice thickness at 2.5mm, interval as 2.5mm, Scan FOV Cardiac small at 120 kVp, and ECG modulated mA as a minimum of 140 to a maximum of 500 (**Table1**).

Table 1: Research Equipment

Equipment	Light Speed Volume CT 64 channel(GE healthcare, USA)
Scan Type	Cardiac
Cardiac Mode	Snap Shot Segment(Helical)
Rotation Time	0.35sec
Detector Coverage	40.0 mm
Slice Thickness	2.5mm
Interval	2.5mm
Scan FOV	Cardiac small
KVP	120KVP
mA	Max 500 in ECG modulated mA Min 140

Contrast media were non-ionic contrast media Optiray 350 (Ioversol 741 mg/ml, Iyeon Pharmaceuticals) and Choongwae NS 1,000ml/bag (JW) N/S were injected by 5.0 ml/s, respectively. A MEDRAD Stellant Dural Injector was used as an auto injector to acquire the image. Acquired axial images were reconstructed using the GEAW Volume Share 4.5 Advance Workstation program(**Figure 1**).

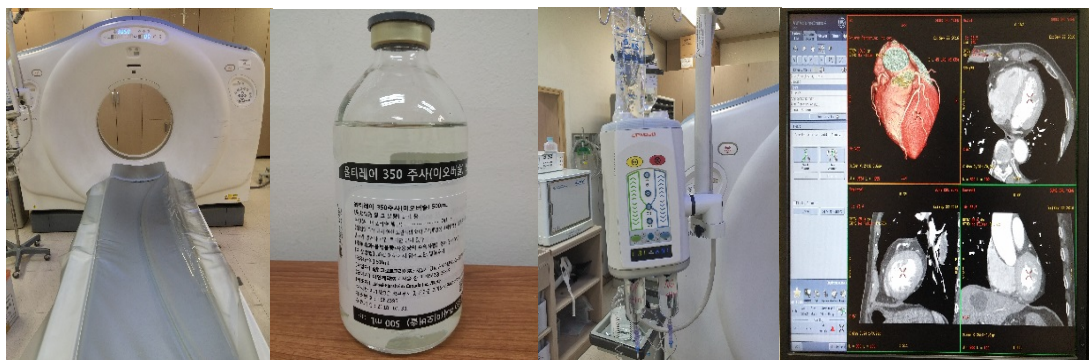


Figure 1: CT Inspection Equipment

B. Test Method

Subjects were patients with chest pain and angina who were referred to cardiac CT routine contrast media examinations as outpatients of a heart disease center at M Hospital in Koyang city, Kyunggi-do. When they signed the form for the contrast medium use, agreement to participate in this study was also obtained. Patients with heart rate less than 65 per minute were classified into 4 groups according to BMI: less than 23 kg/m² (grade 1, from 23 kg/m² to 25 kg/m² (grade 2), from 25 kg/m² to 30 kg/m² (grade 3), and over 30 kg/m² (grade 4). Based on the mean contrast media amount used in Korean hospitals (80ml for Optiray 350 contrast media and 50ml for N/S), we examined using contrast media at 90ml, 80ml, 70ml and 60ml respectively.

For an objective image evaluation, the Region of Interest (ROI; cm²) was set as large as possible in order not to include blood vessel walls or neighboring tissues; CT Density (Hounsfield Unit; HU) was measured and standard deviations (SD) calculated to determine the Signal to Noise Ratio (SNR); this was done by setting ROI at the left main coronary artery (LMA) and the proximal ascending aorta (Figure 2).³⁾

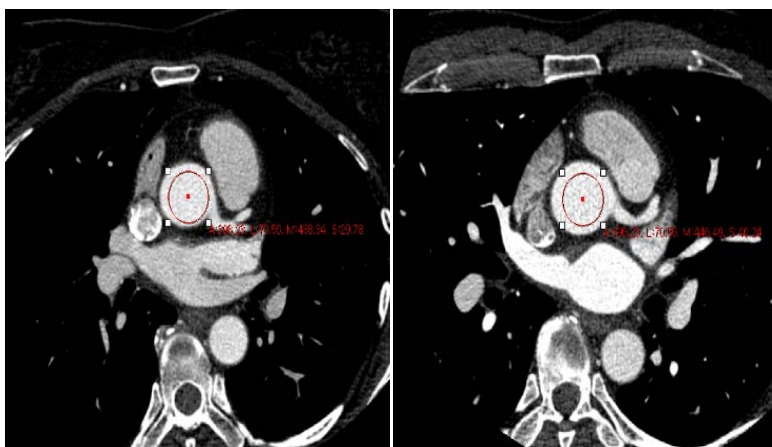


Figure 2: Measurement of ROI of the Image

For the subjective evaluation of image quality, two cardiologists analyzed the information in four steps as follows. Very good (four points)- Nearly no artifacts and easy to diagnose because of good contrast; good (three points)-Although there are several artifacts, they do not influence diagnosis with good contrast; fair (two points)-Although there are severe artifacts, a diagnosis can be made with some contrast; poor (one point)-when the coronary artery is not visible or diagnosis cannot be made because of too many artifacts.

SNR was measured at the proximal ascending Aorta and, then, the mean SNR was calculated [Formula 1].

SNR = HU Mean of Proximal Ascending Aorta/SD of Proximal Ascending Aorta ----- [Formula 1]

Data analysis was conducted using the SPSS statistics package (Statistical Package for the Social Science)Version 23.0 to identify general characteristics of subjects, mostly by frequency analyses and descriptive statistics.

Analyses on the BMI and contrast media were performed by one way ANOVA and correlational analyses. Statistical significance was set at the significance level of 95% ($p < .05$). To determine the minimum sample size, G power, a statistical power analysis program, was utilized.

III. RESULTS

A. General Characteristics of Subjects

Out of the 246 subjects, 145 (58.9%) were males and 101 (41.1%) females. By contrast media dose, 78 patients (31.7%) received 90ml, 74 (30.1%) 80ml, 50 (20.3%) 70ml, and 44 (17.9%) 60ml. The BMI groups were as follows: under-weight $n = 62$ (25.2%), normal $n = 45$ (18.3%), over-weight $n = 103$ (41.9%), and severely obesity $n = 36$ (14.6%). The mean BMI was 25.4 (**Table 2**).

Table 2: General Characteristics of the Subjects

	Classification	n(%)
Sex	male	145(58.9)
	female	101(41.1)
Injection volume	90ml	78(31.7)
	80ml	74(30.1)
	70ml	50(20.3)
	60ml	44(17.9)
BMI	Underweight	62(25.2)
	Normal	45(18.3)
	Overweight	103(41.9)
	Severely Obesity	36(14.6)

B. HU and SNR Measurement According to BMI

The LMA HU of the four groups by BMI was the highest for the group of under 23 at $M = 540.9$ ($SD = 55.0$) and lowest for the group of 30 and more, $M = 363.6$ ($SD = 58.2$), $F=49.799$, p value 0.000, there was statistically significant difference among groups ($p < .001^{**}$). The SNR was also the highest at under 23, $M = 20.4$ ($SD = 3.3$) and lowest at 30 and more, $M = 9.1$ ($SD = 3.1$), $F=132.694$, p value 0.000, there was statistically significant difference among groups ($p < .001^{**}$). HU and SNR measurements were the highest for underweight and lowest for severely obesity individuals (**Table 3**).

Table 3: Changes in HU and SNR According to BMI

	Underweight (23under)	Normal (23~24.9)	Overweight (25~29.9)	severely obesity (30more)
n	62	45	103	36
LMA HU	540.9±55.0	475.8±74.8	452.8±80.4	363.6±58.2
SNR	20.4±3.3	14.9±2.7	12.8±2.7	9.1±3.1

C. HU and SNR Measurement According to Contrast media Dose

The LMA HU value according to contrast media dose was the highest at 90ml, $M = 484.3$ ($SD = 85.2$) and lowest at 80ml, $M = 446.2$ ($SD = 86.1$), $F=2.77$, 8, p value 0.042, there was statistically significant difference among groups ($p < .05^{*}$). SNR according to the contrast media dose was the highest at 90ml, $M = 15.2$ ($SD = 4.6$) and the lowest at 80ml, $M = 13.7$ ($SD = 4.2$), $F = 1.343$, p value 0.261 but the differences were not statistically significant ($p > .05$). It is suggested that we can get high quality image with a sufficiently high SNR value even lower amount of contrast media is used than specified in manuals (**Table 4**).

Table 4: Changes in HU and SNR According to the Amount of the Contrast Media dose

	90ml	80ml	70ml	60ml
n	78	74	50	44
LMA HU	484.3±85.2	446.2±86.1	476.5±99.8	455.7±84.0
SNR	15.2±4.6	13.7±4.2	14.4±4.8	14.8±5.7

D. Correlations Analysis of HU and SNR According to BMI and Contrast Media Dose

The BMI was positively correlated with LAD HU($R=0.621$, $p < 0.001^{**}$) and SNR($R=-0.784$, $p < 0.001^{**}$), but there was no statistically significant correlation with contrast media dose ($p > .05$).

LAD HU displayed a negative correlation relationship with BMI($R=-0.621$, $p < 0.001^{**}$) and a positive one with SNR($R=0.754$, $p < 0.001^{**}$), but the relationship with contrast media dose was not significant ($p > .05$).

The SNR- BMI correlation was $R=-0.784$ ($p < 0.001^{**}$) and SNR-LAD HU $R=0.754$ ($p < 0.001^{**}$); SNR did not correlate meaningfully with contrast media dose ($p > .05$).

The most noteworthy result is that the contrast media dose did not correlate with any of the groups analyzed ($p > .05$)(Table 5).

Table 5: Correlation Analysis for BMI and Contrast Media Dose

	BMI	Contrast media dose	LAD HU	SNR
BMI				
Contrast medium dose	0.120			
LAD HU	- 0.621**	0.076		
SNR	- 0.784**	0.026	0.754**	

($p < 0.001^{**}$)

IV. DISCUSSION

As state-of-the-art medical technology development accelerates, CT examination which is an important part of radiography for diagnoses has reached a high usability level as the equipment and examination methods and skills have advanced in diverse aspects. Enhancement of usefulness and improvement of reliability of CT exam brought increase of examination incidents and rapid increase of CT contrast media use. By applying an optimal amount of contrast media, their side effects can be minimized while maintaining a high level of CT diagnosis power.¹³⁾

Accordingly, this study tried to provide data for optimal amount of contrast media to reduce side effects while acquiring optimal quality image by applying different amount of contrast media according to BMI.

Kim (2014)¹⁴⁾ reported that HU of patients showed significant difference inversely proportional to body weight, contrast media amount did not make effects on HU, and much bigger contrast effect could be acquired with the use of optimal amount of contrast media. In this study, HU and SNR values according to BMI were the highest at underweight and the lowest at severely obesity.

HU and SNR values according to contrast media dose were the highest at 90ml, followed by 60ml and 70 ml, while lowest at 80ml. In the test reducing contrast media amount according to BMI, LAD HU and SNR values showed statistically significant differences were demonstrated ($p < 0.001$). If the contrast media amount is determined by the most effective contrast, side effects for patients are minimizable.

Yang (2012)⁵⁾ reported that when 130 ml or over-contrast media were used, side effects arose most frequently and the with low amounts of contrast media dose, the less frequently side effects arose. Lee (2011)¹¹⁾ reported that diluting contrast media with saline could reduce dose-dependent side effects by reducing the former's amount which also improved the image quality level. Kim (2008)¹³⁾ reported that CT could be developed to become a safe and reliable test if contrast media amounts were reduced without sacrificing image quality and while taking risk factors of contrast media(side effects) with the development of CT into account. As shown in previous studies, we could get high quality SNR even when a low amount of contrast media was injected.

However, it must be kept in mind that we used patients as subjects and different tests could not be performed on the same individual. This is a study limitation that future research should compensate.

V. CONCLUSION

LMA HU and SNR values were different according to BMI and contrast media dose. Quality images could be obtained with appropriate high HU and SNR levels, even when a smaller amount of contrast media was used than specified in test manuals. When CT testing, we need to use different amount of contrast media according to the BMI of patients.

A protocol to check the BMI of patients before performing CT examinations and to determine least necessary contrast media amount for the test should be developed. Based on the results of this study, we need to minimize contrast medium side effects while acquiring an excellent SNR by selecting the most optimal contrast media amount considering the patients' BMI.

ACKNOWLEDGMENT

This Study was supported by the 2015 Academic Research Support Project of Hanseo University.

REFERENCES

- [1] Seung-WoonJeung, Cheong-Hwan Lim, Young-CheolJoo, A Study on the Work Environment and VDT Syndrome in Radiation Technologists Working in the Area of 3D Processing, *Indian Journal of Science and Technology*, 2015 August, Vol.8 No.18.
- [2] In-Gyu You, Cheong-Hwan Lim, Young-CheolJoo , A Study on the of Justification of Low Dose Chest Computed Tomography during Health Examinations, *Indian Journal of Science and Technology*, 2015 January, Vol.8 No.S1.
- [3] Hyeong-Jin Kim, Evaluation of radiation dose and image quality between manual and automatic exposure control mode according to body mass index in cardiac CT . *Department of Radiological Physics Graduate School of Dongshin University*, 2013.
- [4] Woo-Tae Yang, Seung-Hee Shin, Research on contrast media injection method by Heart rate for diagnostic area extension when do Cardiac CTA, *Journal of Korean Society of computed Tomographic Technology*, 2008, vol. 10, no. 1, pp. 89-94.
- [5] Won-Seok Yang, Seong-Gyu Shin, Consideration of Adverse Reaction to MDCT Contrast Media, *J Korean Soc Radiol*, 2012, vol. 35, no. 1, pp. 51-57.
- [6] Jong-Kap Oh, An Estimate of image Quality and Radiation Doses of Coronary Artery in MDCT Using Prospective and Retrospective ECG Gating Scan Mode, *J Korean Soc Radiol*, 2011, vol. 34, no. 4, pp. 315-321.
- [7] Ki-Soo Kwon, Analysis of Adverse Reaction to CT Contrast Medium, *Department of Clinical Nursing, Graduate School of Industrial Technology University Ulsan*, 2004
- [8] Woo-Sang Lee, Heung-Seon Im, The Method of CT Aortography and Contrast Media Injection in 64-MDCT, 2013, vol. 15, no. 1, pp. 127-135.
- [9] Min Kang, Study of Optimum Contrast Medium Quantity During Abdominal CT Using Dual Energy Technique, *J Korean Soc Radiol*, 2015, vol. 9, no. 1, pp. 9-16.
- [10] Young-Deog Kim, The side effect of contrast media and its related factors in contrast enhanced computed tomography, *Department of public health Graduate School Chonnam National University*, 2005.
- [11] Seong-Ju Lee, Yeon Park, Da-Hi Jeong, Seung-Ho Ock, Hi-Jin Hwang, Heung-Seon Hwang, A Study on the usefulness of Dilution of Contrast Media in CT Examinations, *Journal of Korean Society of computed Tomographic Technology*, 2011, vol. 13, no. 2, pp. 161-167.
- [12] Dong-Hoon Lee, Evaluation of image quality with the change of KV and BMI in the abdominal CT, *Department of Radiological Science Graduate School of Life Sciences Catholic University*, 2012.
- [13] Jeong-Hoon Kim, Jae-Yeon Chung, Ki-Hong Kim, Reduction of Contrast Volume in Head Angiography by MDCT, *Journal of Korean Society of computed Tomographic Technology*, 2008, vol. 10, no. 1, pp. 117-121.
- [14] Yun-Ki Kim, Myeong-Sung Kim, Comparison of the contrast effect of the amount and iodineconcentration of CT contrast agent, *Journal of Korean Society of computed Tomographic Technology*, 2014, vol. 16, no. 2, pp. 181-187.



ISSN
0975-6299

The Importance of Radiation Safety Control for Those Close to the Patient and Radiation Worker throughout the Course of PET-CT

Sang-Tae Kim, Radiation Safety Division, Nuclear Safety and Security Commission, Seoul, Republic of Korea.
E-mail:rad21@korea.kr

Jung-Keun Cho*, Jeonju University, Department of Radiological Science, Jeonju, Republic of Korea. E-mail:cjk0129@jj.ac.kr

Abstract---

In nuclear medicine and molecular imaging tests in particular, PET-CT is frequently used. The safety level of those close to patients who had been administered ^{18}F -FDG and of the patient himself was measured until the radiation dose reached below the background level. Moreover, through measurement of space dose distribution, the dose of radiation that medical staff receive during their course of work was forecast to verify the need for radiological protection. This study provides a basic set of data to verify this need, bring all areas under the safety standards for radiation and to adopt new regulations.

Keywords--- PET-CT, Radiation Dose, Radiological Protection, Radiation Safety Regulations.

* Corresponding Author

I. INTRODUCTION

Nuclear medicinal diagnosis using radiopharmaceuticals is on the increase as it allows for the assessment of physiological pharmacokinetic functions¹. The use of radiological isotopes in medical fields offer clear benefits in justifying diagnosis and treatment but medical staff, professional nurses or guardians can be exposed to potential risks². Positron Emission Tomography-CT(PET-CT) which takes up a large share in cancer diagnosis offered a chance to analyze tumors on in units of molecular images³. PET-CT is a method of imaging cancer by administering internally radiological drugs combined with isotopes that emit positrons, then combining the detailed anatomical information acquired through CT with the radiological distribution from PET. Radiological isotopes used for realizing such images are ¹⁸F-Fluoro-deoxyglucose(FDG)⁴.

However, when internally administered, the body becomes the source of radiation and radiation is constantly emitted until it leaves the body through the kidneys. Most diagnosis or treatment situations do not offer such information to the patient, professional nurse or guardian and as a result these people are exposed to radiation. This is due to the lack of an isolated space in medical institutions and a low awareness of radiation of those near the patient that can occur from nuclear medicinal tests. Compared to the regulations on radiological pharmaceutical products, regulations on radiation emitted from the patient after tests are not specified, adding to the problem. In particular, patients that have difficulty in moving, elderly patients, their guardians or nurses are exposed to a greater degree than others but this fact is neglected. To date, the harm caused by radiation is known to include decreased numbers of globules in the blood, cataract and various cancers.

ICRP strongly recommends guidelines on radiation dose. At present, the control standards for radiological protection is based on the Nuclear Safety Act that was legislated based on ICRP 26. In the field of medicine, quality control and radiation safety control are carried out for radio isotopes used for the diagnosis and treatment of nuclear medicine, radiation equipment and those working in the field. Under the Medical Act, rules on the safety control of diagnostic radiation generators are legislated to measure the radiation dose of those working in the field. According to the report UNSCEAR 2000, it is estimated that radiation from medical services will exceed natural radiation⁵. ICRP emphasizes the importance of radiological protection as an increasing number of people are exposed to ionizing radiation from medical services, and those near the patient or those working in radiation related fields are also heavily exposed.

Therefore, when using radiation, it recommends that 'the minimum dose of radiation should be used to gain the maximum benefits'. While artificial radiation cannot be removed entirely, minimizing it to within the degree that doesn't cause damage the benefits of diagnosis is a main theme of studies conducted around the world⁶. The aggregate benefits gained by using radiation includes not only direct benefits (diagnostic information or treatment of diseases) for the patient, but also indirect benefits that goes to the family or society. Although major radiation is exposed to the patient, they are not the object of radiological protection. It is recommended that radiation that the medical staff, nurses and patients' guardians are exposed to must also be considered⁷. Therefore, this study measures the radiation dose received by those around the patient, his guardian and the general public from the moment ¹⁸F-FDG which is most commonly used is administered to the patient until it is completely removed from the body after the test to measure the safety levels. By measuring the space radiation, the dose of radiation medical staff is exposed to is also forecast to be used as a basic set of data for studies on radiological protection.

II. MATERIALS AND METHODS

A. *Measurement Equipment*

Space scattered dose was measured by RadEye B20(Thermo Scientific™, Inc.). PET-CT scanner used for nuclear medicinal molecular imaging test was Discovery 690(GE, Inc.).

B. *Subjects*

Out-patients who were reserved for a PET-CT scan were used as subjects in the experiment group. There were 30 patients and they all had a disease. After gaining prior approval from the medical staff, these patients were monitored for 24~48 hours following their injection. The space scattered radiation was measured at 100 centimeters from the patient at the same time. The average age of the subjects was 61 years old, their height 160.5cm, and body weight 63kg. The radiation received by the abdomen and the space scattered

radiation from 100 centimeters away from the body were measured for 48 hours with subjects without any illness. The average injection activity of ^{18}F -FDG was 10mCi and it was injected throughout the entire body.

C. Measurement Method of Radiation Dose

Measurement of Radiation Dose Rate Near the Patient

After injecting ^{18}F -FDG for the full body PET-CT test, the space scattered radiation dose was measured. 100 centimeters away from the abdomen was used as the reference point to measure radiation emitted from the patient's body immediately after, as well as 1~24 hours and 48 hours after injecting the ^{18}F -FDG (an average of 370 MBq). It was measured until radiation was completely removed from the body and reached background level.

Measurement of Medical Radiation Dose Rate

To measure the radiation dose to which medical staff is exposed, the time they stay in the injection room and stabilization room from ^{18}F -FDG is injected and the radiation dose were measured. The time it takes for the radiologist to adjust the patient's location or posture in the PET-CT room and the time it takes for them to guide the patient to the test room till they leave the room were measured to calculate the accumulative radiation dose of those working in the field of radiation.

Measurement of the Radiation Received by those Near the Patient During the PET-CT test and Emitted by the Location of the Abdomen

The space scattered radiation dose from the moment the patient who had been administered ^{18}F -FDG undergoes the PET-CT test in the test room and throughout the scan was measured. To compare the radiation emitted from the location of the abdomen, it was measured and compared against the radiation from near the patient.

III. RESULTS AND DISCUSSIONS

A. Measurement of Space Scattered Radiation from the Body Trunk of the Patient

Measurement of the radiation that the patient's guardian and nearby people receive immediately following the injection of ^{18}F -FDG for the full body PET-CT test up to 48 hours after showed that the average dose immediately after injection was 83.51 $\mu\text{Sv/hr}$. After 60 minutes it was 58.22 $\mu\text{Sv/hr}$, and 6 hours after it decreased to 9.10 $\mu\text{Sv/hr}$. After 24 hours, there was a dramatic decrease to 0.14 $\mu\text{Sv/hr}$ but it was higher than the surrounding radiation (Figure 1). Such results show that compared with the background radiation of 0.1 $\mu\text{Sv/hr}$, it is still higher than the surrounding radiation 24 hours after. Therefore, patient who had been administered with ^{18}F -FDG require isolation for 24 hours or more.

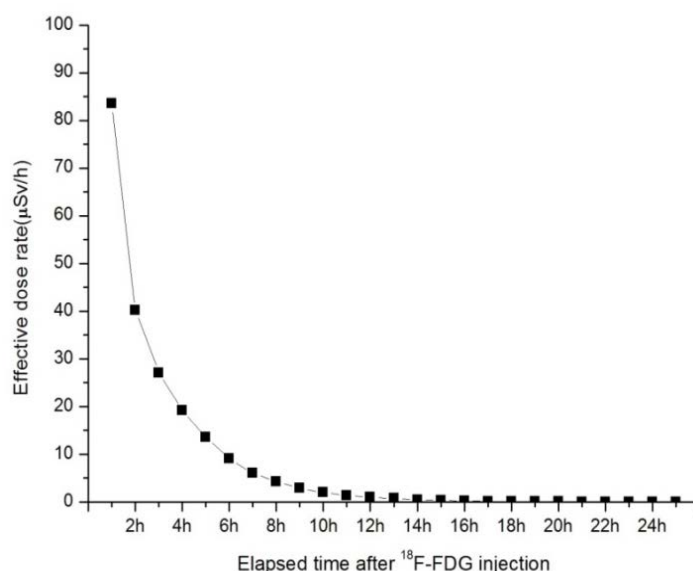


Figure 1: Changes in Radiation Around the Patient at 100 cm Distance

B. Surface Radiation(Abdomen)

To compare the total dose of radiation received by the patient himself, radiation was measured at intervals after injecting ^{18}F -FDG 370 MBq and until it matched the background radiation dose. Immediately following the injection and up to 15 hours, the radiation from the abdomen location was 11 times higher than the body trunk radiation. After 48 hours, it was measured to be about the same level of the background radiation. The surface radiation of the abdomen location was 1,101.1 $\mu\text{Sv/hr}$. After 1 hour it was 685.5 $\mu\text{Sv/hr}$, and after 6 hours it was 103.2 $\mu\text{Sv/hr}$. 12 hours after injection it was 10.6 $\mu\text{Sv/hr}$. Even after 24 hours it measured 0.38 $\mu\text{Sv/hr}$, indicating that not all had left the body through the kidneys and the radiation energy received by the patient is more than 10 times that of the body trunk radiation (Figure 2).

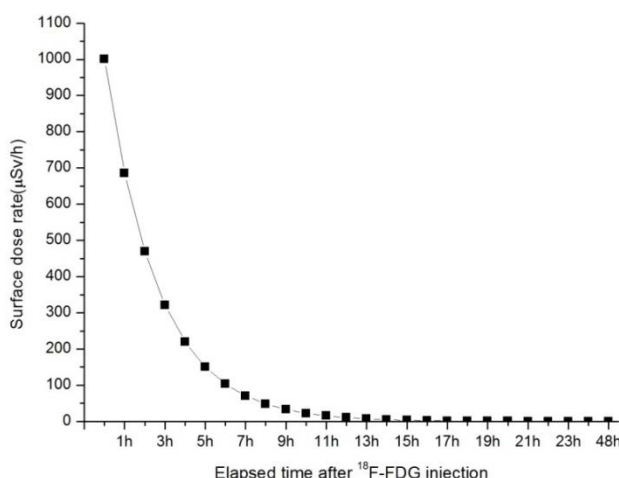


Figure 2: Changes in Surface Radiation Over Time

C. Evaluation of Radiation Exposure of Radiation Worker

While it will vary across different medical institutions, if a radiologist in the PET-CT test room were to take 10 patients per day, they interact with patients for about 100 minutes per day. Since most tests are conducted within 60 minutes of the injection of ^{18}F -FDG, radiation workers are exposed to a relatively high level of radiation. If we assume they work five days a week for 50 weeks a year, annual radiation is 4.63 mSv/y. Compared to the exposure of the general public which is 2.4 mSv/y⁸, they receive more than 3 times. There are also differences in the test preparation times and how long they spend in the test room, depending on their skill levels. Therefore, a moveable shield wall should be used as a protective measure for those working in the PET-CT room for a more proactive effort for radiological protection of radiologists in the field.

Radiation received by the patient's guardian or nurse was calculated under the assumption that these were professionals. Radiation was measured at 30 minute intervals after injecting ^{18}F -FDG until it reached a similar level to background radiation (0.1 μSv). The value measured was then calculated into radiation per hour. The results show that when nursing one patient who had undergone PET-CT test using ^{18}F -FDG, the daily radiation received is about 334 μSv .

However, these nurses do not stay at the patient's bedside throughout the entire year and exposure is very limited. This is not a worrisome level. However, since nurses are applied the radiation limit of the general public, if they were to nurse more than three patients a year who had been administered radio isotopes, then they may exceed the annual radiation limit for the general public. This study showed that most of the professional nurses are part-time workers that have not undergone training on caution required for radiation. Therefore medical institutions must provide radiological protective measures and safety training for the guardians or nurses of patients who had undergone tests using radiopharmaceuticals. Meanwhile this study showed that there was no significant difference in surrounding radiation across different diseases.

The radiation from the body trunk of a patient administered with ^{18}F -FDG and undergone full body PET-CT scans showed that the average radiation was 4.0 mSv/y which is a very high level. Therefore when conducting a PET-CT scan, shielding is extremely important and a focused effort on minimizing the radiation exposure of the patient is needed (Figure 3).

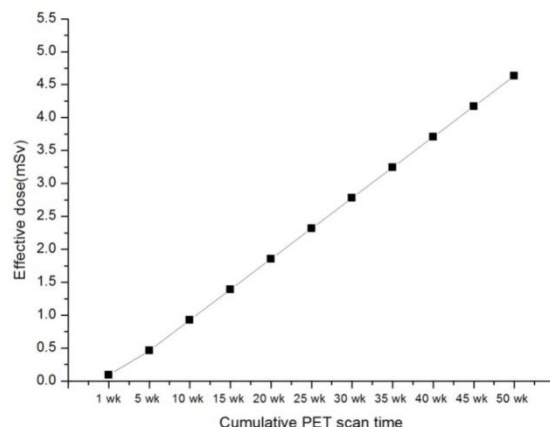


Figure 3: Effective Dose of Work Duration According to the Venue Where Radiological Isotopes are Handled

IV. CONCLUSION

This study was conducted as a basic study on safety evaluation for radiation received by patients undergoing PET-CT test using ^{18}F -FDG, their guardians (nurses) and radiologists. By measuring radiation in each unit, the importance of radiological protection for radiologists was highlighted and the need for radiology safety training for patients, their guardians and nurses and for related regulations was also brought into focus. The following conclusions were reached.

First, the measurement of space scattered radiation from the patient's body trunk showed that for 24 hours following injection of ^{18}F -FDG, a higher energy was emitted than the background radiation. The space scattered radiation over time shows that 1 hour after it decreased by about 32% and by about 90% after 6 hours. After 24 hours, it was only slightly higher than the background level, indicating the need for the patient's isolation for 24 hours following ^{18}F -FDG injection.

Second, a comparison of the radiation from the abdomen and the body trunk shows that radiation received by the patient is 10 times higher than that of the body trunk, suggesting an urgent need to minimize radiation exposure of the patient.

Third, when a radiologist is assumed to test 20 patients a day, the space scattered radiation received is 4.63mSv/yr.

Fourth, although nursing of patients who had been administered radiological isotopes is not done all year long and exposure is over a limited time, nurses still fall under the guideline limit for radiation of the general public.

Therefore if they nurse three or more such patients per year, they can exceed the annual limit. A more systematic radiation safety control measure that includes control of nursing history is recommended. Those near the patients that undergo PET-CT tests are vulnerable in terms of radiation safety or regulations. Patients who had undergone such tests must be isolated by the medical institution and recommended to avoid being in rooms with many other people. Radiologists must be monitored continuously through a new system for managing accumulative radiation dose. A standard for radiological protection for out-patients who undergo tests must be established and measures to better manage patients after tests are also in urgent need.

REFERENCES

- [1] AC. Duponta, D. Guilloteaua, M. Kassiouc, MJ. Ribeiroa, J. Vercouilliea, A. Katsifisd, N. Arlicota. Radiopharmaceuticals for PET imaging of neuroinflammationLes radiopharmaceutiques pour l'imagerie TEP de la neuroinflammation. *Medecine Nucleaire*. 2016, 40 (1), pp. 72-81.
- [2] L B. Zablotska1, E Ron, A V. Rozhko, M Hatch, O N. Polyanskaya, A V. Brenner, J Lubin, G N. Romanov, R J. McConnell, P O'Kane, V V. Evseenko, V V. Drozdovitch, N Luckyanov, V F. Minenko, A Bouville and V B. Masyakin. Thyroid cancer risk in Belarus among children and adolescents exposed to radioiodine after the Chernobyl accident. *British Journal of Cancer*.2011, 104(1), pp. 181-187.
- [3] Michael EPhelps. Positron emission tomography provides molecular imaging of biological processes.*Proceedings of the National Academy of Sciences of the United States of America*.2000 ,

- 97(16), pp. 9226-9233.
- [4] David S. Boss. Renato Valdes Olmos, Michiel Sinaasappel, Jos H. Beijnen, and Jan H M. Schellens. Application of PET/CT in the Development of Novel Anticancer Drugs. *The oncologist*. 2008,. 13(1), pp. 25-38.
 - [5] UNSCEAR (United Nations Scientific Committee on the Effects of Radiation) Sources and effects of ionizing radiation. United Nations, New York, 2000.
 - [6] Elaine Ron. Ionizing radiation and cancer risk: evidence from epidemiology. *Pediatric Radiology*. 2002, 32(4), pp. 232-237.
 - [7] International Commission on Radiological Protection, General Principles for the Radiation Protection of Workers. ICRP Publication 75, Annals of ICRP 27, Nr.1, 1997.
 - [8] Mehdi Sohrabi. World high background natural radiation areas: Need to protect public from radiation exposure. *Radiation Measurements*. 50. 2013, pp. 166-171.



ISSN
0975-6299

Effect of Proper Defensive Equipment in the Radiological Examination Environment

Sang-Tae Kim, Radiation Safety Division, Nuclear Safety and Security Commission, Seoul, Republic of Korea.

E-mail:rad21@korea.kr

Jung-Keun Cho*, Jeonju University, Department of Radiological Science, Jeonju, Republic of Korea. E-mail:cjk0129@jj.ac.kr

Abstract---

In the medical imaging field, an imaging examination was performed using a diagnostic X-ray unit, and the radiation shielding efficiency was measured of 0.25mmPb and 0.5mmPb lead aprons against each of a X-ray and a γ -ray by hypothesizing an image acquisition situation using radiopharmaceuticals which are most commonly used in the nuclear medicine examination field. In the case of using a diagnostic X-ray unit, effective doses were measured based on comparison between the situations where a lead apron was worn and where it was not, at the distances of 25cm and 100cm away from the radiation field center under the 70kVp, 20 mAs exposure condition. This result showed that the radiation shielding efficiency of a 0.5mmPb apron increased by about 67.9% at the distance of 25cm and about 66.5% at the distance of 100cm, compared to a 0.25mmPb apron. Also, when compared to a 0.25mmPb apron, the radiation shielding efficiency of a 0.5mmPb apron against the radiopharmaceutical(140keV) of ^{99m}Tc series increased by about 43.1% at the distance of 25cm and about 43.3% at the distance of 100cm while it increased by about 2.3% at the distance of 25cm and about 8.0% at the distance of 100cm against the relatively high energy of 131I, which revealed its very low radiation shielding efficiency.

Keywords--- Diagnostic X-Ray Unit, Radio Pharmaceuticals, Lead Apron, Radiation Shielding Efficiency.

* Corresponding Author

I. INTRODUCTION

Using radiation in medical institutions or industries is only allowed when the expected benefits are greater than the predicted losses from being exposed to however low levels of radiation, and reducing a chance of being exposed to radiation can decrease the incidence of stochastic effects and decisive effects caused by the exposure to radiation ¹. Also, with the increasing public concerns of health, there has been a rapid increase in the use of radioisotopes and radiation generators by medical institutions. Therefore, the management of an exposure dose on patients and radiation workers in a bid to reduce physical effects of radiation is one of the most importance tasks ²⁻⁴.

As ways to prevent exposure to electromagnetic radiation, the leads with higher atomic numbers are known to have the most excellent radiation shielding effect, and the radiation defense lead aprons with over 0.25mmPb in compliance with the IEC 61331-3 standards are being used. There are two types of electromagnetic radiation, X-ray and γ -ray, used in medical institutions, with the X-ray using the low effective energy below 50 keV usually in the general imaging rooms and the γ -ray using the relatively high energy of radiopharmaceuticals between 140 keV and 511 keV in the nuclear medicine departments where γ -rays are usually used for diagnostic purposes ⁵. Some researchers argue that a lead apron can create a radiation shielding effect by interacting with the high-energy electromagnetic radiation γ -rays used in the nuclear medicine departments, whereas others suggest the very opposite opinion that a lead apron has no shielding effect but only exacerbates the exposure to radiation ⁴.

In addition, among the three defense principles against exposure to the external radiation including a distance, a time, and shielding, the exposure to radiation is inevitable when a patient or a guardian assist the radiation imaging.

Even though it should be desirable to wear a lead apron in this case, it is increasingly ignored for the reasons like its heaviness and discomfort ⁶.

This issue has been gaining more attention because of the recent increase in the amount and the frequency of the use of ¹³¹I and ^{99m}TcO₄⁻ with their rapidly increasing speed ⁷. In particular, with ¹³¹I being frequently used for the treatment and the diagnosis of thyroid diseases, radiation workers and patients are required to endeavor to reduce the amount of radiation exposure dose from the radionuclide during their nuclear medicine examinations.

As it is very important to make use of lead aprons in case radiation exposure is unavoidable, this study aims to emphasize the significance of the radiation defense by making accurate measurements of the radiation shielding efficiency according to the X-ray energy of a diagnostic X-ray unit and the γ -ray energy of radiopharmaceuticals in ^{99m}Tc series and ¹³¹I, for the purpose of reducing a radiation exposure dose onto workers and guardians from the radiation safety management side.

II. MATERIALS AND METHODS

A. Diagnostic Radiological Examination

Effective Dose Measurement

In the geometric arrangement (Figure 1) to measure the effective energy of a X-ray, 200 times of exposure in the exposure condition of 70kVp, 20mAs was performed under the assumption of a general plain abdomen radiograph, and the effective doses at the distances of 25cm and 100cm were measured by comparing between the cases where a lead apron was worn and where it was not.

In order to compare the difference in radiation shielding efficiency between the aprons at different thicknesses, lead aprons at thickness of 0.5mmPb and 0.25mmPb were applied. For comparison of radiation shielding efficiencies in the assumption that an actual radiation worker is examining a patient close to the X-ray source, a survey meter was attached at the front and the back of an apron against the firm supporting structure so that comparison can be done for when an apron is present and when it is not, at the distances of 25cm and 100cm.

The measurement height was set at 120cm, assuming that it is the same height as the radiation worker's heart at which a personal dosimeter is attached.

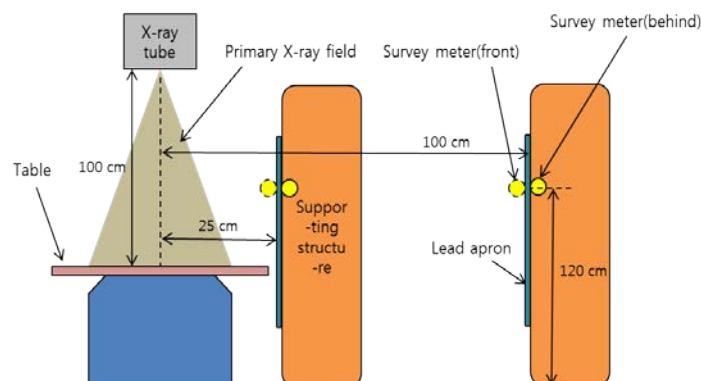


Figure 1: Geometric Structure to Measure Effective Dose in Diagnostic Radiological Examination

Verification Calculation

It is assumed that the effective energy is 37 keV when there is 200 times of exposure (200×1s=200s) in the exposure condition of 70 kVp, 20 mA. After 200 times of exposure, an effective dose rate at the distance of 100cm away from the X-ray field was calculated and its verified result is as follows.

- ① Number of generated electrons : $N = (20 \times 10^{-3} \text{ C/s}) / 1.6 \times 10^{-19} \text{ C/ip} = 3.2 \times 10^{17} \text{ ip}$
- ② Incidence rate of braking radiation : $ZE/800 = 74 \times 0.037 \text{ MeV} / 800 = 0.0034225$
- ③ Amount of braking radiation : $0.006475 \times 6.25 \times 10^{18} \text{ ip} = 2.214 \times 10^{16}$
- ④ Equivalent activity : $(2.214 \times 10^{16}) / (3.7 \times 10^{10} \text{ Bq/Ci}) = 598378.3$
- ⑤ Gamma(γ) constant(Γ) = $0.037 \text{ MeV} / 2 = 0.0185 \text{ R} \cdot \text{m}^2 / \text{Ci} \cdot \text{h}$
- ⑥ Effective dose rate at distance of 1m : $0.0185 \times 598378.3 \text{ Ci} = 11070 \text{ R/h} = 3.075 \text{ R/s} = 3.075 \text{ rem/s} = 0.03075 \text{ Sv/s} = 30.75 \text{ mSv/s}$

- ⑦ Effective dose when a lead apron worn
 (25 cm point) $30.75 \text{ mSv/s} \times 1/1000 \times 200 \text{ s} \times 12 \text{ m} / 0.252 \text{ m} = 98.4 \text{ mSv}$
 (100 cm point) $30.75 \text{ mSv/s} \times 1/1000 \times 200 \text{ s} \times 12 \text{ m} / 12 \text{ m} = 6.15 \text{ mSv}$
- ⑧ Effective dose when a 0.25 mmPb apron worn
 (25 cm point) : $6.15 \text{ mSv} \times (1/10) 0.25 / 0.52 \times 12 \text{ m} / 0.252 \text{ m} = 32.5 \text{ mSv}$
 (100 cm point) : $6.15 \text{ mSv} \times (1/10) 0.25 / 0.52 \times 12 \text{ m} / 12 \text{ m} = 2.03 \text{ mSv}$
- ⑨ Effective dose when a 0.5 mmPb apron worn
 (25 cm point) : $6.15 \text{ mSv} \times (1/10) 0.5 / 0.52 \times 12 \text{ m} / 0.252 \text{ m} = 10.8 \text{ mSv}$
 (100 cm point) : $6.15 \text{ mSv} \times (1/10) 0.5 / 0.52 \times 12 \text{ m} / 12 \text{ m} = 0.67 \text{ mSv}$

In the case of formula ⑦, the reason why 1/1000 is multiplied is because of the NCRP 49 stating that leakage radiation is 1/1000 times of radiation dose rate from the exposure direction⁸.

In the case of formula ⑧, the ANSI/HPS N 43.3-2008 and the NCRP 147 Structure Shielding Design for Medical X-ray Imaging Facilities were referred to for TVL.

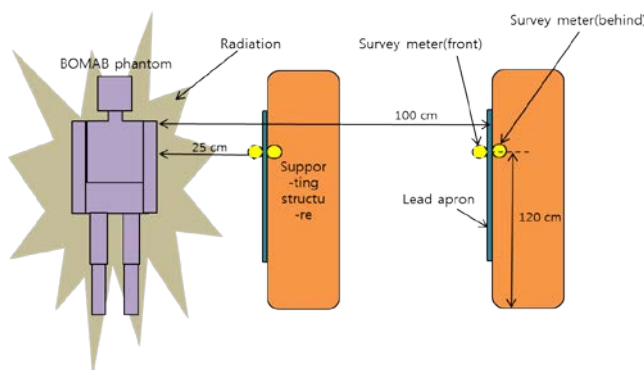


Figure 2: Geometric Structure to Measure Effective Dose in Nuclear Medicine Examination

Verification Calculation

The assumption for verification calculation is same as that for effective dose measurement. The verified result of effective dose rates through calculation is as follows. It was assumed to be 150 keV because the maximum energy released from ^{99m}Tc is 141 keV(89%) while it was conventionally assumed to be 500 keV because the maximum energy released from ^{131}I is 637 keV 7%, 365 keV(82%).

'Handbook of Health Physics and Radiological Health Third Edition⁹ was referred to for a mass attenuation coefficient. It means that linear attenuation coefficients of ^{99m}Tc and ^{131}I for lead are like the formula (1) and (2) respectively, and a gamma(γ) constant is like the formula (3).

$$\mu_{Pb, ^{99m}Tc} = \frac{2.014 \text{ cm}^2/\text{g}}{\text{g}} \times \frac{11.35 \text{ g}}{\text{cm}^3} = 22.86 \text{ cm}^{-1} \text{ ----- (1)}$$

$$\mu_{Pb, ^{131}I} = 1.614 \text{ E} - 01 \frac{\text{cm}^2}{\text{g}} \times \frac{11.35 \text{ g}}{\text{cm}^3} = 1.83 \text{ cm}^{-1} \text{ ----- (2)}$$

$$I = \frac{\tau \cdot A}{r^2} e^{-\mu \cdot t} \text{ ----- (3)}$$

τ of ^{99m}Tc is 3.317×10^{-5} mSv/h/MBq/m while τ of ^{131}I is 7.647×10^{-5} mSv/h/MBq/m.

< ^{99m}Tc >

1) Effective dose when a lead apron is not worn

(25 cm point) : $(3.317 \times 10^{-5} \times 1100) / 0.252 \times 100\text{h} = 58 \text{ mSv}$

(100 cm point) : $(3.317 \times 10^{-5} \times 1100) / 12 \times 100\text{h} = 3.7 \text{ mSv}$

2) Effective dose when a 0.25 mmPb apron is worn

(25 cm point) : $\{(3.317 \times 10^{-5} \times 1100) / 0.252\} e^{-22.86 / 0.025 \times 100\text{h}} = 33 \text{ mSv}$

(100 cm point) : $\{(3.317 \times 10^{-5} \times 1100) / 12\} e^{-22.86 / 0.025 \times 100\text{h}} = 2.1 \text{ mSv}$

3) Effective dose when a 0.5 mmPb apron is worn

(25 cm point) : $\{(3.317 \times 10^{-5} \times 1100) / 0.252\} e^{-22.86 / 0.05 \times 100\text{h}} = 18.6 \text{ mSv}$

(100 cm point) : $\{(3.317 \times 10^{-5} \times 1100) / 12\} e^{-22.86 / 0.05 \times 100\text{h}} = 1.2 \text{ mSv}$

< ^{131}I >

1) Effective dose when a lead apron is not worn

(25 cm point) : $(7.647 \times 10^{-5} \times 370) / 0.252 \times 100\text{h} = 58 \text{ mSv/h}$

(100 cm point) : $(7.647 \times 10^{-5} \times 370) / 12 \times 100\text{h} = 3.7 \text{ mSv/h}$

2) Effective dose when a 0.25 mmPb apron is worn

(25 cm point) : $\{(7.647 \times 10^{-5} \times 370) / 0.252\} e^{-1.83 / 0.025 \times 100\text{h}} = 43.2 \text{ mSv}$

(100 cm point) : $\{(7.647 \times 10^{-5} \times 370) / 12\} e^{-1.83 / 0.025 \times 100\text{h}} = 2.7 \text{ mSv}$

3) Effective dose when a 0.5 mmPb apron is worn

(25 cm point) : $\{(7.647 \times 10^{-5} \times 370) / 0.252\} e^{-1.83 / 0.05 \times 100\text{h}} = 41.3 \text{ mSv}$

(100 cm point) : $\{(7.647 \times 10^{-5} \times 370) / 12\} e^{-1.83 / 0.05 \times 100\text{h}} = 2.6 \text{ mSv}.$

III. RESULTS

A. Effective Dose According to the Thickness of an Apron and the Distance from the Ray Source

The nuclear medicine examination using a plain abdomen radiograph and a radiopharmaceutical is fundamentally a flow of phantom energy of X-ray and γ -ray, only differing in the kind of radiation sources for diagnosis. It is shown that the thicker the lead and the further it is from the ray source, the lower the effective dose, which leads to the increased radiation defense effect. Of course, this result is consistent with the prediction that the effect will increase as the radiation exposure time reduces. (%Diff. = {(measurement - calculation) / measurement} $\times 100$)

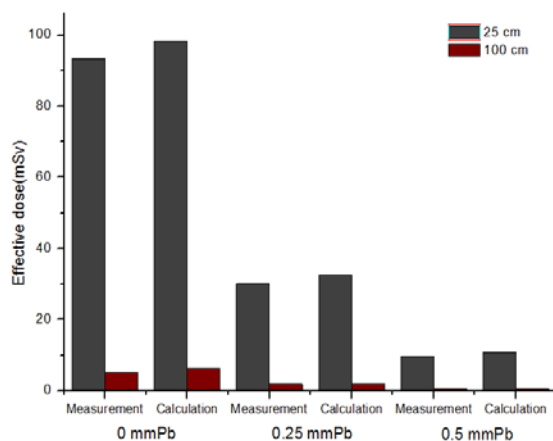
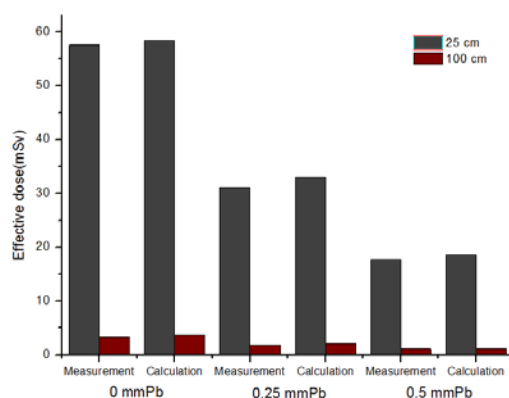
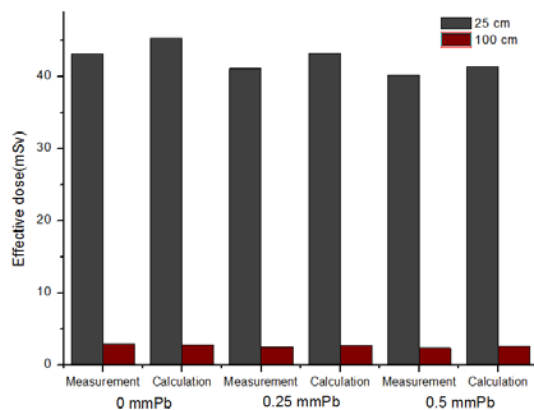


Figure 3: Comparison of Effective Dose Measurement Values and Verification Calculation Values when using a Plain Abdomen Radiograph



(a) ^{99m}Tc



(b) ^{131}I

Figure 4: Comparison of Effective Dose Measurement Values and Verification Calculation Values when using a Radiopharmaceutical

B. Radiation Shielding Efficiency According to the Difference in γ -Ray Energy

According to the measurement result of the radiation shielding efficiency of lead aprons depending on different kinds of radiopharmaceuticals, which is the difference in the γ -ray energy, the change in effective doses at the distances of 25cm and 100cm when the direct exposure to the radiopharmaceutical 1100 MBq of ^{99m}Tc series was shielded by 0.25 and 0.5 mmPb aprons is illustrated in Figure 5.

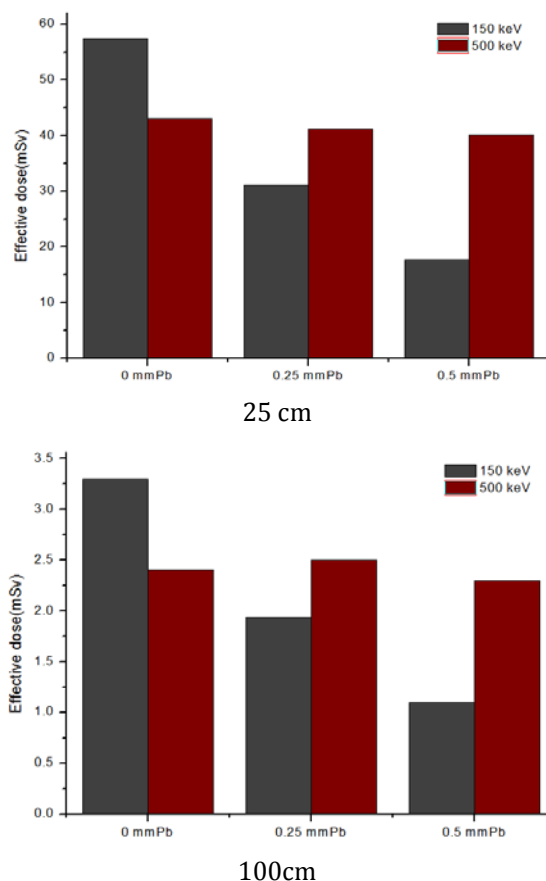


Figure 5: Change in Radiation Shielding Efficiency According to Difference in γ -ray Energy

What is notable is that there was very little radiation shielding efficiency at 4.4% and 6.8% respectively when the direct exposure to ^{131}I 370 MBq was shielded by 0.25 and 0.5 mmPb aprons, which suggests very little radiation shielding effect of an apron. Accordingly, because of the very little radiation shielding efficiency of aprons against ^{131}I which releases a relatively high γ -ray at 500 keV, the kinds of lead aprons usually used in the examination fields using radiation had almost no radiation shielding effect.

IV. CONCLUSION

Even though it is undeniable that using a lead apron is of benefit for radiation defence, even a thick 0.5 mmPb apron could only pull it down to the level of 1/10, which was not close to the expected level of radiation shielding effect from radiation workers. Consequently, it was obvious that exposure to radiation is inevitable while treating radiation.

The two kinds of aprons showed similar radiation shielding efficiency against a primary ray and a scatter ray, and had high radiation shielding efficiency up to 88~90% against 70 kVp (available energy 37 keV) of a X-ray. Also, they had up to 67~69% of radiation shielding effect against the radiopharmaceutical (150 keV) of $^{99\text{m}}\text{Tc}$ series whereas showed very little radiation shielding effect at about 6~20% against ^{131}I (500 keV) that releases relatively high energy. Because a lead apron is hardly effective, people dealing with radiation including radiation workers should manage the contact time with a patient to be short, keep the distance as far as possible when talking, and make the best of mobile shielding walls while using radiation for thyroid examination or treatment.

Also, in a diagnostic X-ray unit and within the energy range of $^{99\text{m}}\text{Tc}$, it is supposed to be desirable wearing a lead apron in order to reduce unnecessary exposure to radiation. In addition, a proactive research and development of the material with lighter, more flexible, and higher radiation shielding efficiency than existing lead apron are needed.

REFERENCES

- [1] D A. Schauer, O W. Linton. NCRP Report No. 160, Ionizing Radiation Exposure of the Population of the United States, Medical Exposure? Are We Doing Less with More, and Is There A Role for Health Physics? *Health Physics*. 2009, 97(1), pp. 1-5.
- [2] National Research Council. Health risks from exposure to low levels of ionizing radiation: BEIR VII phase 2. Washington, DC: National Academies Press, 2006.
- [3] The 2007 recommendations of the International Commission on Radiological Protection: ICRP publication 103. *Ann ICRP* 2007, 37, pp. 1-332.
- [4] AD Wrixon. New ICRP recommendations. *Journal of Radiological Protection*. 2008, 28, pp. 161-168.
- [5] International Electrotechnical Commission. IEC International Standard IEC 61131-3: Programmable Controllers, Part 3: Programming Languages, IEC, 2003.
- [6] Notes for guidance on the clinical administration of radiopharmaceuticals and use of the sealed radioactive sources. Oxon, United Kingdom: Administration of Radioactive Substances Advisory Committee, Health Protection Agency, 2006.
- [7] Ajmi, Sami, Ali, Khadija Ben, Fredj Maha Ben, Ghannouchi, Nairouz, Khalifa Mabrouk, Letaief Amel, Tc-99m and I-131 Uptake in Widespread Bone Metastases From Undetectable Digestive Adenocarcinoma. *Clinical Nuclear Medicine*. 36(11). 2011, pp. 1020-1022.
- [8] NCRP Report 49. National Council on Radiation Protection and Measurements. Structural shielding design and evaluation for medical use of x rays and gamma rays of energies up to 10 MeV, NCRP. Ref Type : Report, 1976.
- [9] Shleien, B., and M. S. Terpilak, Eds. The Health Physics and Radiological Health Handbook, 3rd Edition. Silver Spring, MD: Scinta, Inc, 1992.



ISSN
0975-6299

Controlling Spatiotemporal Chaos in Coupled Chaotic Lattices with Small-World Connectivity

Jeongho Cho*, Department of Electrical Engineering, Soonchunhyang University, Asan, Korea. E-mail:jcho@sch.ac.kr

Abstract---

Background/Objectives: Spatiotemporal chaos observed in complex systems has been an interesting representation of dynamical behavior in networks of coupled systems or oscillators when all of the individual systems or oscillators acquire identical chaotic behavior. Such behavior of a network forms many systems of interest in engineering, physics, biology, and so on.

Methods/Statistical analysis: In this study, we have thus presented a simple control method for stabilization of a particular periodic orbit or to regulate such spatiotemporal chaos existing in the small-world network where the activity of a chaotic model in each node evolves from a randomly coupled network with other dynamical nodes. The control strategy is organized through information from the local community of a subsystem and does not require any knowledge on system dynamics in advance.

Findings: Feasibility on transitions of the system under control from the district of spatiotemporal chaos to the regular one with a fixed point have been demonstrated with a small-world network combined with simple chaotic logistic map.

Keywords--- Small-World Networks, Chaos, Delay Feedback Control, Unstable Periodic Orbit, Coupled Map.

* Corresponding Author

I. INTRODUCTION

There are many complex systems capable of being described by a network or a map in nature. The network, in general, has a feature of small-world and aggregation by demonstrating a comparatively short route between any two sites despite the fact that the volume of the network is enormous. In the study of inferring the underlying interconnection topology of complex systems, small-world networks have thus consistently become a subject of investigation very involved owing to their potentials as models for interacting formations composed by large numbers of nodes¹. The connecting structure of small-world networks is positioned between regular and random connectivity. Their main benefit is that they present a high tendency of clustering, like common networks but simultaneously have short path ranges like random ones. The union of high clustering and small path length makes small-world networks most favorable organizations for processing information and to discover information reproduction principle in real world systems¹⁻³. When numerous entities are interconnected forming a network, new distinction which is typically unlike that in individual elements may come out. Therefore, real network systems are complex, and their characteristics cannot be simply illustrated as a combination of individual components. In numerous cases in real life, it is more plausible to be assumed that interactions in a network are not completely regular nor completely random but somewhere in between⁴⁻⁶.

Along with the direction of research on small-world networks, chaotic synchronization has also received an increasing interest and has been studied on electronic devices, biological and chemical systems, and others^{4-5,7-8}. Synchronization between two coupled networks exists in our lives, e.g., the infectious disease that propagates among different communities, countries, or networks such as MERS, SARS, AIDS, bird flu and so on. In order to control such chaotic synchronization many techniques of chaos control have been developed. Among a number of chaos control methodologies using a feedback loop⁹⁻¹⁶, there are two most extensively employed methods acclaimed; these are the approach from Ott, Grebogi, and Yorke (OGY)⁹ which applies small disruptions to a system parameter such that a given periodic orbit embedded in a chaotic oscillator is to be stabilized and the approach from Pyragas¹⁰ who proposed to modify state variables instead of control parameters. The dominant contribution of Pyragas was to advise a correction on a basis of delayed variable rather than endeavor on a variable. The correction action is harmonious to the discrepancy between values of a given variable at different times; the delay time is chosen as the duration of the unstable periodic orbit (UPO) in order for the stability to be secured. This is called time-delayed feedback control (DFC)¹⁰ and constructs a control signal based on the divergence between the current state of the system and its delayed one. For suitable determination of the time delay τ , the control force dissipates if the state to be stabilized is achieved. This feedback architecture is uncomplicated to implement in an experimental setup and is able to secure both fixed points and periodic orbits even if the dynamics changes very rapidly. Moreover, the DFC strategy does not require any a priori internal representation of the system dynamics as the control force is built from information of the system itself^{10,12,14}.

An exceptionally interesting form of dynamical behavior, spatiotemporal chaos^{4-5,8,17}, occurs in networks of coupled systems or coupled chaotic attractors when all of the single entities or oscillators acquire identical chaotic behavior. Such activity of a network models various systems of interest in engineering, sociology, physics, biology, etc.¹⁸⁻¹⁹. In this study, we thus employ a simple DFC approach to control spatiotemporal chaos existing in the small-world network where the activity of a chaotic model in each site evolves from a randomly coupled network with other dynamical sites. The control policy is organized through information from the local community of a subsystem and does not require any knowledge on system dynamics in advance. Transitions of the system under control from the regime of spatiotemporal chaos to the regular homogeneous ones with a fixed point have been demonstrated.

II. SMALL-WORLD NETWORKS

A special form of complex networks with features of not only a high tendency of local clustering but a small average distance is termed as a small-world network. It is fairly well known that the small-world network structure can be attained starting from randomly rearranging a regular network with a certain probability which makes the network more disordered as it goes higher¹⁻². The small-world properties is thus preserved when the rewiring probability is maintained at an appropriately intermediate value and the network is constructed initially with a one-dimensional ring lattice of N nodes. Each node is associated with its N_s nearest neighbors and randomly chosen nodes among each connection of the lattice is rearranged with

the rewiring probability of ξ with a few exceptions of multiple connections as well as self-loops⁶. Thus, $\xi = 0$ gives a regular network and $\xi = 1$ gives a random network as depicted in Figure 1 where an illustration of the network by varying amount of long-distance connections is also given. In the network in Figure 1(a) and (b), the ring of nodes is connected in a completely regular lattice ($\xi = 0$), with each cell connected to its 2 or $N-1$ nearest neighbors. Figure 1(c) represents the network by increasing values of ξ and this is a small-world network as it consists of regular and local connections mostly but a small part of connections are destroyed and reconnected to build long-distance connections. The network becomes lost the small-world property that most connections are local, as it gets added by more long-distance connections as shown in Figure 1(d) where the network looks much more random ($\xi = 1$).

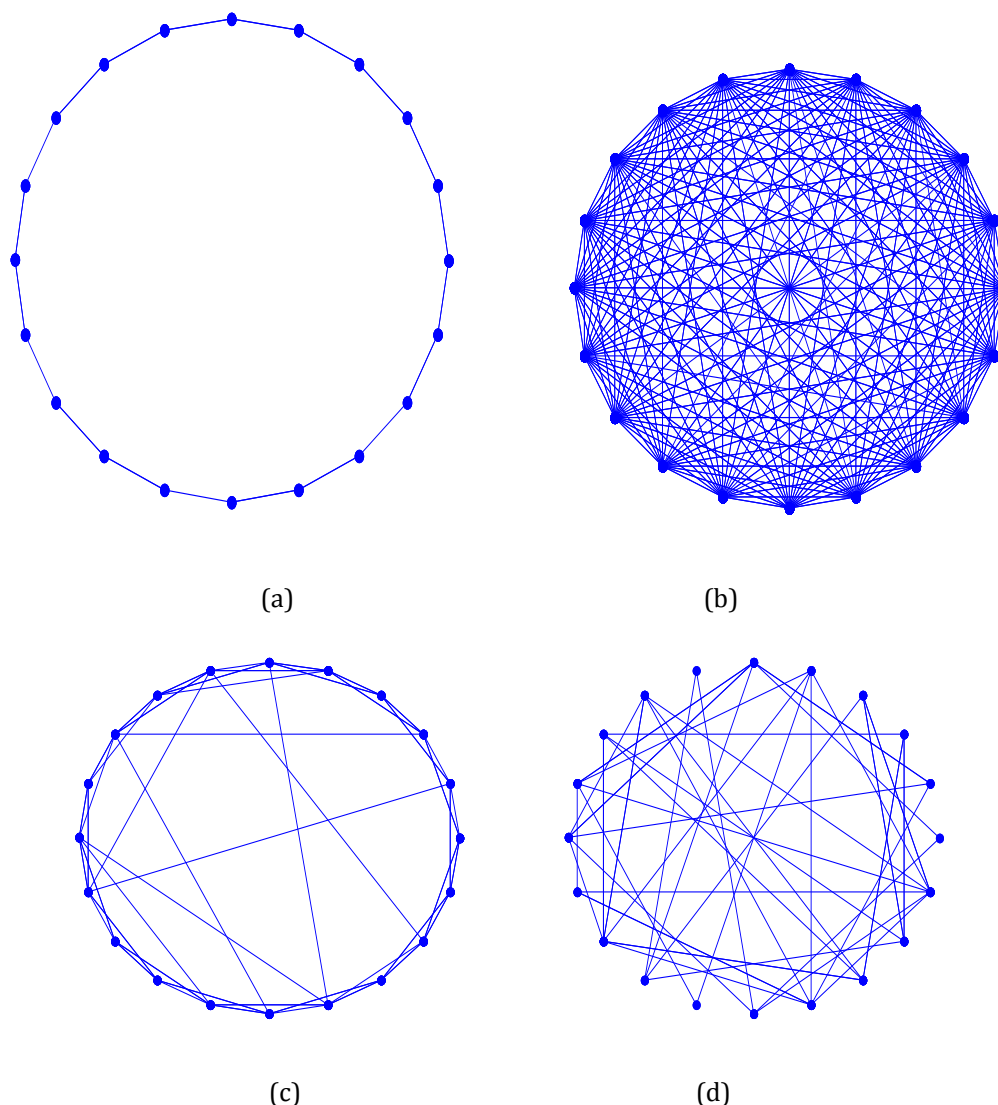


Figure 1 :Small-world network with $N=20$ nodes: each node consists of a function f

(a) $\xi = 0, N_B = 2$ (b) $\xi = 0, N_B = N-1$ (c) $0 < \xi < 1, 1 < N_B < N$ (d) $\xi = 1$.

On a basis of the properties of small-world networks, we consider the synchronous chaos in coupled map lattices^{4-5,17} with small-world connectivity, which is an extensive connectivity in the sense that the range of interaction keeps growing with the lattice size. Let us define a generic coupled map on a linear lattice of N nodes consisting of a function, f , and N_B connections between the nodes. Let each node of the network be a

state variable $x_{i,k}$ where i is a discrete spatial index ($i = 1, \dots, N$) at instance k . The evolution of the state variables is then written as

$$x_{i,k+1} = (1 - \varepsilon)f(x_{i,k}) + \frac{\varepsilon}{b_i} \sum_{\substack{j=1 \\ j \neq i}}^N C_{ij}f(x_{j,k-\tau_{ij}}) \quad (1)$$

where $\tau_{ij} \geq 0$ is the delay time in the correlation process between i th and j th nodes, and ε is the coupling strength. The topology of the network is presented through the neighboring matrix C with elements C_{ij} taking values 1 or 0 on a basis of whether i and j are connected or not. C is symmetrical in which diagonal elements are zero and $b_i = \sum C_{ij}$ is the degree of node i . The terms $1 - \varepsilon$ and b_i are employed for normalization, and the function $f(x)$ represents the local nonlinear map.

III. DECENTRALIZED CONTROL OF COUPLED CHAOTIC LATTICES

To control spatiotemporal chaos, we employ the DFC scheme derived from the construction of a special form of time-continuous perturbation; the controller does not transform the desired UPO but it can stabilize the UPO under certain conditions. Assume that the system (1) has a homogeneous state $[x_{1,k}, \dots, x_{N,k}]^T = [x_f, \dots, x_f]^T$; the local chaotic attractor $f(x)$ has a fixed point x_f satisfying $x_f = f(x_f)$. The control objective is then to suppress the turbulent behavior observed in the network as $\lim_{k \rightarrow \infty} x_{i,k} = x_f$, $i = 1, \dots, N$. Now we add the control signals to the network (1) as follows:

$$x_{i,k+1} = (1 - \varepsilon)f(x_{i,k}) + \frac{\varepsilon}{b_i} \sum_{\substack{j=1 \\ j \neq i}}^N C_{ij}f(x_{j,k-\tau_{ij}}) + u_{i,k} \quad (2)$$

where $u_{i,k}$ is the control signal of the i th site. The local controllers are given as

$$\hat{u}_{i,k} = \mu(x_{i,k} - x_{i,k-\tau}) \quad (3)$$

where μ is the feedback gain we have to design. It should be noticed that the controller does not utilize any clue about the fixed point x_f as well as information from other sites. It is undesirable for the control signal $\hat{u}_{i,k}$ to be added to the local map when the local state $x_{i,k}$ is far from x_f , since a large control signal may make the control system fall into a divergent regime. To avoid this undesired phenomenon, the local observer is employed as follows:

$$u_{i,k} = \begin{cases} \hat{u}_{i,k} & \text{if } |x_{i,k} - x_{i,k-\tau}| < v \\ 0 & \text{if } |x_{i,k} - x_{i,k-\tau}| \geq v \end{cases} \quad (4)$$

This observer passes the local control signal $\hat{u}_{i,k}$ to the local map only when the difference between $x_{i,k}$ and $x_{i,k-\tau}$ is less than a small positive threshold v .

The feedback scheme generates a control signal from the divergence, $x_{i,k} - x_{i,k-\tau}$, between the current and the delayed version of an appropriate state x of the system. It is not interfered since the control forces fade away if the target state, i.e., a steady state or a periodic orbit, is achieved. Due to this property, the unstable states of the original system are not altered directly by the control forces, but only their neighboring region is regulated in a way that neighboring time series come nearer to the target state; the control forces are activated only if the system diverges from the state to be stabilized. Owing to no numerically huge computations and experimental setups with fairly straightforward applicability, time-delayed feedback control is greatly suited to control complex systems having chaotic behaviors with very fast dynamics in real time. Moreover, the complete knowledge on the target state of the system is not required.

IV. SIMULATION RESULTS

A decentralized delayed feedback control method has been employed to control a small world network coupled with the logistic map as the local map. The logistic map is a dynamical system, which demonstrates the coexistence of attractors for certain parameter values. This map has long been utilized as a discrete time representation of population dynamics under limited resources. The model is given by the recursion

$$f(x_{i,k}) = ax_{i,k}(1 - x_{i,k}), \quad (5)$$

where $x_{i,k} \in [0,1]$ and $a \in [0,4]$ are the state variable corresponding to the population density and the parameter which controls the growth rate, respectively, and k is referred to as the iteration or the generation number of population; the population cannot go beyond a certain size due to resource limitations. Given an initial state $x_{i,0}$, the state $x_{i,k}$ can be obtained after k iterations. The logistic map exhibits apparently unpredictable behavior when the growth rate exceeds 3.58, i.e., a strictly deterministic process for $a \geq 3.58$ becomes chaotic.

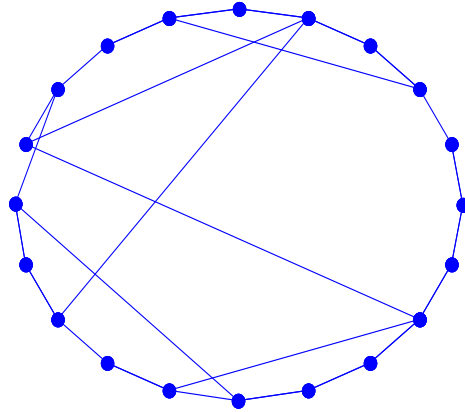
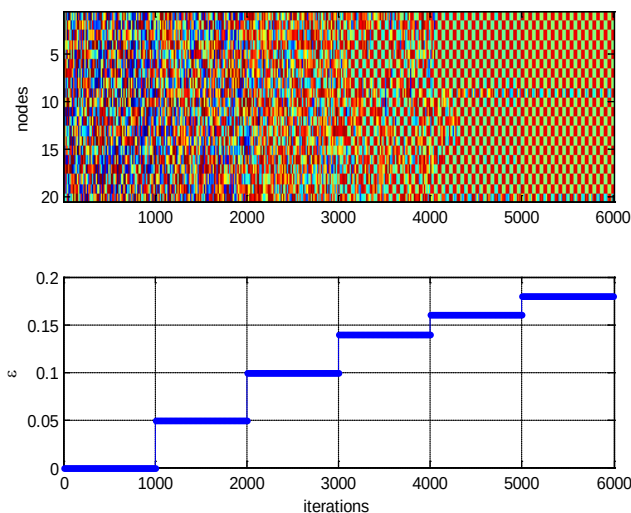
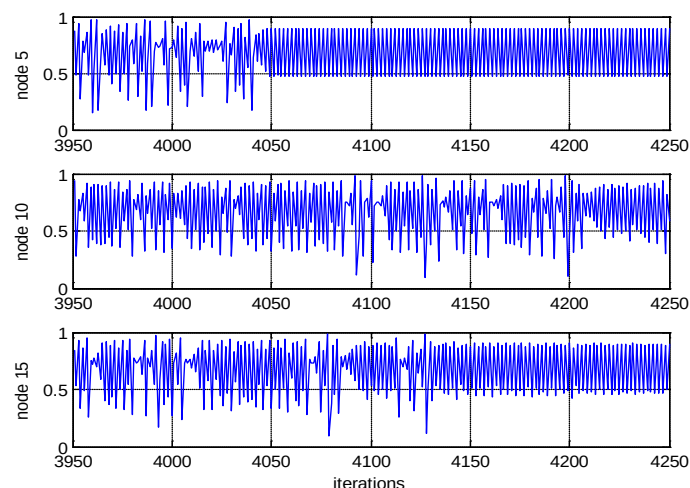


Figure 2: Small-World Network with $\xi = 0.1$, $N_B = 3$ Used in the Simulation

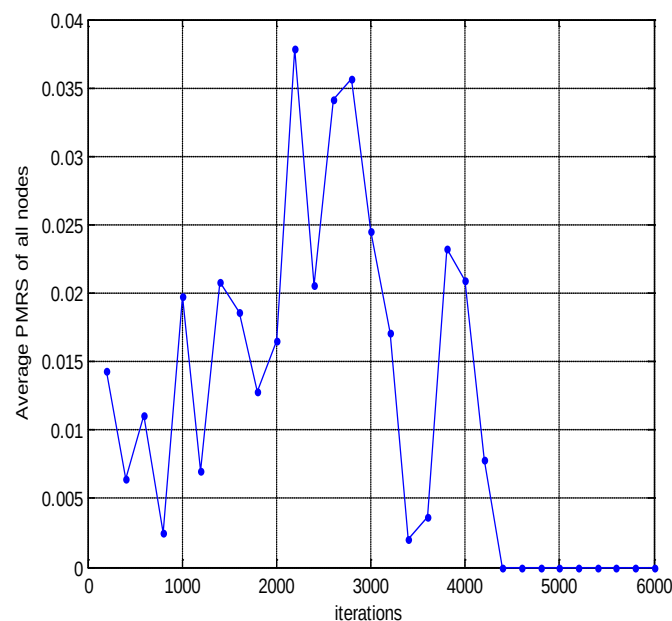
To evaluate the applicability of the DFC to the spatiotemporal chaos, we have constructed the small-world network with $N = 20$ nodes, the rewiring probability of $\xi = 0.1$, and the nearest neighbors of $N_B = 3$ as depicted in Figure 2. The logistic map (5), as a local attractor, has been formed with a parameter of $a = 3.98$ and the evolution of the state variable $x_{i,k}$ has then been obtained by constructing the coupled map (1) with the coupling strength of $\varepsilon = 0.1$ and the delay time of $\tau = 1$. Figure 3 depicts the case in which the constructed small-world network varying the coupling strength, ε , where we can observe that almost all sites are strongly coupled and generates rhythmic patterns when ε becomes 0.16; (a) is space-time plot, (b) is time-series of arbitrary 5, 10, and 15 nodes, and (c) is pattern match regularity statistics (PMRS)²⁰ which proves all sites produce periodic signals after ε is beyond 0.14.



(a)



(b)



(c)

Figure 3: Small-World Network Coupled with the Logistic Map Varying the Coupling Strength(ε): (a) Space-Time Plot (b) Time-Series of Arbitrary 3 Nodes (c) Pattern Match Regularity Statistics

Then, we carried out a simulation to force the small-world network coupled with the logistic map to approach a static point, $x_f = 0.7487$ when the map was coupled by $\varepsilon = 0.16$. For this mission, the control parameters of $\mu = 0.75$ in (3) and $v = 0.31$ in (4) were selected by trial and error as the instance when the controller demonstrated the fastest convergence of the desired static point. The network ran without control until $k = 4000$. Followed by onset to control at $k = 4000$, in Figure 4, it demonstrates that a set of DFCs employed is able to regulate signals from all nodes to maneuver to a static point; (a) represents time-space plot, (b) and (c) are time-series and control force of arbitrary 5, 10, and 15 nodes, respectively. In addition, we intended to govern only arbitrary 3 nodes in the network by 3 corresponding local controllers and it also demonstrated that the convergence to the fixed point after starting to supervise at $k = 4000$ was achieved from the designated 3 sites only with trivial oscillations.

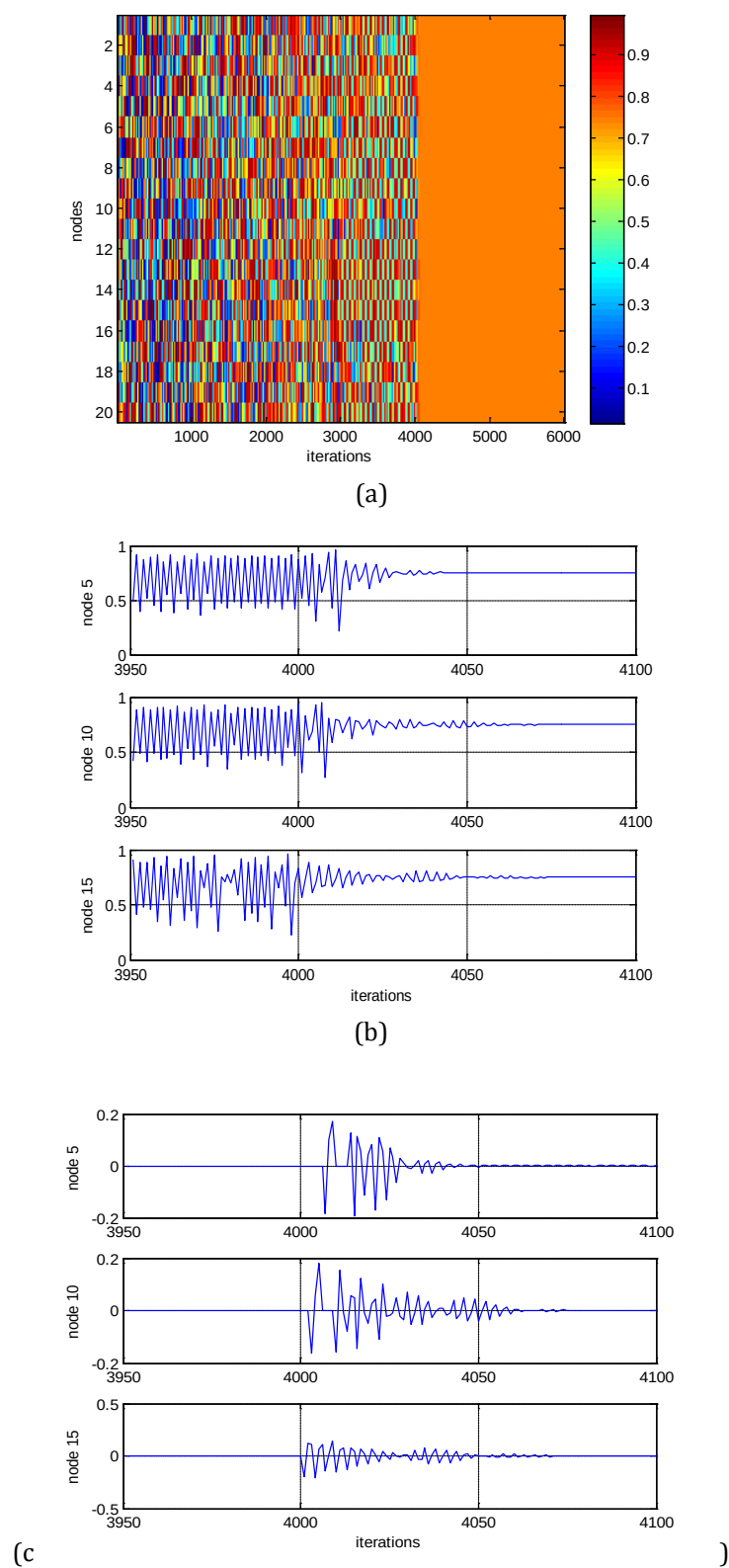
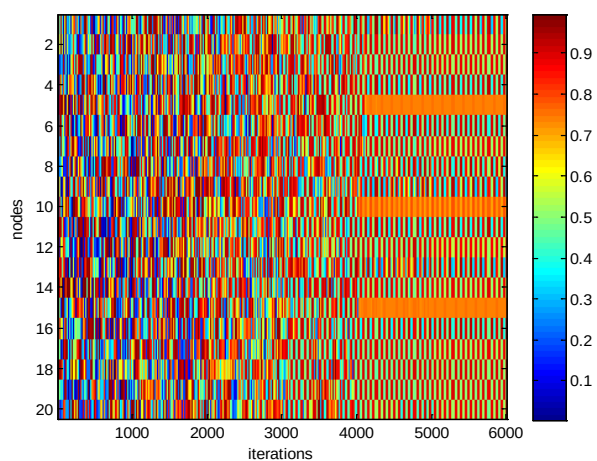
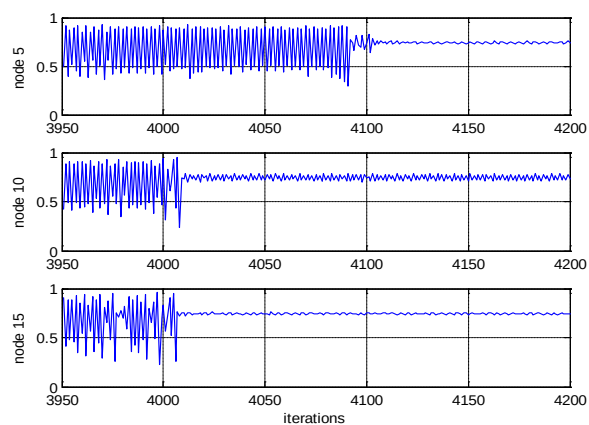


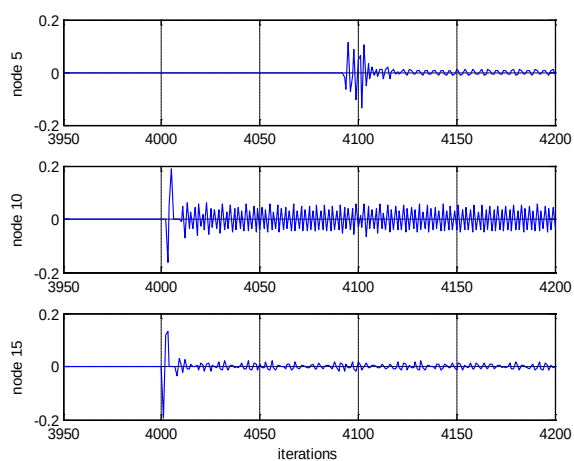
Figure 4: Static Point Tracking Performance when Coupling Strength is $\epsilon = 0.16$: (a) Space-Time Plot (b) Time-Series of Arbitrary 3 Nodes (c) Control Force of Arbitrary 3 Nodes



(a)



(b)



(c)

Figure 5: Static Point Tracking Performance of Arbitrary 3 Nodes Only by 3 Local Controllers: (a) Space-Time Plot (b) time-Series of Arbitrary 3 Nodes (c) Control Force of Arbitrary 3 Nodes

V. CONCLUSION

Spatiotemporal chaos frequently observed in complex systems has been a quite interesting feature representing dynamical behavior in networks of coupled systems or oscillators in the case of all sites composed by systems or oscillators attain identical chaotic behavior. Such behavior of a network forms many systems of interest in engineering, physics, biology, and others. We have thus presented in this study a simple control scheme for stabilization of a particular periodic orbit or to regulate such spatiotemporal chaos existing in the small-world network where the activity of a chaotic model in each node evolves from a randomly coupled network with other dynamical nodes. The control strategy has been established through information from the local community of a subsystem and does not require any knowledge on system dynamics in advance. Feasibility of transitions of the system under control from the regime of spatiotemporal chaos to the regular homogeneous ones with a fixed point have been demonstrated through simulation results.

REFERENCES

- [1] Strogatz SH. Nonlinear dynamics and chaos. Levant Books, 2007.
- [2] Gong P, Leeuwen C. Evolution to a small-world network with chaotic units. *Europhysics Letters*. 2007, 67 (2), pp. 328-333.
- [3] Xu X, Luo JW. Dynamical model and control of a small-world network with memory. *Nonlinear Dynamics*. 2013, 73, pp. 1659-1669.
- [4] Sinha S. Random coupling of chaotic maps leads to spatiotemporal synchronization. *Physical Review E*. 2002, 66, 016209-1-6.
- [5] Jalan S, Amritkar RE, Hu CK. Synchronized clusters in coupled map networks. I. Numerical studies. *Physical Review E*. 2005, 72, pp. 016211-1-15.
- [6] Rubido N, Marti AC, Bianco-M E, Grebogi C, Baptista MS, Masoller C. Exact detection of direct links in networks of interacting dynamical units. *New Journal of Physics*. 2014, 16, pp. 1-11.
- [7] Marzbarnrad J, Keshavarzi A. Chaotic vibrations of a nonlinear air suspension system under consecutive half sine speed bump. *Indian Journal of Science and Technology*. 2015, 8(S3), pp. 72-84.
- [8] Marcelo PC, Masoller C, Marti AC. Synchronizability of chaotic logistic maps in delayed complex networks. *European Physical Journal B*. 2009, 67, pp. 83-93.
- [9] Ott E, Grebogi G, Yorke JA. Controlling chaos. *Physical Review Letters*. 1990, 64 (11), pp. 1196-1199.
- [10] Pyragas K. Continuous control of chaos by self-controlling feedback. *Physics Letters A*. 1992, 170, pp. 421-428.
- [11] Martinez-Zerega BE, Pisarchik AN, Tsimring LS. Using periodic modulation to control coexisting attractors induced by delayed feedback. *Physics Letters A*. 2003, 318, pp. 102-111.
- [12] Pyragas K. Delayed feedback control of chaos. *Philosophical Transactions of the Royal Society A*. 2006, 364, pp. 2309-2334.
- [13] Wiener RJ, Callan KE, Hall SC. Proportional feedback control of chaos in a simple electronic oscillator. *American Journal of Physics*. 2006, 74 (3), pp. 200-206.
- [14] Tamasevicius A, Mykolaitis G, Pyragas V, Pyragas K. Delayed feedback control of periodic orbits without torsion in nonautonomous chaotic systems: Theory and experiment. *Physical Review E*, 2007, 76, pp. 1-6.
- [15] Ma L, Ding D, Cao T, Wang M. Bifurcation control in a small-world network model via TDFC. *Proceedings of AMEII*, 2015, pp. 1232-1237.
- [16] Zhao H, Xie W. Hopf bifurcation for a small-world network model with parameters delay feedback control. *Nonlinear Dynamics*. 2011, 63, pp. 345-357.
- [17] Gade PM, Hu C-K. Synchronous chaos in coupled map lattices with small-world interactions. *Physical Review E*. 2000, 62 (5), pp. 6409-6413.
- [18] Mahwish B, Shah TM, Tariq S. Text embedded into encrypted image based on genetic algorithm on piece-wise linear chaotic map. *Indian Journal of Science and Technology*. 2016 Feb, 9 (8), pp. 1-7.
- [19] Karthikeyan R, Prasina A, Babu R, Raghavendran S. FPGA implementation of novel synchronization methodology for a new chaotic system. *Indian Journal of Science and Technology*. 2015 June, 8 (11), pp. 2-7.
- [20] Skinner H. Asymmetries in EEG signal properties in those with temporal lobe epilepsy and psychogenic non-epileptic seizures. Thesis of the University of Florida. 2012.



ISSN
0975-6299

Effects of Stabilization and Traditional Exercises on the Daily Life of Herniated Lumbar Disc Patients Treated with Epidural Steroid Injection

Young-Bae Kim, Physical Therapist, Institute of Rehabilitation Therapy, Wooshinhyang Hospital, Seongbuk-gu, Anam-dong, Seoul, Korea. E-mail: mind-reader@hanmail.net

Dae-Hun Kim* Professor, Department of Physical Therapy, Faculty of Health Science, Kyung dong University, Goseong-gun, South Korea. E-mail: vertetrac@kduniv.ac.kr

Abstract---

Background/Objectives: The purpose of this study was to identify the effects of traditional, stabilization and no exercise on the daily life of herniated lumbar disc patients treated with epidural steroid injection.

Methods/Statistical Analysis: This study selected and analyzed 13 patients in each group: traditional, stabilization and non-exercise groups. Crunch, pelvic tilting, and prone position press-up were performed as traditional exercises, and a CENTAUR[®] 3-D machine was used for stabilization exercises. The exercises were performed for 40 minutes, twice a week, for 8 weeks. A questionnaire was used to measure the VAS before and after the exercises, degree of ODI, and degree of satisfaction.

Findings: Results of the VAS showed that the stabilization and traditional exercise groups had significantly higher values than those in the control group, indicating high levels of pain reduction. Also Results of the ODI showed the highest statistically significant increase in the stabilization exercise group, followed by the traditional exercise group and the control group in order of significance. Results of the RM showed that the stabilization and traditional exercise groups had significantly higher values than those in the control group, indicating high levels of satisfaction.

Improvements/Applications: Traditional and stabilization exercises were found to be more effective than no exercise. Among the exercises, stabilization exercises were the most effective in improving the degree of VAS.

Keywords--- Traditional Exercise, Stabilization Exercise, Herniated Lumbar Disc, Low Back Pain, Chronic Pain.

* Corresponding Author

I. INTRODUCTION

Patients diagnosed with herniated lumbar disc receive various treatments, including conservative treatment, epidural steroid injection, and surgical treatment. Conservative treatment requires long-term, continuous management. Medical procedural treatment enables pain relief, but the relief may not last more than 3 months¹. Short-term results of surgical treatment are superior to those of conservative treatment, but their effects may not be sustained². Most patients feel burdened by the long-term period of conservative treatment and after effects of surgical treatment. For this reason, epidural steroid injection has recently become a frequent treatment method for lumbar pain and lower-limb radiating pain³.

One important reason for lumbar pain is spinal instability due to continuous defects in muscular strength and movement⁴. However, most patients fail to address this fundamental cause of lumbar pain once their pain is reduced because of steroid effects after the treatment. Even if lumbar pain is reduced after steroid injection, additional conservative treatments, such as exercise methods, should be performed to maintain long-term improvement and an active daily life.

In the early 1990s, exercise treatments were introduced in earnest in the rehabilitation process for spinal diseases⁵. As a traditional exercise treatment method, lumbar extensor strengthening exercise while fixing the pelvis was reported to significantly reduce the degree of pain in patients with lumbar pain, improve extensor muscle strength, reduce leg pain, increase joint range of motion (ROM), and improve the ability to perform daily activities⁶. The importance of exercise treatments since then has continued to be emphasized. In the late 1990s, the concept of lumbar stabilization exercises started to be widely accepted as a tool to prevent repeated damage to intervertebral discs and intervertebral process joints and repeated loss of other adjacent tissues, providing control of vertebral segments and dynamic stability. Lumbar stabilization exercises are widely used in advanced countries for preventing the recurrence of lumbar pain⁷, the degree of disability, and the level of satisfaction by comparing patients treated with epidural steroid injection, which underwent traditional exercises, stabilization exercises, and no exercise.

II. METHODOLOGY

A. Study Subjects Ethical Consideration

Study subjects were patients who visited a hospital specializing in vertebral joints between August and November 2013, were diagnosed with herniated lumbar disc on MRI scan within the previous 3 months, and were treated with epidural steroid injection once. Those who developed increased lumbar pain after the treatment or had discectomy, spinal canal stenosis, or spondylolisthesis were excluded. Sixty patients who understood the study's purpose and agreed to participate were randomly divided into 3 groups, each with 20 patients, and 13 patients were ultimately selected from each group: traditional exercise, stabilization exercise, and non-exercise groups. General characteristics of the subjects are summarized in Table 1.

Table 1: General Characteristics of the Subjects (Mean $\pm$ SD)

	Age (y)	Weight (kg)	Height (cm)
Stabilization group (n = 13)	47.81 $\pm$ 11.48	62.07 $\pm$ 9.69	166.53 $\pm$ 8.8
Traditional group (n = 13)	46.45 $\pm$ 10.44	61.23 $\pm$ 8.36	164.84 $\pm$ 9.04
Control group (n = 13)	47.63 $\pm$ 9.01	64.69 $\pm$ 10.15	163.3 $\pm$ 7.87

B. Measurement Method

Traditional exercises consisted of crunch, pelvic tilting, and prone position press-up. In the 5th week, the amount of exercise was increased by increasing the number of sets. Stabilization exercises used a CENTAUR[®] 3-D machine (BFMC Systems, Germany). When a subject could not maintain a neutral position while inclining 90° vertically or complained of pain, the tester discontinued the experiment. Exercises were performed for 40 minutes, twice a week, for 8 weeks.(Table 2)

Table 2: Traditional Versus Stabilization Exercises

Phase		Type	Content	Time
Warm-up		Bicycle & stretching		10 minutes
Main exercise	Traditional	Crunch pelvic tilting prone position press-up	10 seconds $\times$ 10 times $\times$ 3 sets	20 minutes
	Stabilization	3-D machine	Eight directions on the horizontal surface	
Cool-down		Stretching		10minutes

Lumbar pain before and after exercises, the degree of disability in daily life, and the level of satisfaction were researched using a questionnaire prepared through outpatient consulting. To secure the integrity and accuracy of the research, one physical therapist with over 10 years' experience was selected.

The degree of lumbar pain was measured using a visual analogue scale (VAS). In terms of the degree of lumbar pain felt by patients, 0 indicated that the pain had no influence on daily life and caused no subjective symptoms, and 10 indicated that the patient was unable to carry out daily activities at all and had continued unbearable lumbar pain. Using a 10-cm table divided into 10 parts, the subjects recorded their level of pain subjectively⁸.

The level of disability in daily life was measured using a lumbar pain disability questionnaire (Oswestry Disability Index: ODI). Although the questionnaire originally consisted of 10 questions, including pain management, personal management, lifting, walking, sitting, standing, sleeping, social life, going out, and sexual life, this study used only 9 questions, excluding the question regarding sexual life, which might have been uncomfortable for some subjects to answer. Each question was evaluated with a range from 0 points (no disability) to 5 points (large disability). A higher score indicated a corresponding higher degree of disability⁹. The level of satisfaction (Roles & Maudsley: RM) was divided into four categories: excellent, good, average, and poor. A higher score indicated a corresponding lower level of satisfaction¹⁰.

C. Data Analysis

The study's results were statistically processed using SPSS 18.0 for Windows. The comparison before and after the experiment within each group used paired t-tests. A one-way analysis of variance (ANOVA) was performed to test effectiveness among the groups. When statistically significant differences were exhibited, the analysis method of Duncan was used for post-hoc tests. The statistically significant level was set at $p < 0.05$ for statistical verification.

III. FINDINGS

A. Changes in the Evaluation of VAS, ODI, and RM in Each Group Before and After Exercises

Results of the VAS showed that the stabilization and traditional exercise groups experienced reduced lumbar pain with statistical significance ($p < 0.05$). However, the control group did not show statistically significant differences ($p < 0.05$). Results of the ODI showed that the stabilization and traditional exercise groups experienced reduced degrees of disability in daily life ($p < 0.05$). However, the control group exhibited no statistically significant differences ($p < 0.05$). Results of the RM showed that the stabilization and traditional groups had no differences before and after exercises and maintained the level of satisfaction before the exercises ($p < 0.05$). However, the RM of the control group reduced with statistical significance ($p < 0.05$) (Table 3)

Table 3: A Comparison of the VAS, ODI, and RM Before and After Exercises in Each Group [Unit: %]

Group		Pre-test	Post-test	t-value	p-value
Stabilization exercise	VAS	4.23 ± 1.87	1.84 ± 1.14	3.394	0.002**
	RM	-1.76 ± 0.72	-1.92 ± 0.95	1	0.337
	ODI	12.07 ± 4.82	6.3 ± 3.56	3.906	0.002**
Traditional exercise	VAS	4.15 ± 2.23	2.92 ± 1.11	2.792	0.016*
	RM	-1.84 ± 0.68	-2.03 ± 0.59	1.237	0.415
	ODI	12.69 ± 8.96	8.76 ± 6.86	3.267	0.007**
Control group	VAS	4.38 ± 1.75	4.92 ± 1.97	-0.775	0.453
	RM	-1.88 ± 0.68	-3.3 ± 0.75	5.043	0.000***
	ODI	13.69 ± 7.2	16 ± 9.42	-1.604	0.135

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

VAS, visual analogue scale; RM, Roles & Maudsley; ODI, Oswestry Disability Index

B. Changes in the Evaluation of the VAS, ODI, RM Among the Groups

Results of the VAS showed that the stabilization and traditional exercise groups had significantly higher values than those in the control group, indicating high levels of pain reduction. Results of the ODI showed the highest statistically significant increase in the stabilization exercise group, followed by the traditional exercise group and the control group in order of significance. Results of the RM showed that the stabilization

and traditional exercise groups had significantly higher values than those in the control group, indicating high levels of satisfaction.(Table 4)

Table 4: A Comparison of Evaluation of the VAS, ODI, and RM among the Groups [Unit: %]

Group	Side	Source	SS	df	MS	F	p-value	Post-hoc
Stabilization	VAS	between	101.282	2	50.641	12.434	0.000***	a,b > c
Traditional		within	146.615	36	4.073			
Control		total	247.897	38				
Stabilization	RM	between	13.551	2	6.776	12.267	0.000***	a,b > c
Traditional		within	19.885	36	.552			
Control		total	33.436	38				
Stabilization	ODI	between	630.154	2	315.077	15.265	0.000***	a > b > c
Traditional		within	743.077	36	20.641			
Control		total	1373.231	38				

*p < 0.05, **p < 0.01, ***p < 0.001

a: Stabilization exercise group, b: Traditional exercise group, c: Control group

VAS, visual analogue scale; RM, Roles & Maudsley; ODI, Oswestry Disability Index

IV. DISCUSSION

Medical procedural treatments are more effective in relieving pain in the short term than in the long term, and do not visibly differ from physical therapy in terms of long-term treatment effects¹¹. This suggests that even if lumbar pain decreases after performing medical treatment, the additional practice of conservative treatment to maintain long-term treatment effects will provide positive effects in the long-term daily life of patients by reducing vertebral instability. However, no research has been conducted regarding the effects of conservative treatment after medical procedural treatment on the daily life of patients.

This study compared lumbar pain, the degree of disability in daily life, and the level of satisfaction among patients who performed stabilization exercises, traditional exercises, and no exercise. In a study by Ferreira (2010), lumbar pain was reduced more after 8 weeks of deep abdominal muscle stabilization exercises than after trunk muscle strengthening exercises¹². Rhee (2012) also reported in his study that after early stabilization exercises for 4 weeks, differences in the effects of pain reduction were further accelerated, and therefore, even if large muscles in the wide muscle system contracted, unstable shaking in the deep abdominal muscle disappeared¹³. In this study, results of the VAS before and after the exercises of each group showed reduction in lumbar pain in both the stabilization and traditional exercise groups. However, the control group showed no statistically significant differences. Comparison of the three groups revealed higher levels of pain reduction in the stabilization and traditional exercise groups than in the control group.

In a 2011 study, Hibbs conducted a 3-week exercise program for patients with over 3 months' continued lumbar pain, dividing them into deep abdominal muscle and superficial abdominal muscle exercise groups. After the 3-week exercise program, scores for questions regarding the disability of lumbar pain showed a statistically more significant decline in the deep abdominal muscle exercise group than in the superficial abdominal muscle exercise group¹⁴. This study also showed, through the results of the ODI before and after exercises, that both the stabilization and traditional exercise groups had a decrease in the disability index in daily life. However, the control group exhibited no statistically significant difference. Comparison of the ODI among the three groups showed the largest statistically significant increases in the stabilization exercise group, followed by the traditional exercise group and the control group in order of significance. This supports a study by Ebenbicher (2001) in which deep abdominal muscle exercises provided stability in various motions, not only by strengthening the lumbar muscles, but also by strengthening the deep abdominal muscles that stabilize the lumbar area¹⁵. In particular, 3-D lumbar stabilization exercise equipment inclines itself at various vertical and horizontal angles using gravity while joints are fixed and gradually increases the motion load of individual muscles. As a result, it is a very effective exercise that decreases disabilities in daily life by increasing the stability of vertebral segments¹⁵.

In the present study, results of the RM before and after exercises showed that the stabilization and traditional exercise groups maintained their level of satisfaction; however, the control group's level of

satisfaction declined with statistical significance¹⁶. In comparison of the three groups, the stabilization and traditional exercise groups showed higher levels of satisfaction than the control group¹⁷. While this result could not be compared with results of other studies because of the lack of comparable research, physical, psychological, and social benefits from declines in lumbar pain and disability in daily life, which are derived from participation in exercise programs after medical treatment, were likely to have positive effects on the level of satisfaction in life.

In conclusion, the stabilization exercise group showed greater improvement than the traditional exercise and control groups in terms of degree of disability in daily life. This is likely because stabilization exercises strengthen the deep abdominal muscles in the lumbar area, increasing the stability of vertebral segments in various motions.

ACKNOWLEDGEMENT

Therefore, the stabilization exercise group may have benefited more than the traditional exercise group or the non-exercise group in managing daily activities. While medical procedural treatments are relatively speedy, safe and simple treatment methods, their effects do not last for a long period of time and may result in disabilities in daily life in the long term.

Accordingly, even if back pain is reduced after medical treatments, it is necessary to set a plan for conservative treatment to enhance stable daily life.

REFERENCES

- [1] Armon C, Argoff CE, Samuels J, Backonja MM: Use of epidural steroid injections to treat radicular lumbosacral pain. *American Academy of Neurology*, 2007, 6(9), pp.723-729.
- [2] Weinstein JN, Lurie JD, Tosteson TD, Skinner JS, Hanscom B, Tosteson AN, et al.: Surgical vs nonoperative treatment for lumbar disk herniation. The spine patient outcomes research trial (sport) observational cohort, 2006, 296(9), pp. 2451-2459.
- [3] Van Tulder, MW, Koes BW, Bouter LM: Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions. *Spine (Phila Pa 1976)*, 1997, 22(56), pp.2128-2135.
- [4] Go YD, Kim DJ, Kim JO, Woang JM, Bae SY, Jang SL: Clinical and radiologic factors predicting the low back pain after discectomy. *Kor J Spine*, 2002, 9(3), pp. 178-183.
- [5] John G, Juliette H: Exercise in the treatment of musculoskeletal disease. Oxford, Blackwell Publishing, 2005, pp.169-188.
- [6] Nelson B, O'Reilly E, Miller M, Hogan M, Wegner J, Kelly C: The clinical effects of intensive, specific exercise on chronic back pain. A controlled study of 895 consecutive patients with 1-year follow-up. *Orthopedics*, 1995, 18(2), pp. 971-981.
- [7] Becker GB, Boucher JP, Gagey PM: Spinal Stabilization Exercise Program, In C. Liebenson(ed) *Rehabilitation of the Spine*. Maple Press, 1996, pp. 293-317.
- [8] Mark P, Paul K, Sanford B: The measurement of clinical pain intensity, 1986.
- [9] Fairbank JC, Pynsent PB: The Oswestry Disability Index. *Spine*, 2000, 25(22), pp. 2940-2952.
- [10] Roles NC, Maudsley RH: Radial tunnel syndrome, resistant tennis elbow as a nerve entrapment, 1972, 54(3), pp. 499-508.
- [11] Ballin NC: Paraplegia following epidural analgesia. *Anesthesia*, 1981, 36(2), pp. 952-953.
- [12] Ferreira PH, Ferreira ML, Maher CG, Refshauge K, Herbert RD, Hodges PW: Changes in recruitment of transversus abdominis correlate with disability in people with chronic low back pain. *British Journal of Sports Medicine*, 2010, 44(16), pp. 1166-1172.
- [13] Rhee HS, Kim YH, Sung PS: A randomized controlled trial to determine the effect of spinal stabilization exercise intervention based on pain level and standing balance differences in patients with low back pain, 2012, 18(3), pp. 81-174.
- [14] Hibbs AE, Thompson KG, French DN, Hodgson D, Spears IR: Peak and average rectified EMG measures: which method of data reduction should be used for assessing core training exercise?. *Journal of Electromyography and Kinesiology*, 2011, 21(2), pp.102-111.
- [15] Anders GB: Activation characteristics of trunk muscle during whole body tilt with unsupported trunk. *Institute for Pathophysiology and Pathobiochemistry. Motor Research Group Friedrich-Schiller-University Jena*, 2005, 2(5), pp. 83-89.

- [16] Kim DH, WY Yoon; Effect of Core Program Exercise for Lumbar Extensor Strength and Pain of the Patient with Chronic Low Back Pain. Indian Journal of Science and Technology, 2015,8(S1), pp. 353-359.
- [17] Cho HY, Park YJ, Moon HH, Park SS, Kang KM, Yoon WY, Kim MK; The Effect of Swiss Ball Stabilisation Exercise on Deep and Superficial Cervical Muscle and Pain in Patients with Chronic Neck Pain. Indian Journal of Science and Technology, 2015,8(S1), pp. 14-19.



ISSN
0975-6299

Effects of Emotional Control Program for Drug Addicts

Se-Jin Ju, Dept. of Nursing, Namseoul University 331707, 21 Maeju-ri, Seongwan-eup, Seobuk-gu, Cheonan-city, Choongnam, Korea. E-mail:lovepdd@nsu.ac.kr

Youn-Sil Kim*Dept. of Nursing, Doowon Technical University 17520, 51 Gwaneumdang-gil, Juksan-yeon, Anseong-si, Gyeonggi-do, Korea. E-mail:sil0218@doowon.ac.kr

Gyun-Young Kang, Dept. of Nursing, Kyungdong University 26495, 815 Gyeonhwon-ro, Munmak-eup, Wonju-si, Gangwon-do, Korea. E-mail:mental74@kduniv.ac.kr

Abstract---

Objectives: This study was done to verify effects of an emotional control program using meditation and poems on Impulsiveness and Resilience in patients with drug addiction.

Methods/Statistical Analysis: A nonequivalent control group pre-post design was used. Participants were 25 people (control group=13 and experimental group=12) who were diagnosed with a drug addiction in Institute of Forensic Psychiatry Ministry of Justice. The data were collected from March 1 to April 30, 2015. The experimental group received the emotional control program 12 times over 6 weeks. Data analysis was conducted using χ^2 -test and t-test with SPSS/Win 21.0 program.

Findings: As the result of the intervention, there were no significant differences in Impulsiveness. But resilience ($p < .001$) improved significantly in the experimental group compared to the control group.

Improvements/Applications: The results suggest that the emotional control program can be widely utilized as one of the intervention programs for drug addiction

Keywords--- Resilience, Drug Addicts, Emotional Control Program, Impulsiveness.

* Corresponding Author

I. INTRODUCTION

The problem of substance addiction (gross) is recognized as an important social problem and the number of drug criminals in Korea is continuously increasing. In 2015, the number of truck criminals surpassed 10,000 with 11,916 and among them, there were 4,486 re-offenders, showing a second offense rate of 37.6%¹. The cumulative number of drug-related arrests in Korea between January and August in 2016 was 9641 and compared to the same period in the year before (7888) it was found to have increased by 22.2%¹, and compared to the year before, it is expected that the number will surpass well over 10,000. The range of these drug offenders are expanding to the general population such as youth, housewives, sorry man, and farmers¹ and this is a result showing that Korea is not a place safe from drugs. Problem of substance addiction cause severe damage to personal physical, psychological, social, and spiritual function and in addition to personal problems, it causes problems with family, occupation, and law and it requires close attention.

Although drug offenders are increasing and second offense rate is surpassing 37%, treatment systems for substance addicts in Korea are evaluated to be very poor compared to developed nations such as the US². However, according to Article 40³ of Law on Narcotics Administration, the Minister of health and welfare or mayors and provincial governors can install, operate, and designate treatment care institutions to evaluate drug addictions in users and to treat and protect people evaluated as drug addicts. It can be seen that on the national level, there is a system for treatment for drug addicts in a direction of treatment and rehabilitation rather than punishment.

Then, there is a need to explore how effectively programs for rehabilitation and treatment of substance addicts at nationally designated treatment and care institutions are being run and also the need to develop and operate programs for substance addicts.

There are various factors for causes of drug addiction such as low self-esteem, depression, family discord, and lack of spiritual values^{4,5,6}. Also it was stated that behavioral characteristics of these people included that they were frequently realists, had keen interest on details, had difficulties in emotional expression, and acted upon impulse⁷.

Characteristics of substance addicts such as depression, low self-esteem, difficulties in emotional expression, and impulsive behavior is difficult for the addicts to moderate just with their will or commitment. Also repeated recurrence further lower self-esteem and this influences quitting and recovery. Especially substance addicts in treatment custody show severe state of addiction and have high risk of re-offense which requires rehabilitation in various approaches so that they can receive effective treatment⁸. Impulsiveness, which best represents the psychological characteristic loss of controllability, showed 50 to 75% of simultaneous occurrence with impulse control disorders and substance abuse and dependency⁹, and it was found that impulsiveness was higher with more severe addiction¹⁰.

As aggressiveness and impulsiveness showed strong correlation with smart phone addiction^{11,12}, to resolve addiction problems, personal mental factors must be strengthened to mitigate impulsive behavioral characteristics. Although it might be difficult to expect the effect of quitting through short-term programs¹³, it is important for the subjects to experience for themselves that through addiction education and programs, control of emotions such as compulsivity is possible.

Resilience is a dynamic process created through adversity¹⁴, and the fundamental methods to increase resilience include increase in positive emotions such as meditation and good deeds¹⁵. Also in previous studies, Mindfulness Based Cognitive Therapy (MBCT) and intensive irritation programs showed increase in the levels of self-esteem and abstinence self-efficacy in addicts^{5,13}.

Many studies consider self-esteem and accident self-efficacy in substance addicts. However, there were almost no studies on the behavioral characteristics impulsivity and resilience. For this the purpose of the study is to apply an emotional control program utilizing meditation and poems to verify the effects on the impulsivity and resilience of subjects.

II. RESEARCH METHODS

A. Research Design

The study is a quasi experimental study of non-equivalent control group pretest-posttest design to verify the effects of an emotional control program on the impulsivity and resilience of substance addicts.

B. Subjects

The subject of the study were 27 patients receiving treatment for substance addiction in Institute of Forensic Psychiatry Ministry of Justice who understood the purpose of the study and agreed to participation and excluding 2 subjects were eliminated during the program, a total of 25 subjects were selected. The selection criteria was a person that was diagnosed with substance addiction that did not participate in programs similar to this program within the last six months. The exclusion criteria included subjects with withdrawal symptoms due to substances and those who were determined to be inappropriate for participation from physicians due to the instability of the patient at the time of the program.

C. Emotional Control Program

The program used in the study was designed to control emotion utilizing meditation and poems. A total of 12 sessions were conducted with 60 minutes per session. Programs per session were composed of the introduction stage, development stage, and the finishing stage. In the introduction stage, familiarity was built and tension was alleviated through greetings and light warm-ups. In the development stage, meditations and poems were provided and the subjects expressed their own thoughts and feelings. The finishing stage was composed of freely sharing their impressions.

D. Research Tools

Impulsivity

For impulsivity, Barratt Impulsiveness Scale II (1969)¹⁶ was used. Factors of impulsivity were composed of cognitive impulsivity, exercise impulsivity, and unplanned impulsivity. It was composed of a 4 point Likert scale in 22 questions and higher points represent higher impulsivity.

Resilience

For resilience, a resilience index¹⁷ that was developed based on Resilience Quotient Test (RQT)¹⁸ was used. Sub factors of resilience included controllability factor including cost analysis, emotion control, and impulse control, positivity factor including appreciation, life satisfaction, and optimism, and sociability factor including relationship, communication ability, and empathy.

It is composed of a 5 point Likert scale of 27 questions and higher points represent higher resilience.

E. Data Analysis

The data collected for this study was analyzed using SPSS/ WIN 21.0 program.

- 1) For general characteristics of subjects, descriptive statistics such as real number, percentage, average, and standard deviation was used.
- 2) For pre-homogeneity verification of general characteristics of experiment or group and control group, analysis was done through χ^2 -test and t-test.
- 3) For homogeneity verification on impulsivity and resilience in experiment or group and control group was done through t-test and analysis through independent t-test was conducted to determine changes before and after the experiment.

F. Ethical Consideration

The study was conducted with the approval from the research ethics committee at N university in C city. Before starting experimental treatment, research purpose and method, procedures, and programs were adequately explained to all subjects and agreements were received from those who voluntarily agreed to participate in the study. It was notified that the research subjects could withdraw any time without any disadvantageous actions. It was notified that the survey would be used solely for the purpose of the study and that anonymity of the subjects will be guaranteed. When subjects participating in the control group desired to participate in the program, the program was conducted after the termination of the study. A small compensation was given to the control group and experiment a group for the participation in the study.

III. RESULTS

A. Homogeneity Verification on General Characteristics of Subjects and Dependent Variables

The average age of subjects was 41, where the experimental group was 42.33, and the control group was 39.92, and all of the subjects were male. In marital status, the most frequent was unmarried with 19 (76%) and 19 (76%) subjects had religious affiliation.

The average number of treatments for substance addiction was 2.28 ± 0.79 . It was found that Gen. Characteristics of subjects were homogenous between the two groups (Table 1). Before the execution of the intervention program, impulsivity and control group and instrumental group, and sub factors of impulsivity unplanned impulsivity, exercise impulsivity, and cognitive impulsivity scores showed no statistically significant differences and homogeneity on impulsivity was acquired.

Also in resilience, sub factors controllability factor, positivity factor, sociability factor, and total resilience scores showed no significant differences between experiment the group and control group and homogeneity was acquired (Table 1).

Table 1: General Characteristics of Subjects (N=25)

Characteristics		total	Control group (n=13)	Experiment group (n=12)	χ^2/t	P
		n(%) or Mean $\pm$ SD				
Age(year)		41.08 $\pm$ 6.63	39.92 $\pm$ 7.35	42.33 $\pm$ 5.82	0.903	.376
Gender	Male		13(100.0)	12(100.0)		
Marital state	Single	19(76.0)	9(69.2)	10(683.3)	1.014	.602
	Married	2(8.0)	1(7.7)	1(8.3)		
	Other	4(16.0)	3(23.1)	1(8.3)		
Religion	Not having	6(24.0)	3(23.1)	3(25.0)	0.013	.910
	Having	19(76.0)	10(76.9)	9(75.0)		
Incarceration		228 $\pm$ 0.79	7.15 $\pm$ 3.73	5.75 $\pm$ 3.25	-0.998	.329
Impulsiveness		232 $\pm$ 0.23	235 $\pm$ 0.17	2.29 $\pm$ 0.29	-0.635	.532
	Unplanned impulsivity		246 $\pm$ 0.30	2.39 $\pm$ 0.36	-0.475	.642
	Exercise impulsivity		213 $\pm$ 0.40	1.98 $\pm$ 0.38	-0.915	.370
	Cognitive impulsivity		247 $\pm$ 0.38	2.50 $\pm$ 0.44	0.153	.880
Resilience		3.33 $\pm$ 0.46	3.22 $\pm$ 0.37	3.44 $\pm$ 0.52	1.217	.236
	Controllability		3.46 $\pm$ 0.63	3.74 $\pm$ 0.75	0.998	.329
	Positivity		3.12 $\pm$ 0.51	3.43 $\pm$ 0.45	1.585	.127
	Sociability		3.09 $\pm$ 0.37	3.17 $\pm$ 0.60	0.405	.690

B. Effects of Emotional Control Program

When control group and experimental group were compared to explore the changes in impulsivity through the emotional control program, there were no significant differences. While subfactors unplanned impulsivity and cognitive impulsivity showed no significant differences, exercise impulsivity showed significant differences ($t=-2.87$, $p=.008$). Sub factors of resilience controllability factor ($t=3.44$, $p=.002$) and positivity factor ($t=3.71$, $p=.002$) was higher in the experiment the group compared to the control group, showing significant differences. However, there were no significant differences in sociability factor ($t=-0.04$, $p=.966$). In overall resilience, it was 3.01 ± 0.24 points in the control group and 3.44 ± 0.41 points in the experimental group which showed significant differences ($t=3.19$, $p=.006$), and the results are shown in Table 2.

Table 2: Emotional Control Program Effects (N=25)

Variables		Control group (n=13)	Experiment group (n=12)	t	p
		M±SD	M±SD		
Impulsiveness		235±0.34	235±0.17	0.03	.969
	Unplanned impulsivity	224±0.65	248±0.43	1.04	.308
	Exercise impulsivity	252±0.29	202±0.55	-2.87	.008
	Cognitive impulsivity	228±0.41	256±0.33	1.90	.068
Resilience		3.01±0.24	3.44±0.41	3.19	.006
	Controllability	2.93±0.22	3.65±0.75	3.44	.002
	Positivity	2.88±0.28	3.46±0.47	3.71	.002
	Sociability	3.21±0.70	3.20±0.38	-0.04	.966

IV. DISCUSSION

The study was conducted to check if there are significant effects on impulsivity and resilience in subjects under inpatient treatment for substance addiction through application of an emotional control program. In impulsivity, the control group and experiment a group participating in the emotional control program and the study did not show significant differences. Unlike the study, it was reported that dance and movement therapy programs decreased impulsivity¹⁹. Also it show differences from the result of decrease in impulsivity in substance addicts after mindfulness program⁵ and the study²⁰ the reported decrease in impulsivity and alcohol addicts after expressional art therapy. Impulsivity has significant relation to anxiety¹⁹ and it is determined that physical relaxation through movement has influence on stress, which is effective in lowering impulsivity. The program in the study lowers anxiety by controlling stress using meditation and poems rather than physical activity and it is considered that the effects should be confirmed in long-term. Also, impulsivity in addicts is a psychological characteristic that is often present in people with substance abuse and dependency⁹ and impulsivity increases with higher level of addiction^{10,21}. The subjects participating in the study were substance addicts and it is determined that there would have been differences with previous studies due to the severity of addiction compared to other addictions such as alcohol addiction. Therefore, it is necessary to provide activities to strengthen individual emotional factors and alleviate tension to relief impulsivity to confirm the long-term effects of the program.

In the study, there were no differences in resilience points between the two groups before the experiment and after the program it was found that resilience increased in the experimental group, and it showed significant differences showing that after intervention the resilience significantly improved. Also, the study result matches the results of the study²² that measured resilience in youths with Internet addiction after musical therapy. Also in previous studies related to meditation, Mindfulness Based Cognitive Therapy(MBCT) and intensive irritation programs showed increase in the levels of self-esteem and abstinence self-efficacy in drug addicts^{5,13}. Emotional control program utilizing poems and irritation is an activity increasing positivity and it is reported that it increases avoidance from substance use¹⁰. Also because resilience functions as regulating variable of substances in addicts²¹, it is determined that emotional control program based on points and meditation increased resilience in substance addicts. Based on the study, it is suggested to confirm the long-term effects of the program and the influence of resilience on impulsivity.

V. CONCLUSION AND SUGGESTIONS

The study is a quasi experimental study of non-equivalent control group pretest-posttest design to verify the effects of an emotional control program on the impulsivity and resilience of substance addicts. The motion control program was conducted for a total of six weeks, twice a week and 60 minutes per session. As a result, it was confirmed that there was an effect of increasing resilience in substance addicts. The results can be used as basic data for the clinical effects of emotional control program and it is considered that it is nursing intervention that can be actively utilized on addicts. The study would like to suggest as follows. First, the study suggests confirmation of influence on impulsivity through long-term intervention and confirmation of influence of resilience on impulsivity. Second, the study suggests repeated studies integrating various techniques in treatment of addicts and development of programs for prevention of recurrence.

REFERENCES

- [1] Korean Association Against Abuse. drugs and crime facts. http://pr.drugfree.or.kr/information/index.html?contentsNum=2&category=DRUG_2&headNum=&seq=2189&tpage=4. Date accessed: 01/10/2016.
- [2] Park JS. Study on the Current Condition of Treatment for Narcotic Addicts and Countermeasure. *Chung-Ang Journal of Legal Studies*, 2015, 39(2), pp. 201-36.
- [3] Ministry of Government Legislation. <http://www.law.go.kr>. Date accessed: 01/10/2016.
- [4] Kim BS, Kim HB. The New Paradigm to the Addiction Crime. *Journal of Korea Addiction Crim*, 2011, pp. 89-113.
- [5] Cho JH, Son CN. Effects of the Mindfulness-Based Cognitive Therapy Program on Depression, Impulsivity, and Drug Abstinence Self-Efficacy of Drug Addicts. *The Korean Journal of Clinical Psychology*, 2013, 32(1), pp. 13-31.
- [6] Baik HU, Han IY. The Recovery Experience of Drug Addicts in a Community - The Regeneration in the Real World. *Mental Health & Social Work*, 2014, 42(3), pp. 151-77.
- [7] Kim YJ. A Study on the Effects of cognitive behavioral behavior on adult drug behavior of adult drug addicts. *Soongsil University, master thesis*, 1998.

- [8] Nam SM. An effective measures for Prevention of the spread of Drugs and crime. *Correction Review*, 2014, 64, pp. 33-57.
- [9] Grant, J. Rural women's stories of recovery from addiction. *Addiction Research and Theory*, 2007, 15(5), pp. 521-41.
- [10] Choi EM, Shin JR, Bae JH, Kim MS. The Relationships among Depression, Anxiety, Impulsivity and Aggression and Internet Addiction of College Students - Moderating Effect of Resilience. *The Journal of the Korea Contents Association*, 2014 Aug, 14(8), pp. 329-41.
- [11] Kim MK, Kim HJ, Kim KS, Ju SJ, Choi JH, Yu M. Smartphone Addiction: (Focused Depression, Aggression and Impulsion) among College Students. *Indian Journal of Science and Technology*, 2015 October, 8(25), pp. 1-6. DOI: 10.17485/ijst/2015/v8i25/80215.
- [12] Kim MY. The Relationship between Cellular Phone Addiction and Impulsiveness, Depression, and Self-esteem of Multicultural Adolescents. *Indian Journal of Science and Technology*, 2016 September, 9(35), pp. 1-4. DOI: 10.17485/ijst/2016/v9i35/101757.
- [13] Yoon HJ. The Effects of Samatha meditation program for drug addicts on Carving, Self-Esteem and Drug Abstinence self-efficacy. *BulGyoHak Bo*, 2016, 75, pp. 285-313.
- [14] Lee MH, Lee YS. The Effects of happiness enhancement program based on character strength on subjective Well-being, Resilience, and Interpersonal relation among High school students. *Korean Journal of Counseling and Psychotherapy*, 2013, 25(4), pp. 813-31.
- [15] Kim JY, Ko YG. Positive clinical psychology: focusing on mental fitness and positive psychotherapy. *Korean Psychological J Culture Soc Issues*, 2009, 15(1) pp. 155-68.
- [16] Lee HS. Patterns of Impulsiveness. *Journal of Humanities*, 1994, 21, pp. 93-104.
- [17] Shin WY, Kim MG, Kim JH. Developing Measures of Resilience for Korean Adolescents and Testing Cross, Convergent, and Discriminant Validity, *Studies on Korean Youth*, 2009, 20(4), pp. 105-31.
- [18] Reivich K, Shatte A. The resilience factor: Seven essential skill overcoming life's inevitable obstacles. New York: Broadway Books. 2002.
- [19] Moon SH. Effects of Dance-Movement Therapy Programs on Test Anxiety and Impulsiveness of Adolescents. *Jeju National University, master thesis*, 2011.
- [20] Byeon IK, Whang ST. Effect of Person-Centered Expressive Arts Therapy for Improvement of the Impulsivity & the Self-esteem of Alcoholics. *Korean Jernal Art Therapy*, 2009, 16(6), pp. 1003-027.
- [21] Choi EM, Shin JR, Bae JH, Kim MS. The Relationships among Depression, Anxiety, Impulsivity and Aggression and Internet Addiction of College Students - Moderating Effect of Resilience. *Korea Contents Association Review*, 2014, 14(8), pp. 329-41.
- [22] Yeo JY. The Effect of Music Therapy Activities on Resilience of Internet Addicted Adolescents. *Korean Journal of Music Therapy*, 2012, 14(1), pp. 12-40.



ISSN
0975-6299

Depression and the Related Factors of Osteoporosis among Korean Women

Myoung-Hee Kim*, Professor, Department of Nursing, Semyung University, 65 Semyung-Ro, Jecheon, Chungcheongbuk-do, Republic of Korea. E-mail: mh1352@semyung.ac.kr

Abstract---

Background/Objectives: The purpose of this study is to examine the correlation between osteoporosis and depression.

Methods/Statistical Analysis: Using raw data from the Korean National Health and Nutritional Examination Survey (KNHANES) conducted from 2008 to 2011, a secondary analysis was performed with data from 3,737 women aged 40 years and older. The χ^2 -test and logistic regressions were used for data analysis.

Findings: The results are as follows: The prevalence of osteoporosis among women aged 40-59 was affected by age (OR= 1.17, 95% CI=1.08~1.27), BMI (OR= 0.87, 95% CI=0.78~0.97), smoking (OR= 0.09, 95% CI=0.01~0.59), and taking estrogen (OR= 3.78, 95% CI=1.58~9.03). The prevalence of osteoporosis among women aged 60 and older was affected by age (OR= 1.16, 95% CI=1.12~1.22) and BMI (OR= 0.84, 95% CI=0.76~0.93).

Improvements/Applications: This study did not find any correlation between osteoporosis and depression in both groups.

Keywords--- Bone Mineral Density, BMD, Osteoporosis, Depression, KNHANES.

* Corresponding Author

I. INTRODUCTION

Osteoporosis is a disease that results in 59.5% of women and 23.8% of men over age 50 experiencing at least one fracture during the course of their lives ^{1,2}. In Korea, the number of people who visited medical facilities due to osteoporosis went from 530,000 in 2007 to 770,000 in 2011 and during the same year, medical costs due to osteoporosis increased by 35%, going from 53,500,000,000 Korean won to 722,000,000 Korean won ³.

The medical costs related to osteoporosis are expected to increase more rapidly in Korea as the elderly population increases.

Korean adults reach their maximum bone density rate when they are aged between 20-29. Osteoporosis is considered to be one of primary diseases among women since they usually have a lower bone density rate than men due to the decrease of estrogen after menopause resulting in a higher incidence rate among women than men ⁴. Accordingly, it is very important to focus efforts on promoting older women's health through osteoporosis intervention.

Osteoporosis is a disease characterized by low bone mineral density (BMD). The established risk factors for osteoporosis include increasing age, female sex, smoking, alcohol use, inactivity, and low calcium intake ⁵⁻⁷. Also, depression has been implicated as a possible risk factor for low BMD. However, the results to date have not been consistent ⁸.

Among women, some studies have reported an association between depression and low BMD ^{9, 10}, although other studies found no such relationship ^{11, 12}. There were some studies suggesting a correlation between depression and low bone density, but the results were varied and depression has not yet been considered as a risk factor for osteoporosis. Other research suggests that the relationship may vary depending on gender or race ^{9, 11}.

Therefore, this study sought to examine whether or not depression can be a primary cause of osteoporosis among Korean women. Since bone density decreases rapidly after menopause, this study included depression as a cause of osteoporosis among women and divided female participants into two groups: middle-aged women and older women.

The purpose of this study was to investigate the correlation between osteoporosis and depression in women (middle-aged women and older women).

II. METHODS

A. Study Design

This study is a secondary analysis examining raw data from the Korean National Health and Nutrition Examination Survey (KNHANES), conducted between 2008 and 2011.

B. Study Population

This study used the KNHANES IV (2008-2009) and KNHANES V (2010-2011) of the Korean National Health and Nutrition Examination Survey, which included osteoporosis tests conducted by the Korean Center for Disease Control and Prevention.

The KNHANES is a nationwide, cross-sectional survey conducted among the South Korean population which used stratified, multi-stage clustered probability sampling to select a representative sample of the civilian, non-institutionalized South Korean population ¹³.

KNHANES is composed of three component surveys: a health interview, health examination and nutrition survey ¹⁴.

The osteoporosis test was conducted from late 2008 to early 2011 in the 4th edition (2007~2009) and 5th edition (2010~2012).

Between 2008 and 2011, a total of 37,753 people (17,195 men and 20,558 women) participated in the KNHANES. In this study, a total of 3,737 female participants over the age of 40 were selected to become final

study subjects and were asked to complete a dual-energy X-ray absorptiometry, have an in-person health interview, and complete a nutrition survey ³. This study was approved by the institutional review board (SMU-EX-2016-07-002).

C. Definition of Osteoporosis, Depression and Associated Factors

Osteoporosis was defined according to the World Health Organization (WHO) T-score criteria (T-score $\leq$ -2.5). If a participant had a low T-score (T-score $\leq$ -2.5) in a BMD measurement of the lumbar spine and/or femoral neck, the participant was classified as having osteoporosis.

This study defined 'participants with depression' as those who answered they are diagnosed with depression in health interview or those who answered 'during the past year they have felt sad or hopeless for two or more weeks straight and that their mood negatively affected their daily life' in a mental/emotional test.

Other causes related to osteoporosis were age, marriage, household income, BMI, alcohol consumption, smoking, average of daily sleeping hours, days of intense physical activities in a week, days of moderate intensity physical activities in a week, days of walking in a week, days of physical activities for muscular strength in a week, days of physical activities for body flexibility in a week, daily dietary calcium intake, age at menarche, age at menopause, hormone intake, and a history of osteoporosis in their parents.

D. Statistical Analysis

This study used a complex, stratified, multi-stage clustered probability sampling method. General characteristics and osteoporosis-related factors were identified with descriptive statistics such as frequency, percentage, mean and standard error.

The chi-square test was used to examine the relationships between the subject's age group and osteoporosis, and age group and depression. In order to study factors that cause osteoporosis for middle-aged women and older women, logistic regression analyses were used.

SPSS program 19.0 (SPSS Inc., Chicago, IL, USA) was used to analyze the data. A value of $p < 0.05$ was considered statistically significant.

III. RESULTS

A. General Characteristics of Subjects

Table 1 presents the socio-demographic characteristics of the study participants. Study subjects were made up of 2649 of middle-aged women between 40 to 59 and 1088 of older women 60 or over. 87.6% of middle-aged women and 54.2% of older women were married and lived with their spouse. Regarding household income, 34.3% of middle-aged women belonged to the upper class and 46.3% of women aged 60 or more belonged to the lower class. Regarding drinking habits, 70.6% of total subjects answered that they drink less than one time a week.

Regarding smoking, 91.5% of total subjects were answered they do not smoke. The average of daily sleeping hours of total subjects was 6.71 hours.

Regarding physical activity, 66.8% of middle-aged women and 82.9% of older women answered that they never have any intense physical activities in a week. 55.4% of middle-aged women and 69% of older women answered that they never even do moderate intensity physical activities in a week. Regarding walking, 35.2% of middle-aged women and 46.1% of older women answered that they walk 6-7 times a week. 78.4% of middle-aged women and 90.2% of older women answered they never do any physical activities for muscular strength and 41.3 % of middle-aged women and 62.7% of older women reported that they are never involved in physical activities for body flexibility in a week. Daily calcium intake among women aged 40-59 was 482.67mg and women aged 60 or more was 394.54mg. The average age of subjects' menarche was 15.04 years old and the average age of subjects' menopause was 48.29 years old. 9.7% of middle-aged women and 10.3% of older women were taking hormone medications. 20.3% of participants had a history of osteoporosis in family.

Table 1: General Characteristics of Study Participants

(N=3737)

Variables	Whole group (N=3737)			40-59 years (N=2649)			60 years and older (N=1088)		
	No.	Mean (%)	SE (%)	No.	Mean (%)	SE (%)	No.	Mean (%)	SE (%)
Family structure	3737			2649			1088		
With spouse	2931	80.7	0.9	2320	87.6	0.8	611	54.2	2.0
Others	800	19.2	0.9	323	12.3	0.8	477	45.8	2.0
Not applicable	6	0.1	0.1	6	0.1	0.1			
Household income	3689			2622			1067		
Lower class	794	17.2	0.9	267	9.8	0.8	527	46.3	2.0
Lower-Middle class	914	25.9	1.1	630	25.5	1.2	284	27.3	1.8
Upper-Middle class	954	27.3	1.0	808	30.4	1.1	146	15.0	1.4
Upper class	1027	29.7	1.3	917	34.3	1.5	110	11.4	1.3
Body mass index (BMI)	3732	23.4	0.1	2648	23.5	0.1	1084	23.2	0.1
Alcohol consumption during the previous year	2836			2149			642		
None	553	17.6	0.8	368	16.0	0.9	185	26.3	2.1
1 serving/week or less	1987	70.6	1.1	1583	71.5	1.2	404	65.4	2.2
2-3 serving/week	224	9.1	0.7	196	10.1	0.8	28	4.0	0.8
4 serving/week or more	72	2.7	0.4	47	2.4	0.4	25	4.3	1.1
Smoking	3733			2645			1088		
Never	3448	91.5	0.6	2466	92.1	0.7	982	89.3	1.2
At one time, but no longer	49	1.8	0.3	32	1.5	0.3	17	2.5	0.9
Occasionally	75	2.1	0.3	45	1.8	0.3	30	3.0	0.6
Currently	161	4.7	0.5	102	4.5	0.6	59	5.1	0.8
Daily sleeping hours	3737	6.7	< 0.1	2649	6.8	.03	1088	6.3	< 0.1
Intense physical activities in a week (days)	3735			2648			1087		
None	2691	70.1	1.0	1797	66.8	1.1	894	82.9	1.6
1-2	459	13.5	0.7	388	15.3	0.8	71	6.5	1.0
3-5	430	12.4	0.7	353	13.8	0.8	77	6.9	1.0
6-7	155	3.9	0.4	110	4.0	0.5	45	3.7	0.7
Moderate intensity physical activities in a week (days)	3735			2649			1086		
None	2159	58.2	1.2	1452	55.4	1.3	707	69.0	2.0
1-2	528	14.4	0.8	420	15.8	0.9	108	9.0	1.1
3-5	616	17.1	0.9	474	18.3	1.0	142	12.5	1.4
6-7	432	10.3	0.7	303	10.5	0.8	129	9.4	1.0
Walking in a week (days)	3737			2649			1088		
None	593	14.9	0.8	376	14.1	0.9	217	18.2	1.4
1-2	558	15.5	0.8	412	16.1	1.0	146	12.9	1.3
3-5	1142	32.1	1.0	910	34.5	1.2	232	22.9	1.6
6-7	1444	37.5	1.0	951	35.2	1.2	493	46.1	1.9
Physical activities for muscular strength in a week (days)	3736			2649			1087		
None	3057	80.8	0.9	2075	78.4	1.0	982	90.2	1.1
1-2	300	8.5	0.6	265	9.8	0.7	35	3.2	0.6
3-4	233	6.6	0.5	203	7.6	0.6	30	3.0	0.7
≥5	146	4.1	0.4	106	4.2	0.5	40	3.6	0.6
Physical activities for body flexibility in a week (days)	3736			2649			1087		
None	1851	45.7	1.0	1134	41.3	1.2	717	62.7	1.9
1-2	663	20.2	0.9	566	23.2	1.0	97	9.0	1.1
3-4	659	19.0	0.8	563	21.1	1.0	96	10.9	1.3
≥5	563	15.1	0.7	386	14.5	0.8	177	17.4	1.5
Daily calcium intake (mg)	3737	464.4	7.2	2649	482.6	8.4	1088	394.5	11.5
Age at menarche	3673	15.0	< 0.1	2622	14.6	< 0.1	1051	16.4	< 0.1
Age at menopause	2003	48.2	0.1	992	48.1	0.2	1011	48.5	0.2
Taking hormone medications	3737			2649			1088		
Yes	386	9.8	0.6	273	9.7	0.7	113	10.3	1.2
No	3351	90.2	0.6	2376	90.3	0.7	975	89.7	1.2
History of osteoporosis in family	3737			2649			1088		
Yes	718	20.3		571	22.0	1.0	147	13.6	1.3
No	2995	78.8	0.9	2059	77.1	1.1	936	85.5	1.3

B. The Prevalence of Osteoporosis and Depression According Age Group

The prevalence of osteoporosis and depression according age group is shown in Table 2. According to results on the correlation between age and depression, 21.4% of the total participants suffered from depression.

The rate of depression increased from 20.3% of women aged 40-59 to 25.9% of women aged 60 or more and there was significant difference in statistics between the two groups ($\chi^2=11.43$, $p=0.003$). According to these results on the correlation between age and osteoporosis, 16.7 % of total participants had osteoporosis.

The rate of osteoporosis increased from 5.9% in women aged 40-59 to 57.9% of women aged 60 or more and there was a significant difference in the statistics between the two groups ($\chi^2=1189.07$, $p<0.001$).

Table 2: The Prevalence of Osteoporosis and Depression According Age Group
(N=3737)

Variables	40-59 years (N=2649)			60 years and older(N=1088)			χ^2	p
	No.	Mean (%)	SE (%)	No.	Mean (%)	SE (%)		
Depression							11.43	0.003
No	2100	79.7	0.9	811	74.1	1.8		
Yes	549	20.3	0.9	277	25.9	1.8		
Osteoporosis							1189.07	<0.001
Normal	2477	94.1	0.5	466	42.1	1.9		
Osteoporosis	172	5.9	0.5	622	57.9	1.9		

C. Risk Factors that affect Osteoporosis of Subjects by Age Group

Risk factors that affect osteoporosis of subjects by age group were displayed in Table 3. To analyze factors affecting osteoporosis within the subjects, logistic regression analysis was performed.

Among women aged between 40-59, age, BMI, smoking, and estrogen-intake were the main risk factors affecting osteoporosis, but other factors including depression were not significantly correlated to the prevalence of osteoporosis.

In women aged 40-59, the incurrence rate of osteoporosis increases as much as 1.17 times (95% CI=1.08~1.27) for every year they grow older, and as their BMI gets one unit lower, the incurrence rate of osteoporosis decreases as much as 0.87 times (95% CI=0.78~0.97). In addition, the currently non-smoking group of participants showed as low as 0.09 times (95% CI=0.01~0.59) the rate of osteoporosis as the smoking group and the participants who do not take estrogen medications had 3.78 times higher incurrence rate of osteoporosis than those who do takes estrogen medicines (95% CI=1.58~9.03).

Among women aged 60 or more, age and BMI were factors that significantly affected osteoporosis, and other factors including depression did not show any significant correlation. In women aged 60 and over, as they get one year older, the incurrence rate of osteoporosis increases by as much as 1.16 times (95% CI=1.11~1.22) and as their BMI gets one unit lower, the incurrence rate of osteoporosis decreases by as much as 0.84 times (95% CI=0.78~0.97).

Among middle-aged women, smoking and taking estrogen were statistically significant factors affecting osteoporosis, but in older women, smoking and taking estrogen did not show any significant correlations.

Table 3: Odds Ratios for Osteoporosis by Age Group (N=3737)

Variables	40-59 years (N=2649)		60 years and older (N=1088)	
	Exp (B)	95% CI	Exp (B)	95% CI
Age (years)	1.17	1.08~1.27	1.16	1.11~1.22
Family structure				
With spouse	1		1	
With other family member	1.74	0.38~7.99	0.53	0.21~1.31
Single	0.83	0.23~2.92	0.90	0.37~2.16
Household income				
Lower class	1.65	0.70~3.86	1.11	0.49~2.51
Lower-middle class	2.09	0.94~4.67	1.36	0.59~3.14
Upper-middle class	1.44	0.64~3.24	1.36	0.55~3.37
Upper class	1		1	
Body mass index (BMI)	0.87	0.78~0.97	0.84	0.76~0.93
Alcohol consumption during the previous year				
None	1		1	
1 serving/week or less	0.99	0.48~2.04	1.37	0.79~2.39
2-3 serving/week	0.67	0.19~2.39	0.95	0.30~2.98
4 serving/week or more	2.53	0.54~11.77	1.50	0.20~10.81
Smoking				
Never	1		1	
At one time, but no longer	2.24	0.36~13.99	3.89	0.81~18.61
Occasionally	2.70	0.34~21.14	1.36	0.28~6.50
Currently	0.09	0.01~0.59	0.98	0.37~2.58
Daily sleeping hours	0.98	0.93~1.03	0.98	0.85~1.13
Intense physical activities in a week (days)				
None	0.64	0.09~4.56	1.68	0.40~7.07
1-2	0.34	0.04~2.96	0.80	0.17~3.70
3-5	0.67	0.08~5.39	1.14	0.19~6.67
6-7	1		1	
Moderate intensity physical activities in a week (days)				
None	1.25	0.31~5.01	0.77	0.39~1.51
1-2	0.85	0.24~3.00	0.95	0.31~2.94
3-5	1.63	0.52~5.01	0.96	0.40~2.31
6-7	1		1	
Walking in a week (days)				
None	0.38	0.13~1.12	0.90	0.47~1.71
1-2	0.65	0.34~1.25	1.42	0.69~2.93
3-5	.48	0.18~1.27	1.51	0.85~2.70
6-7	1		1	
Physical activities for muscular strength in a week (days)				
None	3.93	0.41~37.61	0.96	0.34~2.71
1-2	2.37	0.21~26.25	0.24	0.03~1.72
3-4	0.90	0.07~10.47	1.75	0.34~9.00
≥5	1		1	
Physical activities for body flexibility in a week (days)				
None	0.51	0.19~1.34	0.94	0.50~1.76
1-2	0.59	0.20~1.74	1.28	0.55~2.98
3-4	0.42	0.13~1.31	0.40	0.14~1.15
≥5	1		1	
Daily calcium intake (mg)	0.99	0.99~1.00	1.00	0.99~1.00
Age at menarche	1.14	0.97~1.34	1.01	0.90~1.14
Age at menopause	0.98	0.93~1.03	0.99	0.95~1.04
Taking hormone medications				
Yes	1		1	
No	3.78	1.58~9.03	1.88	0.90~3.90
History of osteoporosis in family				
Yes	1.61	0.79~3.30	0.71	0.38~1.31
No	1		1	
Depression				
No	1		1	
Yes	1.40	0.75~2.63	0.93	0.53~1.61

IV. CONCLUSION

In this study, factors affecting osteoporosis were different in middle-aged women and older women and there were no correlations between depression and osteoporosis. Middle-aged women's daily lifestyle is different from that of older women and as women age, the incurrence rate of osteoporosis does not directly correlate to the incurrence rate of depression. Therefore, results of this study can be useful information to develop prevention programs for osteoporosis through further considering characteristics of women by age group.

ACKNOWLEDGMENT

This paper was supported by the Semyung University Research Grant of 2016.

REFERENCES

- [1] Oh H J. Development of guideline for life cycle osteoporosis health care. Osong: Korea Centers for Disease Control and Prevention, 2011. Available at <http://cdc.go.kr/CDC/notice/CdcKrInfo0201.jsp?menuIds=HOME001-MNU1154-MNU0005-MNU1889&cid=1547>
- [2] Cawthon P M. Gender differences in osteoporosis and fractures. *Clinical Orthopaedics and Related Research*, 2011, 469, pp. 1900-1905.
- [3] Kim Y M, Kim J H, Cho D S. Gender difference in osteoporosis prevalence, awareness and treatment: Based on the Korea National Health and Nutrition Examination Survey 2008~2011. *J Korean Acad Nurs*, 2015, 45, pp. 293-305.
- [4] Alswat K, Adler S M. Gender differences in osteoporosis screening: Retrospective analysis. *Archives of Osteoporosis*, 2012, 7, pp. 311-313.
- [5] Ross P D. Osteoporosis: Frequency, consequences, and risk factors. *Arch Intern Med*, 1996, 156, pp. 1399-1411.
- [6] Lee H Y, Kim D H, Kim S H. An analysis of nutrients intake, related factors of anemia and bone density in ballet dancers. *Indian Journal of Science and Technology*, 2015, 8(25), DOI: 10.17485/ijst/2015/v8i25/80463
- [7] Yoon S I, Kim S H, Yoon Y B. The relationship between teaching experience, exercise habit, health related fitness, bone density and arterial stiffness of Korean female teachers. *Indian Journal of Science and Technology*, 2015, 8(S7), pp. 332-338.
- [8] Wu Q, Magnus J H, Liu J, Bencaz A F, Hentz J G. Depression and low bone mineral density: a meta-analysis of epidemiologic studies. *Osteoporosis international*, 2009, 20, pp. 1309-1320.
- [9] Mussolino M E, Jonas B S, Looker A C. Depression and bone mineral density in young adults: results from NHANES III. *Psychosomatic medicine*, 2004, 66, pp. 533-537.
- [10] Jacka F N, Pasco J A, Henry M J, Kotowicz M A, Dodd S, Nicholson G C, Berk M. Depression and bone mineral density in a community sample of perimenopausal women: Geelong Osteoporosis Study. *Menopause*, 2005, 12, pp. 88-91.
- [11] Whooley M A, Cauley J A, Zmuda J M, Haney E M, Glynn N W. Depressive symptoms and bone mineral density in older men. *J Geriatr Psychiatry Neurol*, 2004, 17, pp. 88-92.
- [12] Yazici A E, Bagis S, Tot S, Sahin G, Yazici K, Erdogan C. Bone mineral density in premenopausal women with major depression. *Joint Bone Spine*, 2005, 72, pp. 540-543.
- [13] Park E J, Joo I W, Jang M J, Kim Y T, Oh K W, Oh H J. Prevalence of osteoporosis in the Korean population based on Korea National Health and Nutrition Examination Survey (KNHANES), 2008-2011. *Yonsei Med J*, 2014, 55, pp. 1049-1057.
- [14] Kweon S, Kim Y, Jang M J, Kim Y, Kim K, Choi S, et al. Data resource profile: The Korea National Health and Nutrition Examination Survey (KNHANES). *International Journal of Epidemiology*, 2014, 43, pp. 69-77.



ISSN
0975-6299

The Effects of Different Exercise Treatment Methods on the Spinal Curvature Structure, Cervical Pain and Neck Disability Index of Chronic Neck Patients with Kyphosis

Hyunghun Moon, Dept. of Sports Medicine, Cha University, Pocheon, Republic of Korea. E-mail:moon7610@naver.com

Yonggon Seo, Dept. of Sports Medicine, Korea University, Sejong, Republic of Korea. E-mail:Yongon79@naver.com

Sangseo Park, Dept. of Sports Medicine, Korea University, Sejong, Republic of Korea. E-mail:sps07@naver.com

Jaeho Yu, Dept. of Physical Therapy, SunMoon University, Asan, Republic of Korea. E-mail:naresa@sunmoon.ac.kr

DoYoun Kim, Dept. of Sports Medicine, Inha University, Republic of Korea. E-mail:doyoun@inha.ac.kr

Yunjin Park*, Dept. of Sports Medicine, Korea University, Sejong, Republic of Korea. E-mail:africca3535@gmail.com

Abstract---

Background/Objectives: The objectives of this research were to examine the effects of three different exercise treatment programs, including a corrective exercise program, resistance exercise program and physical therapy program, on the spinal curvature structure, cervical pain and neck disability index of chronic neck patients with kyphosis.

Methods/Statistical analysis: 24 kyphosis patients with neck pain were participated in this study. All subjects performed specific exercise program including collective exercise and resistance exercise with three times per week for 12 weeks and were evaluated whole spine lateral x-ray tests, cervical angle and shoulder angle tests, visual analogue scale(VAS) and neck disability index(NDI) test before and after the intervention. Paired sample t-test was conducted on the pre and post factors for the exercise programs within each group and one-way ANOVA was conducted to verify the effects of each of the types of exercise programs for each randomly assigned group. When statistical significance was confirmed through this analysis, post verification was additionally conducted using Duncan's new multiple range test.

Findings: The findings of the research confirmed that the Thoracic Cobb's angle, forward head angle and shoulder angle for the CEG(Corrective exercise group) and REG(Resistance exercise group) were reduced by statistically significant amounts ($p < 0.001$) while the largest differences were confirmed for CEG. However, the PTG (Physical Therapy Group) did not show statistically significant differences when comparing the results for before and after physical therapy. The VAS and NDI measurements were confirmed to have been reduced by statistically significant amounts ($p < 0.001$), while the largest differences were confirmed for CEG.

Improvements/Applications: Base on these results it was possible to confirm that both corrective exercises and also resistance exercises were effective for treating the neck pain and disability for chronic neck pain patients with kyphosis.

Keywords--- Kyphosis, Neck Pain, Corrective Exercise, Resistance Exercise, Cobb's Angle, Forward Head Angle, Shoulder Angle, Visual Analogue Scale(VAS), Neck Disability Index(NDI).

* Corresponding Author

Special Issue on "Medical Science"

I. INTRODUCTION

Spine curvature is affected in our everyday lives as a result of our environments, lifestyles and postures, and maintaining postures that require the same spine curvature for prolonged periods of time can be the cause of pain accompanied by other etiological factors that cause muscular skeletal diseases^{1,2}. An excessive increase in the kyphotic curve at the sagittal plane induces the upper cross syndrome and can cause a forward head posture by shortening the cervical extensor and weakening the flexors^{3,4}. Also increased tension in the tissue around the neck is known to lead to neck pain⁵. Poor posture and forward head posture are especially known to cause chronic neck pain, and it has additionally been reported that poor posture and forward head posture occurs more frequently in patients with Kyphosis than patients without kyphosis^{6,7}.

Recently there have been many different treatment applications that have been implemented to treat and prevent excessive symptoms of kyphosis⁸. Corrective exercises and resistance exercises are known to be especially effective in strengthening the muscles around the spine and are reported to increase the stability of the spine curvature⁹⁻¹².

Previous study⁸ demonstrated that a home based exercise program which was conducted with 32 patients for a total of 52 sessions was associated with decrease of thoracic Cobb's angle. Another similar study⁹ reported a decrease in the cervical angle and the thoracic Cobb's angle for patients prescribed to an upper muscle groups stretching and strengthening program that strengthened the muscles around the spine.

These preceding studies have confirmed the effectiveness of exercise in improving kyphosis symptoms and also confirmed that various different exercise methods are being used to treat Kyphosis. However there is still an absence of research that examines the effects of these benefits and improvements in the symptoms in neck pain patients with kyphosis who have been treated using these exercises. Therefore the objectives of this research are to provide kyphosis patients with corrective exercise, resistance exercise and physical therapy treatments to examine the effects that improvements in spine curvature have on the neck pain and disability symptoms of kyphosis patients and to conclusively suggest the most effective treatment methods.

II. PROPOSED WORK

A. Subjects

This research was targeted against 24 kyphosis patients with chronic neck (continuous pain for more than 6 months) that were treated at the P Orthopedic Hospital in Korea that were diagnosed with a VAS (Visual Analogue Scale) scale of higher than 7.0.

The research subjects were randomly assigned into one of the following 3 treatment groups: the Corrective Exercise Group (CEG, n=8), the Resistance Exercise Group (REG, n=8) and the Physical Therapy Group (PTG, n=8). The research subjects were informed of the details and processes of this research before the intervention was conducted and test subjects were chosen among the patients that understood and agreed to participate in the study. Patients with upper limb radiating pain, hypoesthesia, nerve compression syndromes, and muscular skeletal diseases, and patients with a previous history of spinal surgeries were excluded from participating in the intervention. The physical characteristics of the test subjects are shown in Table 1.

Table 1: Physical Characteristics

	Gender	Age(yrs.)	Height(cm)	Weight(kg)	BMI(kg/m ²)	Neck pain(month)
CEG(n=8)	F:8	49.00± 7.03	159.76± 4.42	57.00± 5.73	22.32± 1.92	8.50± 2.33
REG(n=8)	F:8	46.88± 4.52	159.18± 3.94	57.95± 3.96	22.92± 2.06	7.88± 1.96
PTG(n=8)	F:8	52.25± 6.16	159.16± 5.32	56.69± 4.44	22.45± 2.37	9.00± 2.27

Corrective Exercise Group (CEG), Resistance Exercise Group (REG), Physical Therapy Group (PTG)

B. Study Design

The target subjects of this research were randomly assigned into one of the following 3 treatment groups: the Corrective Exercise Group (CEG, n=8), the Resistance Exercise Group (REG, n=8) and the Physical Therapy Group (PTG, n=8), and the thoracic Cobb's angle, forward head angle and shoulder angle, visual analogue scale(VAS) and neck disability index(NDI) of the patients were measured before the intervention and these values were comparatively analyzed with post measurements(measuring using the identical methods) on the

same index values after the patients completed the 12-week exercise program provided in this intervention study(Figure 1).

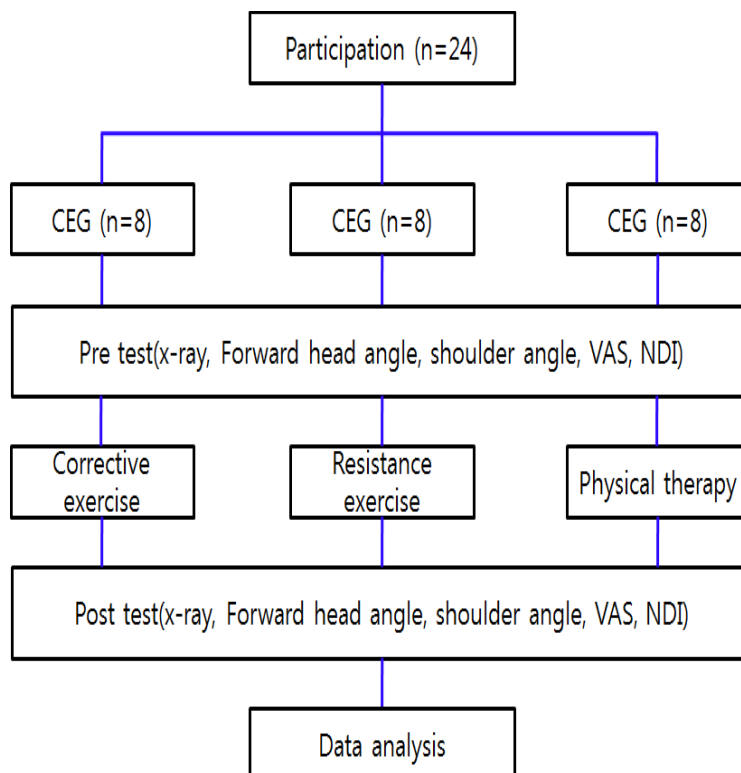


Figure 1: The Screening g Process

C. Material & Method

Thoracic Cobb's Angle Test (x-ray test)

The thoracic Cobb's angle test was conducted using x-ray equipment(ACCURAY-525R, Korea). After both of the upper limbs of the patient were bent forward at 60-90° in the standing position, the entire length of the spine of the patient from their head to their legs was x-rayed, and the Cobb's method was used to calculate the Cobb's angle. Cobb's method calculates the intersecting angle between perpendicular lines that are drawn from both the upper epiphyseal plate of the 2nd vertebrae and the 12th vertebrae.

Forward Head Angle and Shoulder Angle Test

The forward head angle and shoulder angle tests were conducting using PAS equipment(Posture Analyzing System, Korea) that implemented a photographic technique¹³. For this method, the patient is made to stand next to a wall with a grid pattern surface after attaching landmarks to their right ear, scapula acromion and 7th cervical vertebra. X-rays images were taken after having the patients spread their two feet shoulder width with both of their arms bent at 90°. The position angle of the cervical vertebral was measured as the angle between the perpendicular line passing the 7th cervical vertebra and the line passing the protrusion area of the 7th cervical vertebra. The shoulder angle was measured as the angle between the perpendicular line passing the 7th cervical vertebra and the line extended from the 7th cervical vertebra to the scapula acromion.

Visual Analogue Scale(VAS)

The changes in the degree of pain levels of the chronic neck pain patients were measured using the visual analogue scale(VAS). The scale for the pain level was set by calibrating the level where there is no pain perceived by the patient during everyday activities as '0', and by calibrating the level where the pain is too extreme to the extent that the patient could not engage in daily activities as '10', and by defining the subjective level of pain in increments of about 10cm, after determining a pain level of between 0 and 10, the patients evaluated their own current levels of pain based on visual perception¹⁴.

Neck Disability Index(NDI)

The neck disability index(NDI) was used to measure changes in the functional impairments of the cervical vertebrae¹⁵. Each of the index categories were based on one of the five index categories from the Oswestry Disability Index. The index categories included level of pain, lifting an object, concentrating, reading, self-care, driving, working, sleeping and engaging in leisure activities etc., with each index category being evaluated through a self-administered questionnaire with an index score between 0 and 5, where a value of '0' meant 'no pain or no functional impairment' and a value of '5' meaning 'unbearable pain or complete functional impairment'.

D. Exercise Intervention

Corrective Exercise Program

The resistance exercise program was designed with based on the previous researches^{3,9,16}.The corrective exercise program was designed to include cervical corrective exercises, thoracic corrective exercises, back extensor exercises, latissimusdorsi and pectoralis stretching and schroth method exercises.

Preparation and cooling down exercises were designed to maintain an exercise intensity of rating of perceived exertion(RPE) 11~13, which is a 'slightly vigorous' level, and the main exercises designed in this research were designed to maintain an exercise intensity of RPE 11~13, which is a 'vigorous' level of intensity.

The exercises were conducted for 12 weeks, during which sessions were held 3 times a week for 60 minute durations. The rest period between each set was 30 seconds while the rest period between each exercise was 60 seconds, and the details of the results from the corrective exercise program are as shown in table 2.

Table 2: Corrective Exercise Program

	Exercise type	Contents(time)	Target assignment	Intensity
Warming up	Stretching	Stretching of major joint and muscle group(5min)	Joint movement & muscle stretching improvement	RPE 11~13
Exercise	Cervical Corrective Exercise	· cervical retraction exercise(4min) · cervical mobilization exercise(3min) · cervical flexion exercise(3min)	Neck flexors strengthen	RPE 13~15
	Thoracic Corrective Exercise	· thoracic extension exercise(4min) · thoracic mobilization exercise(4min) · scapula adduction exercise(3min) · shoulder horizontal abduction exercise(3min)	Thoracic extensors strengthen	
	Back Extensor Exercise	· trunk extension exercise(3min) · arm & leg raise exercise(3min)	Back extensors strengthen	
	Latissimusdorsi & Pectoralis stretch	· roll form stretching(3min) · gymball stretching(3min)	Latissimusdorsi & Pectoralis relaxation	
	Schroth Method Exercise	· kneeling between chair(4min) · standing in a doorway(4min)	Respiratory muscles strengthen	
Cool -down	Stretching	Stretching of major joint and muscle group(5min)	Relaxation	RPE 11~13

Resistance Exercise Program

The resistance exercise program designed in this research is based on the exercises used in previous studies^{17,18}.

The intensity of the exercise program was designed so that each exercise required 30% of the measured 1RM for each exercise, and the rest period between each set was 30 seconds while the rest period between each exercise was 60 seconds. The details of the results from the resistance exercise program are as shown in table 3.

Table 3: Resistance Exercise Program

	Exercise type	Contents(time)	Target assignment	Intensity
Warming up	Stretching	Stretching exercise of lower and upper limb muscles	Joint movement & muscle stretching improvement	RPE 11~13
Exercise	Cervical Resistance Exercise	· cervical retraction with theraband(4min) · cervical bridge exercise(4min)	Neck flexors strengthen	1RM 30% / every week re-evaluated
	Shoulder, Scapular Muscle Strengthen Exercise	· scapular retraction with theraband(4min) · lat pull-down with theraband(4min) · seated low rowing with theraband(4min) · prone lying with arm elevator with theraband(4min)	Thoracic extensors strengthen	
	Improve Posture Exercise	· back extension with weight backpack(4min) · four point kneeling with transversus abdominus(4min)	Back extensors strengthen	
	Leg Strengthen Exercise	· half squat(progress to holding dumbbells) (5min) · step ups(progress to holding dumbbells) (5min)	Latissimusdorsi&Pectoralisrelaxation	
Cool - down	Stretching	Stretching exercise of lower and upper limb muscles	Relaxation	RPE 11~13

Physical Therapy

Physical therapy treatment used hot packs that were at a temperature between 50 to 55°C to conduct heat treatment for 25 minutes, and treatment with an ICT (Interferential Current Therapy) device (ITO, Japan) was conducted at 100Mz for 15 minutes, and a treatment with an ultrasonic wave therapy device (ITO, Japan) at a frequency of 1 MHz and an intensity of 1.5W/cm² for 10 minutes, for a total physical therapy treatment duration of 10 minutes.

E. Date Analysis

Using the data obtained from this study, the Mean(M) and Standard Deviation(SD) were calculated using the SPSS/PC 18.0 statistics program in Windows. Paired t-testing analysis was conducted on the pre and post factors for the exercise programs within each group. One-way ANOVA was conducted to verify the effects of each of the types of exercise according to each group. When statistical significance was confirmed through this analysis, post verification was additionally conducted using Duncan's new multiple range test. For this study, statistical significance was adopted at $P < 0.05$.

III. RESULTS

Table 4 shows the factors that affected structural changes in the spine curvature and the functional changes in the cervical vertebra after the test subjects were prescribed to the 12 week exercise program design in this research. Changes in the thoracic Cobb's angle and the head angle and shoulder angles, which are factors that affect structural changes in the spine curvature, were confirmed to decrease by statistically significant amounts ($p < 0.001$) in the CEG and REG groups when comparing the pre and post exercise program results, while there was no statistically significant difference confirmed for the PTG group. The results of the one-way ANOVA analysis confirmed that there was a statistically significant difference between the groups according to the type of exercise program ($p < 0.001$), and the post verification conducted using Duncan confirmed that the CEG group was more significantly affected when compared to the REG and PTG groups.

The VAS and the NDI, which are factors that affect the functional changes in the cervical vertebra, were confirmed to decrease by statistically significant amounts ($p < 0.001$) in the CEG, REG and PTG groups when comparing the pre and post exercise program results ($p < 0.001$).

The results of the one-way ANOVA analysis confirmed that there was a statistically significant difference between the groups according to the type of exercise program ($p < 0.001$), and the post verification conducted using Duncan's new multiple range test confirmed that the CEG group was more significantly affected when compared to the REG and PTG groups.

Table 4: Changes to Spinal Curvature Structural Variable after the 12 Week

		CEG(n=10)	REG(n=10)	PTG(n=10)	<i>p</i>	Post-hoc
Thoracic cobb's angle	pre-test	38.13±2.10	37.75±1.28	36.75±1.49	0.000***	a>b
	post-test	25.75±1.98†††	33.38±1.92†††	36.88±1.73		a>c
forward head angle	pre-test	38.13±2.10	37.75±1.28	36.75±1.49	0.000***	a>b
	post-test	25.75±1.98†††	33.38±1.92†††	36.88±1.73		a>c
shoulder angle	pre-test	42.25 ± 0.71	41.75 ± 2.32	42.00 ± 1.60	0.000***	a>b
	post-test	33.38 ± 1.85†††	36.88 ± 1.73†††	41.75 ± 1.75		a>c
Pain scale(VAS)	pre-test	7.50±0.54	7.38±0.92	7.25±0.46	0.000***	a>b
	post-test	2.13±0.84†††	3.88±0.84†††	4.13±0.84†††		a>c b>c
neck disability index(NDI)	pre-test	24.00 ± 1.07	24.50 ± 1.31	25.25 ± 1.49	0.000***	a>b
	post-test	8.38 ± 2.20†††	14.38 ± 1.19†††	18.88 ± 2.36††		a>c b>c

mean± SD. $p < 0.05$ †, $p < 0.01$ ††, $p < 0.001$ †††, $p < 0.05$ *, $p < 0.01$ **, $p < 0.001$ ***, † paired t-test, * one-way ANOVA, CEG : Corrective Exercise Group, REG : Resistance Exercise Group, PTG : Physical Therapy Group, a : CEG, b : REG, c : PTG

IV. DISCUSSION

The excessive angling of kyphosis causes misalignment of the cervical vertebra, and the curvature of the cervical vertebra causes a head angle that is translated in the forward direction. When the forward head posture is prolonged for long periods of time, this can lead to chronic cervical vertebra diseases, which can cause pain syndromes^{3,6}. Therefore, the objective of this research was to provide various treatment methods for kyphosis patients suffering from neck pain and to examine the effects of these treatment methods on thoracic Cobb's angle, neck pain and NDI to conclusively provide effective treatment methods for kyphosis patients suffering from neck pain.

The results confirmed from the changes in the thoracic Cobb's angle confirmed that there was a statistically significant decrease in the CEG and REG groups when comparing the pre and post exercise program results. But there was no statistically significant difference confirmed for the PTG group for the factors related to the thoracic Cobb's angle. The results also confirmed that there was a statistically significant difference between the groups according to the type of exercise program ($p < 0.001$), and confirmed that the CEG group was the most significantly affected group. Previous study⁸ reported that a corrective exercise program applied to 70 kyphosis patients had confirmed a decrease in the thoracic Cobb's angle and these results are consistent with the results of this research. The increase in the thoracic Cobb's angle according to kyphosis causes muscular imbalance such as the weakening of the cervical extensor and the shortening of the pectoralis major muscle and also decreases the activity and movement of the diaphragm between breathes taken. Therefore the active stretching exercises that strengthen the cervical extensor and help the pectoralis muscle relax will have had a positive effect on the CEGs and REGs in this research. The schroth method corrective exercises that strengthen the respiratory muscles will have resulted in a greater statistically significant decrease for the recovery of the movement of the thorax and strengthening of the respiratory muscles in the REG. The research results on the changes in the cervical angle and shoulder angle confirmed that there was a statistically significant decrease in the CEG, REG and PTG groups when comparing the pre and post exercise program results. But there was no statistically significant difference confirmed for the PTG group for the factors related to the thoracic Cobb's angle. The results also confirmed that there was a statistically significant difference between the groups according to the type of exercise program ($p < 0.001$), and confirmed that the CEG group was the most significantly affected group. These results are consistent with the results of the previous study⁹ that confirmed a decrease in the cervical angle and shoulder angle according to the 12 week corrective exercise program designed in this research study provided to kyphosis patients.

The forward head posture that results from kyphosis cause both a position change of the cervical joint and also an imbalance of related muscles⁶. Also an increase in the thoracic curvature causes a shortening and exacerbation of the shoulder muscle which causes droopy and round shoulders that are rotated inwards. Therefore this research induced a statistically significant change for the position change of the cervical

vertebra by providing a corrective exercise program and a resistance exercise program to strengthen the muscles and restore felicity to the pectoralis major and the muscle surrounding the cervical vertebra. It is considered that the corrective exercise program is effective in implementing a statistically significant decrease for chest mobility related exercises for the scapula and the stability exercises for the winging scapula especially when compared to resistance exercise programs and physical therapy treatment.

The change in the neck pain and NDI confirmed in this research decreased by statistically significant amounts when comparing the pre and post exercise program results. The results of this research also confirmed a statistically significant difference between the groups according to the type of exercise program ($p < 0.001$), and confirmed that the CEG was the most significantly affected group. A study by reference proposed that a forward head posture increased pressure towards the rear joint of the cervical vertebra and the back of the spine and changed the length of the surrounding soft tissue, which resulted in pain¹⁹. In this research, it is considered that patients benefitted from relieved neck pain as the thoracic Cobb's angle and the cervical kyphotic angle became smaller, by decreasing the imbalance and tension in the surrounding muscles to enable the spine curvature to recover to a normal angle. This decrease in neck pain also resulted in a beneficial change for the NDI. This is considered to be due to an increase in the quality of life according to the decrease in pain perceived during daily activities²⁰. The strengthening of the respiratory in the CEG by having the test subjects perform the schroth method corrective exercises is considered to be the most effective treatment method for kyphosis patients with back pain because this also increases the muscular strength of surrounding muscles¹⁶.

The results above can be summarized to confirm that proper spine curvature improvement for kyphosis patients with chronic neck pain is effective in terms of both decreasing pain and also recovering the functions of the cervical vertebra, and that corrective exercise programs are the most effective exercises that achieve this result. Through a follow up prospective study based on this research that examines the duration that the pain alleviation can be maintained after a patient is treated for neck pain, it is considered that there must be active development for exercise programs that have both a prolonged treatment efficacy and pain alleviation effect.

REFERENCES

- [1] KatzmanWB, Wanek L, Shepherd JA, Sellmeyer DE. Age-related hyperkyphosis: its causes, consequences, and management. *J Orthop Sports PhysTher.* 2010;40, pp. 352-360.
- [2] Angle EM, O'Brien MF, Thoracic and Thoracolumbar Kyphosis in Adults. *Spine*, 2006, 31(19), pp.161-170.
- [3] Kendall FP, McCreary EK, Provance P. *Muscles testing and function, with posture and pain.* 5th ed. Baltimore, Williams and wilkins, 2005.<https://www.lww.com/Muscles--Testing-and-Function--with-Posture-and-Pain/p/9780781747806>.
- [4] Janda V. Evaluation of muscular imbalance in Liebenson C(ED) pilot study. *Man Ther*, 1996, 15(6), pp. 552-56.
- [5] Borisut S, Vongsirinavarat M, Vachalathiti R, Sakulsriprasert P. Effects of Strength and Endurance Training of Superficial and Deep Neck Muscles on Muscle Activities and Pain Levels of Females with Chronic Neck Pain. *J PhysTher Sci.* 2013, 25(9), pp. 1157-1162.
- [6] Kim EY, Kim KJ, Park HR. Comparison of the effects of deep neck flexor strengthening exercise and Mackenzie neck exercises on head forward postures due to the use of smartphones. *Indian Journal of Science and Technology.* 2015, 8(S7), pp.569-575.
- [7] Yip CH, Chiu TT, Poon AT, The relationship between head posture and severity and disability of patients with neck pain. *Man Ther*, 2008, 13(2), pp. 148-154.
- [8] Vaughn DW, Brown EW., The influence of an in-home based therapeutic exercise program on thoracic kyphosis angle. *J Back MusculoskeletRehabil*, 2007, 20, pp. 155-165.
- [9] Foadseidi, Reza Rajabi, Ismail Ebrahimi, MohamadHosseinAlizaddo&HoomanMinoonejad, The efficiency of corrective exercise interventions on thoracic hyper-kyphosis angle. *Journal of Back and Musculoskeletal Rehabilitation.* 2013, 27(1), pp. 7-16.
- [10] Symon B, Wendy BK, Lora MG, Exercise for improving age-related hyperkyphoticposture: A systematic review. *Arch Phys Med Rehabil.* 2014, 95, pp. 129-140.
- [11] Jenna SB. Effects of a 10-week exercise intervention on thoracic kyphosis, pulmonary function, endurance, back extensor strength and quality of life in women with osteoporosis, in college of health

- science. Unpublished Doctoral dissertation. Texas Women's University, 2010.
- [12] Kay TA, Gross A, Goldsmith CH, Rutherford S, Voth S, Hoving JL, et al, Exercises for mechanical neck disorder. Cochrane Database of Systematic Reviews, 2012, Issue 8.1.
- [13] Harman K, Chery LH, Butler H, Effectiveness of an exercise program to improve forward head posture in normal adults. J Man Manip Ther, 2005, 13(3), pp. 163-70.
- [14] Chesworth BW, Culham EG, Tata GE, Peat M, Validation of outcome measures in patients with patellofemoral syndrome. J Otrhop Sports Phys Ther, 1989, 10, pp. 302-08.
- [15] Vernon H. The Neck Disability Index: State-of-the-art, 1991-2008. J Manipulative Physiol Ther, 2008, 31(7), pp. 491-502.
- [16] Lehnert-Schroth C, Three-dimensional treatment for scoliosis. The Schroth Orthopedic Breathing System. A physiotherapeutic method to improve deformities of the spine. Germany: Books on Demand, 2007.
- [17] Renno Ana CM, Granito N, Driusso Patricia, Costa Dirceu, Oishi Jorge, Effects of an exercise program on respiratory function, posture and on quality of life in osteoporotic women: a pilot study. Physiotherapy, 2005, 91, pp. 113-18.
- [18] Bergstrom I, Kronhed B, Karlsson, AC, Grahn K, Susanne K, Brinck J, Back extensor training increases muscle strength in postmenopausal women with osteoporosis, kyphosis and vertebral fractures. Informa healthcare, 2011, 13(3), pp. 110-17.
- [19] Silva AG, Punt TD, Sharples P, Vilas-Boas JP, Johnson MI, Head posture and neck pain of chronic nontraumatic origin: a comparison between patients and pain-free persons. Arch Phys Med Rehabil, 2009, 90(4), pp. 669-74.
- [20] Cho HY, Park YJ, Moon HH, Park SS, Kang GM, Yoon WY, Kim MK, The effect of swiss ball stabilization exercise on deep and superficial cervical muscle and pain in patients with chronic neck pain. Indian J. Sci and Technol, 2015, 8(S1), pp. 14-19.



ISSN
0975-6299

Health-Related Behaviors and Osteoporosis among Korean Men: Based on KNHANES 2008-2011

Myoung-Hee Kim*, Professor, Department of Nursing, Semyung University, 65 Semyung-Ro, Jecheon, Chungcheongbuk-do, 27136, Republic of Korea. E-mail: mh1352@semyung.ac.kr

Abstract---

Background/Objectives: The purpose of this study was to measure the prevalence of osteoporosis and to assess related factors among Korean men.

Methods/Statistical Analysis: Using raw data from the Korean National Health and Nutritional Examination Survey (KNHANES) conducted from 2008 to 2011, a secondary analysis was performed with data from 4,264 men aged 20 years and older. We calculated adjusted proportions of osteoporosis in men, and we performed logistic regression analysis.

Findings: The proportions of osteoporosis among Korean men were 0.8% among those aged 20-29 years, 0.6% in 30-39 year-olds, 2.3% in 40-49 year-olds, 4.1% among 50-59 year-olds, 7.8% in those aged 60-69 years and 17.8% in those aged 70 years and older, respectively. The prevalence of osteoporosis was significantly associated with age, body mass index, intense physical activities, and walking. However, we did not find any correlations between other health-related behaviors and osteoporosis.

Improvements/Applications: Results of this study can provide useful information to develop prevention programs for osteoporosis through further consideration of the characteristics among men.

Keywords--- BMD, Bone Mineral Density, Osteoporosis, Men, KNHANES.

* Corresponding Author

I. INTRODUCTION

Osteoporosis is a general skeletal disease in which decreased bone mineral density (BMD) increases the risk of broken bones or fractures ^{1,2}. Osteoporosis morbidity rapidly increases after 50 years of age but there are typically no symptoms until a broken bone occurs so an emphasis on preventative management is extremely important. However, osteoporosis is less likely to be recognized as a concern for men because it is often considered a female disease due to high morbidity among women in or after menopause. Recently as interest in men's osteoporosis has increased, many new research studies aiming to discover differences in osteoporosis between women and men by studying the causes, occurrence rate of fractures, and treatment process have yielded valuable results ^{3,4}.

Unlike osteoporosis in their female counterparts, drinking and long-term use of aglucocorticoid account for over 50% of male cases. In addition, men are more vulnerable to bone fractures related to osteoporosis and 30% of patients with osteoporosis-related bone fractures are men ³. 20~30% of patients with femur fractures caused by osteoporosis die within a year due to complications, with men experiencing a higher mortality rate percentage within a year after the fracture (30% for men compared to 17% for women) ^{4,5}.

As indicated above, men have different risk factors or incidence rates for osteoporosis and it is necessary to develop preventative countermeasures that are appropriate and specialized for men's osteoporosis considering men's characteristics. The risk factors of osteoporosis include age, insufficient calcium intake, family history, smoking, excessive alcohol intake, low activity lifestyle, lack of exercise, previous history of fractures, petite body size, etc. ⁶⁻⁸.

It is difficult to cure osteoporosis. Medicine for osteoporosis helps to minimize bone loss, but does not increase bone mineral density. Studies have shown that maximizing peak bone mineral mass gain during growth and avoiding risk factors of bone loss are the best preventive measures ⁶. Therefore, in order to prevent and manage osteoporosis, it is important to maintain an active lifestyle through regular exercise and a healthy diet including maximizing calcium intake, calcium supplements and vitamin D intake, avoiding smoking cigarettes, limiting drugs and caffeine, having routine bone mineral density check-ups and health examinations ^{9,10}.

Osteoporosis is a major disease which can be avoided with appropriate preventative activities and early detection, appropriate interventions and treatments can reduce the incidence rate of broken bones or fractures ¹¹. Therefore, developing and applying appropriate preventative intervention programs that take into consideration the patient's gender and risk factors will ensure positive outcomes. Therefore, this study examines men's bone mineral density by age and risk factors that affect bone mineral density (BMD) and how closely they are correlated.

II. METHODS

A. Study Design

This study investigates the risk factors affecting the incidence rate of osteoporosis among men who are 20 years old using descriptive research. This study is a secondary analysis examining raw data from Korean National Health and Nutrition Examination Survey (KNHANES) conducted between 2008 and 2011.

B. Study Population

The KNHANES is a nationwide, cross-sectional survey conducted among the South Korean population which used stratified, multi-stage clustered probability sampling to select a representative sample of the civilian, non-institutionalized South Korean population ¹².

The osteoporosis test was conducted from late 2008 to early 2011 in the 4th edition (2007~2009) and 5th edition (2010~2012). Between 2008 and 2011, a total of 37,753 people (17,195 men and 20,558 women) participated in the KNHNEs.

In this study, we selected 4,264 males aged 20 years and older who were asked to complete a dual-energy X-ray absorptiometry, have an in-person health interview, and complete a nutrition survey. This study used raw survey data downloaded from the Korean National Health and Nutrition Examination Survey (KNHANES) homepage.

This study was approved by the institutional review board (SMU-EX-2016-07-002).

C. Definition of Osteoporosis and Associated Factors

In the Korean National Health and Nutrition Examination Survey, the lumbar 1~4 and femoral neck bone mineral density (BMD) was measured by using DXA(Dual energy X-ray absorptometry) (DISCOVERY QDR-4500W, Hologic INC., USA).

According to the World Health Organization, osteoporosis occurs when the measured bone mass is below 2.5 of the standard deviation from the young adults mean, and osteopenia is below 1~2.5 of standard deviation from the young adults mean ^{1, 2}.

In this study, if a participant had a low T-score (T-score $\leq$ -2.5) in a BMD measurement of the lumbar spine and/or femoral neck, the participant was classified as having osteoporosis.

Health-related behaviors related to osteoporosis examined included: alcohol consumption, smoking behavior, days of intense physical activities in a week, days of moderate intensity physical activities in a week, days of walking in a week, days of physical activities for muscular strength in a week, days of physical activities for body flexibility in a week, and daily dietary calcium intake.

Socio-demographic factors examined included: age, household income, BMI (Body Mass Index), and a history of osteoporosis in their parents.

D. Statistical Analysis

We used a weighted population sample to reflect a complex, stratified, multi-stage clustered probability sampling method.

We calculated the estimated proportions and standard errors for factors associated with osteoporosis. In order to study factors that cause osteoporosis for men, logistic regression analyses were used. The SPSS program 19.0 (SPSS Inc., Chicago, IL, USA) was used to analyze the data. A value of $p < 0.05$ was considered statistically significant.

III. RESULTS

A. General Characteristics of Subjects

Table 1 presents the general characteristics of the study participants.

Study subjects were made up of 4,264 of men aged 20 years and older. Among these subjects, estimated proportions of age were 24.8% for 20-29 years, 27.3% for 30-39 years, 24.4% for 40-49 years, 14.3% for 50-59 years, 5.9% for 60-69 years, and 3.4% for 70 years and older, respectively. Household income was 29.3% in the upper class, 33.2% in the upper-middle class, 25.5% in the lower-middle class, and 11.9% in the lower class, respectively.

The Korean Society for the study of obesity's Obesity Treatment Guideline (2012) ¹³ defined that BMI under 18.5 is underweight, over 18.5 and under 23.0 is normal, over 23.0 and under 25.0 is overweight, and over 25.0 and under 30 is obese, and over 30 is extremely obese. In this study, 4.8% of subjects were underweight (BMI under 18.5), 36.3% were normal (BMI 18.5~23.0), 25.4% were overweight (BMI 23.0 ~ 25.0), 29.9% were obese (25.0~30.0) and 3.6% were extremely obese (BMI over 30). The mean BMI of total subjects was 23.83. 12.8% of participants had a history of osteoporosis in family. Regarding health-related behaviors related to osteoporosis, 54.7% of subjects answered that they drink less than one time a week and 47.7% of subjects answered that they smoke.

Regarding physical activities, 50.5% of subjects answered that they never have any intense physical activities in a week. 48.1% of subjects answered that they never even do moderate-intensity physical activities in a week.

Regarding walking, 43.1% of subjects answered that they walk 6-7 times a week. 57.6% of subjects answered they never do any physical activities for muscular strength and 43.2 % of subjects reported that they are never involved in physical activities for body flexibility in a week. Daily calcium intake of subjects was 581.07mg.

Calcium intake among subjects aged 50+ was less than 700mg, which is the suggested dietary reference intakes for Koreans (KDRIs) over 50 years old according to the Korean Nutrition Society ¹⁴.

Table 1: General Characteristics of Study Participants (N=4264)

Characteristics	Categories	Estimated proportion % (SE)	Characteristics	Categories	Estimated proportion % (SE)
Age (years)	20 ~ 29	24.8 (1.1)	Intense physical activities in a week (days)	None	50.5 (1.0)
	30 ~ 39	27.3 (1.0)		1-2	28.1 (0.9)
	40 ~ 49	24.4 (0.9)		3-5	15.5 (0.7)
	50 ~ 59	14.3 (0.7)		6-7	5.9 (0.4)
	60 ~ 69	5.9 (0.3)	Moderate intensity physical activities in a week (days)	None	48.1 (1.0)
Household income	≥ 70	3.4 (0.3)		1-2	25.3 (0.9)
	Lower class	11.9 (0.7)		3-5	17.0 (0.6)
	Lower-middle class	25.5 (1.0)	Walking in a week (days)	6-7	9.5 (0.6)
	Upper-middle class	33.2 (1.0)		None	12.4 (0.7)
BMI (kg/m ²)	Upper class	29.3 (1.0)		1-2	17.4 (0.7)
	< 18.5	4.8 (0.4)	Physical activities for muscular strength in a week (days)	3-5	27.1 (0.8)
	18.5 ~ < 23.0	36.3 (0.9)		6-7	43.1 (0.9)
	23.0 ~ < 25.0	25.4 (0.8)		None	57.6 (1.0)
Alcohol consumption during the previous year	25.0 ~ < 30.0	29.9 (0.8)		1-2	19.7 (0.7)
	≥ 30.0	3.6 (0.4)	Physical activities for body flexibility in a week (days)	3-4	13.1 (0.6)
	None	7.2 (0.5)		≥ 5	9.7 (0.6)
	1 serving/week or less	54.7 (1.0)		None	43.2 (0.9)
Smoking	2-3 serving/week	25.7 (0.9)	Daily calcium intake (mg)	1-2	22.0 (0.8)
	4 serving/week or more	12.4 (0.6)		3-4	16.3 (0.7)
	Never	20.3 (0.8)		≥ 5	18.5 (0.7)
History of osteoporosis in family	At one time, but no longer	13.8 (0.7)	History of osteoporosis in family	Yes	12.8 (0.6)
	Occasionally	18.2 (0.7)		No	87.2 (0.6)
	Currently	47.7 (0.9)			

B. Bone Mineral Density and the Prevalence of Osteoporosis by Age Group among Korean Men

As shown in Table 2, the mean value of BMD at lumbar spine site among Korean men was 1.00 g/cm² in those aged 20-29 years, 0.99 g/cm² among 30-39 year-olds, 0.97 g/cm² in 40-49 year-olds, 0.94 g/cm² in 50-59 year-olds, 0.93 g/cm² in 60-69 year-olds and 0.89 g/cm² among those 70 years and older, respectively.

The mean value of BMD at femoral neck site among Korean men was 0.92 g/cm² in those aged 20-29 years, 0.86 g/cm² among 30-39 year-olds, 0.82 g/cm² in 40-49 year-olds, 0.78 g/cm² in 50-59 year-olds, 0.75 g/cm² in 60-69 year-olds and 0.67 g/cm² among those 70 years and older, respectively.

The proportions of osteopenia among Korean men were 22.3% in those aged 20-29 years, 27.2% among 30-39 year-olds, 35.2% in 40-49 year-olds, 43.4% in 50-59 year-olds, 48.4% in 60-69 year-olds and 57.3% among those 70 years and older, respectively.

The proportions of osteoporosis among Korean men were 0.8% in those aged 20-29 years, 0.6% among 30-39 year-olds, 2.3% in 40-49 year-olds, 4.1% in 50-59 year-olds, 7.8% in 60-69 year-olds and 17.8% among those 70 years and older, respectively.

Table 2: Bone Mineral Density and the Prevalence of Osteoporosis by Age Group (N=4264)

Age (years)	BMD at lumbar spine (g/cm ²)	BMD at femoral neck (g/cm ²)	Normal	Prevalence of osteopenia	Prevalence of osteoporosis
	Mean (SE)	Mean (SE)	Estimated proportion % (SE)	Estimated proportion % (SE)	Estimated proportion % (SE)
20 ~ 29	1.00 (0.005)	0.92 (0.006)	76.9 (1.9)	22.3 (1.9)	0.8 (0.4)
30 ~ 39	0.99 (0.004)	0.86 (0.004)	72.3 (1.6)	27.2 (1.6)	0.6 (0.2)
40 ~ 49	0.97 (0.005)	0.82 (0.004)	62.5 (1.6)	35.2 (1.6)	2.3 (0.5)
50 ~ 59	0.94 (0.006)	0.78 (0.005)	52.5 (2.4)	43.4 (2.3)	4.1 (0.9)
60 ~ 69	0.93 (0.007)	0.75 (0.005)	43.8 (2.4)	48.4 (2.4)	7.8 (1.2)
≥ 70	0.89 (0.011)	0.67 (0.008)	24.9 (3.0)	57.3 (3.2)	17.8 (2.5)

C. Risk Factors that Affect Osteoporosis of Subjects

Risk factors that affect osteoporosis of men were displayed in Table 3.

Multiple logistic regression analyses were used to evaluate the association of the prevalence of osteoporosis and variables including alcohol consumption, smoking behavior, days of intense physical activities in a week, days of moderate intensity physical activities in a week, days of walking in a week, days of physical activities for muscular strength in a week, days of physical activities for body flexibility in a week,

and daily dietary calcium intake (mg) as health-related behaviors related to osteoporosis and age, household income, BMI, and a history of osteoporosis in their parents as socio-demographic factors. The prevalence of osteoporosis was significantly associated with age, body mass index, and intense physical activities. The elderly subjects had a high risk for osteoporosis (40-49 years, OR = 4.12, 95% CI = 1.61-10.68; 50-59 years, OR = 7.08, 95% CI = 2.61-19.16; 60-69 years, OR = 7.79, 95% CI = 2.85-21.24; 70 and more, OR = 12.82, 95% CI = 4.57-35.94; 20-29 years, reference). A low BMI was significantly associated with a risk of osteoporosis (BMI 18.5~<23.0, OR = 0.25, 95% CI = 0.14-0.44; BMI 23.0~<25.0, OR = 0.12, 95% CI = 0.05-0.25; BMI 25.0~<30.0, OR = 0.06, 95% CI = 0.02-0.13; BMI $\geq$ 30.0, OR = 0.10, 95% CI = 0.01-0.78; BMI<18.5, reference). The prevalence of osteoporosis among intense physical activities of 3-5 times a week was higher than that among intense physical activities of 6-7 times a week (OR= 3.33, 95% CI = 1.12-9.88). The prevalence of osteoporosis among walking of 3-5 times a week was lower than that among walking of 6-7 times a week (OR= 0.04, 95% CI = 0.21-0.76). However, other health-related behaviors did not show any significant correlations with osteoporosis.

In this study, the prevalence of osteoporosis in Korean men is associated with age, body mass index, intense physical activities, and walking, which is not affected by other health-related behaviors factors.

The result was consistent with that reported by Genant et al.¹⁵.

According to by Genant et al.¹⁵, there are a number of known demographic factors such as age, race and BMI as well as secondary causes of low bone mineral density. Of these factors, BMI is considered a strong predictor of bone mineral density (BMD) irrespective of age and gender and a bone scan is recommended if BMI <19.

Table 3: Risk Factors that Affect Osteoporosis of Subjects (N=4264)

Characteristics	Categories	Exp (B)	95% CI
Age (years)	20 ~ 29	1	
	30 ~ 39	0.95	0.29~3.11
	40 ~ 49	4.15	1.61~10.68
	50 ~ 59	7.08	2.61~19.16
	60 ~ 69	7.79	2.85~21.24
	$\geq$ 70	12.82	4.57~35.94
Household income	Lower class	1.31	0.70~2.45
	Lower-middle class	1.26	0.69~2.29
	Upper-middle class	0.83	0.43~1.63
BMI (kg/m ²)	Upper class	1	
	<18.5	1	
	18.5 ~ <23.0	0.25	0.14~0.44
	23.0 ~ <25.0	0.12	0.05~0.25
	25.0 ~ <30.0	0.06	0.02~0.13
	$\geq$ 30.0	0.10	0.01~0.78
Alcohol consumption during the previous year	None	1	
	1 serving/week or less	1.19	0.59~2.38
	2-3 serving/week	1.52	0.72~3.20
	4 serving/week or more	0.49	0.23~1.05
Smoking	Never	1	
	At one time, but no longer	0.87	0.42~1.79
	Occasionally	0.71	0.36~1.42
	Currently	0.58	0.33~1.03
Intense physical activities in a week (days)	None	2.11	0.87~5.14
	1-2	1.73	0.57~5.22
	3-5	3.33	1.12~9.88
	6-7	1	
Moderate intensity physical activities in a week (days)	None	1.04	0.55~1.98
	1-2	0.53	0.24~1.17
	3-5	0.93	0.42~2.05
	6-7	1	
Walking in a week (days)	None	0.84	0.46~1.53
	1-2	1.19	0.67~2.13
	3-5	0.40	0.21~0.76
	6-7	1	
Physical activities for muscular strength in a week (days)	None	0.71	0.29~1.74
	1-2	0.47	0.13~1.60
	3-4	0.69	0.25~1.90
	$\geq$ 5	1	
Physical activities for body flexibility in a week (days)	None	1.74	0.84~3.58
	1-2	1.16	0.47~2.82
	3-4	1.22	0.54~2.74
	$\geq$ 5	1	
Daily calcium intake (mg)		1.00	0.99~1.00
History of osteoporosis in family	Yes	0.85	0.44~1.66
	No	1	

IV. CONCLUSION

Study results indicated that men's bone mineral density continually decreases after 20 years of age and osteoporosis morbidity among men over 50 exceeds 40% and the osteoporosis incidence rate over a man's lifetime is over 4.1%. This shows that men are exposed to an increased risk of osteoporosis as they get older. Decreased bone density increases the occurrence of bone fractures and further threatens quality of life. Accordingly, it is necessary to increase awareness among medical professionals of the impact of osteoporosis among men to emphasize the importance of prevention. Appropriate screening and osteoporosis prevention intervention for men with risk factors can prevent the morbidity and mortality associated with bone loss.

In this study, the main causes that affect men's bone mineral density were age and BMI and ones who have low BMI by age should be considered as high risk group of osteoporosis and preventative interventions should be developed for this group of people. However, study results did not show any significant correlations between additional causes of osteoporosis such as drinking and smoking and osteoporosis morbidity so it is required to have additional studies on this topic. Additionally, mostly there were no significant correlations between osteoporosis and exercises, while there were some correlations between them so it is necessary to have supplemental research on that area as well.

ACKNOWLEDGMENT

This paper was supported by the Semyung University Research Grant of 2016.

REFERENCES

- [1] World Health Organization. WHO study group on assessment of fracture risk and its application on to screening for postmenopausal osteoporosis. Technical Report No. 843, 1994, Geneva, Switzerland.
- [2] Kanis JA. Assessment of fracture risk and its application to screening for postmenopausal osteoporosis: Synopsis of a WHO report. WHO Study Group, Osteoporosis Int., 1994, 4, pp. 368-381.
- [3] Alswat K, Adler SM. Gender differences in osteoporosis screening: Retrospective analysis. Archives of Osteoporosis, 2012, 7(1-2), pp. 311-313. <http://dx.doi.org/10.1007/s11657-012-0113-0>
- [4] Hawkes WG, Wehren L, Orwig D, Hebel JR, Magaziner J. Gender differences in functioning after hip fracture. The Journals of Gerontology Series A, Biological Sciences and Medical Sciences, 2006, 61(5), pp. 495-499.
- [5] Lee SR, Kim SR, Chung KH, Ko DO, Cho SH, Ha YC, V. Mortality and activity after hip fracture: A prospective study. Journal of the Korean Orthopaedic Association, 2006, 40(4), pp. 423-427. Available at http://www.koa.or.kr/upload/journal/1/1_2006004004_012978.pdf
- [6] Ruffing J A, Nieves J W, Zion M, Tendy S, Garrett P, Lindsay R, et al. The influence of lifestyle, menstrual function and oral contraceptive use on bone mass and size in female military cadets. Nutrition & Metabolism, 2007, 4, 17. <http://dx.doi.org/10.1186/1743-7075-4-17>
- [7] Lee H Y, Kim D H, Kim S H. An analysis of nutrients intake, related factors of anemia and bone density in ballet dancers. Indian Journal of Science and Technology, 2015, 8(25), DOI: 10.17485/ijst/2015/v8i25/80463
- [8] Yoon S I, Kim S H, Yoon Y B. The relationship between teaching experience, exercise habit, health related fitness, bone density and arterial stiffness of Korean female teachers. Indian Journal of Science and Technology, 2015, 8(S7), pp. 332-338.
- [9] Kim Y M, Kim M H. Osteoporosis awareness and bone mineral density among college women . International Journal of Applied Engineering Research, 2014, 9(2), pp. 15455-15467.
- [10] Sedlack CA, Doheny M O, Jones S L. Osteoporosis education programs: Changing knowledge and behavior. Public Health Nurs, 2000, 17, pp. 398-402.
- [11] Lee K. Evidence-based management for osteoporosis. Journal of the Korean Medical Association. 2011, 54(3), pp. 294-302. <http://dx.doi.org/10.5124/jkma.2011.54.3.294>
- [12] Park EJ, Joo IW, Jang MJ, Kim YT, Oh KW, Oh HJ. Prevalence of osteoporosis in the Korean population based on Korea National Health and Nutrition Examination Survey (KNHANES) 2008-2011. Yonsei Med J, 2014, 55, pp. 1049-1057.
- [13] Korean Society For The Study Of Obesity. Obesity Treatment Guideline, 2012. Seoul: Author; 2012.
- [14] The Korean Nutrition Society. Dietary reference intakes for Koreans. Seoul: Author; 2010. Available at http://www.kns.or.kr/Data/FileRoom/2010KDRIs_open_final.pdf
- [15] Genant H K, Cooper C, Poor G, Reid I, Ehrlich G, Kanis J, Nordin B E, Barrett-Connor E, Lack D, Bonjour

J P, Dawson-Hughes B, Delmas P D, Dequeker J, Ragi Eis S, Gennari C, Johnell O, Johnston Jr. C C, Lau E M, Liberman U A, Lindsay R, Martin T J, Masri B, Mautalen C A, Meunier P J, Khaltayev N et al. Interim Report and Recommendations of the World Health Organization Task-force for Osteoporosis. *Osteoporos Int*, 1999, 10, pp. 259-264.



ISSN
0975-6299

A Survey on Recognition of Dental Care Customers according to a Health Insurance Support Project for Smoking Cessation Treatment

Yu-Ri Choi, Dept. of Dental Hygiene, Hallym Polytechnic University, Chuncheon-si, Gangwon-do, South Korea .

E-mail:cyr0032@naver.com

Sun-Ok Jang, Dept. of Dental Hygiene, Hallym Polytechnic University, Chuncheon-si, Gangwon-do, South Korea.

E-mail:sojhappy@hanmail.net

Youn-Soo Shim, Dept. of Dental Hygiene, College of Health Science, Sunmoon University, Asan-si, Chungcheongnam-do, South Korea. E-mail:shim-21@hanmail.net

Eun-Mi Choi*, Dept. of Dental Hygiene, Kyungdong University, Wonju-si, Gangwon-do, South Korea, South Korea.

E-mail:emchoi@kduniv.ac.kr

Abstract---

Objectives: This study aims to utilize it as basic data in enforcing the relevant policy by surveying the dental consumer's awareness according to the health insurance coverage for smoking cessation treatment within a dental clinic that is being implemented.

Methods/Statistical Analysis: This study was surveyed from May 1, 2016 to May 20 by applying convenience sampling. Totally 255 respondent were collected. Excluding 7 respondent with the impossibility of the application among the collected questionnaires, totally 248 respondent were used in statistical analysis.

Findings: 22% of the men smoked. The smoking amount was the largest in less than half a pack of cigarettes. The smoking rate in less than 39 years old was the highest. The lower income level led to smoking. A drinker had high smoking rate. The recognition and learning route about the Health-insurance subsidy program according to general characteristics. The recognition on the Health-insurance Subsidy Program for smoking cessation treatment was low. (10%) Out of it, the 40s was knowing much. The Health-insurance Subsidy Program for smoking cessation treatment came to be known through internet and a person around. Appropriateness of frequency and cost for a non-smoking system of the Health-insurance Subsidy Program for smoking cessation treatment according to general characteristics

The response as saying that the appropriateness of frequency on a non-smoking system was high. Even the response as saying of not knowing well even the appropriateness of cost for a non-smoking system was high.

Improvements/Applications: As a result of comparatively analyzing general matters & quality of life, knowledge, recognition and attitude, there was a significant difference in awareness of dental health according to income level.

Keywords--- Dental Consumer, Health Insurance Coverage, Smoking, Non-smoking, Dental Health, Dental Hygiene.

* Corresponding Author

Special Issue on "Medical Science"

I. INTRODUCTION

Smoking not only becomes a major cause for what cholesterol, which is a factor of causing coronary artery disease such as artery hardening or myocardial infarction, comes to pile up in the walls of a blood vessel, but also damages the inner wall of blood vessel, increases total cholesterol level, and has a great influence upon a reduction in high-density and low-protein cholesterol^{1,2,3}. Also, it leads to the activation in sympathetic nerve, to the acceleration in coronary arteriosclerosis, and to the coronary artery disease and stroke caused by inflammation, thereby being reported to increase mortality caused by vascular disease to about 4 times^{4,5}. WHO(World Health Organization) reported that 38% of the smokers suffer cardiovascular disease, that 27% of the smokers suffer stroke, and that smoking is a direct cause for more than 5 million deaths among 6 million deaths with a smoking-related disease every year⁶.

Seeing a change in the mouth caused by the continuously long-term smoking, it leads to getting higher in the acidity of saliva, to a reduction in buffering capacity, and to being not smooth in self-purification inside the mouth, thereby resulting in a rise in the dental caries experience owing to the excessive formation of dental plaque. The chemicals in cigarette come to directly contact the oral cavity caused by smoking and are leading to a harmful affect on oral health due to it. It is causing several kinds of oral diseases from coloring without clinical harm and bad breath to a periodontal disease, acute necrotizing gingivitis, leukoplakia, and oral cancer. In addition, it was reported to have bad influence even upon the lifespan of implant and to get lower in an effect of periodontal treatment owing to the delayed wound.

According to the non-smoking guidelines by AHCPR(Agency for Health Care Policy and Research), it has ever been reported that the non-smoking recommendation of a health and medical service personnel is certainly needed and that a smoker's success rate of non-smoking given performing the non-smoking education targeting smokers is higher in the more frequency of a medical professional's non-smoking counseling, in the lengthier non-smoking consulting, and in the more non-smoking education of a medical professional. CDHA(Canadian Dental Hygienist Association) announced the importance of the non-smoking counseling that recommends the non-smoking education and the proper healing method as one of the important roles in dental hygienists within a dental parlor. Many research surveys relevant to the non-smoking counseling targeting dental hygienists are being conducted⁷.

Our country was opened a non-smoking clinic for the free non-smoking counseling and healing service at about 250 health centers nationwide from 2005 in order to help smokers' non-smoking, along with a policy-based project of regulating smoking, and was trained professional manpower such as a smoking cessation counselor. A direct effect of a reduction in smoking rate of our country's adult men caused by a non-smoking clinic of health center was reported to be 0.24% in 2007 and to be 0.18% in 2008. From February 25, 2015, even a dental clinic, which is registered in a non-smoking treatment institution, as well as a health center, is available for the 12-week non-smoking counseling and the prescription of non-smoking treatment medicine and for getting a support for the cost of a smoking cessation aid. However, it tends to be mostly lacking in a promotional program necessary for the execution of policy in our country. It is reality that there are few cases of managing the public information operations team or of receiving an expert's consulting.

It was indicated that a ratio of making a success oneself in anti-smoking accounts for 5-6%, but that the probability of a success given carrying out the non-smoking recommendation and drug treatment by a medical professional reaches 30%. Even in a guide book of the non-smoking performance in America, the non-smoking rate given stopping non-smoking by a medical professional was shown to get higher⁸. reported that the application of consulting time can lead to playing a positive role in case of the anti-smoking guidance activity because the dental treatment is lengthily consumed the counseling time compared to other medical treatments. The dental treatment time is characterized by long term and by needing to visit the dentist periodically. In light of this, a dental practitioner is available for easily observing a change inside the mouth caused by smoking and for effectively performing the non-smoking guidance for a smoker.

A smoker's success rate of non-smoking given performing the non-smoking education targeting smokers is being reported to be higher in the more frequency of a medical professional's non-smoking counseling, in the lengthier non-smoking consulting, and in the more non-smoking education of medical professionals. Accordingly, the non-smoking education by a medical professional is considered to be likely to be certainly necessary.

Hence, this study aims to utilize it as basic data in enforcing the relevant policy by surveying the dental-care consumers' recognition according to the Health-insurance Subsidy Program for Smoking Cessation Treatment within a dental clinic that is being implemented.

II. RESEARCH METHOD

A. Research Subjects

This study was surveyed from May 1, 2016 to May 20 by applying convenience sampling. Totally 255 respondent were collected. Excluding 7 respondent with the impossibility of the application among the collected questionnaires, totally 248 respondent were used in statistical analysis.

B. Research Method and Analytical Method

In a questionnaire tool, the research subjects' general characteristics included 3 items such as gender, age and income. An item on the Health-insurance Subsidy Program for Smoking Cessation was composed of 6 questions about smoking appearance & smoking amount, about the recognition & learning route on the Health-insurance Subsidy Program, and about the appropriateness for cost and frequency of non-smoking system. An item related to the quality of life was modified, supplemented and completed by seeing Slade's thesis. An item relevant to knowledge, awareness and attitude toward oral health was modified, supplemented and completed by referring to Jeon Mi-jin's thesis. As a result of surveying an item relevant to the quality of life, and to knowledge, awareness & attitude toward oral health by using a 5-point Likert scale, the reliability of the surveyed items was indicated to be Cronbach's alpha.

A statistical analysis was used SPSS window ver. 18.0 (IBM Co., Armonk, Ny, USA). The items on smoking appearance & smoking amount according to general characteristics, on the recognition & learning route about the Health-insurance Subsidy Program, and on cost & frequency of a non-smoking system were carried out chi-square test(χ^2 -test). The quality of life, knowledge, recognition & attitude toward oral health according to gender among subjects' general characteristics were used t-test. The quality of life, knowledge, recognition & attitude toward oral health according to age and income were used one-way ANOVA. A group-based difference was conducted Tukey's post-analysis. The decision of statistical significance was considered with less than $p < 0.05$.

III. PROPOSED WORK

A. The Smoking Appearance and the Smoking Amount

Table 1 was confirmed the smoking appearance and the smoking amount according to general characteristics. In case of the smoking appearance, the response as saying of smoking in a male by gender accounted for 46.4%, thereby having been indicated to be higher than 3.5% in a female($\chi^2=74.003$, $p < 0.001$).

Depending on annual salary, the response as saying of smoking accounted for 24.3% in under 19.99 million won, 14.0% in 20 million won-29.99 million won, 46.2% in 30 million won-39.99 million won, and 35.7% in over 40 million won. Thus, the response was shown to be high as saying that the higher annual income leads mostly to the higher smoking ($\chi^2=13.305$, $p < 0.05$).

Table 1: According to Sociodemographic Characteristics of Smoking Appearance and the Smoking Amount

Characteristics	Smoking					Smoking amount						
	yes	no	Stop-smoking	χ^2	p	Under half pack	half pack	1 pack	Over 1 pack	2 pack	χ^2	p
Gender				74.003	0.000***						1.141	0.888
male	71(46.4)	78(51.0)	4(2.6)			10(14.1)	31(43.7)	22(31.0)	6(8.5)	2(2.8)		
female	5(3.5)	135(95.7)	1(0.7)			1(20.0)	3(60.0)	1(20.0)	0(0.0)	0(0.0)		
Age(y)				6.468	0.167						8.678	0.370
≤39	39(32.2)	79(65.3)	3(2.5)			8(20.5)	20(51.3)	10(25.6)	1(2.6)	0(0.0)		
40~49	17(18.3)	75(80.6)	1(1.1)			1(5.9)	7(41.2)	6(35.3)	2(11.8)	1(5.9)		
≥50	20(25.0)	59(73.8)	1(1.3)			2(10.0)	7(35.0)	7(35.0)	3(15.0)	1(5.0)		
Year income (10,000KRW)				13.305	0.038*						11.427	0.493
≤1999	41(24.3)	124(73.4)	4(2.4)			8(19.5)	17(41.5)	14(34.1)	2(4.9)	0(0.0)		
2000~2999	8(14.0)	48(84.2)	1(1.8)			0(0.0)	6(75.0)	1(12.5)	1(12.5)	0(0.0)		
3000~3999	12(46.2)	14(53.8)	0(0.0)			2(16.7)	4(33.3)	3(25.0)	2(16.7)	1(8.3)		
≥4000	15(35.7)	27(64.3)	0(0.0)			1(6.7)	7(46.7)	5(33.3)	1(6.7)	1(6.7)		
Drink				6.259	0.044*						1.188	0.880
Yes	58(30.2)	130(67.7)	4(2.1)			9(15.5)	26(44.8)	17(29.3)	4(6.9)	2(3.4)		
No	18(17.6)	83(81.4)	1(1.0)			2(11.1)	8(44.4)	6(33.3)	2(11.1)	0(0.0)		
Total	76(25.9)	213(72.4)	5(1.7)			11(14.5)	34(44.7)	23(30.3)	6(7.9)	2(2.6)		

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

B. Awareness Level and Acquisition Route of the Health Insurance Support Project

In case of a recognition on the health insurance support project according to general characteristics in Table 2, the response as saying of 'don't know' about the health insurance support project depending on gender, age, annual salary and the drinking appearance possessed the greater part. Thus, a statistically significant difference was not shown. As for an acquisition route of the health insurance system, 40-49 years old according to age accounted for 52.6% in internet, thereby having been shown to be higher than other age groups. On the other hand, over 50 years held 50.0% in TV & Radio. And under 39 years old took up 26.3% in the surrounding people. Thus, each age group was indicated to be higher than other age groups ($\chi^2=15.554$, $p<0.05$).

Table 2: According to Socio demographic Characteristics of Awareness Level and Acquisition Route of the Health Insurance Support Project

Characteristics	Health insurance support project of recognized				Health insurance support project of acquisition route						χ^2	p
	yes	no	χ^2	p	Internet	TV & Radio	newspaper	Surrounding people	etc			
Gender			0.143	0.771							8.989	0.061
male	32(20.9)	121(79.1)			8(25.8)	9(29.0)	3(9.7)	10(32.3)	1(3.2)			
female	27(19.1)	114(80.9)			9(33.3)	8(29.6)	2(7.4)	2(7.4)	6(22.2)			
Age(y)			2.166	0.339							15.554	0.049*
≤39	20(16.5)	101(83.5)			4(21.1)	4(21.1)	1(5.3)	5(26.3)	5(26.3)			
40~49	19(20.4)	74(79.6)			10(52.6)	3(15.8)	2(10.5)	3(15.8)	1(5.3)			
≥50	20(25.0)	60(75.0)			3(15.0)	10(50.0)	2(10.0)	4(20.0)	1(5.0)			
Year income (10,000KRW)			0.170	0.982							9.492	0.660
<2000	31(20.8)	118(79.2)			7(21.9)	10(31.3)	3(9.4)	6(18.8)	6(18.8)			
2000~2999	11(19.3)	46(80.7)			6(54.5)	2(18.2)	0(0.0)	3(27.3)	0(0.0)			
3000~3999	6(23.1)	20(76.9)			1(16.7)	2(33.3)	1(16.7)	1(16.7)	1(16.7)			
≥4000	9(21.4)	33(78.6)			3(33.3)	3(33.3)	1(11.1)	2(22.2)	0(0.0)			
Drink			0.094	0.878							3.198	0.525
Yes	39(20.3)	153(79.7)			10(26.3)	11(28.9)	5(13.2)	8(21.1)	4(10.5)			
No	19(18.8)	82(81.2)			7(35.0)	6(30.0)	0(0.0)	4(20.0)	3(15.0)			

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

C. The Adequacy of Frequency and Cost in a Non-smoking Scheme of the Health Insurance Support Project for the Smoking Cessation Treatment

Table 3 was inquired into the adequacy of frequency and cost in a non-smoking scheme of the health insurance support project for the smoking cessation treatment according to general characteristics. As for the adequacy of frequency, the response as saying of being appropriate depending on annual salary accounted for 29.0% in under 20 million won, 36.4% in 20 million won-29.99 million won, 16.7% in 30 million won-39.99 million won, and 22.2% in over 40 million won. Thus, the response was indicated to be high as saying that the lower annual income leads generally to the more appropriate frequency ($\chi^2=15.343$, $p<0.05$).

As for the adequacy of cost, the response as saying of being appropriate depending on annual salary took up 25.8% in under 20 million won, 18.2% in 20 million won-29.99 million won, 0.0% in 30 million won-39.99 million won, and 22.2% in over 40 million won. Thus, the response as saying that cost is proper was indicated to be higher in the remaining groups than a group whose annual salary is 30 million won-39.99 million won ($\chi^2=15.495$, $p<0.05$).

Table 3: The Adequacy of Frequency and Cost in a Non-smoking Scheme of the Health Insurance support Project for the Smoking Cessation Treatment

Characteristics	Adequacy of frequency of the health insurance					Adequacy of cost of the health insurance					χ^2	p
	yes	no	Don't know	χ^2	p	yes	No	Don't know	χ^2	p		
Gender				0.103	0.950				1.203	0.548		
male	8(26.7)	4(13.3)	18(60.0)			8(26.7)	2(6.7)	20(66.7)				
female	8(29.6)	3(11.1)	16(59.3)			4(14.8)	2(7.4)	21(77.8)				
Age(y)				4.624	0.328				5.260	0.262		
≤39	7(38.9)	0(0.0)	11(61.1)			6(33.3)	0(0.0)	12(66.7)				
40~49	5(26.3)	3(15.8)	11(57.9)			3(15.8)	1(5.3)	15(78.9)				
≥50	4(20.0)	4(20.0)	12(60.0)			3(15.0)	3(15.0)	14(70.0)				
Year income (10,000KRW)				15.343	0.018*				15.495	0.017*		
<2000	9(29.0)	1(3.2)	21(67.7)			8(25.8)	0(0.0)	23(74.2)				
2000~2999	4(36.4)	0(0.0)	7(63.6)			2(18.2)	0(0.0)	9(81.8)				
3000~3999	1(16.7)	2(33.3)	3(50.0)			0(0.0)	1(16.7)	5(83.3)				
≥4000	2(22.2)	4(44.4)	3(33.3)			2(22.2)	3(33.3)	4(44.4)				
Drink				1.542	0.463				2.387	0.303		
Yes	11(28.9)	6(15.8)	21(55.3)			7(18.4)	4(10.5)	27(71.1)				
No	5(26.3)	1(5.3)	13(68.4)			5(26.3)	0(0.0)	14(73.7)				

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

D. Quality of Life, Knowledge, Recognition and Attitude

Table 4 was figured out the quality of life, knowledge, recognition and attitude according to general characteristics. As for the quality of life, a statistically significant difference was indicated according to age ($p<0.05$). The quality of life was shown to be higher in under 39 years old than in 40-49 years old and in over 50 years old.

In case of knowledge, a statistically significant difference was shown depending on gender ($p<0.01$), age ($p<0.05$) and annual salary ($p<0.05$). The knowledge by gender was indicated to be higher in a female than a male. The knowledge was shown to be higher in over 40 years old than in below 39 years old according to age, and to be higher in above 20 million won than in below 20 million depending on annual income.

In case of recognition, a statistically significant difference was indicated depending on gender ($p<0.001$) and annual salary ($p<0.05$). The knowledge was shown to be higher in a female than a male according to gender. The awareness was indicated to be highest in a group with 20 million won-29.99 million won depending on annual income.

In case of attitude, a statistically significant difference was shown according to annual salary ($p<0.05$). Under 20 million won came to 3.20 points. 20 million won-29.99 million won stood at 3.46 points. 30 million won-39.99 million won amounted to 3.18 points. Over 40 million won stood at 3.37 points. Thus, the attitude was indicated to be highest in a group whose annual salary is 20 million won-29.99 million won.

According to whether or not drinking, the response as saying of smoking in a group with drinking accounted for 30.2%, thereby having been shown to be higher than 17.6% in a group without drinking ($\chi^2=6.259$, $p<0.05$).

Table 4: According to Socio demographic Characteristics of Quality of Life, Knowledge, Recognition and Attitude					
Characteristics	N	Quality of life	Knowledge	Recognition	Attitude
Gender					
male	153	4.46±0.67	3.75±0.46	3.70±0.70	3.23±0.69
female	141	4.42±0.65	3.89±0.42	3.93±0.46	3.32±0.51
p-value*		0.622	0.008**	0.001***	0.196
Age(y)					
≤39	121	4.56±0.75 ^b	3.74±0.49 ^a	3.71±0.77	3.20±0.69
40~49	93	4.36±0.59 ^a	3.89±0.32 ^b	3.90±0.41	3.38±0.48
≥50	80	4.36±0.58 ^a	3.85±0.50 ^b	3.85±0.49	3.27±0.61
p-value*		0.038*	0.034*	0.062	0.107
Year income (10,000KRW)					
<2000	128	4.51±0.72	3.75±0.48 ^a	3.76±0.66 ^{ab}	3.20±0.61 ^a
2000~2999	57	4.36±0.49	3.96±0.34 ^b	4.01±0.45 ^b	3.46±0.49 ^b
3000~3999	26	4.43±0.59	3.81±0.34 ^{ab}	3.68±0.40 ^a	3.18±0.44 ^a
≥4000	37	4.30±0.65	3.87±0.46 ^{ab}	3.83±0.62 ^{ab}	3.37±0.80 ^{ab}
p-value*		0.226	0.019*	0.033*	0.026*
Smoke					
Under 1package	45	4.37±0.90	3.66±0.42	3.61±0.85	3.31±0.49
Under 1-2package	29	4.45±0.55	3.66±0.57	3.59±0.58	3.36±0.60
Over 2 package	2	3.36±1.03	3.86±0.00	3.73±0.05	3.04±0.88
p-value*		0.177	0.851	0.961	0.695

*by chi-square test or t-test or one way ANOVA

a,bby Tukey's test means with same letters are not significantly different($\alpha=0.05$)

E. A Correlation among the Quality of Life, Knowledge, Recognition and Attitude toward Whether or Not Smoking

Examining a correlation among the quality of life, knowledge, recognition and attitude toward whether or not smoking as seen in table 5, a statistically significant correlation was not shown, first of all, among the quality of life, knowledge, recognition and attitude.

Sequentially, a positive(+) correlation was indicated between knowledge and recognition in $r=0.538$ ($p<0.01$) and between knowledge and attitude in $r=0.277$ ($p<0.01$). In other words, it can be known that the high knowledge leads even to the high awareness and the high attitude.

Finally, a positive(+) correlation was indicated between recognition and attitude in $r=0.583$ ($p<0.01$). That is to say, it can be known that the high recognition leads even to the high attitude.

Table 5: A Correlation among the Quality of Life, Knowledge, Awareness and Attitude toward Whether or Not Smoking

Characteristics	Quality of life	Knowledge	Awareness	Attitude
Quality of life	1			
Knowledge	0.033	1		
Awareness	-0.002	0.538**	1	
Attitude	-0.011	0.277**	0.583**	1

* $p < 0.05$, ** $p < 0.01$.

About 60 carcinogens, which are included in a cigarette, come to have serious influence upon many organs of human body. The most representative disease is lung cancer. But it has a great effect even on mouth organs of being touched the first given smoking.

A cigarette has been reported to be a cause for a failure in the initial fixing of the implant and for a rise in the incidence of mouth cancer due to the injuries of blood vessel inside the mouth, to bringing about the hypoxia of tissue and a change in immune system, to the occurrence in periodontitis, and to an increase in a loss of alveolar bone.

According to a previous research, there was a report as saying that a risk of periodontitis occurs more highly by 2.6-6 times compared to non-smokers (Position paper). There was a report as saying that prognosis was worse because smoking had effect on the outcome given the periodontal treatment in periodontitis patients⁹.

As a result of this study, the response as saying that men smoke by gender was high. The response as saying that the higher annual salary leads to the more smoking was shown to be high. Also, a group with drinking did smoke.

The perception level of the health insurance support project for the smoking cessation treatment was indicated to be low (79.1%). It is considered to be likely needed an effort for increasing the awareness level of the health insurance support project for the smoking cessation treatment. Among the respondents by age who are recognizing the health insurance support project for the smoking cessation treatment, the respondents aged over 50 were knowing the most. 50.0% of those aged over 50 said that they learnt it from TV & Radio. To promote it to diverse age brackets, even the publicity of the corresponding policy project is considered to be likely necessary through internet and others.

The questionnaire respondents generally thought that the frequency and the cost of the non-smoking scheme of the health insurance support project for the smoking cessation treatment were appropriate. The current health insurance support project for the smoking cessation treatment (enforced on February 25, 2015) involves the contents of supporting 70% of the specialized medical consultation within 6 times for 12 weeks based on twice a year, and of backing up 30-70% of purchasing an anti-smoking drug and a smoking cessation aid. The questionnaire respondents were being satisfied with the current contents. Thus, the contents of this policy are considered to be probably good even if being literally maintained.

According to a previous research, smokers were indicated have more in attachment loss and alveolar bone loss¹⁰. The smokers were shown to have more in supra-gingival calculus and sub-gingival calculus^{11,12}. Hence, this study surveyed the quality of life, knowledge, recognition and attitude in relation to oral health.

In consequence of this study, the quality of life in oral health showed a statistically significant difference depending on age. It was indicated that the higher age leads to the lower quality of life related to oral health. Thus, it is supposed that the more rise in age leads to suffering from more dental caries and periodontal disease and to the more fall even in the quality of life.

Oral health knowledge was shown to be high in a woman's knowledge. The knowledge related to oral health was indicated to be high in the more age and in the higher annual income. Compared to men, women are guessed to have likely gotten higher in knowledge acquisition on oral health while suffering a problem relevant to oral health in the higher interest in oral health and in the more age. Also, a person with the higher annual salary leads to the higher accessibility to the dentist, thereby being considered to have high knowledge level.

In the aspect of oral health attitude, the respondents were having a good attitude toward the caries

prevention such as dental floss and interdental brush. This form showed a significant difference depending on annual salary. It was indicated that the higher annual income leads to the higher attitude related to oral health. This can be thought to be similar to knowledge level. The higher annual salary leads to the higher accessibility to the dentist and to the more opportunity available for being exposed to the relevant education, resulting in being confirmed to have been likely higher in the interest related to oral health.

Smokers were shown to be low in oral health knowledge, in oral health awareness and in oral health attitude. Also, the outcome was shown that the high oral health knowledge leads to both the high perception related to oral health and the high attitude. In other words, it was indicated that the high oral health perception leads even to the high attitude related to oral health.

The purport of the health insurance support project for the smoking cessation treatment, which is a program of being implemented by the government in order to reduce a cigarette of causing many problems inside the mouth, is good. And the respondents were also satisfied with the corresponding contents. However, the recognition level was indicated to be low because the positive promotion was not made. Accordingly, the publicity for the relevant policy seems to be likely to be necessarily spread positively for people's oral health promotion and mental health.

As for a limitation of this study, the corresponding questionnaire survey subjects included adults who dwell in some areas, thereby being considered to be likely unreasonable to be generalized as an outcome of all the adults in our country. Also, a follow-up research is thought to be necessarily performed on a plan available for increasing perception level of the health insurance support project for the smoking cessation treatment, and on the development in a smoking cessation program.

IV. CONCLUSION

As a result of surveying the recognition level in this study on the health insurance support project for the smoking cessation treatment, which was enforced for maintaining oral health, the awareness level was shown to be low. The quality of life in oral health showed a statistically significant difference depending on age. The oral health knowledge was indicated that the higher age and annual income lead to the higher knowledge. In consequence of the oral health attitude, it was shown that the higher annual salary leads even to the better attitude toward oral health.

Smokers were shown to be low in oral health knowledge, in oral health recognition and in oral health attitude. In addition, the outcome was indicated that the high oral health knowledge leads to both the high oral health awareness and the high oral health attitude. Namely, it was shown that the high oral health perception leads even to the high oral health attitude.

At this point of time that a smoking cessation policy is being reinforced in many places, the medical circles and the dental world are making a great effort for the smoking cessation counseling activity. Based on this study, it is considered to be likely a foundation of developing diverse smoking cessation programs and of gathering a policy of the smoking cessation treatment.

REFERENCES

- [1] Doll C, Nack C, Raguse JD, Sticker A, Duttenhoefer F, Nelson K, Nahles S. Survival analysis of dental implants and implant-retained prostheses in oral cancer patients up to 20 years. *Clinical Oral Investigation*. 2015,19, pp.347-52.
- [2] Yun HK, Park IS. Factors Influencing Intermittent Smoking in Male and Female Students in Korea. *Indian Journal of Science and Technology*. 2016, 9(25), PP.1-8.
- [3] Kim HJ. Smoking Cessation and Relapse among Smoking Cessation Scholarship Beneficiaries. *Indian Journal of Science and Technology*. 2016, 9(25), PP.1-8.
- [4] S. Karthigeyan, T. Kavitha. An Intelligent Toll Booth System for Vehicle Smoke Emission Monitoring and Prepaid Toll Transactions. *Indian Journal of Science and Technology*. 2015, 8(14), PP.1-5.
- [5] Kotsakis GA, Javed F, Hinrichs JE, Karoussis IK, Romanos GE. Impact of cigarette smoking on clinical outcomes of periodontal flap surgical procedures: a systematic review and meta-analysis. *Journal Periodontology*. 2015, vol. 86, pp. 254-63.
- [6] World Health Organization (WHO). *The MPOWER: A policy package to reverse the tobacco epidemic*. Geneva Switzerland: World Health Organization Press.
- [7] Fiore MC, Backer TB, Bailey WC, Goldstein MG, Heyman RB, Cohen SJ "Treating tobacco use and

- dependence. A Clinical Practice Guideline. Rockville, Md: US Dept. of Health and Human Services" (AHRQ publication No. 00-0032), 2000.
- [8] Ryu MH, Kim J. Tobacco and oral disease, smoking cessation strategies in dental clinic. *Kor J oral Maxillofacial Pathology* 2005, 29, pp.381-390.
- [9] Heasman L, Stacey F, Preshaw PM, McCracken GI, Hepburn S, Heasman PA. The effect of smoking on periodontal treatment response: a review of clinical evidence *J Clinical Periodontology*. 2006, 33, pp.241-53.
- [10] Baljoon M, Natto S, Bergstrom J. The association of smoking with vertical periodontal bone loss. *J Periodontol* 2004; 75:844-51. Bergstrom J. Tobacco smoking and subgingival dental calculus. *J Clinical Periodontology*. 2005, 32, pp.81-8.
- [11] Bergstrom J. Tobacco smoking and subgingival dental calculus. *J Clinical Periodontology*. 2005, 32:pp. 81-8.
- [12] Susin C, Oppermann RV, Haugejorden O, Albandar JM. Periodontal attachment loss attributable to cigarette smoking in an urban Brazilian population. *J Clinical Periodontology*. 2004, 31, pp. 951-8.



ISSN
0975-6299

The Effect of Samumgyo (SP-6) Acupressure on Bowel Functions and Constipation in Women

Kwang Ok Lee*, Department of Nursing, Sangmyung University, Korea. E-mail:kolee@smu.ac.kr

Hyo rim Kim, Department of Nursing, Sangmyung University, Korea.

Da Hae Kim, Department of Nursing, Sangmyung University, Korea.

Ok young Shin, Department of Nursing, Sangmyung University, Korea.

Jeong Hwa Lee, Department of Nursing, Sangmyung University, Korea.

Ha Young Lim, Department of Nursing, Sangmyung University, Korea.

Eun Jin Hwang, Department of Nursing, Sangmyung University, Korea.

Abstract---

Background/Objectives: This is a pre and post-test design, quasi-experimental nonequivalent control group study to examine the effect of Samumgyo(SP-6)acupressure on revitalization of bowel functions and alleviation of constipation among women with abnormal bowel functions and constipation.

Methods/Statistical Analysis: This study implemented from Oct.1, 2013 to Dec20, 2013 on total of 69 people (experimental group 36, control group 33) nationwide. This study analyzed paired t-test between experimental group and control group in SPSS22.0.

Findings: After Samumgyo(SP-6) acupressure intervention, persons who complained of discomforts decreased by 5.55($\pm$ 2.76) in the experimental group and increased by 1.22($\pm$ 2.45) in the control group. And after the intervention, persons who felt discomforts in bowel functions decreased by 6.48($\pm$ 4.15) in the experimental group and increased by 1.19($\pm$ 3.11) in the control group.

Keywords--- Samumgyo(SP-6) Acupressure, Bowel Function, Constipation.

* Corresponding Author

I. INTRODUCTION

Modern people's living is accompanied by lots of discomforts due to irregular lifestyle, excessive stress consequent on environments, and the ever-prolonged sedentary lifestyle. As people have become accustomed to the food life focused on instant-style high-fat and high calorie due to the development of Western-style food culture, their opportunity to take in fresh vegetables and fruits has decreased. On account of such an influence, constipation has become a universal disease to modern people. Constipation refers to the condition, in which feces get hardened due to the decrease in moisture from their long stay in the intestinal canal, and difficulty in bowel movement(The great encyclopedia of nursing science, 1996), and even if the number of times of bowel movement is normal, constipation is defined in the light of subjective symptoms, such as aspects of feces, status of the feeling of residual stool, and discomfort to the lower abdomen, because of a problem of bowel movement. Also, in case of women, their large intestine hangs loosely due to the weaker muscular strength than men, and they have the constipation symptom by more than 3~4 times in comparison with men due to the slowdown in large intestine mobility(Walter S, hallbook O, Gotthaved R, Bergmark M, & Sjodahl R., 2002). According to the National Statistical Office, the number of patients who received treatment of constipation in our country has increased to 1,428,000 in 2009 from 927,000 in 2002, showing the 65% increase rate over the last only 7 years, among which female constipation patients' proportion was surveyed to account for 56% of all constipation patients; accordingly, women's constipation prevalence rate turned out to be very higher than men(National Health Insurance Corporation, 2010). Like this, it is reported that young women's constipation prevalence rate is increasingly increasing.

Among the large number of women having a constipation symptom, the ratio of the women, who engage in active therapy in order to resolve constipation, is no more than one fifth, showing how passive they are in constipating therapy. It's because most of the women having a constipation symptom tend to take it lightly in comparison with other diseases, and thus the case where they do self-therapy rather than receiving specialized therapy at a hospital, or a pharmacy is amounting to 67%, showing that the ratio of specialized therapy on constipation is very low relatively in comparison to other diseases. In recent times, non-pharmacological, non-invasive intervention has been much researched in medical circles, and abdominal muscles intensification therapy, an exercise cure, and biofeedback, etc. are introduced as a palliative therapy(Emily, 1998; Karam & Nies, 1994) while alternative remedies include biofeedback, abdominal meridian massage & moxibustion, sticker needle therapy, soybean paste fomentation therapy, aromatherapy and meridian acupressure therapy, etc.

However, in case of biofeedback, its equipment is expensive, and meridian massage requires lots time in mastering professional education and techniques; in addition, moxibustion, sticker needle, soybean fomentation and aromatherapy, etc. are less effective in time and expenses due to the hassle of having to prepare related tools(Jung YH, 2007). On the contrary, meridian acupressure treatment is an intervention therapy, which anyone can easily apply because it requires no specially necessary tools, and brings no physical damage to its users, along with a simple method and no side effect.

Meridian acupressure treatment do function of preventing and exterminating diseases by improving self-regulating ability through promotion of Qi-Blood circulation function; also acupressure treatment regulates nerve function by stimulating the nerves near acupuncture points, does function of soothing pain due to endorphin's secretion action & gateway control, and it has the strength to regulate pain by producing substances which kills pain and calms down by showing an effect only through the press of the nearby points even if the point is not an accurate meridian area unlike an acupuncture.

The meridian, as one of the reflection points of function of internal organs, regulates the function of five viscera and six entrails, and internal secretion disorder by stimulating the meridians appearing on the body surface(Ko KS, 2005). Sameumgyo(SP-6) is located between the tibia below the hollow area backside of the tibia 9 cm above from the ankle bone inside the leg, and muscle extensor digitorum longus. Sameumgyo(SP-6) in Chinese medicine is used roughly for a gynecological disease, urologic diseases, and a digestive trouble. To put it concretely, it is reported that Sameumgyo(SP-6) is associated with gastro-intestinal diseases, such as, tympanites, loss of appetite, gastritis, diarrhea, and constipation, etc.(Hong SI, 2012). Sameumgyo(SP-6) activates metabolism, and maintains homeostatis by revitalizing parasympathetic nerve which is the autonomic nervous system controlling gastro-intestinal tract. This study made an attempt at this research in an effort to promote a user's safety and to apply Sameumgyo(SP-6) to efficient self-nursing by reducing discomfort suffered by users due to constipation by grasping the influence of Sameumgyo(SP-6)

acupressure on constipation palliation and intestinal function revitalization.

II. PURPOSE

The purpose of this study is to provide Sameumgyo(SP-6) acupressure to women by looking into its effect after conducting Sameumgyo(SP-6) acupressure in a bid to grasp its influence on intestinal function revitalization and constipation palliation targeting women suffering from intestinal dysfunction and constipation,

- 1) To grasp the effect of Sameumgyo(SP-6) acupressure on women's intestinal function
- 2) To grasp the effect of Sameumgyo(SP-6) acupressure on women's constipation palliation

III. HYPOTHESIS

Hypothesis 1. The experimental group which intervened Sameumgyo(SP-6) acupressure will show the smoother intestinal effect than the control group, to which Sameumgyo(SP-6)acupressure is not applied.

Hypothesis 2 The experimental group who intervened Sameumgyo(SP-6)acupressure will produce more effect on palliation of constipation than the control group, to which Sameumgyo(SP-6)acupressure is applied.

IV. METHOD

A. Design

As a quasi-experimental research tried to understand the effect on the activation of the intestine function and the alleviation of constipation after exercising the acupressure on Sameumgyo(SP-6) for the females suffering from the improper intestine functions and constipation, this research was based on the pre and post -test design of the nonequivalent control group.

B. Sample

After explaining the purpose, method and precautions of the research to the females from across the whole country, this research was conducted to 36 subjects in the experiment group and 33 subjects in the control group who agreed to the conditions explained and the selection criteria for the research subjects were as follows.

- a. Persons with measurement result at 4 Points (0 ~ 16 Points) or above in Constipation Assessment Scale (CAS)
- b. Persons with measurement results in the range between 12 and 36 points in Bowel Elimination Checklist.

C. Instrument

1) General Information

This is composed of total 7 questions related to the age, occupation, level of income, level of education, whether breakfast is taken, types of food enjoyed and whether physical exercises practiced.

2) Constipation Assessment Scale

As the scale developed by McMillan and Williams, this was used for confirmation of homogeneity before application of the experiment. This scale includes total 8 questions related to the discomfort in abdomen and the conditions of feces caused by constipation and each question can be answered in one of 'Not At All (0 Point)', 'Slightly So (1 Point)' or 'Very Much So (2 Points)' and the higher the points tallied based on the answers, it means the constipation is the more serious (McMillan SC, Williams FA., 1989).

3) Bowel Elimination Checklist

The Bowel Elimination Checklist was reorganized after amendment by the author based on the tool for which the validity and reliability were verified after remaking by Yeong-Hee Kim (2003) from the measurement tool for bowel excretion with total 16 questions developed by Schmelzer (1990). This scale includes total 12 questions on the scale of 3 points each with the range of points between 12 and 36 for the questions no. 1 through 12, which were classified into 3 categories including the time it took for excretion, the feeling at the time of excretion and the shape of feces and the higher the points, it means the condition of the intestine function is the worse.

D. Process

As the comparison was difficult because there were no results from the precedent researches on the effects the acupressure on Sameumgyo(SP-6) has on the intestine function and constipation, the preparatory research was progressed. By composing each team with 2 persons, Team A progressed the experiment 15 minutes per day for 4 days, Team B 25 minutes and Team C 30 minutes. After exercising the acupressure on Sameumgyo(SP-6) for 15 minutes, Team A could not perceive any effects but the CAS points were lowered from 4 points to 2 points with Team B after exercising the acupressure for 25 minutes to signify the alleviation of the discomfort in abdomen.

As a result of the exercise for 30 minutes, Team C represented the discomfort in abdomen and the excretion of gas eased with the points lowered from 4 points to 2 points. As a result of the above, the exercises for 25 minutes and 30 minutes showed the similar effects of acupressure with significance and thus the research was progressed by the exercise for 25 minutes. Summing up the above, however, the repetition research should be progressed to seek the method to assure the persistent effects with the proper functioning of the intestine and the alleviation of constipation based on the effects from the exercise of the acupressure on Sameumgyo(SP-6) for 25 minutes in this research.

The followings are the posture when the acupressure on Sameumgyo(SP-6) is practiced(Lee KO, 2003).

The procedure is as follows. The method of acupressure, the time needed and precautions are explained to the subject.

- 1) Let the subject lie comfortably on the bed.
- 2) The subject slowly breathes deep breath while receiving the acupressure.
- 3) Standing at the end of the toe of the subject, the practitioner of the acupressure looks for the Sameumgyo(SP-6) meridian point on the backside of tibia up 9.09cm from the ankle bone inside both of the legs.
- 4) After softly closing the fist and with the elbow stretched straightly as much as possible, press with the thumb joint (vertical pressure) after holding the thumb in a vertical position. The strength of power begins softly by pressing for 3 seconds and then press for 5 seconds with gradually increasing strength (continuous pressure).
- 5) With the finger still on the meridian, release the power for 2 seconds and then repeat the acupressure in the same sequence for 25 minutes.
- 6) When the vertical pressure and the continuous pressure are applied, the practitioner and the subject concentrate their mind with sincerity by gathering the spiritual energy with the united will for cure (harmony pressure).
- 7) Refrain from conversations during the practice of acupressure as much as possible and conduct the interview with the subject before and after the exercise regarding the status of the subject and the response after the practice of acupressure.

E. Data Analysis

The data is analyzed by using the SPSS 22.0 program. The improvement effects of the constipation and the intestine function before and after exercising the acupressure on Sameumgyo(SP-6) acupressure were analyzed by paired-T-test.

V. RESULTS

The Homogeneity test of general characteristics, bowel function and relief of constipation between Groups before Sameumgyo(SP-6) acupressure treatment is shown in Table 1. General characteristics, bowel function and relief of constipation between Groups before Sameumgyo(SP-6) acupressure do not have at least a statistically significant difference between the two groups was found to be homogeneous. Age was 22.72(± 0.94) in the experimental group and 22.42(± 1.55) in the control group.

Bowel function is shown by 28.53(± 3.73) in the experimental group and 26.88(± 3.69) in the control group. The relief of constipation shown by 9.92(± 2.60) in the experimental group and 8.69(± 3.08) in the control group.

Table 1: Homogeneity Test between Groups

Variable	Exp.(n=36)	Con.(n=33)	T or χ^2	p
	n(%) or (M $\pm$ SD)	n(%) or (M $\pm$ SD)		
Age	22.72 $\pm$ 0.94	22.42 $\pm$ 1.55	0.94	.351
Eat breakfast yes	4(11.1%)	10(30.3%)	4.36	.113
Rarely	18(50%)	15(45.5%)		
No	14(38.9%)	8(24.2%)		
Eat bread	13(36.1%)	20(60.6%)	6.84	.077
Instant	16(44.4%)	7(21.2%)		
Meat	5(13.9%)	2(6.1%)		
fruit	2(5.6%)	4(12.1%)		
Exercise 1~2 times/week	9(25.0%)	7(21.2%)	1.24	.743
2~3 times/week	8(22.2%)	7(21.2%)		
4~5 times/ week	5(13.9%)	8(24.3%)		
	14(38.9%)	11(33.3%)		
Bowel function	28.53 $\pm$ 3.73	26.88 $\pm$ 3.69	1.72	.091
Constipation	9.92 $\pm$ 2.60	8.69 $\pm$ 3.08	1.69	.096

The change in bowel function after Sameumgyo(SP-6) acupressure treatment is shown in Table 2. Experiencing difficulty when having bowel movement increased by 0.85($\pm$ 0.76) in the experimental group and decreased by 0.08($\pm$ 0.65) in the control group. The time takes to complete a bowel movement increased by 0.67($\pm$ 0.69) in the experimental group and decreased by 0.06($\pm$ 0.58) in the control group. The bowel function increased by 6.48($\pm$ 4.15) in the experimental group and decreased by 1.19($\pm$ 3.11) in the control group.

Table 2: Change in Bowel Function Before and After Intervention

Variable	Exp.(n=36)	Con.(n=33)	t	p
	post-pre(M $\pm$ SD)	post-pre(M $\pm$ SD)		
The time before the bowel movement	-0.55 $\pm$ 0.56	0.25 $\pm$ 0.50	6.21	.000
The extent of bowel movement exertion	-0.61 $\pm$ 0.66	0.14 $\pm$ 0.59	4.95	.000
pain around the sphincter	-0.55 $\pm$ 0.62	0.14 $\pm$ 0.42	5.41	.000
experiencing difficulty when having bowel movement	-0.85 $\pm$ 0.76	0.08 $\pm$ 0.65	5.51	.000
the time takes to complete a bowel movement	-0.67 $\pm$ 0.69	0.06 $\pm$ 0.58	4.70	.000
mood after bowel movement	-0.58 $\pm$ 0.66	0.17 $\pm$ 0.45	5.50	.000
size of stool	-0.30 $\pm$ 0.64	0.00 $\pm$ 0.63	1.98	.052
amount of stool	-0.39 $\pm$ 0.50	0.03 $\pm$ 0.65	3.00	.004
diameter of stool	-0.61 $\pm$ 1.00	0.11 $\pm$ 1.09	2.84	.006
mass of stool	-0.33 $\pm$ 0.69	0.03 $\pm$ 0.70	2.16	.035
thinness of stool	-0.48 $\pm$ 0.57	0.14 $\pm$ 0.42	5.21	.000
shape of stool	-0.58 $\pm$ 0.50	0.056 $\pm$ 0.23	6.80	.000
Total	-6.48 $\pm$ 4.15	1.19 $\pm$ 3.11	8.75	.000

The extent of alleviation of constipation after Sameumgyo(SP-6) acupressure intervention is shown in Table 3. After Sameumgyo(SP-6)acupressure treatment, uncomfortable sense of defecation increased by 0.88($\pm$ 0.60) in the experimental group and decreased by 0.19($\pm$ 0.71) in the control group. Hurts when having bowel movement increased by 0.85($\pm$ 0.51) in the experimental group and decreased by 0.28($\pm$ 0.61) in the control group. The number of bowel movement increased by 0.82($\pm$ 0.77) in the experimental group and decreased by 0.03($\pm$ 0.70) in the control group. The extent of alleviation of constipation increased by 5.55($\pm$ 2.76) in the experimental group and decreased by 1.22($\pm$ 2.45) in the control group.

Table 3: The Existence of the Relief of Constipation Before and After the Intervention

Variable	Exp.(n=36)	Con.(n=33)	t	p
	post-pre(M $\pm$ SD)	post-pre(M $\pm$ SD)		
Being flatulent	-0.67 $\pm$ 0.74	0.19 $\pm$ 1.65	5.85	.000
Increased volume of evacuated gas	-0.52 $\pm$ 0.83	0.19 $\pm$ 0.52	4.27	.000
The number of bowel movement increased	-0.82 $\pm$ 0.77	-0.03 $\pm$ 0.70	4.48	.000
Incontinence of watery feces	-0.21 $\pm$ 0.70	0.22 $\pm$ 0.76	2.47	.016
Uncomfortable sense of defecation	-0.88 $\pm$ 0.60	0.19 $\pm$ 0.71	6.75	.000
Hurts when having bowel movement	-0.85 $\pm$ 0.51	0.28 $\pm$ 0.61	8.26	.000
Small in volume or no feeling of refreshment after defecation	-0.79 $\pm$ 0.55	0.06 $\pm$ 0.58	6.19	.000
Hard to evacuate	-0.82 $\pm$ 0.68	0.11 $\pm$ 0.57	6.14	.000
Total	-5.55 $\pm$ 2.76	1.22 $\pm$ 2.45	10.78	.000

VI. CONCLUSION

This research was conducted to enable the assurance of comfort and the efficient nursing by oneself by reducing the discomfort experienced by the subjects due to the constipation by way of the understanding of the influence the exercise of the acupressure on Sameumgyo(SP-6) has on the alleviation of constipation and the activation of the intestine function. As a result of the exercise with total 69 subjects including 36 in the experiment group and 33 in the control group, it was confirmed that the acupressure on Sameumgyo(SP-6) had the effect on the proper intestine functions and the alleviation of constipation of the females. As a non-invasive and independent method of nursing, the acupressure on Sameumgyo(SP-6) can be easily exercised without costs and hence is considered to be able to be actively utilized. Therefore, it is proposed by way of this research to use the acupressure on Sameumgyo(SP-6) as the method of nursing for alleviation of constipation and the activation of intestine functions by applying to the females. In addition, a more systematic research is necessary across different age ranges by supplementing a broad range of subjects from different age groups and the research is also necessary for the males. The repetition researches are also recommended in relation to the continuous effects after the completion of the acupressure on Sameumgyo(SP-6) by utilizing the acupressure on Sameumgyo(SP-6) used in this research.

REFERENCES

- [1] Korean society of nursing science. The great encyclopedia of nursing science. Seoul: Researcher Korea dictionary. 1996
- [2] Walter S, Hallbook O, Gotthaved R, Bergmark M, & Sjodahl R. A population-based study on bowel habits in a Swedish community: prevalence of faecal incontinence and constipation. *Scand J Gastroenterol*. 2002 Aug; 37(8): pp.911-6.
- [3] National Health Insurance. Health Insurance Statistics Yearbook 2009. 2010
- [4] Emly M. Abdominal massage. *Nursing Times*, 1993 Jan, 89(3), pp.34-36.
- [5] Karam SE, Nies DM. A pilot bowel management. *J Gerontology Nurs*, 1994 Mar, 20(3), pp.32~40.
- [6] Jung YH. The Effect of meridian acupressure on constipation in the bed-ridden aged with stroke. *The Journal of Korean academic society of adult nursing*, 2007, 20(4), pp.664-673.
- [7] Ko KS. 21C Acupressure: chiropractic and natural physical therapy. Seoul: Calligraphy literary artists' paintings, 2005.
- [8] Hong SI. Introduction to Oriental Medicine. Seoul: Bomungak, 2012.
- [9] McMillan SC, Williams FA. Validity and reliability of the Constipation Assessment Scale. *Cancer Nurs*. 1989 Jun; 12(3): pp.183-8.
- [10] Kim YH. Effects of Foot Reflexology Education Program on Bowel Function, Anxiety and Depression in Nursing Students. *Korean journal of women health nursing*, 2003; 9(3): pp.277-286.
- [11] Lee KO. The effect of gas passing of SP6 acupressure with patient for laparotomy. Master thesis of Yonsei University, Seoul, 2003.



ISSN
0975-6299

The Need to Change the Roles of the Emergency Medical Service System in the National Response System due to the East Respiratory Syndrome Coronavirus(MERS-CoV) Crisis in the Republic of Korea in 2015

Sang-Sub Park*, Dept. Emergency Medical Technology, ChungCheong University, 38 Wolgok-Gil Gangnae-Myeon, Heungdeok-Gu, Cheongju-Si, Chungcheongbuk-Do, South Korea. E-mail:woonseo@hanmail.net

Yoon-Ho Lee, Dept. Faculty of Food & Nutrition, ChungCheong University, 38 Wolgok-Gil Gangnae-Myeon, Heungdeok-Gu, Cheongju-Si, Chungcheongbuk-Do, South Korea. E-mail:63yunho@hanmail.net

Abstract---

Background/Objectives: The purpose of this study was to determine the need to change the roles of the emergency medical service system in the national response system due to the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) crisis in the Republic of Korea in 2015.

Methods/Statistical analysis: For this purpose, the data from the Ministry of Health and Welfare (MOHW) and the Korea Centers for Disease Control and Prevention (CDC) were used. The data released from the Korean Broadcasting System (KBS) supervising disasters at the national level were used. The MERS outbreak duration in the Republic of Korea ranged from May 20 to December 23, 2015. The data were analyzed using SPSS for Windows 12.0 Version.

Findings: During this duration, 186 persons were officially diagnosed with MERS. Super-spreaders #1, #14, #15, #16, and #76 infected 154 (82.7%) out of 186 deaths. Of these, #14 infected 85 (55.2%) patients. 52.6% of the infections by the five super-spreaders occurred in "emergency room". The period between after diagnosis and death was 16.78 days on average. The period between after diagnosis and discharge was 20.06 days on average

Improvements/Applications: On the basis of these results, there is a need for the emergency medical service system in the national response system to play an efficient role.

Keywords--- Emergency Medical Service, MERS, Infection, Disaster, Super-Spreader.

* Corresponding Author

I. INTRODUCTION

The WHO¹ reported that MERS infection broke out in a total of 26 countries: 9 in Middle East, 8 in Europe, 3 in Africa, 5 in Asia, and 1 in Americas. MERS broke out in Saudi Arabia in 2012². It was related to bats³. MERS CoV was associated with camels⁴. Hemida et al⁵ also reported that it was associated with camels. The median incubation period for the condition was estimated at 5.2 days, with the serial interval of 7.6 days⁶.

MERS infection might involve such symptoms as chest pain, fever, cough, and difficulty in breathing⁷. Banik et al⁸ estimated that MERS-CoV (40.0%) was at higher risk of causing death than SARS (10.0%). Hunter et al⁷ contended that a medical employee and a patient could primarily transmit MERS to each other. Kim⁹ noted that as the number of MERS patients increased, that of healthcare providers infected with MERS also increased, possibly resulting in safety problems and its spread.

The MERS outbreak on May 20, 2015 has changed the social system and awareness in South Korea. The infection-related disaster resulted in closure of schools and changes in the pattern of using public transportation and in the tourism industry. Kim¹⁰ contended that the failure of the government to cope with the MERS infection immediately after its outbreak increased fear of the infection among citizens.

It lead to serious economic and social spin-off effects due to closure of schools, the depressed tourism industry, and the depressed industry for domestic demand.

It can be said that the MERS infection is one of the infection-related disasters that can spread anxiety and fear at both social and psychological levels. This study aimed to determine the need to change the roles of the emergency medical service system in the national response system due to the MERS infection outbreak. It intends to help the emergency medical service system reinforce its personnel, facilities, equipment, and systems due to the MERS infection outbreak. It also aimed to help make a plan, take a measure, and make restoration more efficiently when an infection-related disaster breaks out and to provide basic data that could help activate programs related to the emergency medical service system in the national response system.

II. METHOD OF RESEARCH

This study aimed to determine the need for the emergency medical service system in the national response system to play a role due to the MERS infection outbreak in South Korea in 2015. The MERS crisis lasted seven months from May 20, 2015 when it broke out until December 23, 2015 when the end of MERS was finally declared. During the period of seven months, 186 persons were officially diagnosed with MERS infection.

Both the data from the "briefing concerning the daily status" by MOHW¹¹ and CDC¹² and those concerning the "MERS infection status", as disclosed by KBS¹³ supervising disasters at the national level, were used.

The "briefing concerning the daily status" by MOHW¹¹ and CDC¹² mentioned the number of MERS infections, deaths, discharge, treatment, infection stage, infection place, and so on. The briefing was given in the morning.

The data concerning the "MERS infection status", as disclosed by KBS¹³ supervising disasters at the national level, were updated online in terms of the number of MERS infections, death, discharge, treatment, infection phase, infection place, and so on. These data made up for the missing data in the "briefing concerning the daily status" by MOHW¹¹ and CDC¹².

After the MERS infection outbreak, the "briefing concerning the daily status" by MOHW¹¹ and CDC¹² and the data concerning the "MERS infection status", as disclosed by KBS¹³, were coded until the declaration of its end. The daily MERS status was updated.

The common variables between the "briefing concerning the daily status" and the data concerning the "MERS infection status" were classified into gender, age, infection stage, infection place, patient category, health status, date of diagnosis, date of death.

Date of discharge, and super-spreader status. For the purpose of this study, the incubation period, the period between diagnosis and death, and the period between diagnosis and discharge were recoded. The variables were coded for the purpose of this study to obtain results.

III. ANALYTICAL METHOD

The "briefing concerning the daily status" by MOHW and CDC ⁸ were coded using an SPSS for Windows 12.0 Version program. Frequency analysis, cross-tabulation analysis, descriptive statistics, t-test, and ANOVA were performed. The significance level was set at $p < .05$.

IV. RESULTS

A. MERS Crisis Characteristics by Gender

The MERS crisis characteristics by gender are as shown in Table 1. Both males (38.7%) and females (44.0%) in their "60's" were more likely to get infected with MERS. Both males (86.5%) and females (68.0%) who were "ordinary people" were statistically significantly more likely to get infected with MERS ($p < .001$). Both males (74.8%) and females (84.0%) were more likely to be "discharged".

Table 1: MERS Crisis Characteristics by Gender

		Gender(N: 186)		total (N: 186)	χ^2	p- value
		Male111(59.7)	Female75(40.3)			
Age	10's	1(0.9)	-	1(0.5)	7.118	.310
	20's	4(3.6)	9(12.0)	13(7.0)		
	30's	18(16.2)	8(10.7)	26(14.0)		
	40's	19(17.1)	11(14.7)	30(16.1)		
	50's	26(23.4)	14(18.7)	40(21.5)		
	60'ss	43(38.7)	33(44.0)	76(40.9)		
Patient category	Ordinary person	96(86.5)	51(68.0)	147(79.0)	27.354	.000***
	Healthcare provider	7(6.3)	16(21.3)	23(12.4)		
	Caregiver	-	8(10.7)	8(4.3)		
	Medical assistant	8(7.2)	-	8(4.3)		
Health status	Death	26(23.4)	12(16.0)	38(20.4)	3.044	.218
	Discharged	83(74.8)	63(84.0)	146(78.5)		
	Treatment	2(1.8)	-	2(1.1)		

*** $p < .001$

B. MERS Crisis Characteristics by Health Status

The MERS crisis characteristics by health status are as shown in Table 2. The most frequent infection place was an "emergency room" for deaths (50.0%) and discharges (43.8%). The most frequent infection stage was "tertiary" for deaths (81.6%) and discharges (63.0%). The largest patient category was "ordinary people" for deaths (97.4%) and discharges (74.0%).

Kim ⁹ warned that many healthcare providers could be vulnerable to MERS infection because they needed to diagnose, treat, and care MERS patients personally. His warning can be consistent with the finding that lots of MERS infections occurred in emergency room. In emergency room, healthcare providers seem to be at higher risk of infection due to frequent contact with patients.

Table 2: MERS Crisis Characteristics by Health Status

		Health status(N: 186)			total (N: 186)	χ^2	p- value
		Death 38(20.4%)	Discharged 146(78.5%)	Treatment 2(1.1%)			
Infection place	Unidentified	-	2(1.4)	-	2(1.1)	6.629	.998
	Middle East	-	1(0.7)	-	1(0.5)		
	Sickroom	8(21.1)	19(13.0)	-	27(14.5)		
	Sick ward	10(26.3)	47(32.2)	1(50.0)	58(31.2)		
	Examination	-	3(2.1)	-	3(1.6)		
	Emergency room	19(50.0)	64(43.8)	1(50.0)	84(45.2)		
	Outpatient department	-	4(2.7)	-	4(2.2)		
	Ambulance	1(2.6)	2(1.4)	-	3(1.6)		
	Radiation room	-	1(0.7)	-	1(0.5)		
	Intensive care unit	-	1(0.7)	-	1(0.5)		
	Family infection	-	2(1.4)	-	2(1.1)		
Infection stage	primary infection	-	1(0.7)	-	1(0.5)	8.780	.361
	Secondly infection	5(13.2)	25(17.1)	-	30(16.1)		
	Third infection	31(81.6)	92(63.0)	1(50.0)	124(66.7)		
	Fourth infection	2(5.3)	20(13.7)	1(50.0)	23(12.4)		
	Unidentified	-	8(5.5)	-	8(4.3)		
Patient category	Ordinary person	37(97.4)	108(74.0)	2(100.0)	147(79.0)	11.109	.085
	Healthcare provider	-	23(15.8)	-	23(12.4)		
	Caregiver	-	8(5.5)	-	8(4.3)		
	Medical assistant	1(2.6)	7(4.8)	-	8(4.3)		

C. MERS Crisis Characteristics by Super-spreader

The MERS crisis characteristics by super-spreader are as shown in Table 3. Super-spreaders #1, #14, #15, #16, and #76 infected 154 (82.7%) out of 186 deaths. Of these, #14 infected 85 (55.2%) patients.

The infection place were statistically significantly more likely to be "emergency room (52.6%)" ($p < .001$). Super-spreader #1 infected in a "sick ward", #14 in an "emergency room", #15 in a "sick room and sickward", #16 in a "sickroom and sick ward", and #76 in a "sickward".

The infections stage were statistically significantly more likely to be "third(74.0%)" ($p < .001$). Super-spreader #1 was "secondly infection", #14 "third infection", #15 "third infection", #16 "third infection", and #76 "fourth infection".

The patient category were statistically significantly more likely to be "Ordinary people (83.1%)" ($p < .001$). All of the super-spreaders #1, #14, #15, #16, and #76 were "ordinary persons".

The health status were statistically significantly more likely to be "discharge (74.7%)" ($p < .05$). However, super-spreader #14 lead to as many as ≥ 20 "deaths".

Super-spreader infection can be seen as a cough. One of the MERS symptoms was cough ⁷. Cough is a significant medium of transmission to the respiratory system. CDC ¹⁴ reported that respiratory diseases for MERS patients were associated with the mortality rate. Patients with underlying diseases were more vulnerable to mortality ¹⁵. Ramkumar and Suresh ¹⁶ noted that Ebola virus disease could put life in danger. If an infectious disease leads to a disastrous situation, it is expected to increase anxiety.

Table 3: MERS Crisis Characteristics by Super-spreader

		Super-spreader					total (N: 154)	χ^2	p-value
		#1 N: 29(18.8)	#14 N: 85(55.2)	#15 N: 6(3.9)	#16 N: 23(14.9)	#76 N: 11(7.1)			
Gender	Male	17(58.6)	54(63.5)	3(50.0)	13(56.5)	9(81.8)	96(62.3)	2.720	.606
	Female	12(41.4)	31(36.5)	3(50.0)	10(43.5)	2(18.2)	58(37.7)		
Infection place	Sickroom	4(13.8)	3(3.5)	3(50.0)	11(47.8)	1(9.1)	22(14.3)	182.034	.000***
	Sick ward	23(79.3)	3(3.5)	3(50.0)	11(47.8)	4(36.4)	44(28.6)		
	Examination	2(6.9)	-	-	-	-	2(1.3)		
	Emergency room	-	77(90.6)	-	1(4.3)	3(27.3)	81(52.6)		
	Outpatient department	-	2(2.4)	-	-	-	2(1.3)		
	Ambulance	-	-	-	-	2(18.2)	2(1.3)		
	Radiation room	-	-	-	-	1(9.1)	1(0.6)		
Infection stage	Secondly infection	29(100.0)	-	-	-	-	29(18.8)	308.000	.000***
	Third infection	-	85(100.0)	6(100.0)	23(100.0)	-	114(74.0)		
	Fourth infection	-	-	-	-	11(100.0)	11(7.1)		
Patient category	Ordinary person	25(86.2)	76(89.4)	4(66.7)	17(73.9)	6(54.5)	128(83.1)	44.946	.000***
	Healthcare provider	4(13.8)	6(7.1)	1(16.7)	-	2(18.2)	13(8.4)		
	Caregiver	-	1(1.2)	1(16.7)	5(21.7)	-	7(4.5)		
	Medical assistant	-	2(2.4)	-	1(4.3)	3(27.3)	6(3.9)		
Health status	Death	4(13.8)	20(23.5)	-	11(47.8)	2(18.2)	37(24.0)	16.800	.032*
	Discharged	25(86.2)	64(75.3)	6(100.0)	12(52.2)	8(72.7)	115(74.7)		
	Treatment	-	1(1.2)	-	-	1(9.1)	2(1.3)		

* $p < .05$, *** $p < .001$

D. Period between After Diagnosis and Death

The period between after diagnosis and death are as shown in Table 4. The incubation period of MERS was 11.36 days on average. The period between after diagnosis and death was 16.78 days on average. The period between after diagnosis and discharge was 20.06 days on average.

Anxiety was a factor affecting performance of the act to prevent infection ¹⁷. June and Choi ¹⁸ suggested the need to develop a systematic infectious disease response and management system and systematic infectious disease management education at a hospital level. Kim ¹⁹ suggested rationalization of the infectious disease classification and reporting systems. And Kim ¹⁹ suggested that any infected hospital be forced to be closed on the basis of the measures against infectious diseases.

Table 4: Period between after Diagnosis and Death

	N : 186	Mean	S.D
Incubation period	186	11.36	4.99
Period between after diagnosis and death	38	16.78	33.20
Period between after diagnosis and discharge	146	20.06	21.77

E. Difference in Period between After Diagnosis and Death by Infection Status

The difference in the period between after diagnosis and death by infection status is as shown in Table 5. The after diagnosis and death period was longer for the infected patients in emergency room (24.00 days) and ambulances (26.00 days).

Table 5: Difference in Period between After Diagnosis and Death by Infection Status

		N : 38	Period between after diagnosis and death			
			Mean	S.D	t/F	p-value
Gender	Male	26	20.50	39.54	1.014	.317
	Female	12	8.75	7.26		
Infection place	Sickroom	8	9.62	4.59	.669	.577
	Sick ward	10	7.90	6.65		
	Emergency room	19	24.00	45.93		
	Ambulance	1	26.00	-		
Infection stage	Secondly infection	5	7.40	5.63	.237	.790
	Third infection	31	18.48	36.44		
	Fourth infection	2	14.00	16.97		
Patient category	Ordinary person	37	16.54	33.63	.077	.783
	Healthcare provider	1	26.00	-		

V. DISCUSSION AND CONCLUSION

This study aimed to determine the need to change the roles of the emergency medical service system in the national response system due to the MERS crisis in South Korea in 2015. Super-spreaders #1, #14, #15, #16, and #76 infected 154 (82.7%) out of 186 deaths. Of these, #14 infected 85 (55.2%) patients.

The mortality rate was higher for the five super-spreaders (24.0%) than for all the MERS patients (20.4%). The incubation period was 11.36 days on average. The period between diagnosis and death was 16.78 days on average. The high rate of third infection for super-spreaders may indicate that the system to cope with MERS infection was poor.

The following suggestions can be made to prevent infection-related disasters: First, it is necessary to give regular education and training. The best way to prevent infectious diseases is education. Education can maintain the entire process, including planning, management, prevention, and restoration. Second, it is necessary to realize institutional reinforcement. Third, it is necessary to develop an efficient manual. This suggestion seems to mean consistent system management rather than confusion caused by any indiscreet classification system. A consistent management system can be an important means to give greater safety from infection-related disasters. Fourth, it is necessary to realize institutional reinforcement of the central role of the emergency medical service system in case of an infection-related disaster. This suggestion seems to emphasize efficient measures at the national level as part of efforts to protect citizens from infection-related disasters more safely. These measures are expected to help cope efficiently with infection-related disasters.

Infection-related disasters need to be managed rapidly and accurately in the national response system. In addition, an emergency room is more vulnerable to infection, especially third infection. To solve this problem, the emergency medical service system needs to play a central role in the medical part. It is possible to make the infection-related disaster response system more efficient by changing citizens' sense of safety and reinforcing legal and administrative systems at the national level in case of sudden infection-related disaster outbreak. The limitations of this study are as follows. First, only the raw data are used. Second, there is a missing value in the raw data.

REFERENCES

- [1] World Health Organization(WHO), Frequently Asked Questions on Middle East respiratory syndrome coronavirus (MERS-CoV)
- [2] Cotten M, Watson SJ, Kellam P, Al-Rabeeh AA, Makhdoom HQ, Assiri A, Al-Tawfiq JA, Alhakeem RF,

- Madani H, AlRabiah FA, Al Hajjar S, Al-nassir WN, Albarrak A, Flemban H, Balkhy HH, Alsubaie S, Palser AL, Gall A, Bashford-Rogers R, Rambaut A, Zumla AI, Memish Z A, Transmission and evolution of the Middle East respiratory syndrome coronavirus in Saudi Arabia: a descriptive genomic study. *lancet*, 2013, 382 (9909), PP1993–2002.
- [3] Zaki AM, van Boheemen S, Bestebroer TM, Osterhaus AD, Fouchier R A, Isolation of a Novel Coronavirus from a Man with Pneumonia in Saudi Arabia. *N Engl J Med*, 2012, 367(19), pp1814–1820,
- [4] Chu DKW, Poon LLM, Gomaa MM, Shehata MM, Perera RA, Zeid DA, Rifay ASE, Siu LY, Guan Yi, Webby RJ, Ali MA, Peiris M, and Kayal G, MERS Coronaviruses in Dromedary Camels, Egypt. *Emerging Infectious Diseases*, 2014, 20 (6), PP.1049–1053.
- [5] Hemida MG, Chu DKW, Poon LLM, Perera R A, Alhammadi MA, Ng Hy, Siu LY, Guan Yi, Alnaeem A, and Peiris M, MERS Coronavirus in Dromedary Camel Herd, Saudi Arabia. *Emerging Infectious Diseases*, 2014, 20 (7), pp.1231–1234.
- [6] Assiri AI, McGeer A, Perl TM, Price CS, Al Rabeeah AA, Cummings DA, Alabdullatif ZN, Assad M, Almulhim A, Makhdoom H, Madani H, Alhakeem R, Al-Tawfiq JA, Cotten M, Watson SJ, Kellam P, Zumla AI, Memish ZA, KSA MERS-CoV Investigation Team, Hospital Outbreak of Middle East Respiratory Syndrome Coronavirus. *N Engl J Med*, 2013, 369(5), pp.407–416.
- [7] Hunter JC, Nguyen D, Aden B, Al Bandar Z, Al Dhaheri W, Abu Elkheir K, Khudair A, Al Mulla M, El Saleh F, Imambaccus H, Al Kaabi N, Sheikh FA, Sasse J, Turner A, Abdel Wareth L, Weber S, Al Ameri A, Abu Amer W, Alami NN, Bunga S, Haynes LM, Hall AJ, Kallen AJ, Kuhar D, Pham H, Pringle K, Tong S, Whitaker BL, Gerber SI, Al Hosani FI, Transmission of Middle East Respiratory Syndrome Coronavirus Infections in Healthcare Settings, Abu Dhabi. *Emerg Infect Dis*, 2016, 22 (4), pp.647–656.
- [8] Banik GR, Khandaker G, Rashid H, Middle East respiratory syndrome coronavirus "MERS-CoV": current knowledge gaps. *Paediatr Respir Rev*, 2015, 16 (3), pp.197–202.
- [9] Kim SG, Healthcare workers infected with Middle East respiratory syndrome coronavirus and infection control. *J Korean Med Assoc*, 2015, 58 (7), pp.647–654.
- [10] Kim ES, A Social Analysis of the Limitation of Governmental MERS Risk Communication. *Korean Review of Crisis & Emergency Management*, 2015, 11 (10), pp.91–109.
- [11] Ministry of Health and Welfare(MOHW), News Release-Daily Status of MERS. http://www.mohw.go.kr/front_new/al/sal0301ls.jsp?PAR_MENU_ID=04&MENU_ID=0403&BOARD_ID=140&SEARCHKEY=TITLE&SEARCHVALUE. 2016.
- [12] Korea Centers for Disease Control and Prevention(CDC), News Release-Daily Status of MERS. <http://www.cdc.go.kr/>, 2016
- [13] Korean Broadcasting System(KBS), Infectious Status of MERS. <http://dj.kbs.co.kr/resources/2015-06-08/>, 2015
- [14] Korea Centers for Disease Control and Prevention(CDC), Middle East Respiratory Syndrome Coronavirus Outbreak in the Republic of Korea, 2015. *Osong Public Health Res Perspect*. 2015, 6(4), pp.269–278.
- [15] Choi G Y, Park S S, An Analysis of Actual Conditions with the Infectious Disease of Middle East Respiratory Syndrome Coronavirus (MERS-CoV) Spreading in South Korea. *Indian Journal of Science and Technology*, DOI: 10.17485/ijst/2016/v9i25/97228, 2016, 9(25), pp.1-7
- [16] Ramkumar P, Suresh B, Quantum of Ebola Virus Disease Occurrence and Quantum of Research Publications: A Scientrometric Analysis. *Indian Journal of Science and Technology*, DOI: 10.17485/ijst/2015/v8i14/70707 2015, 8(14), pp.1-8
- [17] Kim OS, Oh JH, Lee KH, The Convergence Study on Anxiety, Knowledge, Infection Possibility, Preventive Possibility and Preventive Behavior Level of MERS in Nursing Students. *Journal of the Korea Convergence Society*, 2016, 7 (3), PP.59–69.
- [18] June KJ, Choi ES, Infection Control of Hospital Nurses: Cases of Middle East Respiratory Syndrome. *Korean Journal of Occupational Health Nursing*, 2016, 25 (1), pp.1–8.
- [19] Kim CS, Analysis and de lege ferenda of the Acts Related with Spread of MERS in Korea in the Year 2015 - Focused on the Controversial Clauses of Medical Service Act and Infectious Disease Control and Prevention Act -. *The Korean Society of Law and Medicine Semiannual*, 2015, 16(2), pp.197–225.



ISSN
0975-6299

Comparison of Scapular Stabilizer Muscle Activity during Push Up Plus on the Static Ground and on the Unstable Ground Condition in Subject with Scapular Alata

Ji-won Kim*, Associate Professor, Department of Physical Therapy, Nambu University, 23 CheomdanJungang-ro, Gwangsan-gu, Gwangju, Republic of Korea. E-mail:rehab@nambu.ac.kr

Byeong-Ho Jeong, Department of Biomedical Engineering, Nambu University, 23 CheomdanJungang-ro, Gwangsan-gu, Gwangju, Republic of Korea. E-mail:energy@nambu.ac.kr

Abstract---

Background/Objectives: The aim of this study was to compare muscle activity of scapular stabilizer muscle during pushup plus on the static ground and on the unstable ground condition in persons who has scapular alata was recruited for this study.

Methods/Statistical Analysis: The participants performed pushup plus on the static ground and on the unstable ground condition. Surface electromyography was recorded from the serratus anterior, pectoralis major, upper trapezius, and lower trapezius. A paired t-test was used to compare muscle activity under the static ground and on the unstable ground condition.

Findings: EMG activity of the serratus anterior was significantly greater and pectoralis major was significantly decreased when pushup plus was performed on astatic ground and on an unstable ground condition.

Improvements/Applications: Performing pushup plus on the static ground condition induced serratus anterior EMG activity and reduced pectoralis major muscle than did exercise on the unstable ground condition. These results that the activation of the serratus anterior and pectoralis major during pushup plus is differ according to the type of surface on which it is performed.

Keywords--- Pectoralis Major, Pushup Plus, Scapular Alata, Shoulder Stabilizer Muscle, Surface Condition.

* Corresponding Author

I. INTRODUCTION

Scapular alata is a skeletal condition in which the scapular bone protrudes from a person's back in an abnormal position¹⁻³. The common cause of scapula alata is longthoracic nerve palsy by surgery and injury around scapulothoracic and weakness of serratus anterior⁴. During upper extremity movement, the scapular alignment and movement is important because movement of glenohumeral joint is accompanied by scapular movement. When the scapular fails to perform its alignment or stabilization role, abnormal biomechanics could result in: rotator cuff disease, shoulder impingement, and tendinitis⁵⁻⁶.

Stability and alignment at the scapulothoracic joint depends on the surround musculature⁷⁻¹⁰. While many muscles serve to stabilize the scapulothoracic joint, the main stabilizers are pectoralis major, trapezius, and serratus anterior. The serratus anterior is one of commonly inhibited or weak muscle of scapulothoracic joint that may lead to uncontrolled movement⁷⁻⁹. Therefore, many clinicians focused strengthening exercise of serratus anterior in therapeutic exercise protocols to prevent uncontrolled movement and restore painful shoulders from scapula alata¹⁰⁻¹¹.

The pushup plus exercises have been commonly recommended to elicit and train the serratus anterior muscles¹²⁻¹⁵. The exercise is performed in a prone position by raising the body using arms with maximal scapular protraction¹⁶. In clinical settings, pushup plus exercises performed on different type of support surfaces^{11,17}. To increase neuromuscular activation, clinician trained push up exercise unstable support such as form padding, exercise ball, and wobble board^{11,17}. Kim et al. recommended pushup plus on the unstable support rather than stable condition⁴. Because increased serratus anterior and upper/middle trapezius showed on the unstable support rather than stable condition. However, Seo et al. recommended push up exercise in stable condition rather than unstable condition¹⁸. Because of greater serratus anterior/upper trapezius ratio showed in stable condition rather than unstable condition. Generally, previous studies focused on muscle activity of serratus anterior and trapezius during pushup exercise. Recently, researchers have reported increased pectoralis major activation link to shoulder joint pathology. Despite of emphasizes on push upplus exercise for inhibit pectoralis major; no reported study has examined these muscles in scapular alata.

Thus, the purpose of this study was to compare serratus anterior, pectoralis major, upper trapezius and lower trapezius during pushup plus on the static ground and on the unstable ground condition in persons who has scapular alata were recruited for this study. We hypothesized that push up exercise on static ground would show increased serratus anterior and inhibited pectoralis major electromyography activity than would the push up exercise on unstable ground condition.

II. SUBJECTS AND METHODS

A. Subjects

In total, twenty subjects (13 males, 7 females) who were right handed and attended a local university in Gwang-ju, South Korea, volunteered for this study. Subjects were scapular alata (depth of scapular alata > 2cm) using the methods by Weon et al¹⁹. The general characteristics of subjects show Table 1.

Table 1: Descriptive Data for Participants

	Males	Female	Total
Age (years)	21.8±2.1	20.3±1.3	21.3±2.0
Height (cm)	174.1±5.6	166.3±4.3	170.5±6.3
Body mass(kg)	64.9±11.8	53.6±7.9	59.6±11.4
BMI(kg/m ²)	21.4±3.8	19.5±2.1	20.6±3.3

Data reported as mean± SD

B. Procedures

Muscle activity data was collected using surface EMG electrodes (LXM5308, Laxtha, Korea) on serratus anterior, pectoralis major, upper trapezius, and lower trapezius (figure 1). To assess the electromyography activity of scapular muscles, surface EMG electrode were attached to dominant upper extremity (figure 2). The skin was shaved and cleaned with alcohol reduce skin resistance. In advance all signals were sampled at

1000Hz by an EMG amplifier.

High pass filter was set at 10Hz and the low pass filter at 500Hz; this device was collected to personal computer for data collection. After the EMG, electrodes were placed over the serratus anterior, pectoralis major, upper trapezius, and lower trapezius, and electrode placement was confirmed with manual muscle test. The subjects were asked to perform maximal voluntary isometric contractions for each muscle group²⁰⁻²¹. Maximal voluntary isometric contractions were performed for scapular upward rotation, scapular elevation, and scapular horizontal adduction²². Each subject was then instructed to perform one of two variations of push up exercise (static or unstable support ground), chosen randomly (figure 3).



Figure 1: Laxtha EMG System

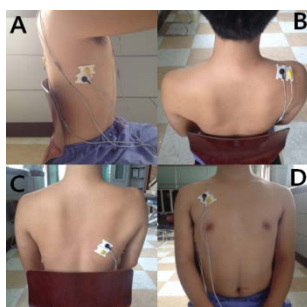


Figure 2: Picture of the Electrode Placement

A: Serratus anterior B: Upper trapezius
C: Lower trapezius D: Pectoralis major

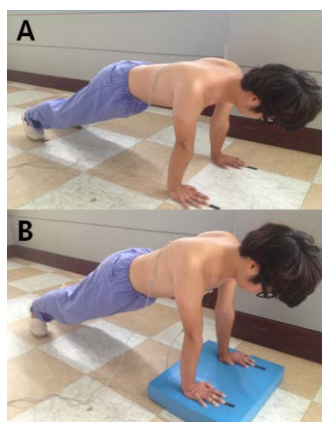


Figure 3: The Figure Showed the Two Type of Push-up Exercise

A. Push-up plus exercise on static surface
B. Push-up plus exercise on unstable surface

C. Statistical Analysis

SPSS 18.0 for window was used to compare EMG data obtained on different support surfaces, with a significance level of. 0.05. Paired t -test was used to analyze differences in EMG data between the different support surface.

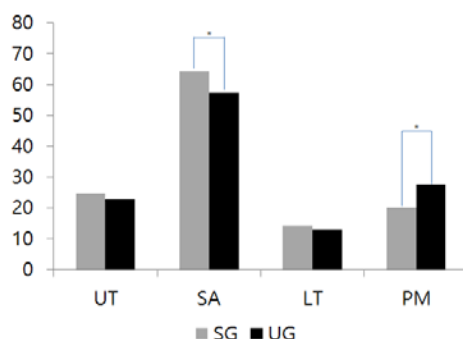
III. RESULTS

The EMG amplitude of the upper trapezius ($p=.014$) and pectoralis major ($p=.002$) was significantly greater when performed on the static condition than it was performed on the unstable conditions (Table 2, figure 4).

Table 2: Activity in the Muscles of the Scapular Stabilizer during Push up Plus Exercise

	static ground	unstable ground	t	p
	mean±standard deviation	mean±standard deviation		
upper trapezius	24.66±22.11	22.89±12.95	.457	.653
serratus anterior	64.38±17.76	57.41±15.77	2.712	.014*
lower trapezius	14.12±19.45	12.95±17.44	1.018	.322
pectoralis major	20.21±11.37	27.72±15.2	-3.686	.002*

*Significant difference between conditions



Figures 4: Descriptive Statistics of Normalized EMG Data of the Scapular Stabilizer Muscles during Push-upplus

UT; Upper trapezius, SA; Serratus anterior, LT; Lower trapezius, PM; Pectoralis major, SG; Static ground, UG; Unstable ground, *, Significant difference between conditions

IV. DISCUSSION

We compared the amplitude of EMG activity in scapular stabilization muscles during pushup plus exercise performed on the static ground and unstable ground condition. The results supported our hypothesis that performing the push upplus on static ground would elicit greater activity in serratus anterior than performing it on an unstable condition.

Serratus anterior activity increased during pushup plus on astatic condition. Our results are similar to those of Seo et al. who found that average amplitude of serratus anterior were significantly greater during pushup plus on astatic surface than on anunstable surface¹⁸. Imbalance and weakness of serratus anterior muscle causes the scapular to rest in downwardly rotation, causing scapular alata²³. Thus, we suggest that the performance of the push up plus exercise on a static condition might have improved normal alignment of scapular in person who has scapular alata.

Compared with that on an unstable condition, pushup exercise performed on a static surface decreased pectoralis major/serratus anterior activity.Park et al et al evaluated EMG amplitudes during push up plus exercise in subject with and without scapular winging and found increased pectoralis major/ serratus anterior activities.kim et al emphasized that unbalanced pectoralis major and serratus anteriorratio can be

harmful for people with scapular alata because high pectoralis major and serratus anterior ratio be associated with shoulder pathology⁴. The current findings suggest that push up plus exercise on an unstable base is useful to prevent shoulder pathology.

Decreased upper and lower trapezius muscle activity, although not statically significant, was found pushup plus exercise performed on a static surface compared with that on an unstable condition. This result is consistent with that of previous investigation of the pushup exercise performed on stable and unstable condition in subjects with scapular dyskinesis. Piraua et al. reported that unstable surface may be more favorable to produce higher levels of trapezius activation and lower levels of serratus anterior activation. In many literatures, over activation of trapezius muscle is contributing to scapular instability²³.

This study has several limitations. First, we did not consider kinematic factor when measuring push up-plus exercise on static condition and on an unstable. Kinematic data could provide more detailed information on the abnormal alignment of scapular. Second, we did not consider terms of the two parts of the serratus anterior muscle ie, upper and lower part of serratus anterior during push up- plus exercise. Further studies will be need to assess the effects of an unstable surface on push-up and push-up plus exercises in terms of the two parts of the serratus anterior muscle in person who has scapular alata. In summary, we found greater serratus anterior muscle activities and lesser trapezius and pectoralis major activities on the unstable support than on the stable support, suggesting that push-up plus, especially on a static support is recommended as an initial program in scapular alata.

V. CONCLUSION

Performing push up plus on the static ground condition induced serratus anterior EMG activity and reduced pectoralis major muscle than did exercise on the unstable ground condition. This result provide to the fundamental data of the levels of scapular stabilizer muscle activity during push up plus exercise in person who has scapular alata.

ACKNOWLEDGEMENT

This study was supported by research funds from Nambu University, 2015

REFERENCES

- [1] Ludewig PM, Cook TM, Translations of the humerus in persons with shoulder impingement symptoms, *J Orthop Sports Phys Ther*, 2002, 32, (6), pp.248-59.
- [2] Ludewig PM, Cook TM, Alterations in shoulder kinematics and associated muscle activity in people with symptoms of shoulder impingement, *Phys Ther*, 2000, 80, (3) pp. 276-91.
- [3] Lukasiewicz AC, McClure P, Michener L, Pratt N, Sennett B, Comparison of 3-dimensional scapular position and orientation between subjects with and without shoulder impingement, *J Orthop Sports Phys Ther*, 1999, 29(10), pp.574-83.
- [4] Park KM, Cynn HS, Kwon OY, Yi CH, Yoon TL, Lee JH, Comparison of pectoralis major and serratus anterior muscle activities during different push-up plus exercises in subjects with and without scapular winging, *J Strength Cond Res*, 2014, 28(9), pp.2546-51.
- [5] Voight ML, Thomson BC, The role of the scapula in the rehabilitation of shoulder injuries, *J Athl Training*, 2000, 35(3), pp.364-72.
- [6] Paine RM, Voight ML, The role of the scapula, *J Orthop Sports Phys Ther*, 1993, 18, pp. 386-91.
- [7] Lehman GJ, Buchan DD, Lundy A, Myers N, Nalborczyk A, Variations in muscle activation levels during traditional latissimus dorsi weight training exercises, An experimental study, *Dyn Med*, 2004, 3(1), pp.4.
- [8] Lukasiewicz AC, McClure P, Michener L, Pratt N, Sennett B, Comparison of 3-dimensional scapular position and orientation between subjects with and without shoulder impingement, *J Orthop Sports Phys Ther*, 1999, 29(10), pp.574-83.
- [9] Peat M, Grahame RE, Electromyographic analysis of soft tissue lesions affecting shoulder function, *Am J Phys Med*, 1977, 56, pp. 223-40.
- [10] Anderson KG, Behm DG, Maintenance of EMG activity and loss of force output with instability, *J Strength Cond Res*, 2004, 18, pp. 637-40.
- [11] Lehman GJ, MacMillan B, MacIntyre I, Chivers M, Fluter M, Shoulder muscle EMG activity during push up variations on and off a Swiss ball, *Dyn Med*, 2006, 5, pp.7.

- [12] Cools, AM, Dewitte, V, Lanszweert, F, Notebaert, D, Roets, A, Soetens, B, Cagnie, B, Witvrouw, EE, Rehabilitation of scapular muscle balance: Which exercises to prescribe?, *Am J Sports Med*, 2007, 35, pp.1744–51.
- [13] Decker, MJ, Hintermeister, RA, Faber, KJ, and Hawkins, RJ, Serratus anterior muscle activity during selected rehabilitation exercises, *Am J Sports Med*, 1999, 27, pp.784–91.
- [14] Hardwick, DH, Beebe, JA, McDonnell, MK, Lang, CE. A comparison of serratus anterior muscle activation during a wall slide exercise and other traditional exercises, *J Orthop Sports Phys Ther*, 2006, 36, 903–10.
- [15] Martins J1, Tucci HT, Andrade R, Araújo RC, Bevilacqua-Grossi D, Oliveira AS, Electromyographic amplitude ratio of serratus anterior and upper trapezius muscles during modified push-ups, 2008, 22(2), pp.477–84.
- [16] Ludewig PM, Hoff MS, Osowski EE, Meschke SA, Rundquist PJ. Relative balance of serratus anterior and upper trapezius muscle activity during push-up exercises, *Am J Sports Med*, 2004, 32, pp. 484–93.
- [17] Park SY, Yoo WG, Differential activation of parts of the serratus anterior muscle during push-up variations on stable and unstable bases of support, *J Electromyogr Kinesiol*, 2011, 21(5), pp. 861–7.
- [18] Seo SH, Jeon IH, Cho YH, Lee HG, Hwang YT, Jang JH, Surface EMG during the Push-up plus Exercise on a Stable Support or Swiss Ball: Scapular Stabilizer Muscle Exercise,
- [19] *J Phys Ther Sci*, 2013, 25(7) pp. 833–7.
- [20] Weon JH, Kwon OY, Cynn HS, Lee WH, Kim TH, Yi CH, Real-time visual feedback can be used to activate scapular upward rotators in people with scapular winging: an experimental study, *J Physiother*, 2011, 57(2), pp.101–7.
- [21] Lee SJ, Jin DY, No HJ, Kwon SJ, Yoon MH, Jung YJ, Bae WS, Lee KC, Lee DY, The effects of squat exercises on the space between the knees of persons with genu-varum, *Indian Journal of Science and Technology*, 2016, 9(25), pp.1–5.
- [22] Kim JW, Jung BH, Effects of Patellar and Mixed Hip and Patellar Taping on Muscle Activation during the Squat Exercise, *Indian Journal of Science and Technology*, 2016, 9(35).
- [23] Watson CJ, Schenkman M, Physical therapy management of isolated serratus anterior muscle paralysis, *Phys Ther*, 1995, 75, pp.194–202.
- [24] Pirauá AL, Pitangui AC, Silva JP, Pereira dos Passos MH, Alves de Oliveira VM, Batista Lda S, Cappato de Araújo R, Electromyographic analysis of the serratus anterior and trapezius muscles during push-ups on stable and unstable bases in subjects with scapular dyskinesis, *J Electromyogr Kinesiol*, 2014, 24(5), pp.675–81.



ISSN
0975-6299

Effects of the Pelvic Control Strategy on Trunk and Hip Extensor Muscle Activity during Leg Lift Task in Prone Position in Person who has Lumbar Spine Uncontrolled Movement Patterns

Ji-won Kim*, Associate Professor, Department of Physical Therapy, Nambu University, 23 CheomdanJungang-ro, Gwangsan-gu, Gwangju, Republic of Korea. E-mail:rehab@nambu.ac.kr

Byeong-Ho Jeong, Department of Biomedical Engineering, Nambu University, 23 CheomdanJungang-ro, Gwangsan-gu, Gwangju, Republic of Korea. E-mail:energy @nambu.ac.kr

Abstract---

Background/Objectives: The purpose of this study was to compare with various intervention of pelvic control strategy in subjects with lumbar spine uncontrolled movement pattern during leg lift task.

Methods/Statistical Analysis: In this study, 20 subjects with lumbar spine uncontrolled movement pattern were instructed to perform general leg lift exercise, leg lift exercise with internal pelvic control strategy, leg lift exercise with external pelvic control strategy, and leg lift exercise with tactile feedback. Surface electromyography signal was recorded from the erector spinae, gluteus maximus, and medial hamstrings.

Findings: The muscle activity of the both erector spinae was significantly lower and gluteus maximus was significantly higher while performing leg lift exercise with internal pelvic control strategy compare with general leg lift exercise, leg lift exercise with external pelvic control strategy, and with and leg lift exercise with tactile feedback($p < .05$).

Improvements/Applications: The findings suggest that the leg lift exercise with internal pelvic control strategy is effective in activating the gluteus maximus and minimizing elector spinae muscle activation in prone position.

Keywords--- Elector Spinae, Gluteus Maximus, Hip Lift, Lumbo-pelvic, Uncontrolled Movement.

* Corresponding Author

I. INTRODUCTION

The leg lift in prone position is often performed for torso and leg muscle strengthening in individuals with lumbar and hip joint disorders¹. Uncontrolled lumbar spine and uncontrolled pelvic girdle frequently occur during trunk and leg exercise in patients with lumbar spine pain²⁻³. Repeated hip joint movement linked with uncontrolled lumbar spine and pelvic girdle motion may generate musculoskeletal disease in person who has uncontrolled movement in lumbar spine and pelvis girdle. To prevent uncontrolled lumbar spine and pelvic girdle motion during leg movement, individuals have been educated to neutralize the pelvic girdle using various interventions⁴⁻⁷.

The pelvis girdle can be neutralized either externally or internally⁶. Internal pelvic control strategy can be gained by co-contraction of superficial and deep muscles. Although superficial muscles can't neutralize each vertebra because they have little attachment to the spinal segments, they have benefit for apply control over extension or rotation of pelvic girdle during leg lift in prone position⁸.

External pelvic control strategy refers to the manual control of a pelvic girdle by the clinician's fingers or external pelvic compression⁹. External pelvic control strategy can be passively gained through passive compression of the pelvic by external pelvic compression that can be controlled in response to attempt. External pelvic compression is primarily used for individuals with uncontrolled pelvic girdle movement and/or lumbopelvic disorders⁹⁻¹¹. The erector spinae and gluteus maximus muscles are superficial, multi-segmental large muscles that are significant maintain structures for neutralizing the pelvic girdle against leg life in prone position⁸. Clinicians have recommended method to maintain the neutralization of the pelvic girdle during leg lift⁶. Liebenson et al. recommended that external pelvic compression can control the stiffness of the lumbopelvic region¹².

Recently, the tactual feedback method through the individuals own hand filling the posterior superior iliac spine in the prone position, has been introduced to be an effective strategy to improve lumbopelvic muscle to control of the faulty lumbopelvic movement¹³⁻¹⁴.

Not with standing clinicians apply pelvic girdle control strategy to avoid substitution such as, lumbar extension and rotation during leg lift in prone position, no study is accessible on whether the pelvic girdle control strategy improve activation of the gluteus maximus more effectively than does applying an external pelvic compression. Therefore, the purpose of this research was to investigate the effects of the pelvic girdle control strategy on torso and hip extensor muscle activity during leg lift exercise in prone position.

Examining the effects of the pelvic girdle control strategy during leg lift exercise will afford valuable knowledge to the therapist and trainer for plan for adequate exercise. We hypothesized that the electromyography activity of the gluteus maximus muscles would increase, and erector spinae would be decreased during leg lift exercise in prone position with the internal pelvic control strategy compared with general leg lift exercise, leg lift exercise with an external pelvic control strategy, and leg lift exercise with tactile feedback.

II. SUBJECTS AND METHODS

A. Subjects

Using convenience sampling, twenty university students (12 male, 8 female), without history of low back pain or hip joint pathology volunteered for this study. Subjects mean age, height and weight were 22 years (SD = 1.45), 168.7 cm (SD = 7.33) and 62.9 kg (SD = 8.3), respectively. The general characteristics of subjects show Table 1. The uncontrolled movement patterns were measured using the methods by Bruno et al¹⁵.

Table 1: Subject's Characteristics, n=20

Variables	Mean (Standard deviation)	Range
Age(years)	22±1.45	20~24
Height(cm)	168.7±7.33	155~182
Weight (kg)	62.9±8.3	50~75

Data reported as mean± SD

B. Procedures

Prior to testing session, subjects were allowed training session in order to familiarize with prone hip

extension task. The familiarized training session was approximately 20 minutes. The EMG activity was measured during general leg lift exercise, leg lift exercise with internal pelvic control strategy, leg lift exercise with external pelvic control strategy, and leg lift exercise with tactile feedback.

The task order was chosen randomly. Each participant was asked to select a card from random box for each of the task with intervention. In prone position, subject extended one's dominant leg; contact the target bar for 5 seconds(Figure 1).



Figure 1: The Figure Showed the Target Bar

a. General Leg Lift Exercise

The participant was asked a prone position on a static bed with the torso and lower extremity in a straight line, both arms at their side. The participant was asked to perform leg lift in the prone position until they touched the target bar(Figure 2, A).

b. External Pelvic Control Strategy

In external pelvic control strategy, a non-elastic compression belt (SI-LOC, Canada) was placed just below the anterior superior iliac spine(Figure 2, B).

c. Leg Lift Exercise with Tactile Feedback

Leg lift exercise with tactile feedback was performed using the pelvic rotatory control method. Under this condition, participants monitor the pelvis neutral position by palpating the posterior superior iliac spine with their hand(Figure 2, C)..

d. Internal Pelvic Control Strategy

Internal pelvic control strategy was performed using the biofeedback unit. In prone lying on the static bed, the pelvis is positioned in neutral alignment. Place the biofeedback unit the abdomen, centered about the umbilicus. Inflated the pad to a base pressure of 70mmhg. During hip lift with biofeedback unit, the pressure should decreased by 10mmhg(Figure 2, D).



Figure 2: The Figure Showed the Leg Lift Exercise

A; Leg lift, B; Leg lift with a pelvic compression belt, C; Leg lift with the pelvic rotatory control method D; Leg lift with biofeedback

C. Electromyographic Data Collection

Elector spinae, gluteus maximus, medial hamstring muscle activity was collected using throwaway, self-adhesive Ag/AgCl surface electrodes fixed each muscle on the subject's trunk and dominant side of leg(Figure 3). Surface electrode placement followed the reference of the Kendall. Data from each surface electrode was

collected via a surface EMG system (LXM5380, LAXTHA, Korea)(Figure 4). Surface EMG signals were sampled at 1000 Hz, amplified and band passed filtered between 10 and 500 Hz¹⁶). Prior to prone hip extension task, subject's maximal voluntary isometric contraction for each muscle was obtained through resisted contractions (trunk extension, hip extension, and knee flexion) so that data could be normalized. During maximal voluntary isometric contraction, participants were instructed maintain a hold for 5 seconds^{16,17}). Data collected during the 5seconds static hold phase were analyzed. Each maximal voluntary isometric contraction task involved 3 repetitions with 2 minutes rest for further analysis.

The normalized muscle activity was expressed as a percentage of the MVIC (%MVIC= [average RMS of each leg lift task/average RMS of three MVICs] 100), and the mean %MVIC of three trials was used for data analysis.

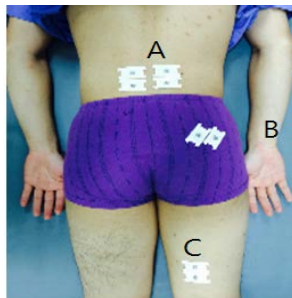


Figure 3: Picture of the Electrode Placement

A: Elector spinae

B: Gluteus maximus

C: Medial hamstring



Figure 4: Laxtha EMG System

D. Statistical Analysis

The independent variables were the leg lift conditions (general leg lift exercise, leg lift exercise with an internal pelvic control strategy, leg lift exercise with an external pelvic control strategy, and leg lift exercise with tactile feedback). The dependent variables were EMG activity of trunk and hip extensor muscle. One way repeated-measures analysis of variance and the post hoc Bonferroni tests were conducted for each muscle among the three conditions (general leg lift exercise, leg lift exercise with an internal pelvic control strategy, leg lift exercise with an external pelvic control strategy, and leg lift exercise with tactile feedback). Statistical analysis was performed with SPSS version 18.0 for Windows (SPSS, Inc., Chicago, IL), with a critical p value of 0.05.

III. RESULTS

The normalized EMG data and the results of the statistical analyses are shown in Table 2 and figure 5. The EMG activity (%MVIC)of gluteus maximus muscles increased and the activity of the elector spinae decreased leg lift exercise in prone position using internal pelvic control strategy compared with general leg lift exercise, leg lift exercise with an external pelvic control strategy, and leg lift exercise with tactile feedback. There were

no significant differences in EMG activity of the medial hamstring between with general leg lift exercise, leg lift exercise with an internal pelvic control strategy, leg lift exercise with an external pelvic control strategy, and leg lift exercise with tactile feedback ($p > 0.05$).

Table 2: EMG Activity (%MVIC) of Trunk and Hip Extensor Muscles During Leg Lift(LL), Leg Lift with an External Pelvic Compression (LL+PB), and Leg Lift with the Pelvic Rotatory Control Method(LL+TF), Leg Lift with Biofeedback(LL+TF)

muscle	Intervention (%MVIC)				F	p
	LL	LL+PB	LL+TF	LL+PBF		
left elector spinae	41.3±26.98	39.34±26.1	39.98±24.94	21.91±23.21	12.050	.000*
right elector spinae	39.81±19.17	37.13±18.08	38.75±19.15	21.56±15.14	7.928	.002*
Gluteus maximus	15.5±8.52	16.03±8.31	14.95±7.01	24.63±16.82	3.567	.036*
Hamstring	27.61±20.87	31.61±24.33	27.65±21.27	30.82±27.42	.900	.462

*Significant difference between conditions

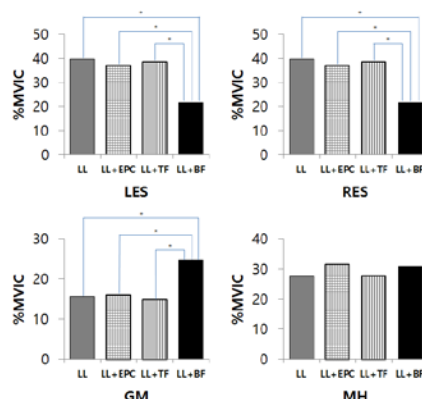


Figure 5: Descriptive Statistics of Normalized EMG Data of the Trunk and Hip Muscles during Hip Lift Exercise

LL; Leg lift, EPC; External pelvic compression, TF; Tactile feedback, BF; Biofeedback, LES; Left elector spinae, RES; Right elector spinae, GM; Gluteus maximus, MH; Medial hamstring, *;Significant difference between conditions

IV. DISCUSSION

When the lumbar spine and pelvic girdle region is adequately neutralized, the hip joint should rise easily from the therapeutic table, and the lumbar spine and pelvic girdle should not extend or rotate during leg lift exercise in prone position^{6, 16}. Controlled pelvic girdle is maintained by the optimal activation of trunk muscles during leg lift exercise in prone position. Therefore, many researchers have suggested activating optimal activation of trunk muscles during leg lift exercise in prone position to prevent uncontrolled lumbar spine and pelvic girdle motion^{9, 18-19}. However, no research has examined the effects of the pelvic girdle control strategy on torso and hip extensor muscle activity during leg lift exercise in prone position.

In our study, elector spinae muscle activity was significantly reduced during leg lift exercise in prone with the internal pelvic control strategy compared with general leg lift exercise alone, leg lift exercise with the external pelvic control strategy, leg lift exercise with tactile feedback. To improve lumbopelvic stiffness, internal pelvic girdle control strategy using the biofeedback unit has been recommended by many researchers¹⁸⁻¹⁹. In this study, internal pelvic girdle control strategy reduce elector spinae, which could be due to the decreased uncontrolled movement, such as lumbar spine rotation and or, extension and anterior pelvic girdle tilt during leg lift exercise in prone position in individuals who has uncontrolled movement¹. Thus, internal pelvic girdle control strategy might have improved the uncontrolled movement to be the pelvic girdle neutral condition. Our results are similar to those of Cynn et al. who found that when leg lift in side-lying position, decreased muscle activity of quadratus lumborum and the amount of pelvic lateral tilt was reduced under internal pelvic girdle control strategy condition compared with that during hip lift alone¹⁹. They demonstrated that internal pelvic girdle control strategy neutralize the pelvic girdle and increase the gluteus medius muscle activity without uncontrolled movement by the quadratus lumborum. Therefore, they

suggest that internal pelvic girdle control strategy during side-lying hip lift exercise is effective in therapy protocols designed to avoid uncontrolled movement by decrease quadratus lumborum activity and increase the gluteus medius.

Compared with that during general leg lift exercise alone, leg lift exercise with the external pelvic control strategy, and leg lift exercise with tactile feedback, leg lift exercise with the internal pelvic control strategy demonstrated increased muscle activation of the gluteus maximus in this study. Our results are similar to those of Oh et al. who found that when leg lift in prone position, increased muscle activity of gluteus maximus and the amount of pelvic rotation was reduced under internal pelvic girdle control strategy condition compared with that during hip lift alone¹⁸⁾. Thus, they suggested that internal pelvic control strategy during hip lift in prone position could be a good strategy when anterior pelvic tilt and lumbar spine motion is to be minimized. These results suggest that using an internal pelvic control strategy during hip lift in prone facilitate activation of the gluteus maximus, while reducing activation of the erector spinae in individuals who has uncontrolled movement.

This study has some limitations. First, we did not measure the activity of the deep muscles such as transverse abdominis and multifidus as indications of main lumbopelvic stabilization. Second, the force of the external pelvic compression was not adjusted. In this research, we recruited only healthy student absent of lumbopelvic disorders. Because leg lift exercise with pelvic girdle control strategy is helpful not only for young student but also for individuals with lumbopelvic disorders, further researches are required to investigate the effect of leg lift exercise with the pelvic girdle control strategy in individuals who has with lumbopelvic disorders.

In spite of these limitations, this study recommends the effectiveness of internal pelvic girdle control strategy using biofeedback unit. Further research is needed to prove whether internal pelvic girdle control strategy can carry forward to optimal trunk muscle activity in functional movement.

V. CONCLUSION

The activity of the gluteus maximus muscles increased and the activity of the elector spinae decreased leg lift exercise in prone position using the internal pelvic girdle control strategy compared with general leg lift exercise, the external pelvic girdle control strategy, leg lift exercise with tactile feedback. The %MVIC of gluteus maximus muscles was greater in leg lift exercise in prone position using the internal pelvic girdle control strategy compared with general leg lift exercise, the external pelvic girdle control strategy, leg lift exercise with tactile feedback. This study suggest that the internal pelvic girdle control strategy using the biofeedback unit is useful for decreasing pelvis girdle extension and rotation and increasing gluteus maximus muscle activity.

REFERENCES

- [1] Tateuchi H, Taniguchi M, Mori N, Ichihashi N, Balance of hip and trunk muscle activity is associated with increased anterior pelvic tilt during prone hip extension, *J Electromyogr Kinesiol*, 2012, 22(3), pp.391-7.
- [2] Ambroz C, Scott A, Ambroz A, Talbott EO, Chronic low back pain assessment using surface electromyography, *J Occup Environ Med*, 2000, 42(6), pp. 660-9.
- [3] Ferguson SA, Marras WS, Burr DL, Davis KG, Gupta P, Differences in motor recruitment and resulting kinematics between low back pain patients and asymptomatic participants during lifting exertions, *Clin Biomech (Bristol, Avon)*, 2004, 19(10), pp. 992-9.
- [4] Mens JM, Vleeming A, Snijders CJ, Stam HJ, Ginai AZ, The active straight leg raising test and mobility of the pelvic joints, *Eur Spine J*, 8(6), pp.468-73.
- [5] Hu H, Meijer OG, van Dieën JH, Hodges PW, Bruijn SM, Strijers RL, Nanayakkara PW, van Royen BJ, Wu W, Xia C, Muscle activity during the active straight leg raise (ASLR), and the effects of a pelvic belt on the ASLR and on treadmill walking, *J Biomech*, 2010, 43(3), pp.532-9.
- [6] Park KH, Ha SM, Kim SJ, Park KN, Kwon OY, Oh JS, Effects of the pelvic rotatory control method on abdominal muscle activity and the pelvic rotation during active straight leg raising, *Man Ther*, 2013, 18(3), pp. 220-4.
- [7] Lima PO, de Oliveira RR, de Moura Filho AG, Raposo MC, Costa LO, Laurentino GE, Reproducibility of the pressure biofeedback unit in measuring transversus abdominis muscle activity in patients with chronic nonspecific low back pain, *J Bodyw Mov Ther*, See comment in PubMed Commons below 2012, 16(2), pp. 251-7.
- [8] Kisner C, Colby LA, Therapeutic exercise: foundations and techniques, F.A. Davis; Philadelphia, PA, 2007.

- [9] Takasaki H, Iizawa T, Hall T, Nakamura T, Kaneko S, The influence of increasing sacroiliac joint force closure on the hip and lumbar spine extensor muscle firing pattern, *Man Ther*, 2009,14(5), pp.484-9.
- [10] Beales DJ, O'Sullivan PB, Briffa NK, The effect of increased physical load during an active straight leg raise in pain free subjects, *J Electromyogr Kinesiol*, 2010, 20(4), pp.710-8.
- [11] Beales DJ, O'Sullivan PB, Briffa NK, The effects of manual pelvic compression on trunk motor control during an active straight leg raise in chronic pelvic girdle pain subjects, *Man Ther*, 2010,15(2), 190-9.
- [12] Liebenson C, Karpowicz AM, Brown SH, Howarth SJ, McGill SM, The active straight leg raise test and lumbar spine stability, *PM & R: The Journal of Injury, Function, and Rehabilitation*, 2009,1, pp.530-5.
- [13] Hoffman SL, Johnson MB, Zou D, Harris-Hayes M, Van Dillen LR, Effect of classification-specific treatment on lumbopelvic motion during hip rotation in people with low back pain. *Man Ther*, 2011,16(4), pp. 344-50.
- [14] Hoffman SL, Johnson MB, Zou D, Van Dillen LR, Sex differences in lumbopelvic movements during hip medial rotation in people with chronic low back pain, 2011, 92(7), pp.1053-9.
- [15] Bruno PA, Bagust J, Cook J & Osborne N, An investigation into the activation patterns of back and hip muscles during prone hip extension in non-low back pain subjects: Normal vs. abnormal lumbar spine motion patterns, *Clinical Chiropractic*, 2008,11(1), pp.4-14.
- [16] Lee SJ, Jin DY, No HJ, Kwon SJ, Yoon MH, Jung YJ, Bae WS, Lee KC, Lee DY, The effects of squat exercises on the space between the knees of persons with genu-varum, *Indian Journal of Science and Technology*, 2016, 9(25), pp.1-5.
- [17] Kim JW, Jung BH, Effects of Patellar and Mixed Hip and Patellar Taping on Muscle Activation during the Squat Exercise, *Indian Journal of Science and Technology*, 2016, 9(35).
- [18] Oh JS, Cynn HS, Won JH, Kwon OY, Yi CH, Effects of performing an abdominal drawing-in maneuver during prone hip extension exercises on hip and back extensor muscle activity and amount of anterior pelvic tilt, *J Orthop Sports Phys Ther*, 2007,37(6), pp. 320-4.
- [19] Cynn HS, Oh JS, Kwon OY, Yi CH, Effects of lumbar stabilization using a pressure biofeedback unit on muscle activity and lateral pelvic tilt during hip abduction in sidelying, *Arch Phys Med Rehabil*, 2006, 87(11), pp.1454-8.



ISSN
0975-6299

Korean Dental Hygienists' Perceptions of Antismoking Intervention Activities and Obstructive Factors

Ji-Hye Han, Dept. Dental Hygiene, Hanseo University, Korea. E-mail:201102761@hanmail.net

Sung-Suk Bae*, Dept. Dental Hygiene, Hanseo University, Korea. E-mail:ssbae@hanseo.ac.kr

Abstract---

Background/Objectives: Smoking contributes to a wide range of diseases. The attitude and perception of Korean dental hygienists toward antismoking intervention activities were determined in this study to seek for improvement plans by determining obstructive factors of antismoking intervention activities.

Methods/Statistical Analysis: The present study was conducted after receiving approval from the Korean Bioethics Association (IRB authorization code: P01-201601-22-003). Questionnaires 200 were used for data analysis. Survey tools of the present study included a questionnaire developed for inquiring into the smoking rate of health and medical personnel around the world by the Tobacco Free Initiative of the WHO and the studies of Yun.²⁷

Findings: Korean dental hygienists' with higher level of education who worked at larger dental hospitals had higher scores in their attitude toward antismoking intervention activities. The perception rate for antismoking intervention activities was higher ($P < 0.05$) in respondents with older ages and longer careers in dental institutions. The need for providing education of antismoking intervention activities among Korean dental hygienists was high. The lack of knowledge about smoking due to the lack of education experience was shown to cause difficulty in their antismoking guidance. Therefore, in order to provide effective antismoking intervention activities by dental hygienists, provision of information which dental hygienists can easily have access in dental institutions such as the production of programs & manuals and the development of media in reputable institutions is required.

Improvements/Applications: This study was performed with only a portion of dental hygienists. Observation on antismoking intervention activities of dental hygienists at state level is needed in the future.

Keywords--- Antismoking, Dental hygienist, Oral Health Education, Smoking Rate, Smoking Intervention.

* Corresponding Author

I. INTRODUCTION

Smoking contributes to a wide range of diseases such as chronic obstructive lung disease, cerebrovascular accident, coronary heart disease, diabetes mellitus and multiple organ cancers.¹As the harmful substances of the tobacco are inhaled into the lungs through the nasal and oral cavity, they are absorbed into the body via the oral mucosa and the respiratory organs², affecting the entire body. According to previous studies, oral cancer occurs 2-5 times higher in smokers than in non-smokers. The acidity of saliva within the oral cavity is increased by smoking.³ It decrease the buffer power of the saliva, thus preventing active self-purification, causing excessive amount of dental plaque, and increasing the incidence rate of bad breath and dental caries.⁴In addition, the smoking-induced periodontal pocket formation directly affects the periodontal diseases by causing the loss of the alveolar bones⁵Smoking also hinders osseointegration when implant is performed because it causes inflammation to tissues around the implants. It has been reported that smoking can leads to 7 times higher failure rate of the implant procedures on the teeth of smokers compared to nonsmokers.^{6,7}Based on a survey, the health levels of smokers' oral cavities are much lower than those of nonsmokers.⁸The deterioration of these oral cavity diseases caused by smoking is a serious social problem. In this regard, the Agency for Health Care Policy and Research (AHCPR) has said that the recommendations of quitting smoking from the health care providers are necessary because it can improve smokers' success rate of quitting smoking by 10%.⁹In other words, smoking is an act that is orally carried out, consequently causing primary health problems on the oral cavity. The role of health and medical professionals in preventing smoking is important¹⁰Dental treatment has a higher frequency rate of having contact with patients because it requires a longer period compared to other general treatments. Health care providers related to the oral cavities can easily observe changes in the oral cavities of smokers They are better positioned to do anti-smoking intervention activities.¹¹In the U.S., Canada, and U.K., it is appropriate to perform counseling for patients' smoking cessation by dental treatment personnels such as dentists and dental hygienists.¹² the Association of Canadian Dental Hygienists has mentioned that antismoking counseling is an important roles of the dental hygienists in the dental offices.¹³Steady activities of groups of health and medical care providers in advanced countries have decreased smoking rate by providing information and education with legislation enforcement activities by civil groups, setting an example for the world.¹⁴Antismoking intervention activities in the dental offices of dental hygienists as primary health and medical care providers, whose main duties are the prevent and educate patients on oral cavity diseases are important.¹⁵and With active interest and participation of patients, it might have potential to greatly influence the success of smoking cessation. In this regard, the objective of this study was to examine the perceptions of antismoking intervention activities by Korean dental hygienists and to seek for the improvement plans by determining obstructive factors to antismoking intervention activities in dental institutions.

II. LITERATURE REVIEW

The smoking rate among the Korean males gradually decreased from 47.3% in 2011 to 42.1% in 2013.¹⁶ However, Korea has the highest but is the highestsmoking rates 37.6% compared to OECD major countries(an average smoking rate of 24.9%).¹⁷ Since 1987, WHO has been recommending the implementation of the programs for reducing the smoking rates around the world.¹⁸ In this regard, antismoking campaign in south korea began with the the 1997 World No Tobacco Day. South Korea implemented the antismoking clinic pilot project across the nation's 10 health centers in 2004 for the improvement of its citizens' oral cavity health, the reduction of their burden of the medical costs, and the nation's economic growth and stability. Since February 25, 2015, under the supervision of the National Health Insurance Corporation, hospitals & clinics and medical institutes (applicable only to health centers or branches of health centers, where doctors and doctors of oriental medicine work) have implemented the health insurance support programs for the smokers who want to get antismoking treatments by providing them with one or two sessions of counseling and medicine cost deduction. Through the studies of Kim¹⁹ and Yun²⁰ it was confirmed that dental hygienists are very well positioned to do antismoking intervention activities, and in the sam vein, the studies of Jung²¹and Park²²suggest that there is the need for the education of antismoking intervention activities among dental hygienists. However, the study of Song²³shows that the success rate of antismoking interventions in dental offices was much lower than those in the general medical offices, and the studies of Kim¹⁹ and Jang¹⁸have also shows lower rate of antismoking intervention activities by dental hygienists in dental offices compared to those in general medical offices, confirming that dental hygienists are not actively engaged in antismoking intervention activities. Dental hygienists' lack of the knowledge and experience has been

deemed to be the greatest obstacle of antismoking intervention activities in dental institutions in the study of Yun.²⁰ The lack of the knowledge about smoking due to the lack of the education experience has shown to cause difficulty in providing antismoking guidance. Therefore, the need to educate Korean dental hygienists about antismoking intervention activities is high. According to a recent survey by Korean Medical Association,²⁴ about 19,924 medical institutions were involved in antismoking projects when these projects were initiated. However, as of August, the number of the medical institutions actually engaged in antismoking treatments was found to have reduced to a mere 9,855, about 50% of the participating institutions. The government pledged for the hiked medical fees as a means to boost the participation, which is expected to strengthen the education for the health and medical care providers.

III. PROPOSED WORK

A. *The Attitude and Awareness toward Oral Health Promotion Activities through Smoking Cessation by Dental Hygienists*

Dental hygienists' attitudes toward antismoking intervention activities had statistically significant difference according to the places of work and the levels of education ($P < 0.05$). In the attitudes, the scores of the workers at dental hospitals (3.96 ± 0.54) were higher than those of the workers at dental clinics (3.72 ± 0.73); the scores of the graduate school graduates (4.27 ± 0.47) were higher than those of the university graduates (3.90 ± 0.67) and college graduates (3.67 ± 0.68). Previous studies on the same dental hygienists have revealed a higher score in their attitude toward antismoking intervention activities (at 3.80) compared to that (3.41) in the study of Kim¹⁹ with 3.41 and was similar to that of the recent study of Yun²⁰ with 3.91. This is thought to be due to the recent paid-antismoking treatment policy. In the meantime, dental hygienists' perceptions of antismoking intervention activities had a significant difference according to their ages and careers ($P < 0.05$). It was found that older dental hygienists with longer career had higher perceptions of antismoking intervention activities compared to younger ones. Those who aged less than 25 years old had the lowest score (3.04 ± 0.63), followed by those who aged between 26 and 34 (3.21 ± 0.60) and those aged more than 35 years (3.53 ± 0.45). In other words, lower age and less experience constitute obstructive factors to antismoking intervention activities of dental hygienists (as shown in table 1).

Table 1: The Attitude and Awareness toward Oral Health Promotion Activities through Smoking Cessation by Dental Hygienists (N=200)

Characteristics	N(%)	Attitude		Awareness	
		M $\pm$ SD	p*	M $\pm$ SD	p*
Gender			0.729		0.132
Female	188(94.0)	3.80 $\pm$ 0.69		3.20 $\pm$ 0.60	
male	12(6.0)	3.73 $\pm$ 0.49		2.92 $\pm$ 0.74	
Age(year)			0.080		0.002*
≤25	79(39.5)	3.70 $\pm$ 0.73		3.04 $\pm$ 0.63	
26-34	95(47.5)	3.81 $\pm$ 0.64		3.21 $\pm$ 0.60	
≥35	26(13.0)	4.04 $\pm$ 0.63		3.53 $\pm$ 0.45	
Working experience(year)			0.872		0.044*
≤2	82(41.0)	3.77 $\pm$ 0.74		3.06 $\pm$ 0.62	
3-9	84(42.0)	3.81 $\pm$ 0.64		3.23 $\pm$ 0.55	
≥10	34(17.0)	3.83 $\pm$ 0.65		3.36 $\pm$ 0.70	
Working place			0.013*		0.063
Dental clinic	134(67.7)	3.72 $\pm$ 0.73		3.13 $\pm$ 0.63	
Dental hospital	64(32.3)	3.96 $\pm$ 0.54		3.31 $\pm$ 0.58	
Education level			0.009*		0.407
College	101(50.5)	3.67 $\pm$ 0.68		3.21 $\pm$ 0.55	
University	91(45.5)	3.90 $\pm$ 0.67		3.14 $\pm$ 0.69	
Postgraduate school	8(4.0)	4.27 $\pm$ 0.47		3.42 $\pm$ 0.34	
Position			0.717		0.062
Team member	142(71.0)	3.78 $\pm$ 0.68		3.13 $\pm$ 0.61	
Team leader	58(29.0)	3.82 $\pm$ 0.68		3.31 $\pm$ 0.60	

* $P < 0.05$, by Independent sample t-test, one-way ANOVA.

B. The Obstructive Factors to Antismoking Intervention Activities of Dental Hygienists

As a result of the survey asking "Do you have experience of getting education for antismoking education practice?", 20% of the participants said "Yes.", which was higher than the results of the previous studies of Yun²⁰ Kim¹⁹ et al. and Jang¹⁸ et al., However, this percentage is still low. As a result of analysis for obstructive factors to antismoking intervention activities in Korean dental institutions (as shown in table 2), the largest percentage (38.2%) of the participants who received education said, "No obstructive factors", making it possible to expect them to have active antismoking intervention activities. However, those with less education experience had higher response rate (82.8%) for the lack of 'knowledge and skill', which might be the greatest obstacle to antismoking intervention activities. Consistent with our study results, the study of Shin¹⁴ targeting nurses has also found that the lack of 'skill', 'knowledge', 'time', and 'confidence' are the greatest obstructive factors to antismoking intervention. In other words, if health and medical care providers are aware that lack the skill, time, and confidence concerning antismoking intervention, it is highly likely that they will not actively provide antismoking intervention activities.

It has been reported that medical care providers who have received more antismoking education have a higher success rate of achieving smoking cessation for smokers,²⁵ indicating that systematic expert antismoking education programs and pre-education are needed to deliver more accurate knowledge to patients. This may enhance their perceptions of antismoking intervention activities.

Table 2: The Obstructive Factors to Antismoking Intervention Activities of Dental Hygienists

Characteristics		obstructive factors				p
		Lack of time	Low count	Lack of Knowledge and skill	No obstructive factors	
Antismoking education experience						0.036*
	Yes	9 (23.1)	2 (28.6)	17 (17.2)	21 (38.2)	
	No	30 (76.9)	5 (71.4)	82 (82.8)	34 (61.8)	
Intend to participation in antismoking education						0.213
	Yes	27 (69.2)	4 (57.1)	58 (58.6)	41 (74.5)	
	No	12 (30.8)	3 (42.9)	41 (41.4)	14 (25.5)	

*P<0.05 by chi-square test.

*P<0.05 by chi-square test.

C. The Expected Effects of Smoking Mediation Activities of Dental Hygienist

Of the dental hygienists who participated in the survey, 65.0% said "Yes" to the question "Do you intend to participate in antismoking education?", which showed a higher rate of affirmative response than that (42.3%) in the study of Kim¹¹ and that in the study of Jang.¹⁸ In the meantime, the comparison of the expectancy effects of antismoking intervention activities (as shown in table 3) found more positive expectancy effects among the respondents with more willingness to participate in the education: improved abilities to manage oral cavities (71.4%), improved knowledge and skill of oral cavity health care (74.4%), increased trust in hospitals (66.7%). On the contrary, the ratio of the response saying "No positive expectancy effects" (64.1%) was found to be higher among the respondents with less willingness to receive the education.

Table 3: The Expected Effects of Smoking Mediation Activities of Dental Hygienist

(N=200)

Characteristics		Expectancy effect				p
		Improved knowledge and skill of oral cavity health care	Manage oral cavities	Increased trust in hospitals	No positive expectancy effects	
Antismoking education experience						0.278
	Yes	13(30.2)	23(20.5)	3(50.0)	10(25.6)	
	No	30(69.8)	89(79.5)	3(50.0)	29(74.4)	
Intend to participation in antismoking education						0.000*
	Yes	32(74.4)	80(71.4)	4(66.7)	14(35.9)	
	No	11(25.6)	32(28.6)	2(33.3)	25(64.1)	

D. The Needs for Dental Hygienists' Practice of the Antismoking Intervention Activities

Table 4 shows the results of an investigation into the needs for dental hygienists' practice of the antismoking intervention activities. 'Production of manuals for programs which can serve as examples for

antismoking intervention activities at dental hospitals & clinics' topped the list with 57.0%, followed by 'courses on antismoking intervention activities' with 28.0%, 'provision of media needed for antismoking intervention activities' with 24.5%, and 'information sharing through the small group gatherings with 6%. Meanwhile, the American Dental Association helps dental hygienists' antismoking intervention activities by giving prior education about smoking cessation counseling activities and providing the information for carrying it out.^{26,27} In South Korea as well, effective provision of information which dental hygienists can easily access in dental institutions, such as the production of programs & manuals and the development of media in the reputable institutions is required.

Table 4: The Needs for Dental Hygienists' Practice of the Antismoking Intervention Activities

Practice plan	N	%
Information sharing through the small group gatherings	6	3.0
Courses on antismoking intervention activities	28	14.0
Production of manuals for programs which can serve as examples for antismoking intervention activities at dental hospitals & clinics	114	57.0
Provision of media needed for antismoking intervention activities	49	24.5
Other	1	1.0
Total	200	100

*The data were analyzed by frequency analysis.

IV. CONCLUSION

This study performed and analyzed a self-administered questionnaire survey targeting 200 dental hygienists working at dental hospitals & clinics to identify the causes of the low success rate of antismoking intervention activities within Korean dental institutions. This study aims to determine the perceptions of and the obstructive factors to antismoking intervention activities of Korean dental hygienists and present the ways to help them do more active smoking cessation counseling activities within dental institutions. The results of this study are as follows:

1. Respondents with a higher level of education who worked at larger dental hospitals had higher scores in the attitudes toward antismoking intervention activities. Given the fact that those with a higher level of education had more positive attitudes toward smoking cessation counseling activities, it can be said that education has a close relationship with the attitudes ($P < 0.05$).
2. It was found that the perception rate in antismoking intervention activities were higher among the respondents with older ages and longer careers in dental institutions ($P < 0.05$).
3. Of the respondents, a significantly low 23.0% said "Yes" to the question "Have you ever received the education for the practice of antismoking intervention activities?" Since 'the lack of knowledge and skill' (82.8%) was found to be the greatest obstructive factor to antismoking intervention activities, it is thought that it is the greatest obstructive factor to antismoking intervention activities in Korean dental institutions.
4. Of the respondents, 130 (65.0%) said "Yes" to the question, "Are you willing to participate in antismoking intervention activities?" showing more affirmative responses to the activities. As a result of the comparison of the resultant expectancy effects of antismoking intervention activities, respondents with more willingness to participate in the education were found to have higher expectancy effects such as 'improved management ability' (71.4%), 'improved knowledge and skill' (74.4%), increased trust (66.7%), while the ratio of "No positive expectancy effects" was found to be higher among those with less willingness to participate in the education with 64.1%.
5. As a result of the analysis of the plans for creating demand for contents of antismoking education for dental hygienists, it was found that the production of manuals for the exemplary programs for their antismoking intervention activities in dental hospitals & clinics topped the list with 57.0%.

As in this study, there is the need to suggest the ways for dental hygienists to actively participate in antismoking intervention activities within dental institutions, by considering obstructive factors to and practice plans for antismoking intervention activities of dental hygienists at a time when policies to reduce smoking rate in this country are being enhanced. To achieve this, legal and institutional support is needed and this is expected to not only improve the people's oral cavity health but also contribute to reducing the smoking-induced social and economic losses. Lastly, this study was performed targeting only a portion of Korean dental hygienists, but it is expected that antismoking intervention activities of dental hygienists will be revitalized at the state level in the future.

ACKNOWLEDGMENT

This study was performed with the help of the research funding from the Industry-Academic Cooperation Group of Hanseo University.

REFERENCES

- [1] HeeJeong K, Smoking cessation and Relapse among Smoking Cessation Scholarship Beneficiaries, Indian Journal of Science and Technology, 2016 July, 9 (25), DOI:10.17485.
- [2] June No, Smoking and dental diseases, The Journal of Korean Dental Association, 1997 April, 35(4), pp. 241-250.
http://www.riss.kr/search/detail/DetailView.do?p_mat_type=1a0202e37d52c72d&control_no=854e40c70aff7f1effe0bdc3ef48d419.
- [3] K Prabhavathi. RLakshmi, Effective Lung Cancer Diagnosis : A survey, Indian Journal of Science and Technology, 2016 February, 9 (8), DOI:10.17485.
<http://www.indjst.org/index.php/indjst/article/view/87962/67780>.
- [4] Ryu MH, Kim J, Tobacco and oral disease, smoking cessation strategies in dental clinic, korJ oral Maxillofacpathol, 2005 29(6), pp. 381-390.
http://academic.naver.com/view.nhn?doc_id=77199784&dir_id=0&field=3&unFold=false&gk_adt=0&sort=0&qvt=1&query=%EB%8C%80%ED%95%9C%EA%B5%AC%EA%B0%95%EC%95%85%EC%95%88%EB%A9%B4%EB%B3%91%EB%A6%AC%ED%95%99%ED%9A%8C%EC%A7%80+29%EA%B6%8C+6%ED%98%B8&q_volume_issue=%EB%8C%80%ED%95%9C%EA%B5%AC%EA%B0%95%EC%95%85%EC%95%88%EB%A9%B4%EB%B3%91%EB%A6%AC%ED%95%99%ED%9A%8C%EC%A7%80+29%EA%B6%8C+6%ED%98%B8&gk_qvt=0&citedSearch=false&page.page=1&ndsCategoryId=10632&library=177.
- [5] Han GS, Kim YS, Kang JK, Hwang YS, Han DH, Bae KH, Relation of smoking and periodontal status among 30s-50s adults in metropolitan area, Journal of Korean Academy Dent Health, 32(2), 2008, pp.250-260.
http://www.riss.kr/search/detail/DetailView.do?p_mat_type=1a0202e37d52c72d&control_no=fc1b2e953205db11ffe0bdc3ef48d419.
- [6] Meraw SJ, Mustapha IJ, Rogers RS, Cigarette smoking and oral lesions other than cancer, Clinics in Dermatology, 1998, 16(5), pp. 625-631.
http://www.riss.kr/search/detail/DetailView.do?p_mat_type=e21c2016a7c3498b&control_no=fb4ff6e994275b17ffe0bdc3ef48d419.
- [7] Moore MS, Wilson RF, Coward PY et al, Periodontal health of London women during pregnancy, Br J Dent, 2001, 191(10), pp. 570-573. <https://www.ncbi.nlm.nih.gov/pubmed/11767859>.
- [8] Kim SH, Jang JH, Park YD, The relation between university student's smoking behavior and their perception on oral health, J Dent Hygiene Science, 2005, 5(3), pp.139-1439.
http://kiss.kstudy.com.library.hanseo.ac.kr:8000/journal/thesis_name.asp?tname=kiss2002&key=276334.
- [9] Fiore MC, Backer TB, Bailey WC, Goldstein MG, Heyman RB, Cohen SJ et al, Treating tobacco use and dependence, A Clinical Practice Guideline, Rockville, Md : US Dept of Health and Human Services, AHRQ publication, No. 00-0032.2000.
- [10] Park YD, Promoting oral health through smoking cessation: The role of oral health professionals to stop smoking, Journal of Korean Academy of Oral Health, 2007, 31(1s), pp31-34.
<http://www.prevent.or.kr/subpage.php?p=m21>.
- [11] Kim DG, Kim JS, Seong JH, Smoking cessation counseling activity among oral health care team in a community, Journal of Korean Academy of Oral Health, 2003, 27(4), pp.511-526.
[http://210.101.116.36/InSiteSearch/\(o5lku045vu1absi0dz5nvl55\)/ISS_Detail.aspx?a_key=2217155](http://210.101.116.36/InSiteSearch/(o5lku045vu1absi0dz5nvl55)/ISS_Detail.aspx?a_key=2217155).
- [12] S R Cummings, S M Rubin, G Oster, The cost-effectiveness of counseling smokers to quit, The Journal of the American Medical Association, 1989, 261(1), pp. 75-79.
<http://jamanetwork.com/journals/jama/article-abstract/375829>.
- [13] Canadian Dental Hygienists Association. 2004, 38(6), pp.1-20. <http://www.cdha.ca/cdha/>.
- [14] Sung Rae S, E Ri Kim, Attitudes to smoking cessation Interventions and Importance of Participation in Tobacco Control Policy Among Clinical Nurses, The korean journal of fundamentals of nursing, 2006 August, 13(2), pp. 294-303.

- <http://www.riss.kr.library.hanseo.ac.kr:8000/link?id=A82383536>.
- [15] Gould KA, Eickhoff-Shemek JM, Stacy RD, Mecklenburg RE, The impact of National Cancer Institute training on clinical tobacco use cessation services by oral health teams, J Am Dent Association, 1998 Oct,129(10), pp.1442-1449. <https://www.ncbi.nlm.nih.gov/pubmed/9787541>.
- [16] Adult smoking rates, South korea 19 years or older adult smoking rate, Department of Health and Human Services(No Smoke Guide).
http://www.nosmokeguide.or.kr/mbs/nosmokeguide/subview.jsp?id=nosmokeguide_010101000000.
- [17] Foreign smoking status, Major national smoking rate(based on 2012, more than 15 years of age),.Department of Health and Human Services(No Smoke Guide).
https://www.nosmokeguide.or.kr/mbs/nosmokeguide/subview.jsp?id=nosmokeguide_010200000000.
- [18] Sun Ok J, Bo Mi S, Mi Hang C, MinUun L, SoRa K, KyungJin K, MinJu Y, DaHae K, Tobacco Cessation Activities of Dental Staffs in Wonju City, Journal of Dental Hygiene Science, 2009, 19(4), pp. 397-404.
http://www.riss.kr.library.hanseo.ac.kr:8000/search/detail/DetailView.do?p_mat_type=1a0202e37d52c72d&control_no=7023f41b09e99068ffe0bdc3ef48d419.
- [19] Suk Hyang K, Chang Hee K, Jong Hwa J, Dental hygienists' Knowledge, Attitude and Practices to Recommend Quitting smoking for smoking patients,Korean Journal of Health Education and Promotion, 2005 March, 22(1), pp. 73-86.
http://www.riss.kr.library.hanseo.ac.kr:8000/search/detail/DetailView.do?p_mat_type=1a0202e37d52c72d&control_no=116700a1105eb292ffe0bdc3ef48d419.
- [20] Jung Won Yun, Jung Hwa Lee, An assessment of smoking cessation counseling among dental hygienists, Journal of korean Academy of Oral Health, 2015 March, 39(1), pp. 51-55.
https://www.researchgate.net/publication/276112664_An_assessment_of_smoking_cessation_counseling_among_dental_hygienists.
- [21] JaeYeon Jung, EunSun Lee, A survey on knowledge, attitudes and needs of smoking cessation education in the dental hygienists, 2015February, 16(3), pp. 447-454.
http://koreascience.or.kr/article/ArticleFullRecord.jsp?cn=CHOSAB_2016_v16n3_447.
- [22] Park JS, Lee Sh, Youn HJ,A comparative study on oral environment between smokers and non-smokers, Journalof Dental Hygiene Science, 2008, 8(3) pp. 139-146.
http://www.riss.kr.library.hanseo.ac.kr:8000/search/detail/DetailView.do?p_mat_type=1a0202e37d52c72d&control_no=c2541090b2b4a039ffe0bdc3ef48d419.
- [23] Je il S. Study on a short term smoking cessation treatment in dental hospitals in korea, Dankook University the department of dentistry paper of masters degree, 2010 August
http://www.riss.kr.library.hanseo.ac.kr:8000/search/detail/DetailView.do?p_mat_type=be54d9b8bc7cdb09&control_no=8a9dc02b863671ffffe0bdc3ef48d419.
- [24] Article title. <http://blog.naver.com/mpt110/220490765883>. Date accessed: 09/24/2015
- [25] Fiore,M C, Bailey W C, Cohen S J et al, Treating Tobacco Use and Dependence, Clinical Practice Guideline, Rockville, Department of Health and Human Services, Public Health Service, 2000.
http://lib.adai.washington.edu/dbtw-wpd/exec/dbtwpub.dll?BU=http%3A//lib.adai.washington.edu/ebpsearch.htm&TN=EBP&QY=Find+AccessNo=50&RF=Full+Display&DF=Full+Display&NP=3&RL=1&DL=0&XC=/dbtw-wpd/exec/dbtwpub.dll&AC=QBE_QUERY&CS=0.
- [26] American Dental hygiene Association.[online] <https://www.adha.org/>.
- [27] MiSil Yun, Clinical Nurses' knowledge Attitude and Practices for Quitting Smoking Recommendation to Smoking Patients, The catholic University of korea, seoul, 2003.
http://www.riss.kr.library.hanseo.ac.kr:8000/search/detail/DetailView.do?p_mat_type=be54d9b8bc7cdb09&control_no=4e235c5e1e6f6ba9ffe0bdc3ef48d419.



ISSN
0975-6299

The Effects of Interval Walking Training on Serum Cytokines and Insulin Resistance

Beak, Soon-Gi, Professor, Dept. of Beauty & Health, Jungwon University, 85 Munmu-ro, Goesan-eup, Goesan-gun Chungbuk, Republic of Korea. E-mail:bsg@jwu.ac.kr

Kim, Do-Jin* Professor, Dept. of Rehabilitation Sports, Bucheon University, 25 Sinheung-ro 56beon-gil Wonmi-gu, Buecheon-si Gyeonggi-do, Republic of Korea. E-mail:taehab@hanmail.net

Abstract---

Background/Objectives: Using walking exercise that is easy to approach in ordinary life, interval training has been applied by control exercise intensity. This study aimed to examine the effect of interval walking exercise on Cytokine and insulin resistance among middle-aged women and provide basic data of training methodologies for obesity improvement.

Methods/Statistical Analysis: The program was performed 3 times a week for 12 weeks for 60 minutes per session. The program was composed of 10 minutes of warming up, 40 minutes of interval walking training, and 10 minutes of cooling down. Upper body and lower body focused stretching was conducted for warming up and cooling down exercises. Treatment group participated in a interval walking training for 12 weeks, and women on the control group were asked to maintain their sedentary lifestyle for the same period. PASW 18.0 statistical program was used on the pre-test and post-test data to identify the effect of 12 week treatment. Descriptive statistics was suggested for each measurement period and two way 2-way RGRM ANOVA was applied to find the interaction of the treatment effect. The significance level was set to be .05.

Findings: Through this process TNF-a showed significant interaction effect between IWTG and CG with $p < .01$. IL-6 showed significant interaction effect between IWTG and CG with $p < .05$. Glucose showed significant interaction effect between IWTG and CG with $p < .05$. Insulin showed non-significant interaction effect between IWTG and CG with $p > .05$.

Improvements/Applications: Interval walking training of this study brought a positive change to Cytokine and insulin resistance. However, there was no statistic difference in insulin, among measurement variables of insulin resistance. It is supposed that this is related to the study subjects and a significant result would be obtained, if a further study targets more subjects. Moreover, diverse approaches to the forms of walking exercise, exercise intensity and exercise time would help in preventing metabolic diseases and vascular diseases.

Keywords--- Interval Walking Training, Cytokines, TNF-a, IL-6, Insulin Resistance, Glucose, Insulin.

* Corresponding Author

Special Issue on "Medical Science"

I. INTRODUCTION

The first major cause for metabolic syndrome is environmental factors including overeating and lack of exercise, the second major cause is insulin resistance, which means a loss of insulin functions and the third major cause is inflammation, which results from excessively accumulated body fat¹. Especially, overeating and lack of exercise can increase body fat and this can cause cytokines. Also, body fat accumulated in the belly affects insulin resistance by increasing expression of insulin-desensitizing adipocytokines.

The most important thing for obesity treatment and prevention is to improve a dietary life. But this is hard to perform continuously for a long period of time and even though weight is reduced using a dietary therapy, many people fail to maintain the reduced weight². Therefore, a dietary therapy should be conducted with an exercise therapy.

According to Esposito et al³ research, when dietary control and aerobic exercise were applied to middle-aged obese women for two years, they lost weight and the adiponectin concentration significantly increased. It was also reported that short-term training and long-term aerobic exercise led to an improvement in insulin resistance and a significant increase in adiponectin^{4 5}.

Aerobic exercise has been recommended to improve respiratory system and metabolic capabilities and prevent coronary artery diseases and it is known that resistance exercise is effective in increasing basal metabolic rate (BMR), improving insulin reaction and preventing an increase or a loss of bone density.

Using walking exercise that is easy to approach in ordinary life, interval training has been applied by control exercise intensity.

It is thought that for examining various forms and kinds of exercise and the results to analyze the physiological effect of exercise would help in verifying the training effect and developing training programs.

Therefore, this study aimed to examine the effect of interval walking exercise on Cytokine and insulin resistance among middle-aged women and provide basic data of training methodologies for obesity improvement.

From this perspective, reducing body fat through regular exercise can prevent inflammatory diseases. Besides, it is thought that applying walking exercise with different exercise intensities and analyzing its effect is meaningful.

II. STUDY METHOD

A. Subject of Study

The research subjects were selected from women in 40-50s living live in Gyeonggi-do Korea who did not participate in physical activity for last six months. The 18 subjects were assigned to interval walking training group(IWTG) and control group(CG) for comparison of the treatment effects. During the process of the program, 2 subjects were excluded for absence and inactive participation. Therefore 16 subjects participated in this study.<Table 1>.

Table 1: Physical Characteristic of Subjects (M±SD)

Group	N	Age(yr)	Height (cm)	Weight(kg)	Fat (%)
IWTG	8	50.22±3.89	162.10±4.35	66.56±3.95	28.30±2.17
CG	8	51.18±4.30	163.85±3.33	65.98±4.16	28.13±1.90

B. Interval Walking Training Program

The program was performed 3 times a week for 12 weeks for 60 minutes per session. The program was composed of 10 minutes of warming up, 40 minutes of interval walking training, and 10 minutes of cooling down. Upper body and lower body focused stretching was conducted for warming up and cooling down exercises. Treatment group participated in a interval walking training (50-70% VO₂max) for 12 weeks, and women on the control group were asked to maintain their sedentary lifestyle for the same period. <Table 2>.

Table 2: Interval Walking Program

Division	Intensity	Warm up/ Cool down	Materials
Early periods(1-4week)	Irregular VO ₂ max 50% maintenance	Upper body/ Lower body Focus Stretching	Sportswear, running shoes, Urethane track,
Middle period(5-8week)	Irregular VO ₂ max 50-60% maintenance 70%/1RM		
Late period(9-12week)	Irregular VO ₂ max 60-70% maintenance		

C. Measurement

During the 12 weeks of program, the serum cytokines and insulin resistance were measured from IWTG and CG before and after treatment to examine the effect of interval walking training program. The collected bloods were requested to specialized nuclear medicine institution.

D. Data Analysis

PASW 18.0 statistical program was used on the pre-test and post-test data to identify the effect of 12 week treatment. Descriptive statistics was suggested for each measurement period and two way 2-way RGRM ANOVA was applied to find the interaction of the treatment effect. The significance level was set to be .05.

III. RESULTS

A. Change in Serum Cytokines

TNF- α showed significant interaction($F=11.222$, $p=.005$) effect between IWTG and CG with $p<.01$. IL-6 showed significant interaction($F=8.873$, $p=.010$) effect between IWTG and CG with $p<.05$. <Table 3><Table 4><Table 5>.

Table 3: Serum Cytokines Descriptive Analysis

factor	group	Pre-test	Post-test
TNF- α (pg/ml)	IWTG	5.98 $\pm$.21	5.40 $\pm$.36
	CG	5.89 $\pm$.17	5.88 $\pm$.23
IL-6 (pg/ml)	IWTG	5.80 $\pm$.18	5.52 $\pm$.30
	CG	5.78 $\pm$.22	5.77 $\pm$.19

Table 4: TNF- α 2-way RGRM ANOVA

factor	SS	df	MS	F	p
Group	.299	1	.229	4.041	.064
Error	1.036	14	.074		
Period	.689	1	.689	12.028	.004
Group*Period	.642	1	.642	11.222	.005
Error	.801	14	.057		

Table 5: IL-6 2-way RGRM ANOVA

factor	SS	df	MS	F	p
Group	.106	1	.106	1.197	.292
Error	1.235	14	.088		
Period	.168	1	.168	10.237	.006
Group*Period	.146	1	.146	8.873	.010
Error	.230	14	.016		

B. Change in Insulin Resistance

Glucose showed significant interaction($F=6.870$, $p=.020$) effect between IWTG and CG with $p<.05$. Insulin showed non-significant interaction($F=1.676$, $p=.216$) effect between IWTG and CG with $p>.05$. <Table 6><Table 7><Table 8>.

Table 6: Insulin Resistance Descriptive Analysis

factor	group	Pre-test	Post-test
Glucose (mg/dl)	IWTG	118.70±13.88	109.37±11.45
	CG	119.89±14.56	118.77±12.08
Insulin (uU/ml)	IWTG	26.36±8.77	24.95±10.34
	CG	26.24±11.01	25.93±12.83

Table 7: Glucose 2-way RGRM ANOVA

factor	SS	df	MS	F	p
Group	223.883	1	223.883	.697	.418
Error	14	321.327			
Period	217.997	1	217.997	11.136	.005
Group*Period	134.488	1	134.488	6.870	.020
Error	274.052	14	19575		

Table 8: Insulin 2-way RGRM ANOVA

factor	SS	df	MS	F	p
Group	1.479	1	1.479	.006	.936
Error	3267.382	14	233.384		
Period	5.917	1	5.917	4.097	.062
Group*Period	2.420	1	2.420	1.676	.216
Error	20.221	14	1.444		

IV. DISCUSSION

Goldberg et al⁶ argued that increased weight, increased body fat, decreased lean body mass, high-carbohydrate diet or high-saturated fatty acid diet, shortage of exercise, diuretic and beta blocker, stress and menopause were major factors to increase insulin resistance. On the contrary, aerobic exercise, strength exercise, decreased weight, high-fiber diet, low-saturated fatty acid, low-sugar diet and estrogen influence a fall in insulin resistance.

Kraus et al⁷ reported that most of a year-physical activities had a very positive effect on glycometabolism and lipid metabolism, when examining the effects of various types of exercise to reduce risk factors that are related to cardiovascular diseases.

TNF- α , which is secreted from adipose tissues and muscular tissues, is reported to cause infection in blood, damage a direct signal of insulin⁸ and increase more in obese people. Also, an increase in TNF- α leads to adiponectin erythrosis by affecting insulin resistance.

According to Tchernof et al⁹ research, obesity is a major factor to increase the IL-6 concentration, has numerous forms of immunity and is produced in immune accessory cells and subcutaneous fatty tissues. They reported that this caused insulin resistance and was associated with dysfunction of endothelial cells, disseminated intravascular coagulopathy (DIC) and chronic heart diseases¹⁰.

This corresponds with the result of this study that walking exercise brought a positive change to the improvement in glucose and Cytokines. Moreover, it is considered that walking exercise with speed change at regular intervals is more effective than simple walking exercise without speed change.

Goodyear & Kahn¹¹ reported that resistance exercise decreased weight and improved glycometabolism by increasing oxidative energy metabolic capabilities and increased muscle mass is effective in preventing diabetes by improving insulin sensitivity.

Ross et al¹² insisted that the reduction in insulin resistance resulted from the decrease in the ratio of visceral fat to subcutaneous fat due to decreased body fat and waist measurement.

Based on Ross et al¹² study finding, walking exercise with speed change in this study influenced the reduction in body fat and visceral fat, but there was no statistically significant difference in insulin. It is considered that although there was no statistic difference, there was a positive change overall.

V. CONCLUSION

It is considered that exercise inhibits expression of insulin-resistant cytokines, which induces increase and differentiation of fat cells and declines insulin functions by increasing calories of adipose tissues. At the same time, it improves metabolic syndrome that causes chronic degenerative diseases by increasing expression of insulin-sensitive cytokines. It was found that not only do adipose tissues store energy but lead to a variety of diseases.

Interval walking training of this study brought a positive change to Cytokine and insulin resistance. However, there was no statistical difference in insulin, among measurement variables of insulin resistance.

It is supposed that this is related to the study subjects and a significant result would be obtained, if a further study targets more subjects.

Moreover, diverse approaches to the forms of walking exercise, exercise intensity and exercise time would help in preventing metabolic diseases and vascular diseases.

REFERENCES

- [1] Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive summary of the third report of the national cholesterol education program(NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol In Adults,Journal of American medical Association, 2001, 285, pp.2486-2497.
- [2] Ditz, W. T. Prevention of childhood obesity. *Pediatr Clin North American*, 1986, 33(4), pp. 823-833.
- [3] Esposito, K., Nappo, F., Gjugliano, F., Di palo, C., Ciotola, M., Barbieri, M., Paolisso, G., & Giugliano, D. Meal modulation of circulating interleukin 18 and adiponectin concentrations in health subjects and patients with type 2 diabetes mellitus.*American Journal Clinical Nutrition*, 2003, 78(6), pp. 1135-1140.
- [4] Kriketos, A. D., Gan, S. K., Poynten, A. M., Furler, S. M., Chisholm, D. J., & Campbell, L. V. Exercise increases adiponectin levels and insulin sensitivity in humans.*Diabetes Care*, 2004, 27(2), pp. 629-630.
- [5] Kondo, N., Nomura, N., Nakaya, Y., Ito, S., & Ohguro, T. Association of inflammatory marker and highly sensitive C-reactive protein with aerobic exercise capacity, maximum oxygen uptake and insulin resistance in healthy middle-aged volunteers.*Circulation Journal*, 2006, 69(4), 452-457.
- [6] Goldberg Y., Boaz M., Matas Z., Goldberg I., & Shargorodsky M. Weight loss induced by nutritional and exercise intervention decrease arterial stiffness in obese subjects.*Clinical Nutrition*, 2009, 28(1), pp. 21-25.
- [7] Kraus, W. E., Torgan, C. E., Duscha, B. D., Morris, J., Brown, S. A., Cobb, F. R., Bales, C. W., Annez, B. H., Samas, G. P., Houmard, J. A., & Slentz, C. A. Studies of targeted risk reduction intervention through defined exercise.*Medicine and Science in Sports and Exercise*, 2001, 33(10), pp. 1774-1784.
- [8] Haque, W. A., & Garg, A. Adipocyte biology and adipocytokines.*Clinical Medicine*, 2004, 24, pp. 217-234.
- [9] Tchernof, A., Nolan, A., Sites, C. K., Ades, C. K., Ades, P. A., & Poehlman, E. T. Weight loss reduces C-reactive protein levels in obese postmenopausal women.*Circulation*, 2002, 105(5), pp. 564-569.
- [10] Stepan, C. M., Bailey, S. T., Bhat, S., Brown, E. J., Banerjee, R. R., Wright, C. M., Patel, H. R., Ahima, R. S., & Lazar, M. A. The hormone resistance links obesity to diabetes.*Nature*, 2001, 409(6818), pp. 307-312.
- [11] Goodyear, L. J., & Kahn, B. B. Exercise, glucose transport and insulin sensitivity.*Annual Review Medicine*, 1998, 49, pp. 235-261.
- [12] Ross, R., Dagnone, D., Jones, P. J., Smith, H., Paddage, A., Hudson, R., & Janssen, I. Reduction in obesity and related comorbid conditions after diet-induced weight loss or exercise-induced weight loss in men: a randomized, controlled trial.*Annual Internet Medicine*, 2002, 133(2), pp. 92-103.



ISSN
0975-6299

Development of Smart Checking System for the Balance Anesthesia Detection

Bong-Hyun Kim, Senior Researcher, Industrial-Academic Convergence Research, 20 Wolpyeongsaeeteum-ro, Seo-gu, Daejeon, Republic of Korea. E-mail:snake93@nate.com

Yong-Sung Suh*, Professor, Dept. of Business Administration, U1 University, 310 Daehak-ro, Yeongdong-eup, Yeongdong-gun, Chungcheongbuk-do, Republic of Korea. E-mail:suhys@u1.ac.kr

Abstract---

Objectives: Fall means to fall because of the strong external shocks. Falls may occur when slipping awakened, and may cause injury away from the bed can easily occur in everyday life that can fall. Especially, an older person makes it easier to fall accident. In this paper, the smart system for providing periodic changes in the human body loses balance as a notification services was studied for development.

Methods/Statistical Analysis: To this end, we designed the system according to the belt design. And, it was the discovery of the balance anesthesia using a tilt sensor provided a notification service via the buzzer.

Findings: In this paper, we develop a sense of balance anesthesia in the system with the four-way tilt sensor integrated. The experimental results were all in the front, back, left and right direction provides alert notification service for the fall. However, if you do not cause a slope of 50 degrees or more it did not provide a notification service. In addition, downsizing is difficult because of the size of the arduino. Therefore, applying a small microcontroller, and by designing a variety of sensors such as impact sensor, damage to the sensor as an integrated module in addition to the tilt sensor, it is necessary to improve the accuracy of the service.

Improvements/Applications: The system developed in this paper is a notification service due to falls. And later, mobile phone applications and the interlocking will develop the services specified around people other than you. This is expected to develop a range of additional applications, features, etc. Contact Guardian.

Keywords--- Balance Sense, Smart System, Falling, Notice Information, Belt Type System.

* Corresponding Author

I. INTRODUCTION

For the past three years (2012-2014) received the Korea Consumer Agency surveillance system for consumers (CISS) over 65 senior citizens Information Number total is 12,195 cases, especially in 2014, it appears to year-on-year 16.2 percent increase in 4453 cases. 'Home' is 7,617 By accident place the gun that accounting for 62.5% of the total, followed by commercial facilities, 1,020 cases (8.4%), health care facilities 833 cases (6.8%), road 652 cases (5.3 percent) appeared to this space can be found, as well as being perceived risks of external generally safe can't do it is not actually disprove a range of occurrence of accidents is also a testament comprehensive throughout life's shown in Table 1.

Table 1: Status of Place by Accident Outbreak

Division	Number	Ratio
Home	7,617	62.5%
Commercial Facility	1,020	8.4%
Healthcare Service Facility	833	6.8%
Road	652	5.3%
Transportation Facility	261	2.1%
Etc	1,812	14.9%
Sum	12,195	100.0%

Safety accidents of children under 14 years of age collected through the monitoring system (CISS) for Consumers, 22,907 cases in 2012 year, 24,312 cases in 2013 year, and the 2014 year continues to increase 27,381 cases, accounting for over 30% of the information for the entire year¹. According to statistics of the US national integration NEISS shows the trend of child safety accident rate compared to the overall safety incidents decreased to 30.5% in '12, '13 and 29.6%, 29.5% in '14. On the other hand, our country is that the annual increase in the proportion of 37.2% in '12, '13 37.2%, 40.8% in '14. As you can see from this status, the case of the elderly body aging and disease by age increases situation is also serious may lead to an increase in accidents and the extent of the injury, in the case of children increases, the risk factors for and new products and facility appearance and thus secure vulnerable hierarchy of children is a situation that is constantly exposed to safety risks^{1,2}.

Fall means to fall because of the strong external shocks. Falls may occur when slipping awakened, and may cause injury away from the bed, come out from the bathroom can easily occur in everyday life that can fall. Especially eye-catching is the winter, slippery vulnerable older people make it easier to fall accident. Fractures due to falls as a problem, but this situation can't long be careful because the behavior is caused skin necrosis, heart disease complications can be more dangerous. Also are several well as when surgery to fractures of the hip bones due to be in bed because the muscles begin to weaken and blood and body fluids go to the limbs do not gather in the body because there is no activity to stimulate the muscle amount is reduced a little infected features It is weakened and may lead to severe cases death. It is susceptible to fracture falling parts knees 38.9%, waist 16.5%, as food ages with a shoulder 11.1%, and buttocks and hips 11.1% Head 5.6% while muscle weakness can't withstand the weight load which appears to be a knee fracture best lot³.

As such fall accidents are also a risk in itself, but the aid is important. So if the elderly were to lose consciousness when he was hurt in an accident it is difficult to ask for help themselves, and also making that may have internal injuries can ask for help as soon as you move people around, so also the risk themselves. Thus, upon the occurrence of physical agility continuous monitoring and safety for the elderly and poor children lack the ability to recognize dangerous situations require a rapid response means that can be done. In this paper, the smart systems for providing periodic changes in the human body lose balance as a notification services was studied for development. To this end, we designed the system according to the belt design. And, it was the discovery of the balance anesthesia using a tilt sensor provided a notification service via the buzzer.

II. TECHNOLOGY TRENDS

The location measurement techniques are needed to prevent the fall of the balance anesthesia. At present, the location measurement technique has a GPS, LBS, UWB, CDMA, infrared-based technology, ultrasonic based technology, such as beacon technology. GPS is a technique that is based on the signal to be transmitted are 27 GPS satellites orbiting the earth in an orbit different 20,183km ~ 20,187km measure the position of

the object. LBS is a technology for location-based services using a mobile phone or the guarantee mobility in the mobile communication network device identifying the location of the person or thing and providing additional services based on it^{4,5,6}. UWB is a wireless technology for transmitting large amounts of digital data through a low power in a wide frequency spectrum from short range interval. The modulation and demodulation functions do not require good transparency in a way that has a lower power density. CDMA has been used as a helpful role for accuracy is not satisfied the requirements of the FCC 99-245 E911 requirements improve the GPS positioning performance such as improved TTFF, a weak signal detected by the AGPS form. Method using infrared rays is a method that the infrared sensor attached to the indoor places to recognize the infrared device with a unique ID code for finding the location. Method using ultrasonic waves by using a transmission rate difference between the relatively slow ultrasound and fast positioning of a RF signal can be three-dimensional as a way to find the position of the object and have the advantage that can be configured for low-power, low-cost system^{7,8}.

Finally, the beacon based positioning technology of known location using Bluetooth distance information calculated by using the RSSI think a Bluetooth device as a reference point and calculates the position by triangulation. Wearable devices are in the spotlight in that most closely forms of computer users to existing devices can't provide this new service has increasingly developed^{9,10}. In fact, look at the Wearable Technology Outlook 2014 ERTI 52% of US consumers are aware of wearable technology device, 1/3 of them are doctors of the investigation that purchased the device of the future development of technology the possibility was also discussed several times. Products of existing wearable device technology is being developed in various parts of the body-specific products / industries such as Life After separating the type of wearable glasses and wristwatch-style device is characterized in that the purpose of accounting for the majority¹¹ in figure 1. Wearable device technology has been designed by a variety of body parts. The smart devices, such as eyes, hair, ears, wrists, fingers, ankles have been grafted. In this paper, we designed a wearable device of the belt type, rather than watches, eyewear styles.

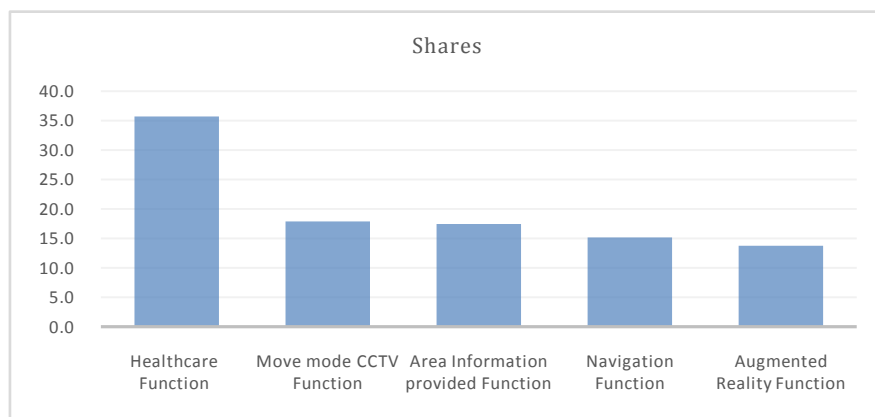


Figure 1: Wearable Device Apply Issues

Biological signals detection technology has been used universally to use body temperature, shock, vital etc. When the body temperature with thermometer sensor technology to help manage conditions such as temperature and measuring temperature mounted on Smartphone and linked to Smartphone to measure the temperature or temperature and can be managed through smart thermometer recorded the app. The impact sensor is a piezo method using a sensor, there is a method using the acceleration sensor¹². A piezo sensor may detect sound, vibration, pressure, etc. to the sensor sandwiched between a thin piezoelectric plate; the piezoelectric element has a property that generates an electrical oscillation doing so, when applying alternating current. Acceleration sensor may specifically detect the exercise state of the object to measure the dynamic force of acceleration, vibration, impact, etc. of the object by processing the output signal. Vital check method can be equipped with a temperature sensor, such as a wearable device that measures the activity consumes distance, calories, elevation changes visible five, steps, calories, time, heart rate, such as a graph.

III. DESIGN AND DEVELOPMENT OF BALANCE CHECKING SYSTEM

Falls are means to fall due to the strong impact of the external. Falls may occur when slipping awakened, and may cause injury away from the bed, come out from the bathroom can easily occur in everyday life that

can fall. Many people think that it is falling slightly at the thought not a big accident. However, the risk of falling is greater than you think. In particular, the elderly, children, people with disabilities fall accident causes a greater risk. Elderly people who are hurting accidents is more scary than chronic diseases.

In this paper, we perform system design and development to reduce the accident rate through prevention of falling incidents. To this end, we developed a variety of sensors based on the arduino as an integrated module. In addition, the design, the final system was developed as a smart wearable device in the form of a belt type. The whole system configuration diagram is shown in figure 2.

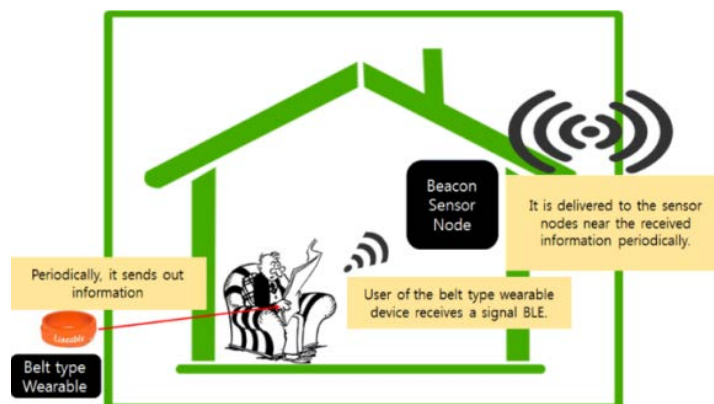


Figure 2: System Configuration Diagram

The system based on smart was designed network based on the configuration of around the sensor node. Beacon signals from the nodes to gather user's wearable device which was classified as a node disposed in the space. Analysis server analyzes the information passed periodically in the Base-station, it was designed in such a way that processing. In other words, by passing to a smart device of protector it provided the information to the guardian. It was classified everyday situations and emergency situations in accordance with the measurement results. In normal circumstances the analytical data was sent at a constant cycle units as guardians of smart devices. Also, it designed an emergency transfer to a smart device of the emergency guardian in figure 3.

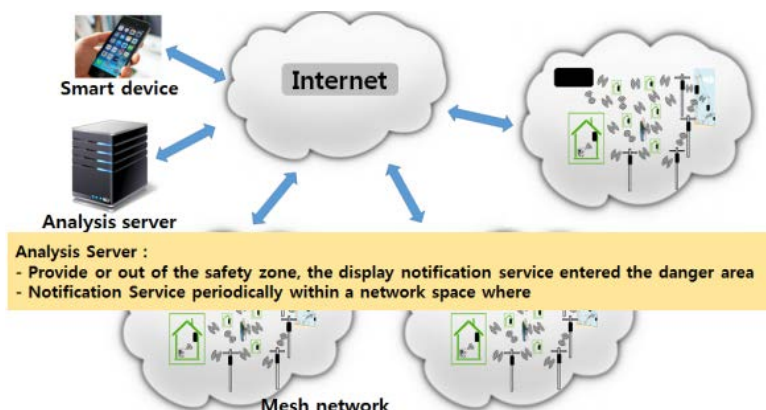


Figure 3: Analysis Server Mesh Network

The belt-type wearable devices were designed, developed and integrated modules based on the arduino. Arduino R3 is an 8-bit AVR microcontroller on a single board. The sensor system is applied to a slope sensor, a temperature sensor, acceleration sensor, a beacon sensor, and it was designed as a single integrated module in figure 4.

- 1) Tilt Sensors: SW-520D was used for the model. Comparator provides more than 15mA output driving ability. And, it is possible to clean signal waveform and adjusting the variable resistor.
- 2) Temperature Sensor: by infrared through the infrared emitted by the human body was applied to a method for measuring the body temperature of the human body.

- 3) Accelerometer Sensor: the method was applied to measure the output value of the acceleration Faw data occurring during walking in three-axis acceleration sensor.
- 4) Beacon Sensor: applied for data communication with the location data and communication repeater. Through a data communication between repeaters attached to the wearable beacon and transmits the data to a server finally. Location will determine the user's position as starting point repeaters which communicate on the most close to the wearable in figure 5.

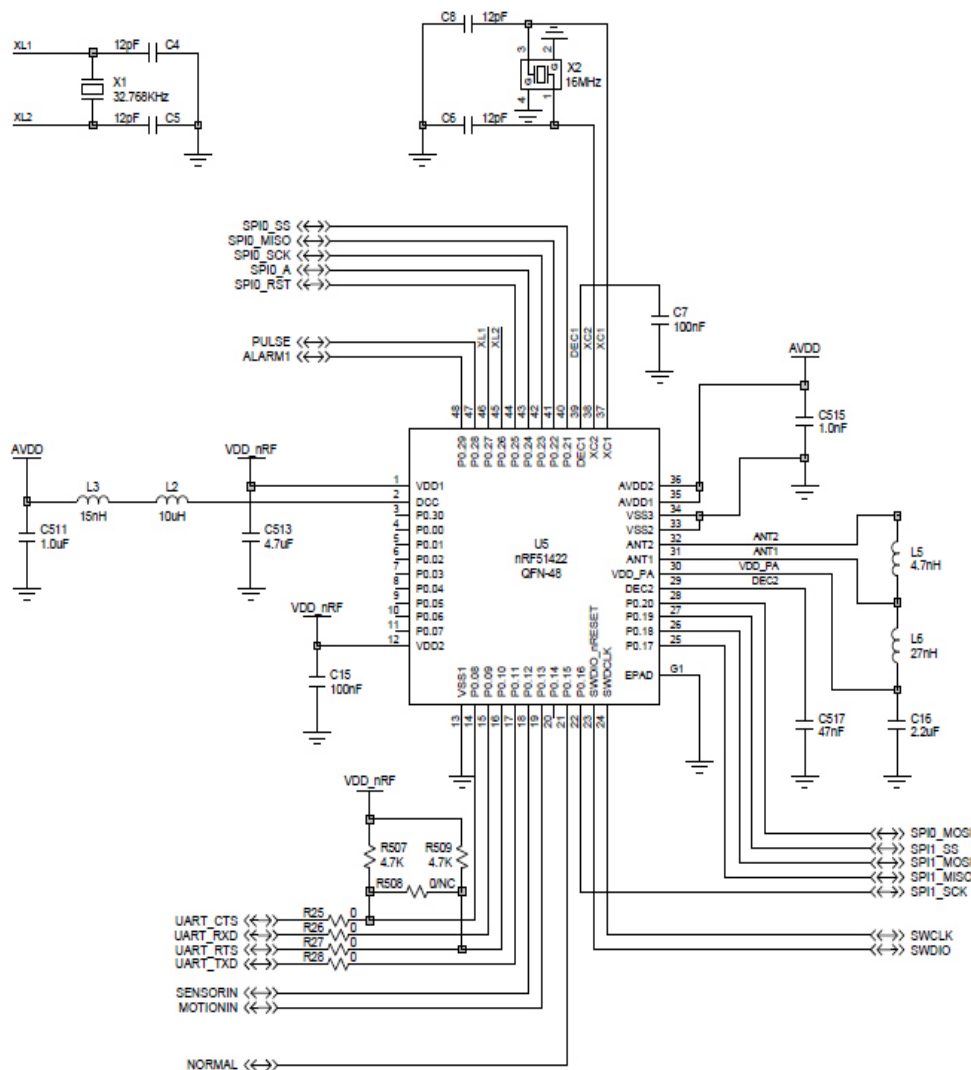


Figure 4: Design Drawing of Integration Module

Management system using an integrated module was developed around the analysis server. The periodic reporting system, the data is not classified as an emergency statistics, analysis of the data analysis period of 10 minutes to deliver a Smartphone application guardian. The emergency reporting system as an emergency guardian of classified data without going through the process of passing statistical information about the state of emergency and the cause of protected groups. In the positioning system to identify the location of the nearest neighbor nodes based on a unique code value for the wearable device to determine the location of the protected groups.

The integrated management system to store and maintain, and manage all data, including biometric data, location data generated by the entire system. Finally, the system for matching the user transmits the data for matching is successful wearable device via the matching of wearable devices unique identification number of the application registered with the guardian.

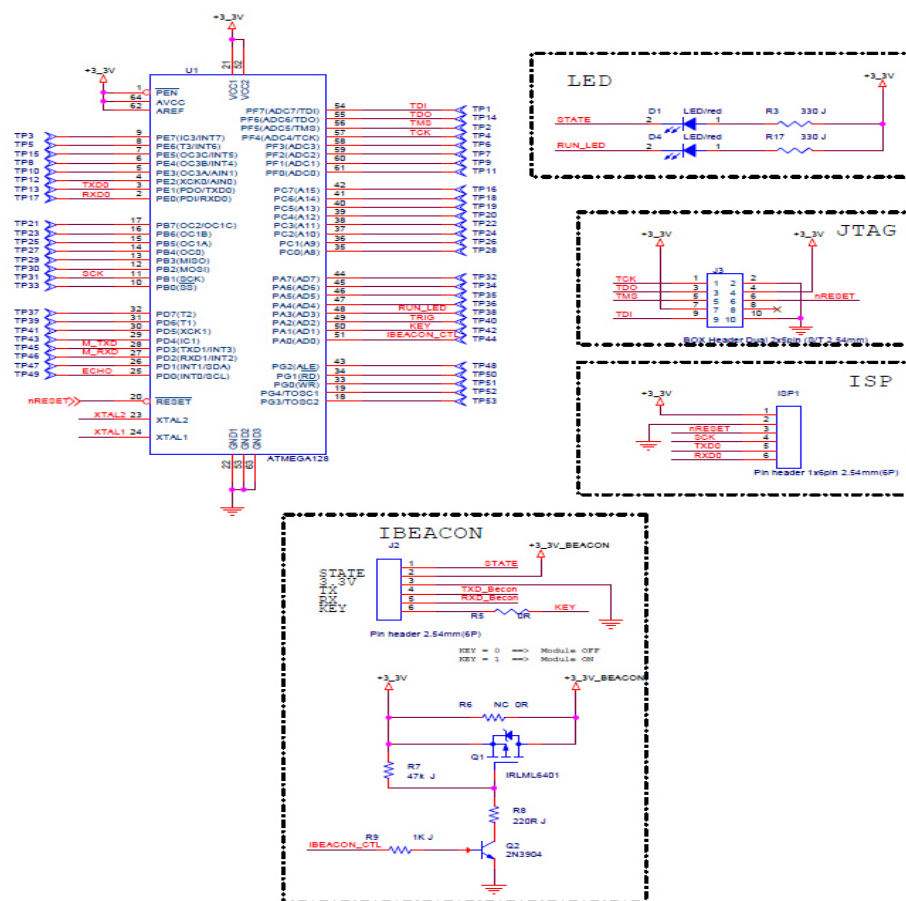


Figure 5: Beacon Sensor Integration Module Design

In this paper, it developed by applying the balance anesthesia of the measurement result based on experiments about the tilt sensor. Thus, using the tilt sensor was checked for response to the angle change. Experimental results, when applied to the body, the sensor 50 was also reacted in the tilt over. In addition, a communication network used for transmitting to the user the result of the reaction through the tilt sensor buzzer and LED.

Also, by collecting the information gathered by the sensing device from the body information collecting apparatus beacon information in a network space it was transmitted through the network proximity sensor networks. And it was sent to the analysis server to the Internet network via the base station. Analysis after analysis of the information was sent to the smart wearable devices, users, guardians.

The experimental results were also checked the balance in the loss of more than 50 slopes and sent to the notification service. In addition, the status information was transmitted through the indoor location measured in the analysis space to the network server 10 seconds. If the 'Golden Time' is a heart attack, when to mean time you can save a respiratory arrest, life after what happened two such massive bleeding, 4 minutes cardiac arrest, one hour if severe patients, 3 hours of stroke, when the collapse of myocardial infarction It can save. As a result, there can be prevented from the design, to apply to various accidents that require protection, such as the elderly, children, disabled through the user system developed in this paper.

IV. CONCLUSION

Fall means to fall because of the strong external shocks. Falls may occur when slipping awakened, and may cause injury away from the bed, come out from the bathroom can easily occur in everyday life that can fall. Especially eye-catching is the winter, slippery vulnerable older people make it easier to fall accident. Fractures due to falls as a problem, but this situation can't long be careful because the behavior is caused skin necrosis, heart disease complications can be more dangerous. Also are several well as when surgery to

fractures of the hip bones due to be in bed because the muscles begin to weaken and blood and body fluids go to the limbs do not gather in the body because there is no activity to stimulate the muscle amount is reduced a little infected features It is weakened and may lead to severe cases death.

Therefore, in this paper, the design system for preventing accidents caused by balance anesthesia's hurt, developed. In addition, by using a temperature sensor, the accelerator sensor developed a module for transmitting the biometric information. Finally, the developed location information measurement module using a beacon sensor integrated into a single module was designed, developed with this belt type of user system. The experimental results were also checked the balance in the loss of more than 50 slopes and sent to the notification service. In addition, the status information was transmitted through the indoor location measured in the analysis space to the network server 10 seconds.

REFERENCES

- [1] Consumer Injury Surveillance System, Main statistical report on consumers injury information. 2015.
- [2] Consumer Product Safety Commission. <http://www.cpsc.gov/en/Research—Statistics>. Date accessed: 06/11/2016.
- [3] Samsung Fire & Marine Insurance. <http://www.samsungfire.com>. Date accessed: 06/29/2016.
- [4] Devasena A, Sowmya B. Wireless sensor network in disaster management, Indian Journal of Science and Technology, 2015 July, 8 (15), pp. 1–6.
- [5] Ishaq I, Carels D, Teklemariam GK, Hoebeke J, Van den Abeele F, De Poorter E, Moerman I, Demeester P. IETF standardization in the field of the Internet of Things (IoT): A survey, Journal of Sensor and Actuator Networks, 2013, 2 (2), pp.235–87.
- [6] Shyamala K, Sunitha Rani T. An analysis on efficient resource allocation mechanisms in cloud computing, Indian Journal of Science and Technology, 2015 8 (9), pp.814–21.
- [7] Bala I, Singh G. Performance considerations for integer lattice design based OOC for incoherent optical CDMA system, Proceedings of International Conference on Transparent Optical Network, India, 2008, pp. 58–61.
- [8] Bhat G M, Mustafa M, Ahmad S, Ahmad J. VHDL modeling and simulation of data scrambler and descrambler for secure data communication, Indian Journal of Science and Technology, 2009, 2 (10), pp. 41–43.
- [9] Kihyun C, Yongseong K, Henagwoo L, Janghoo S. A study on the user and location awareness technology applied dimming lighting control system to save energy, Korean Journal of Air-Conditioning and Refrigeration Engineering, 2015, 27 (1), pp. 14–23.
- [10] Willig A. Recent and emerging topics in wireless industrial communications: A selection, IEEE Transactions on Industrial Informatics, 2008, 4 (2), pp. 102–24.
- [11] Kumar SA, Ilango P. Data funneling in wireless sensor networks: A comparative study, Indian Journal of Science and Technology, 2015 Mar, 8 (5), pp. 472–80.
- [12] Fatourechi M, Bashashati A, Ward RK, Birch GE. EMG and EOG artifacts in brain computer interface systems: A survey, Clinical Neurophysiology, Elsevier, 2007, 118 (3), pp. 480–94.



ISSN
0975-6299

Characteristics of Intentional Acute Drug Intoxication Patients in Emergency Medical Center

Ye-Jin Han, Dept. of Health Care, Hanseo University, Seosan, Korea. E-mail:yjhan7133@hanmail.net

Hong-Ryang Jung*, Dept. of Health Care, Hanseo University, Seosan, Korea. E-mail:hrjung@hanseo.ac.kr

Abstract---

Background/Objectives: The purpose of this study was to determine the characteristics of acute substance poisoning patients admitted at a regional emergency medical center located in an urban rural complex.

Methods/Statistical analysis: The general characteristics of medical records, occurrence season, and emergency care records of acute substance poisoning patients among patients admitted into an emergency medical center located in S region, Chungnam from January to December 2015 were evaluated. SPSS Win 22.0 program was used for statistical analysis, including Chi-square test and Fisher's exact test.

Findings: The percentage of acute substance poisoning patients in the total number of patients admitted at the emergency medical center was 0.12%. Within the intentional substance poisoning group, 70.4% were female patients. This was higher than that (63.6%) in the unintentional poisoning group. Patients were divided into the elderly group and the non-elderly group using a cutoff value of 65 years of age. The percentages of both the intentional substance poisoning group and the unintentional poisoning group were higher in the elderly group than those in the non-elderly group. As for the presence of diseases, there were more cases in the intentional poisoning group compared to that in the unintentional poisoning group. The use of 119 ambulances was the most frequent admission method for both intentional poisoning group and unintentional poisoning group. The use of other vehicles was more common in the unintentional poisoning group compared to that in the intentional poisoning group. Of different months, April was the most frequent month (18.5%) for cases of intentional poisoning while May and December were the most frequent months for cases of unintentional poisoning (27.3%). Emergency treatment results were in the order of hospitalization, transfer, and recovery for the intentional poisoning group rather than unintentional poisoning group.

Improvements/Applications: The general characteristics and substance poisoning related characteristics of subjects were determined. These data will provide basis for suicide prevention programs and national health program.

Keywords--- Emergency, Intoxication, Suicide, Intentional Poisoning, Pesticides.

* Corresponding Author

I. INTRODUCTION

The Organization for Economic Cooperation and Development (OECD) has found that the suicide rate in Korea is 2.3 times higher than the OECD average. Suicide rate in Korea has been ranked the 1st among member countries for 12 years in a row.¹ According to the 2015 cause of death statistics published by the Republic of Korea National Statistical Office, death rate due to suicide is 5.3 per 100,000. It is the fifth highest cause of death after malignant neoplasm, cerebrovascular disease, heart disease, and pneumonia. Death rate related to suicide can fluctuate according to region, gender, age, and social demographic aspects. Unlike general causes of death, suicide death has pathological burden on the population². Generally, acute poisoning caused by side effect of toxic substances can be divided into two types: unintentional and intentional.³ Intentional poisoning has higher rate of death compared to unintentional position because most of the time a high amount is consumed with the purpose of committing suicide. According to data from the World Health Organization, death rate is around 20% in case of intentional poisoning. More than 200,000 deaths worldwide are caused by pesticide alone every year.³ Pesticides and herbicides are commonly used in rural areas while sleeping pills, acid, and alkaline substances are commonly used in urban areas. Administration of poisonous substance for the purpose of committing suicide is the most common in adults. In children, inattention by parents is the most common.⁴ Preventing suicide through bio-psychological factors (genetic, personality characteristics, etc.) and socio-economic factors (recession, family breakdown, etc.), the fundamental causes of suicide, is very difficult. Especially, it is difficult to establish active measures for stress, suicidal thoughts, and suicide attempts, the important intermediate between fundamental causes of suicide and committing suicide. The problem of suicide must not be treated as a problem of individuals, but as part of social problems. Therefore, suicide prevention programs considering subject characteristics should be developed.⁵ For this, the study classified substance poisoning patients admitted into an emergency medical center into two groups: an intentional substance poisoning patient group with a purpose of committing suicide and an unintentional substance poisoning group. By analyzing the general characteristics of subjects and substance poisoning related characteristics, it is expected that our study will be utilized as basic data for suicide prevention programs and national health programs.

II. RESEARCH METHODS

A. Research Subjects

The study subjects were 38 acute substance poisoning patients admitted into an emergency medical center located in S region from January to December of 2015.

B. Research Methods

Gender, age, presence of disease, method of admission, consciousness at the time of admission, or arrival time at the medical center, transition of substance poisoning by month, type of poisoning substance, types of emergency treatment, and emergency treatment results of subjects were investigated. According to the intentionality of acute substance poisoning patient, it was divided into intentional poisoning group and unintentional poisoning group. Investigation was done retrospectively through medical records of patients. Statistical analysis was conducted with SPSS Win 22.0 program. Chi-square test and Fisher's exact test were conducted.

III. STUDY RESULTS

A. Comparison of General Characteristics of Subjects

The total number of patients admitted into the regional emergency medical center within the investigation period was 31,570, including 38 (0.12%) acute substance poisoning patients admitted within the investigation period. Of the 38 subjects, 33 patients whose intentions of poisoning were actually recorded. The 33 patients included 22 subjects who were assigned into the intentional substance poisoning group and 11 subjects who were assigned into the unintentional substance poisoning group. In the intentional substance poisoning group, the percentage of females was 70.4%, which was higher than that (63.6%) in the unintentional substance poisoning group. These 33 patients were also divided into the elderly group and the non-elderly group based on cut off value of 65 years of age. Both unintentional substance poisoning group and intentional substance position group had more elderly patients (55.6% and 63.6%, respectively) compared to non-elderly patients. Regarding the presence of diseases, more cases were found in the intentional

substance poisoning group compared to those in the unintentional substance poisoning group. However, there was no significant difference in the number of cases with the presence of diseases between the two groups (i.e., unintentional substance poisoning group and intentional substance poisoning group). The most frequent admission method was the use of 119 ambulances in both groups. The percentage of using other vehicles was higher in the unintentional poisoning group (18.2%) than that (14.8%) in the intentional substance poisoning group. There was no significant difference in other characteristics between the two groups in Table 1.

Table 1: Comparison of General Characteristics of Subjects

Variables	Intentional poisoning N=22(71.1%)	Unintentional poisoning N=11(28.9%)	p-value*
Gender			0.714
Male	8(29.6)	4(36.4)	
Female	19(70.4)	7 (63.6)	
Age			0.729
Under old age(≥ 64 years)	12(44.4)	4(36.4)	
Old age(65years<)	52(55.6)	7(63.6)	
Medical history			0.955
Yes	12(44.4)	5(45.5)	
No	15(55.6)	6(54.5)	
Transportation			0.796
119 ambulance	23(85.2)	9(81.8)	
Other cars	4(14.8)	2(18.2)	

* by chi-square test and fisher's exact test at $\alpha=0.05$

B. Poisoning Characteristics Comparison of Subjects

Regarding the consciousness state of patients in the intentional substance poisoning group at the time of admission, 51.9% were in clear state of consciousness, 33.3% were in confusion state, and 14.8% were in unconscious state. In the unintentional substance poisoning group, 63.6% of patients were in clear state of consciousness while 18.2% were in confusion state. The percentage of patients in unconscious state in the unintentional substance poisoning group was similar to that in the intentional substance poisoning group.

For emergency treatment at the time of admission, gastric leverage was used for 44.4% and 36.4% of patients in the intentional substance poisoning group and the unintentional substance poisoning group, respectively. Although the percentage of gastric leverage use was higher in the intentional substance poisoning group, the two were not statistically significant ($p > 0.05$). The percentage of charcoal solution use in the unintentional substance poisoning group was 45.5%, which was higher than that (29.6%) in the intentional substance poisoning group. However, the difference between the two was not statistically significant ($p > 0.05$). In the intentional substance poisoning group, the percentages of poisoning substances were: sleeping pills, 63.0%; herbicide, 22.2%; pesticide, 11.1%. In the unintentional substance poisoning group, the percentages of poisoning substances were: sleeping pills, 45.5%; herbicide, 27.3%; pesticide, 18.2%. These percentages by poisoning substance were not significantly different between the two groups in Table 2.

Table 2: Poisoning Characteristics Comparison of Subjects

Variables	Intentional poisoning N=22(71.1%)	Unintentional poisoning N=11(28.9%)	p-value *
Mental status			0.647
Coma	4(14.8)	2(18.2)	
Drowsy	9(33.3)	2(18.2)	
Alert	14(51.9)	7(63.6)	
Gastric lavage			0.647
Yes	12(44.4)	4(36.4)	
No	15(55.6)	7(63.6)	
Charcoal			0.351
Yes	8(29.6)	5(45.5)	
No	19(70.4)	6(54.5)	
Substance			0.454
Pesticide	3(11.1)	2(18.2)	
Herbicide	6(22.2)	3(27.3)	
Sleeping pills	17(63.0)	5(45.5)	
Kitchen detergent	1(3.7)	0(0.0)	
Dementia drugs	0(0.0)	1(9.1)	

* by chi-square test and fisher's exact test at $\alpha=0.05$

C. Comparison of Temporal Characteristics of Subjects

The arrival time of the substance poisoning patients was in the order of morning 40.7%, afternoon and evening 22.2%, and Dawn 14.8% in the intentional substance poisoning group, and in the unintentional substance poisoning group, it was in the order of afternoon 54.5%, morning 27.3%, evening 18.2%, and there were no statistically significant differences between groups.

In the comparison by month, April was the highest with 18.5% in the intentional substance poisoning group with 11.1% in each January, February, and October, and in the unintentional substance poisoning group, it was the highest in May and December with 27.3%, and there were no statistically significant differences between groups in Table 3.

Table 3: Comparison of Temporal Characteristics of Subjects

Variables	Intentional poisoning N=22(71.1%)	Unintentional poisoning N=11(28.9%)	p-value*
Monthly distribution			0.128
January	3(11.1)	1(9.1)	
February	3(11.1)	0(0.0)	
March	2(7.4)	1(9.1)	
April	4(18.5)	1(9.1)	
May	2(7.4)	3(27.3)	
June	1(3.7)	0(0.0)	
July	2(7.4)	2(18.2)	
August	2(7.4)	0(0.0)	
September	2(7.4)	0(0.0)	
October	3(11.1)	0(0.0)	
November	2(7.4)	0(0.0)	
December Winter	0(0.0)	3(27.3)	

* by chi-square test and fisher' exact test at $\alpha=0.05$

D. Comparison of post emergency treatment results in subjects

In the comparison of post emergency treatment results, intentional substance poisoning group showed hospitalization 55.6%, transfer 29.6%, and the cover he 14.8%, and in the unintentional substance poisoning group, hospitalization and transfer was 36.4%, and recovery 27.3% which were similar between groups and there was no statistical significance in Table 4.

Table 4: Comparison of Post Emergency Treatment Results in Subjects

Variables	Intentional poisoning N=22(71.1%)	Unintentional poisoning N=11(28.9%)	p-value *
Management result			0.510
Admission	15(55.6)	4(36.4)	
Transfer	8(29.6)	4(36.4)	
Recovery	4(14.8)	3(27.3)	

* by chi-square test and fisher' exact test at $\alpha=0.05$

IV. DISCUSSION

Depending on the type of poisoning substance, clinical symptoms are diverse. Some are fatal. Some can cause severe convocations after treatment. Substance poisoning brings large financial and emotional burden to guardians. In addition, poisoning patients can become big problems medically and socially.⁶ According to this study, the total number of patients admitted into the emergency medical center for substance poisoning was 38 within one year. It accounted for 0.12% of total patients admitted to the emergency medical center. Frequency of substance poisoning by gender revealed that the percentage of female patients was higher in both the intentional substance poisoning group (70.4%) and the unintentional substance poisoning group (63.6%). This result is consistent with the results of a previous study of Ko⁷ showing that the percentages of female subjects of 60.3% and 61.4% in the two groups. In the United States, while there are more suicide attempts by women, more men have succeeded in committing suicide. Regarding suicide methods, although many women prefer nonfatal substances, men are more likely to use fatal methods.⁸ In this study, after

subjects were divided into the elderly group and the non-elderly group based on the cutoff value of 65 years of age, both the intentional substance poisoning group and the unintentional substance poisoning group had more elderly patients than non-elderly patients. Elderly suicide in Korea has reached a critical level. Among methods of suicide used by the elderly, poisoning through using toxic substances has been reported to be highest (at 7.8%).⁹ At old age, many people experience the feeling of loss and loneliness due to retirement and unemployment, loss of social and financial position, and death of people surrounding including spouses.¹⁰ Due to normal changes associated with aging, the elderly might experience daunted lives with loss of physical functions due to chronic diseases. Suicide is often selected as a measure to solve these problems. Being an elderly has been reported to the highest risk factor of suicide.¹¹ In this study, the presence of disease was higher in the intentional substance poisoning group compared to that in the unintentional substance poisoning group, consistent with the result of a study by ¹². It has been reported that the elderly has 2 to 3 times higher prevalence of disease compared to younger people. Approximately 80% of the elderly have at least one chronic disease while more than half have a combination of two or more chronic diseases.¹³ In this study, the use of 119 ambulances was found to be the most frequent method of admission in both the intentional substance poisoning group and the unintentional substance poisoning group. This result is in agreement which result of a study by Ko⁶ reporting that the use of 119 ambulances is the most frequent admission method in both the intentional poisoning group and the unintentional poisoning group. According to the National Emergency Management Agency, among patients transferred to emergency medical center by 119 ambulances, the number of acute substance poisoning patients is continuously increasing. Regarding patient consciousness state upon admission, clear state of consciousness accounted for the most in both groups, followed by the state of confusion and the state of unconsciousness. In both groups, the most frequent poisoning substance was sleeping pills, followed by herbicide and pesticide. However, for most patients who take sleeping pills, death is not reported.¹⁴ The increase of incidence of sleeping pill taking compared to previous study results showing that herbicides and pesticides are the more frequent poisoning substances might be due to the influence of industrialization. It has been suggested that prevention of acute poisoning should break away from the modest dimensions of education on pesticide spraying or usage of the past to actively promote and educate substance side effects.¹⁵ While conducting effective management on groups with possibility of substance poisoning, there should be emphasis for the need of systematic devices to prevent purchase of poisonous substance for the purpose of committing suicide in the process of substance distribution.¹⁵

In this study, April was found to be the most frequent month of admission in the intentional substance poisoning group while May and December were found to be the most frequent month of admission in the unintentional substance poisoning group. In a study by ¹⁶ investigating the relationship between late hours and suicide rates, it has been reported that suicide rates are higher for both men and women in spring and summer with overall higher amounts of light compared to those in the fall and winter. Regarding the results of emergency treatment, the most frequent treatment method was hospitalization, followed by transfer and recovery in both the intentional substance poisoning group. In the unintentional substance poisoning group, hospitalization and transfer were the highest treatment methods followed by recovery. The ratio of hospitalization and transfer was found to be higher in the intentional substance poisoning group compared to that in the unintentional substance poisoning group, indirectly indicating that the severity of poisoning might be higher in the intentional substance poisoning group as reported previously.¹⁷

V. CONCLUSION

In the results of emergency treatment, most frequent was in the order of hospitalization, transfer, and recovery in the intentional substance poisoning group and in the unintentional substance poisoning group, hospitalization and transfer were the highest and next was recovery. The ratio of hospitalization and transfer was shown to be higher in the intentional substance poisoning group compared to the unintentional substance. The study compared characteristics of 38 substance poisoning patients admitted to an emergency medical center in S region from January to December 2015 by dividing into intentional substance poisoning group and unintentional substance poisoning group. The following results were obtained.

First, the number of substance poisoning patients among admitted patients at the emergency vehicle center was 38, which was 0.12% of total patients. In both intentional substance poisoning group and unintentional substance poisoning group, frequency by gender was higher in females. Based on 65 years of age, it was divided into elderly and nonelderly group and intentional substance poisoning group and

unintentional substance poisoning group were both higher in the elderly group. History of disease was more frequent in the intentional substance poisoning group compared to unintentional substance poisoning group. Method of admission was most frequently 119 ambulances in both groups.

Second, the most frequent state of consciousness at the mission was clear state of consciousness for both groups and then it was in the order of state of confusion, then state of unconsciousness. Usage of gastric leverage and charcoal solutions was more frequent in intentional substance poisoning group compared to unintentional substance poisoning group. For both groups, the most frequent poisoning substances were in the order of sleeping pills, herbicide, and pesticide.

Third, the time of arrival for admission was in the order of morning, afternoon, then evening for the intentional substance poisoning group and for the unintentional substance poisoning group, it was in the order of afternoon, morning, and evening. For season, spring was the most frequent for both groups. The highest frequency in the intentional substance poisoning group was in April and it was the highest in May and December for the unintentional substance poisoning group.

Fourth, in the result of emergency treatment, it was in the order of hospitalization, transfer, and recovery for intentional substance poisoning group and hospitalization and transfer was the highest and then recovery for the unintentional substance poisoning group.

Based on the results, there is urgent need for emotional support within families and suicide prevention programs in the social level to prevent elderly suicide. There is also great need for supervision of sales of pesticides and medication such as sleeping pills used for the purpose of suicide. Both governmental and institutional supports are strongly needed to prevent suicide in Korea.

ACKNOWLEDGMENT

This study was funded by a 2016 Academic Research Support Project of Hanseo University, Republic of Korea.

REFERENCES

- [1] OECD. Health Data 2014. 2015
- [2] Miller M, Azrael D, Barber C. Suicide mortality in the United States: the importance of attending to method in understanding population-level disparities in the burden of suicide. *Annual review of public health*, 2012, 33, pp.393-408.
- [3] Akbaba M, Nazlican E, Demirhindi H, Sütölk Z, Gökel Y. Etiological and demographical characteristics of acute adult poisoning in Adana, Turkey. *Human & experimental toxicology*, 2007, 26(5), pp.401-406.
- [4] Lee J K, Park J H. CLINICAL OBSERVATION OF ACUTE DRUG INTOXICATION. *Journal of the Korean society of emergency medicine*. 1993 June, 4(1), pp. 35-42.
- [5] Suicide. http://www.cdc.go.kr/search/sEngine_new.jsp. Date assessed:22/07/2016
- [6] Persson H E, Sjöberg GK, Haines J A, Garbino J P. Poisoning severity score. Grading of acute poisoning. *Journal of Toxicology: Clinical Toxicology*. 1998, 36(3), pp. 205-213.
- [7] Ko S H, Lee K W. Clinical Analysis of Acute Drug Poisoning Victims by Intentional Poisoning. *Journal of the Korean society of emergency medicine*. 2012 Oct, 5(23), pp. 679-686.
- [8] Kim J, Lee D. A study on the rate of suicide and the countermeasures of policing activity. *Kor J Public SafCrim Just*. 2009 Sep, 36, pp. 59-87.
- [9] Eunkyöng L. Retrospective Study of Elderly Suicide Visited Emergency Center. *KJWHN, (Journal Of the Korean Society Women Health Nursing)*. 2006, 7(2), pp. 1-22.
- [10] Rhim J D, Cho B J, Seöng Y H, Kim S R. A Comparative Analysis of Elderly Intoxication Patient between Urban and Rural Area for the Safety Management and Emergency Care. *Journal of Korea Safety Management & Science*. 2009, 12(1), pp.19-25.
- [11] Kim H S. A Study on Epistemology of Korean Elder's Suicidal Thought. *Journal of the Korean Gerontological Society*. 2002, 22(1), pp.159-172.
- [12] Lee T Y, Kim S R, Cho B J, Park J H. The Analysis of Acute Drug Intoxication in Emergency Medical Center. *Journal of the Korea Academia-Industrial cooperation Society*. 2010, 11(2), pp. 750-757.
- [13] Lim S. A study on elderly health care. Hanseo University, 2006, Master's Thesis.
- [14] Korean statistics information service (http://kosis.kr/statisticsList/statisticsList_01List.jsp?vwcd=

- MT_ZTITLE&parmTabId=M_01_01)
- [15] Choi H S, Choi DH, Lee K. Research of Acute Poisoning on a Local Emergency Medical Facility in an Urban-Rural Area. *Journal of agricultural medicine and community health*. 2008, 33(2), pp.193-203.
 - [16] Park J, Kim S, Ji S, Lee J. Secular trends of suicide mortality in Korea. *Korean Journal of Epidemiology*. 2003, 25(2), pp.84-91.
 - [17] Ye-Jin Han, Hong-Ryang Jung, Cheong-Hwan Lim. Analysis of suicide Attempted Patients Admitted to an Emergency Medical Center. *Indian Journal of Science and Technology*. 2016 August, 9(29), pp.1-6



ISSN
0975-6299

A Study on the National Vaccination of Infants Under 3 Age

Jeong-Hee Kim, Dept. of Health Care, The Graduate School of Hanseo University, 46, Hanseo 1-ro, Haemi-myun, Seosan-si, Chungcheongnam-do, Province, Republic of Korea. E-mail:4506508@korea.kr

Cheong-Hwan Lim*, Dept. of Health Care, The Graduate School of Hanseo University, 46, Hanseo 1-ro, Haemi-myun, Seosan-si, Chungcheongnam-do, Province, Republic of Korea. E-mail:lch116@hanseo.ac.kr

Ok-Ja Jang, Dept. of Nursing, Hyejeon College, 25, Daehak-gil, Hongseong-eup, Hongseong-gun, Chungcheongnam-do, Province, Republic of Korea. E-mail:Changock@hj.ac.kr

Hong-Ryang Jung, Dept. of Health Care, The Graduate School of Hanseo University, 46, Hanseo 1-ro, Haemi-Myun, Seosan-si, Chungcheongnam-do, Province, Republic of Korea. E-mail:hrjung@hanseo.ac.kr

Ki-Jeong Kim, Dept. Health Care, The Graduate School of Hanseo University, 46, Hanseo 1-ro, Haemi-myun, Seosan-si, Chungcheongnam-do, Republic of Korea. E-mail:raidline@kuh.ac.kr

Abstract---

Background/Objectives: The subjects for the National Immunization Program for Children are all children less than the age of 12, those who are born after 1st January 2002.

Methods/Statistical Analysis: In T Administrative district, 360 guardians from 25 kindergartens with children under-3 (born from 1st Jan 2012 to 31st Dec) were conveniently sampled and they were all given survey papers certified by a Institutional Review Board and Research Ethics, a bioethics committee designated by the Ministry of Health and Welfare, and the collected data was analyzed with SPSS ver. 22.0 program.

Findings: The general perception of national immunization program according to characteristics were higher in male guardians and statistically showed a significant difference ($p=0.004$). The perceptions were higher in those aged more than the 50s than the 20s, which showed a significant difference ($p=0.002$). The general demands for national immunization program of the guardians according to their characteristics were higher in guardians more than the age of 50, than those in their 30s. This showed a statistically significant difference ($p<0.001$). In relational person to the children, perceptions of grandmothers were higher than fathers which showed a statistically significant difference ($p<0.001$). As occupations of the guardians, demands of those working in the fishing industry were the highest, than office workers, which showed a statistically significant difference ($p<0.001$). The satisfaction rate of National Immunization Healthcare organization were higher in male guardians, which showed a statistically significant difference ($p=0.014$). In relation person to the children, the satisfaction rate of grandmothers were high, which showed a statistically significant difference ($p<0.001$).

Improvements/Applications: The research data was taken from a healthcare center in c-province, collecting information of 20,589 under-3 children who were immunized and registered in the data.

Keywords--- National Immunization, Subject, Support Vaccine, Infectious Diseases.

* Corresponding Author

Special Issue on "Medical Science"

I. INTRODUCTION

The subjects for the National Immunization Program for Children are all children less than the age of 12, those who are born after 1st January 2002^{1,2,3,4}.

The supported contents are full support for immunization fee for the supported vaccine, and subject vaccines for 2015 free immunization are 14 types, all of which are immunizations recommended by the government^{5,6,7}.

The basic immunization processes that should be done before the age of 3 through National Immunization Program should be regarded importantly needed by the guardians of children under 3^{8,9,10}.

By immunizing the children, they are protected from infectious diseases and they can grow as a healthy child^{11,12,13}.

Through Acts on prevention and appropriate management for infectious diseases, the immunization practice and methods will be settled, and the people and the healthcare provider¹³ will follow these standards.

II. MATERIALS AND METHODS

The research data was taken from a healthcare center in c-province, collecting information of 20,589 under-3 children who were immunized and registered in the data.

In T Administrative district, 360 guardians from 25 kindergartens with children under-3 (born from 1st Jan 2012 to 31st Dec) were conveniently sampled and they were all given survey papers certified by a Institutional Review Board and Research Ethics, a bioethics committee designated by the Ministry of Health and Welfare, and the collected data was analyzed with SPSS ver. 22.0 program.

III. RESULTS

A. Gender Birth Months Status of Infants Under 3 Years in the C Provinces

In the c-province's birth month variations of children under the age of 3, January was the highest and December was the lowest. In gender variations, male were higher than females by 2.6% as seen in Table 1.

Table 1: Birth Months Status of Infants under 3 Years in the C provinces

(N = 20,589)

Resions	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sat	Oct	Nov	Dec	Total
A	14	20	46	30	31	31	23	43	31	39	31	29	368
B	71	64	69	55	77	74	57	56	66	76	66	66	797
C	36	27	27	24	24	31	36	18	29	31	29	25	337
D	80	79	90	74	55	75	70	80	90	73	77	66	909
E	172	178	182	161	151	139	158	160	179	150	161	140	1,931
F	74	56	75	59	65	60	73	56	50	46	69	59	742
G	37	37	45	34	35	35	36	35	25	24	25	31	399
H	178	158	154	140	151	132	163	156	152	153	145	134	1,816
I	30	26	24	16	25	23	25	29	23	30	21	21	293
J	428	366	392	350	337	358	344	339	353	368	344	292	4,271
K	54	47	57	37	41	51	40	43	46	47	33	28	524
L	269	245	294	232	236	223	242	231	246	237	215	201	2,871
M	371	338	378	305	366	314	348	338	356	336	334	271	4,055
N	13	20	20	17	24	11	13	15	17	16	13	16	195
O	32	43	37	36	23	26	36	31	40	37	24	32	397
P	61	57	50	66	59	54	50	51	51	57	54	47	657
Total	1,947	1,761	1,940	1,636	1,700	1,637	1,714	1,681	1,754	1,720	1,641	1,458	20,589
%	9.5	8.6	9.4	7.8	8.2	8.0	8.3	8.2	8.5	8.4	8.0	7.1	100

B. Gender Status of Infants under 3 Years in the C Provinces

The highest male birth rate was in J-city, and the lowest, N town. The highest female birth rate was in J-city, and the lowest, N town as seen in Table 2.

Table 2: Gender Status of Infants under 3 Years in the C Provinces

Unit: N (%)

Gender	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Total
Male (%)	207 (1.0)	407 (2.0)	185 (0.9)	461 (2.2)	1,007 (4.9)	397 (1.9)	209 (1.0)	928 (4.5)	149 (0.7)	2,189 (10.6)	277 (1.4)	1,467 (7.1)	2,038 (10.0)	92 (0.4)	201 (1.0)	340 (1.7)	10,554 (51.3)
Female (%)	188 (0.9)	390 (1.9)	152 (0.8)	448 (2.2)	924 (4.5)	345 (1.7)	190 (0.9)	888 (4.3)	144 (0.7)	2,082 (10.1)	247 (1.2)	1,404 (6.8)	2,017 (9.8)	103 (0.5)	196 (0.9)	317 (1.5)	10,035 (48.7)
Total (%)	395 (1.9)	797 (3.9)	337 (1.6)	909 (4.4)	1,931 (9.4)	742 (3.6)	399 (1.9)	1,816 (8.8)	293 (1.4)	4,271 (20.7)	524 (2.6)	2,871 (14.0)	4,055 (19.7)	195 (1.0)	397 (1.9)	657 (3.2)	20,589 (100.0)

C. Non-vaccination Status of Infants under 3 Years by Vaccine in the C Provinces

The non-immunized children among the under-3 children in c-province were 8.8%, and the non-immunization status according to vaccines displayed, BCG and hepatitis B in M district, DTaP, IPV, DTaP-IPV, and MMR. Pox in J- city, Hib and PVC in E city. Japanese encephalitis was the highest, and in all vaccines, G-District was the lowest. The non-immunization status of children under-3 in c-province was the highest in E-City and H-city was the lowest. It was ranked as the 13th place among 17 administrative districts and perfect immunization rate was 82.7%, which was 3.6% lower than the national average as seen in Table 3.

Table 3: Non-vaccination Status of Infants under 3 Years by Vaccine in the C provinces

Unit: N (%)

Resions	BCG	Hepatitis B	DTaP	IPV	DTaP-IPV	Hib	PCV	MMR	Pox	JEL* (live)	JEL* (dedlive)	Total
A	4(1.5)	16(2.3)	28(2.0)	15(3.2)	10(1.9)	26(1.5)	34(1.3)	5(1.5)	3(0.8)	11(1.6)	36(1.6)	188
B	18(6.8)	28(4.1)	73(5.2)	24(5.1)	28(5.2)	78(4.6)	182(6.8)	26(8.0)	31(8.3)	43(6.3)	134(6.1)	665
C	5(1.9)	17(2.5)	32(2.3)	19(4.0)	20(3.7)	33(2.0)	46(1.7)	11(3.4)	12(3.2)	19(2.8)	48(2.2)	262
D	9(3.4)	34(5.0)	80(5.7)	45(9.5)	46(8.6)	75(4.4)	108(4.0)	21(6.5)	20(5.4)	31(4.5)	77(3.5)	546
E	39(14.7)	50(7.3)	140(10.1)	34(7.2)	38(7.1)	457(27.1)	520(19.4)	34(10.5)	42(11.3)	72(10.5)	236(10.8)	1662
F	15(5.6)	43(6.3)	81(5.8)	38(8.0)	25(4.7)	90(5.3)	130(4.8)	21(6.5)	24(6.4)	43(6.3)	122(5.6)	632
G	2(0.8)	2(0.3)	8(0.6)	1(0.2)	1(0.2)	7(0.4)	34(1.3)	-	-	4(0.6)	10(0.5)	70
H	4(1.5)	25(3.7)	106(7.6)	20(4.2)	25(4.7)	101(6.0)	184(6.9)	22(6.8)	36(9.7)	45(6.6)	166(7.6)	734
I	6(2.3)	17(2.5)	33(2.4)	18(3.8)	20(3.7)	24(1.4)	40(1.5)	10(3.1)	9(2.4)	16(2.3)	36(1.6)	229
J	38(14.3)	96(14.1)	257(18.4)	74(15.6)	84(15.7)	209(12.4)	385(14.4)	48(14.8)	56(15.0)	119(17.3)	454(20.8)	1820
K	6(2.3)	16(2.3)	23(1.7)	13(2.7)	12(2.2)	17(1.0)	64(2.4)	7(2.2)	7(1.9)	15(2.2)	40(1.8)	220
L	30(11.3)	82(12.0)	203(14.6)	54(11.4)	76(14.2)	214(12.7)	362(13.5)	51(15.7)	50(13.4)	102(14.9)	393(18.0)	1617
M	52(19.5)	143(20.9)	195(14.0)	57(12.0)	78(14.6)	224(13.3)	390(14.5)	30(9.3)	34(9.1)	110(16.0)	275(12.6)	1588
N	6(2.3)	10(1.5)	13(0.9)	3(0.6)	7(1.3)	22(1.3)	34(1.3)	4(1.2)	7(1.9)	7(1.0)	34(1.6)	147
O	8(3.0)	23(3.4)	43(3.1)	26(5.5)	23(4.3)	34(2.0)	47(1.8)	10(3.1)	12(3.2)	15(2.2)	34(1.6)	275
P	24(9.0)	81(11.9)	78(5.6)	34(7.2)	41(7.7)	78(4.6)	121(4.5)	24(7.4)	30(8.0)	34(5.0)	90(4.1)	635
Total	266	683	1,393	475	534	1,689	2,682	324	373	686	2,185	11,290

* JEL : Japan Encephalitis

D. Non-vaccination Status of Infants Under 3 Years by Region in the C Provinces

The general perception of national immunization program according to characteristics were higher in male guardians and statistically showed a significant difference ($p = 0.004$). The perceptions were higher in those aged more than the 50s than the 20s, which showed a significant difference ($p = 0.002$). In relationship with children, perceptions of grandmothers were higher than fathers, which showed a significant difference ($p < 0.001$).

In the field educational level, the perceptions of guardians who graduated from middle school were higher than the graduates of high school and universities, which showed a significant difference ($p < 0.001$).

According to the occupations of the guardians, the perceptions of those working in the fishing industry were higher than those working in the agricultural industry, which statistically showed a significant difference ($p < 0.001$) as seen in Table 4.

Table 4: Non-vaccination status of infants under 3 years by region in the C provinces

(Unit: N (%))

Resions	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Total
Total (%)	395 (1.9)	797 (3.9)	337 (1.6)	909 (4.4)	1,931 (9.4)	742 (3.6)	399 (1.9)	1,816 (8.8)	293 (1.4)	4,271 (20.7)	524 (2.6)	2,871 (14.0)	4,055 (19.7)	195 (1.0)	397 (1.9)	657 (3.2)	20,589 (100.0)
Not Vaccination (%)	67 (17.0)	119 (14.9)	14 (4.2)	55 (6.1)	435 (22.5)	36 (4.9)	34 (8.5)	67 (3.7)	12 (4.1)	424 (9.9)	73 (13.9)	155 (5.4)	173 (4.3)	34 (17.4)	54 (13.6)	53 (8.1)	1,805 (8.8)

E. General Characteristics about National Immunization Needs of Guardian

The general demands for national immunization program of the guardians according to their characteristics were higher in guardians more than the age of 50, than those in their 30s. This showed a statistically significant difference ($p < 0.001$). In relational person to the children, perceptions of grandmothers were higher than fathers that showed a statistically significant difference ($p < 0.001$).

As occupations of the guardians, demands of those working in the fishing industry were the highest, than office workers, which showed a statistically significant difference ($p < 0.001$) as seen in Table 5.

Table 5: General Characteristics about National Immunization Needs of Guardian

Characteristics	Classification	N	Mean $\pm$ SD	F	P*
Gender	Male	64	4.48 $\pm$ 0.53	7.133	0.008
	Female	262	4.27 $\pm$ 0.58		
Age	20's	40	4.54 $\pm$ 0.69 ^b	6.667	0.000
	30's	220	4.21 $\pm$ 0.60 ^a		
	40's	57	4.45 $\pm$ 0.49 ^{ab}		
	More than 50	9	4.65 $\pm$ 0.53 ^b		
Relation	Mother	269	4.24 $\pm$ 0.57 ^a	16.863	0.000
	Father	41	4.50 $\pm$ 0.52 ^a		
	Grandmother	16	5.00 $\pm$ 0.00 ^b		
Education	Middle school	32	4.47 $\pm$ 0.54 ^a	1.399	0.248
	High school	95	4.28 $\pm$ 0.63 ^a		
	More than Univ.	199	4.30 $\pm$ 0.56 ^a		
Job	Housewife	134	4.24 $\pm$ 0.52 ^a	4.599	0.000
	Employee	81	4.23 $\pm$ 0.49 ^a		
	Self-employment	60	4.38 $\pm$ 0.76 ^a		
	Male	64	4.48 $\pm$ 0.53		
	Female	262	4.27 $\pm$ 0.58		

* by the independent t-test or one-way ANOVA test at $\alpha = 0.05$

a,b Means followed by different letters are significantly different at $\alpha = 0.05$

F. Satisfaction of the National Immunization and Health Institutions

The satisfaction rate of National Immunization Healthcare organization were higher in male guardians, which showed a statistically significant difference ($p = 0.014$). In relation person to the children, the satisfaction rate of grandmothers was high, which showed a statistically significant difference ($p < 0.001$). In educational levels, the satisfaction rate of guardians who graduated from middle school were higher than those who graduated from high school and university, which showed a significant difference ($p = 0.018$).

In the occupations of the guardians, the satisfaction rate of guardians working in the fishing industry was the highest, than homemakers or the guardians who work in the agricultural industry, which showed a significant difference ($p = 0.021$). Satisfaction rate on trusted healthcare center by the National Immunization program were higher in grandmothers related to children, which showed a significant difference ($p = 0.002$) as seen in Table 6.

Table 6: Satisfaction of the National Immunization and Health Institutions

Unit: N (%)					
Characteristics	Classification	Satisfaction	So So	Dissatisfaction	P*
Gender	Male	43(67.2)	14(21.9)	7(10.9)	0.014
	Female	40(15.3)	94(35.9)	127(48.5)	
Age	20's	29(72.5)	9(22.5)	2(5.0)	0.493
	30's	101(45.9)	82(37.3)	37(16.8)	
	40's	33(57.9)	16(28.1)	8(14.0)	
	More than 50	8(88.9)	1(11.1)	-	
Relation	Mother	127(47.2)	98(36.4)	44(16.4)	0.000
	Father	28(68.3)	16(24.4)	3(7.3)	
	Grandmother	16(100)	-	-	
Education	Middle school	23(68.3)	5(15.6)	4(12.5)	0.018
	High school	51(53.7)	34(35.8)	10(10.5)	
	More than Univ.	97(48.7)	69(34.7)	33(16.6)	
Job	Housewife	65(48.5)	44(32.8)	25(18.7)	0.021
	Employee	41(50.6)	30(37.0)	10(12.3)	
	Self-employment	31(51.7)	22(36.7)	7(11.7)	
	Fishery	15(68.2)	7(31.8)	-	
	Agriculture	15(51.7)	11(37.9)	3(10.3)	

* by Chi-square test and Fisher's exact test at $\alpha = 0.05$

IV. CONCLUSION

The basic immunization processes that should be done before the age of 3 through National Immunization Program should be regarded importantly needed by the guardians of children under 3. By immunizing the children, they are protected from infectious diseases and they can grow as a healthy child.

The high perceptions and satisfaction rate of the guardians of children under the age of 3 should be reflected and thus the National Immunization Program should be expanded, fully subsidized. The number of institutes that carry on the immunization should be increased and the trusted medical care institutions should be induced to actively participate in the program, to deliver correct information on the national immunization program, so that the range of immunization can be expanded.

Through immunization, the infectious diseases within the administrative districts can be prevented and this can be used as reference to enhance the National Immunization program and to provide policies for immunization.

REFERENCES

- [1] Song M J, A Study on the Improvement Plans of Health and Medical Service, 2013, pp.22-23.
- [2] Min J A, Study on teachers' perception of vaccination against infectious disease for infants and young children, 2010, pp.18-19.
- [3] Choe Y G, Study on Optimal Immunization Rate through National Immunization Registry Data in Korea, 2006, pp.10-11.
- [4] Min J A, Study on teachers' perception of vaccination against infectious disease for infants and young children, 2010, pp.18-19.
- [5] Lee Y R, Factors associated with optimal infant vaccination, 2011, pp.10-11.
- [6] Wi H S, Long-term Effect of Vaccination on Human Capital Accumulation, 2013, pp.3-5.
- [7] Jeong J M, Vaccination Rate and Appropriateness of Vaccination in Children Jeonbuk Province, 2013, pp.3-5.
- [8] Lee Y R, Factors associated with optimal infant vaccination, 2011, pp.10-11.
- [9] Wee H S, The Effect of Child Immunization on Child Mortality and Educational Attainment, 2013, 19(1).
- [10] Wi H S, Long-term Effect of Vaccination on Human Capital Accumulation, 2013, pp.3-5.
- [11] Lee M S, Kim E Y, Kim K Y, Up-to-date or Complete Immunization Coverage and Their Related Factors, 2012, 37(4), pp.234-235.
- [12] Song M J, A Study on the Improvement Plans of Health and Medical Service, 2013, pp.22-23.
- [13] Min J N, An Empirical Study on Guardian's Satisfaction for National Immunization Program: Focused on Dong Gu, Gwangju Metropolitan Government, 2012, pp.15-16.



ISSN
0975-6299

Mediating Effect of Subjective Health Status In Relation between Stress and Health-Related Quality of Life

Kyoungcho Choi*, Professor, Department of Basic Medical Science, Jeonju University, Wansan-gu, Jeonju, Korea.

E-mail:ckh414@jj.ac.kr

Abstract---

Background/Objectives: This research is a statistical test to find mediating effect on subjective health status, subjected on adults age of 19 and above based on data of National Nutritional Health Survey in 2014. This research is to provide basic data that can improve understanding of health.

Methods/Statistical Analysis: Mediating regression was used to analyze effect of subjective health status in quality of life related to stresses. Typical methods to test mediating effect are Baron and Kenny method, Sobel test, etc. While Baron and Kenny method is mainly used for the regression analysis, this research tested mediating effect using Sobel test and 3-level test of Baron and Kenny.

Findings: By investigating effect of subjective health status on quality of life which has significant relationship with stresses, mediating effect of subjective health status showed statistical significance in both Sobel test and 3-level test of Baron and Kenny. Especially in 3-level test of Baron and Kenny, the 'Stress' which is an independent variable was statistically significant. This shows that subjective health status has mediating effect partially on quality of life.

Improvements/Applications: This research suggested necessity of mental-health care system and educational program that can manage BMI (Body Mass Index) to improve subjective health status and ultimately, quality of life.

Keywords--- Mediating Effect, Quality of Life, Stress, Subjective Health Status, Baron and Kenny Test.

* Corresponding Author

I. INTRODUCTION

Today, quality of life in the aspect of not only economic but also of health and medical is getting attention as individual stress due to instable labor market in the age of limitless competition is increasing. Especially along with aged society, people are more interested in physically, mentally and socially healthy life, not just a health and longevity itself. In this aspect, many researches related to health-related quality of life are getting off recently ¹. 'Health-related quality of life' is a narrower concept than 'Quality of life', which is a comprehensive concept including every aspect related to human welfare, but it covers broader aspect than concept of just 'health'². Moreover health-related quality of life is individual index, as it is an individual perception about one's social function, role, development, physical function and mental status, etc. ³. One reason that threatens one's quality of life is stress ⁴, which can cause mental problem by negative emotion such as anger, anxiety and depression. Accordingly, stress has negative effect on individual physical and mental health ⁵. Meanwhile subjective health status is claimed to be more reliable than objective status because it is a 'subjective assessment' about physical, psychosocial status done by oneself⁶.

Along with development of science and medical treatment technology, dream of life extension is no more difficult task. However, quality of life does not match increased quantity of life, problems related to quality of life is coming to the fore in many study areas ⁷. Many researches were conducted so far; reference ^{8,3} studied on quality of life related to stress perception and depression, reference ¹ studied on impact of accessibility of medical service and income level have on quality of life, reference ⁴ conducted research applying community-based survey in Jeonlabuk-do. Meanwhile through research of reference ⁹, dealing with the impact of stress and subjectively perceived health level of mentally disabled people have on their life satisfaction, it shows that subjective health status has mediating effect in relationship between stress and medical quality of life. But to explain relation between stress and medical quality of life, only few researches done are subjecting on general people, considering subjective health status as a mediating effect. As so, this research is to statistically test mediating effects of subjective health status in relation between stress and quality of life, based on data of the 6th National Nutritional Health Survey done by Korea Centers for Disease Control and Prevention in 2014. This research will contribute as a basic data in improving quality of life, by figuring out how exactly subjective health status is acting on relationship between stress and the quality of life.

II. METHODOLOGY

A. Data Analysis

Data of National Nutritional Health Survey in 2014 were used for this research. National Nutritional Health Survey is a designated statistics based on article 17 of the Statistics Act, which is a legal survey about health behavior, present condition of chronic diseases and food and nutrition taking condition of the national people. It is a sample survey conducted under the implement of article 16 of National Health Promotion Act, subjected on people aged over 1, living in Republic of Korea. This research subjected on 4,866 respondents aged over 19, without missing value. Meanwhile, data of National Nutritional Health Survey are widely used in researches about factors and correlation related to quality of life ¹⁰.

B. Measurement of Variables

a. General Characteristics

Measurement was done by classification of male and female, married and unmarried. Age was counted in full, educational level was reclassified as under middle-school graduates, high school graduates, more than college graduates. Besides, monthly average family income, PHQ-9 index which indicates mental health, BMI and others were selected as characteristic variable to utilize as control variable.

b. Dependent Variable (EQ-5D index)

In this research, EQ-5D index developed by Euro Qol Group was utilized as an index of medical health status, the dependent variable. According to reference ¹¹, EQ-5D is a measurement already widely recognized to be practical, reliable and valid in many studies; reliability, validity and reactivity were established subjected on Korean people. To calculate EQ-5D index, National Nutritional Health Survey instructs respondents to choose one best describes one's health status from 3 scales (1: fine, 2: have little problem, 3: have serious problem), in 5 areas; exercise capacity, self-management, daily life, pain/discomfort, anxiety/depression.

c. Independent Variable

Stress is individually decided by oneself with personal perception and evaluation in certain situation. Accordingly, this research focused only on subjectively perceived stress, not like in reference ⁵ which focused on objective quantity aspect of stress. As so, from questions of National Nutritional Health Survey, value of a question 'How much stress do you feel in daily life?' was set as independent variable. This question is a 4 scale question, composed of '1-very much, 2-pretty much, 3-little bit, 4-very little'.

d. Mediator Variable

To test statistically whether subjective health status acts as mediator variable, responses of question 'What do you think your health status is usually?' were used to know subjective health status. This question is a 5 scale question, composed of '1-very good, 2-good, 3-so so, 4-bad, 5-very bad.'

e. Control Variable

Generally, as gender, age, marital status, educational level, monthly average family income are demographic variables affecting quality of life, this research tested effectiveness of mediator variable using those as control variables. Control variables were necessary because uncontrolled third variable might induce distorted results in mediating effect model test by affecting mediator and dependent variable.

C. Analysis

To analyze effect of subjective health status in relation between stress and health related quality of life, this research used mediating regression. Baron and Kenny test and Sobel test is representative method in testing mediating effect ⁹. Though Baron and Kenny test is mainly used in regression analysis, this research will test mediating effect using Sobel test and 3-level test of Baron and Kenny.

III. ANALYSIS RESULT

A. Demographic Characteristics

As shown in Table 1, from 4,866 targets, 2,022 (41.6%) were male and 2,844 (58.4%) were female, in average age of 50.85. Most of them, 84.6% had an experience of marriage and monthly average family income was 3,724,900 Korean won. Average index of PHQ-9 was 2.85 (the lower, the healthier mentally) and average BMI was 23.66.

Table 1: Characteristic of Socio-demographic Status (n=4,866)

Variables	n	%
gender		
male	2,022	41.6
female	2,844	58.4
marriage		
married	4,119	84.6
un-married	747	15.4
education		
middle school	1,549	31.8
high school	1,326	27.3
college	1,991	40.9
age	mean=50.85(±16.85)	min=19 max=95
house income	mean=372.49(±416.55)	min=0 max=8,401
PHQ9-score	mean=2.85(±3.89)	min=0 max=27
BMI	mean=23.66(±3.42)	min=15 max=44

B. Descriptive Statistics of Independent, Mediator and Dependent Variables

As shown in Table 2, average of stress measured with 4-scale was 2.91, average of subjective health status measured with 5-scale was 2.88 and average of quality of life which is a dependent variable was 5.69. Here, quality of life has value from 5 to 15, lower value means less problem.

Table 2: Descriptive Statistic of Independent, Mediator, Dependent Variable

Variables	Mean	SD
stress	2.91	0.739
subjectivity health status	2.88	0.859
quality of life	5.69	1.342

Meanwhile, correlation coefficient of independent, mediator and dependent variable is as shown in Table 3. While all 3 variables are statistically significant (*:p<0.05, **:p<0.01), stress has negative correlation with subjective health status and quality of life. Subjective health status and quality of life showed positive correlation.

Table 3: Correlation Coefficient

Variables	Stress	Subjectivity health status	Quality of life
stress	-	-.195*	-.166*
subjectivity health status	-.195*	-	.402**
quality of life	-.166*	.402**	-

C. Test of Mediating Effect of Subjective Health Status

Mediation regression analysis, which tests mediating effect of subjective health status can be conducted through following 3 steps. In 1ststep, check whether independent variable, stress, gives significant effect on subjective health status, the mediator variable. In 2ndstep, test if independent variable has significant effect on quality of life, the dependent variable. Lastly in 3rd step, test whether independent variable and mediator variable have significant effect on dependent variable in the same time. Here, when significance of independent variable on dependent variable at level 1 decreases statistically significantly at level 3, it is called partial mediation. On the other hand, when the impact is completely disappeared and not statistically significant, it is called complete mediation. To prevent distortion from uncontrolled 3rd variable in the process of mediation regression analysis, analysis was conducted after controlling demographic variables affecting quality of life, such as gender, age, marital status, educational level and monthly average family income.

As a result, shown in Table 4 and Figure 1, it was statistically significant in every stage of 3-step test of Baron and Kenny. Especially in level 3, the independent variable, stress, showed statistical significance, it proves that subjective health status has partial mediating effect.

Table 4: Mediating Effect of Subjective Health Status on the Relationship Between Stress and Quality of Life (**:p<0.01)

	step 1	step 2	step 3
	subjective health status	quality of life	quality of life
constant	3.539	-6.573	4.451
stress	-.277**	-.302**	-.166**
subjective health status			.600**
F	192.029**	138.227**	496.158**

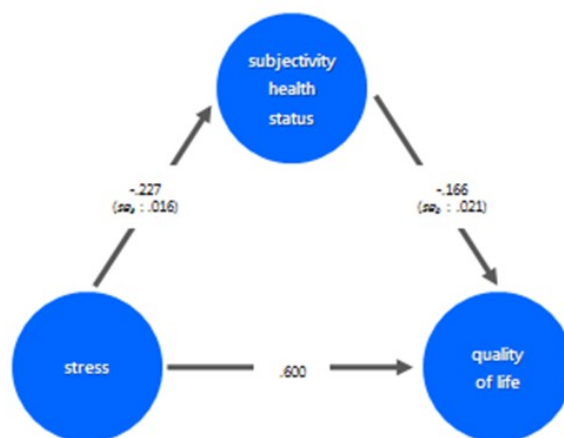


Figure 1: Result of Mediating Effect Test

In sequence as 3-level test of Baron and Kenny has relatively lower test power, additional test was deducted to see mediating effect, using Sobel test. Verification statistics for Sobel test is as formula (1).

$$Z = \frac{a \times b}{\sqrt{a^2 \times se_b^2 + b^2 \times se_a^2}}$$

$$= \frac{(-0.227) \times (-0.166)}{\sqrt{(-0.227)^2 \times (0.021)^2 + (-0.166)^2 \times (0.016)^2}} \quad (1)$$

$$= 13.531$$

As verification statistics value 13.531 is bigger than the critical value 1.96, it shows that subjective health status has mediating effect same as 3-level test of Baron and Kenny.

IV. CONCLUSION

Stress is a comprehensive pressure including all physical and mental experience, naturally come along with body reaction to keep homeostasis from external stimulation. Recently, many studies show high relation of stress and health related quality of life, moreover stress even reduces health related quality of life. Accordingly, many researches are conducted to figure out relation between stress and health related quality of life. However, only few researches done are subjecting on general people, considering subjective health status as a mediating effect. Therefore, this research statistically tested mediating effect of subjective health status in relation between stress and health-related quality of life, subjected on 4,866 adults in age of 19 and above based on data of National Nutritional Health Survey in 2014. As a result, independent variable, mediator variable and dependent variable all showed statistical significance; stress had negative relation with both subjective health status and quality of life, subjective health status and quality of life showed positive relation. Moreover, in 3-level test of Baron and Kenny and Sobel test to test mediating effect of subjective health status, result was statistically significant. Especially in level 3, the independent variable, stress, showed statistical significance; it proves that subjective health status has partial mediating effect. Meanwhile analyzing characteristic variable that are statistically significant with subjective health status, the mediator variable, to induce basic information to improve quality of life, correlation coefficient with PHQ-9 which is a mental health index was the highest, as 0.357 ($p < 0.001$). Furthermore, even correlation coefficient was not that high, BMI also showed statistical significance. From this, mental-health care system and educational program that can manage BMI are considered to be essential to improve subjective health status and ultimately, quality of life. Finally, as this research analyzed how subjective health status acts as in relation between stress and quality of life, it will contribute in providing basic data to improve quality of life.

REFERENCES

- [1] Park H, Park S, The relation between income level and health-related quality of life in Korea, *Health and Social Science*, 2012, 31, pp.107-125.
<http://www.dbpia.co.kr/Journal/ArticleDetail/NODE01905704>
- [2] Lee E H, Tahk S J, Shin J H, Lee Y W, Song R, Development and a psychometric evaluation of cardiovascular disease-specific quality of life reported in Korea, *Journal of Korean Academy of Nursing*, 2007, 37(3), pp.313-323. <http://www.dbpia.co.kr/Journal/ArticleDetail/NODE02031554>
- [3] Choi M N, Lee E H, Relationships of depression symptom, self-esteem, and stress to health-related quality of life in patients with hypertension registered to a community health center, *Journal of Korean Public Health Nursing*, 2015, 29(2), pp.165-176.
<http://www.dbpia.co.kr/Journal/ArticleDetail/NODE06515208>
- [4] Suh K. H, Lee K S, Relationships between life stress and social comparison and subjective well-being of college students, *The Korean Journal of Health Psychology*, 2010, 15(2), pp.327-343.
<http://www.dbpia.co.kr/Journal/ArticleDetail/NODE06368873>
- [5] Lee J H, Mediating effects of subjective health rates on the relationship between stress and life satisfaction of the persons with mental illness, *The Korean Journal of Health Education Promotion*, 2015, 32(1), pp.23-32.
<http://www.dbpia.co.kr/Journal/ArticleDetail/NODE06237321>
- [6] Lee Y. J, Shin H R, Lee M A, Influence of self-perceived health on life satisfaction of retirees: Focused on the moderating effects of economic preparation for aging, *Studies in Social Science*, 2013, 24(3), pp.35-59. <http://www.dbpia.co.kr/Journal/ArticleDetail/NODE02217569>
- [7] Park M N, Choi S Y, The effects of infertility stress depression on quality of life in infertile couples, *Journal of the Korean Data Analysis Society*, 2012, 14(4), pp.1987-2000.
<https://www.kci.go.kr/kciportal/ci/sereArticleSearch/ciSereArtiView.kci?sereArticleSearchBean.artId=ART001688319>
- [8] Bae S S, The influence on health-related quality of life in diabetes mellitus patients over 50 years old

- by stress recognition, depression, and suicidal thinking, The Korean Journal of Health Service Management, 2015, 9(2), pp.57-68. <http://www.earticle.net/Article.aspx?sn=248032>
- [9] Lee I H, Easy flow regression analysis, Hannarae Publishing Co., Seoul, 2015, pp.281-316.
- [10] Park S Y, Yun D H, Associations between physical activity and health-related quality of life in Korean adults: KNHANES V-2, The Korean Journal of Physical Education, 2014, 53(2), pp.201-214. <http://www.dbpia.co.kr/Journal/ArticleDetail/NODE07039194>
- [11] Lee E H, Kim C J, Cho S Y, Chae H J, Lee S, Kim E J, Monitoring the use of health-related quality of life measurement in Korean studies of patients with diabetes, Journal of Korean Academy of Nursing, 2011, 41(4), 558-567. <http://www.dbpia.co.kr/Journal/ArticleDetail/NODE02021808>



ISSN
0975-6299

The Effect of Reducing Exposure Dose in Neurocranium Angiography CT Scan based on 3D Computer Image Processing

Chang-Gyu Kim*, Department of Radiological Science, Gimcheon University, Gimcheon City, Gyung- buk, Korea.

E-mail:radkcg@hanmail.net

Abstract---

Background/Objectives: Recently the generalization of CT has improved the accurateness of CT scan but the occurrence of over-radiation and the overlapping scan of thin cross sections caused by the generalization of 3D reconstruction are raising exposure dose of patients.

Methods/Statistical Analysis: This experiment added silicone polymer, which is made through Nano conversion of barium sulfate(BaSO_4) and bismuth oxide(Bi_2O_3) and has great mix ability, and also added tourmaline, which is well absorbed in X-ray images and has electrical property. Then shields of different thickness were made and shielding efficiency was tested. As for the measurement of exposure dose during neurocranium angiography, by placing 2 glass dosimeter elements each in entry point and exit point where there are crystalline lens and thyroid gland, the radiation sensitive parts, and exposure dose of each part was measured. In order to reduce error, MDCT scan was repeated 5 times. This study used bismuth shields and glass dosimeter, which are harmless to human body, light, and environment-friendly as they do not contain lead, and exposure dose and shielding efficiency were evaluated in neurocranium angiography CT scan.

Findings: In neurocranium angiography CT scan, entrance surface dose was 26.120 ± 0.03 mGy in the right crystalline lens, 27.432 ± 0.04 mGy in left crystalline lens, and 49.663 ± 0.16 mGy in thyroid gland. When 0.1mm bismuth shields were used, radiation dose after shielding was 14.79 ± 0.02 mGy in the right crystalline lens, shielding efficiency being 43%. Radiation dose in the left crystalline lens after shielding was 14.60 ± 0.03 mGy shielding efficiency being 46%. Radiation dose in the thyroid gland after shielding was 20.71 ± 0.03 mGy shielding efficiency being 58%. When 0.25mm bismuth shields were used, radiation dose after shielding was 8.10 ± 0.02 mGy in the right crystalline lens, shielding efficiency being 68%. Radiation dose in the left crystalline lens after shielding was 8.06 ± 0.04 mGy shielding efficiency being 70%. Radiation dose in the thyroid gland after shielding was 18.73 ± 0.04 mGy shielding efficiency being 62%. When 0.5mm bismuth shields were used, radiation dose after shielding was 6.36 ± 0.02 mGy in the right crystalline lens, shielding efficiency being 75%. Radiation dose in the left crystalline lens after shielding was 6.30 ± 0.02 mGy shielding efficiency being 77%. Radiation dose in the thyroid gland after shielding was 11.35 ± 0.02 mGy shielding efficiency being 77%. In the performance evaluation in crystalline lens and thyroid gland, 0.1mm bismuth shield showed 43-58% shielding efficiency, 0.25mm bismuth shield showed 62-70%, and 0.5mm bismuth shield showed 75-77% shielding efficiency.

Improvements/Applications: In the radiological medical test including CT, the use of bismuth shields is expected to expand and contribute to reducing exposure dose of radiation workers and the whole nation.

Keywords--- 3D-CT, Exposure Dose, Image Processing, Radiation Reduction, Shielding Material.

* Corresponding Author

I. INTRODUCTION

Since the development of computed tomography(CT) in 1972, with the development of computer and new image processing technology, test time has been reduced. As reliability and accurateness of test result improved, expectations about early diagnosis of disease rose and the number of tests using CT is increasing¹⁻³.

According to the report of Health Insurance Review & Assessment Service, the number of CT scans in Korea marked 2,833,000 cases in 2006, 3,439,000 cases in 2007, 4,112,000 cases in 2008, 4,785,000 cases in 2009, and 2,619,000 cases in early 2010, showing a rising trend every year. Compared to 2006, the number doubled in 2010^{2,3}.

According to the report of Ministry of Food and Drug Safety, the yearly radiation exposure dose per person in Korea increased from 0.93 mSv in 2007 to 1.4 mSv in 2011, about 51% increase in 5 years.

As of 2011, the radiography tests per person was 75% for general radiography and 2.8% for CT, and the ratio of exposure dose was 56% for CT and 32% for general radiography. The number of general radiography tests far exceeded CT but as for exposure dose, CT is reported to surpass general radiography tests⁴⁻⁸.

Recently, the generalization of the use of MDCT(Multi-Detecto Computed Tomography) reduced test time and improved the accurateness of CT scan thanks to its advantage of obtaining the reconstructed image using high-definition thin cross-section, but the occurrence of over-radiation and the overlapping scan of thin cross sections caused by the generalization of 3D reconstruction are raising exposure dose to patients.

The exposure dose absorbed by tissues due to CT scan is known to be the highest among the exposure doses known to diagnostic radiology(10~100mGy), and considering that CT scans tend to be repeated, this level of dose is known to approach or surpass the level that can directly cause cancer⁹⁻¹³.

Patients go through several types of CT scans so it is hard to conclude there is no possibility of cataract and thyroid cancer due to repeated exposure in eyes and thyroid gland. Scanning without protective gear in eyes and thyroid gland during CT scanning is against patient-centered medicine. So there should be ways to minimize low dose radiation exposure by scattered radiation using shields in eyes and thyroid gland.

Bismuth shields, which are made by mixing barium and tourmaline, are lighter than lead and environment-friendly, so they are expected to be used a lot as radiation shields to reduce the primary direct radiation and the secondary scattered radiation^{8,14}.

Glass dosimeter (Radiophotoluminescent Glass Rod Detector) has a wide measuring range of 10 μ Gy -10 Gy, small dose rate dependence, and very small image fading of fluorescence. Also, it excels in remeasurement and reproducibility and has the advantage that it can be reused after heat treatment¹⁵⁻²⁰.

So this study used bismuth shields, which are made by mixing barium and tourmaline, and measured exposure dose using glass dosimeter in neurocranium angiography 3D-MDCT, and tried to evaluate the clinical application of bismuth shields.

II. OBJECT AND METHOD OF STUDY

A. Material and Equipment

As for the CT scanner that was used for neurocranium angiography was SOMATOM Definition AS+ (Siemens, Germany) CT scanner, which can obtain 128 slides with a single turn. As for scanning conditions, the generally used conditions that are used for the neurocranium test of emergency patients were used and exposure dose was measured by distinguishing distance and direction[Figure 1]. To measure the exposure dose of the subjects, whole body human phantom(Model PBU-31, Kyoto Kagaku, Japan) that was made of materials equivalent human body was used. As for the parts to measure exposure dose and shielding performance, thyroid gland and crystalline lens, which have relatively big radiation tissue load coefficient, were chosen.



Figure 1: CT Scanner and a Phantom Equivalent to Human Body

B. Environment-friendly Bismuth Shields

Bismuth that was used as shields belong to group 15 of periodic table, the nitrogen group, and it does not frequently found in earth's crust. Bismuth is a chemical hydrator and its element symbol is Bi, its atomic number is Z=83, and atomic weight is 208.980.

Bismuth compound that does not contain lead is harmless to human body, economical, light, and highly valuable in cosmetics and medication.

It has multiple thin layers, when X-ray penetrates it, and serves as an effective shield for human body when low energy radiation is absorbed and radiation is used as in Compton scattering, photoelectron rotation angle sampling, and electron relaxation effect.

This experiment added silicone polymer, which is made through nano conversion of barium sulfate(BaSO_4) and bismuth oxide(Bi_2O_3) and has great mixability, and also added tourmaline, which is well absorbed in X-ray images and has electrical property. Then shields of different thickness were made and shielding efficiency was tested^{8, 14}.

C. Measurement of Radiation Dose of Glass Dosimeter

Glass dosimeter, Dose Ace(Model GD-352M and FGD-1000, Asahi Techno Glass Cooperation, Shizuoka, Japan), was used[Figure 2].



Figure 2: Glass Dosimeter

As for the calibration of glass dosimeter, ^{137}Cs standard source was used in Japanese Agency for Radiation Standards and calibration was conducted using glass element that was radiated with 6mGy.

Considering the characteristics of element, through Annealing process before radiation, it was heated at 400oCfor an hour and cooled, and background value was measured and 10-20 μGy was calculated. After conducting panorama scan, it was heated at 70oC for an hour for pre-heating and then cooled. The added amount of radiation in the element was measured 10 times through a reader, and mean and deviation standard were calculated. From the calculated number, the background figure was subtracted and exposure dose was deduced^{6, 8, 10}.

As for the measurement of exposure dose during neurocranium angiography, by placing 2 glass dosimeter elements each in entry point and exit point where there are crystalline lens and thyroid gland, the radiation sensitive parts, and exposure dose of each part was measured. In order to reduce error, MDCT scan was repeated 5 times[Figure 3].

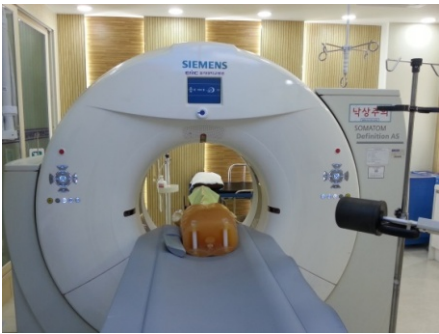


Figure 3: A Test of Exposure Dose Shielding During CT Scan

III. STUDY RESULTS AND CONSIDERATIONS

A. The Acquisition of Images and Measurement Result of Exposure Dose in Neurocranium Angiography CT Scan

Neurocranium angiography CT scan is increasing along with the lengthening lifespan of human and increasing income. For this reason, even if the use of radiation is justified, it is essential to manage the exposure dose of patients to be examined.

In the CT scan of neurocranium, the conditions that are actually used in clinical setting were used as conditions of scanning, and scanning length was set as 252 mm by using Topo program. Tube voltage was 100kVp and effective dose was 369mAs, and the detailed scanning conditions are shown in [Table 1].

Table 1: Neurocranium Angiography CT Scan Parameter

Parameter	128-MDCT
Technique	Topo program
kVp	100
mA	Auto
Time per rotation(sec)	6.83
mA _{Seff}	369
Slice thickness(mm)	0.75
Acquisition(mm)	128×0.6
CTDIvol(16cm)mGy	32.19
DLPmGy*cm	858.9
Scan length(mm)	252

Crystalline lens and thyroid gland are radiation sensitive body parts and the cells there can die easily or can get seriously damaged, so patients' radiation management is essential^{8, 21}.

As in neurocranium angiography CT scan, crystalline lens and thyroid gland are not shielded, entrance surface dose was measured in crystalline lens and thyroid gland.

In neurocranium angiography CT scan, entrance surface dose was 26.120±0.03 mGy in the right crystalline lens, 27.432±0.04 mGy in left crystalline lens, and 49.663±0.16 mGy in thyroid gland[Table 2].

Table 2: Exposure Dose in Neurocranium Angiography CT Scan

scan no.	Rt Lens(mGy)	Lt Lens(mGy)	Thyroid gland(mGy)
1	26.154 ±0.04	27.509 ±0.05	49.808 ±0.15
2	26.143 ±0.03	27.409 ±0.03	49.871 ±0.13
3	26.120 ±0.04	27.439 ±0.06	49.463 ±0.17
4	26.083 ±0.02	27.410 ±0.04	49.505 ±0.15
5	26.104 ±0.01	27.396 ±0.05	49.672 ±0.15
Average	26.120 ±0.03	27.432 ±0.04	49.663 ±0.16

The reason entrance surface dose was measured differently depending on measured area under the same conditions is thought to be due to over-exposure as radiation dose is automatically controlled through auto scan using Topo program and there is difference in thickness in head and shoulder²¹.

Neurocranium angiography CT scan is mainly used to diagnose and prevent cerebrovascular disorder and due to its accurateness and convenience in diagnosing diseases, there is increase in the use of two-dimensional images as well as the use of two-dimensional cross sectional image[Figure 4, 5]. Cerebrovascular disorder refers to various diseases that occur due to disorders in blood vessels in the brain and it is divided into bleeding disorder and ischemic disorder.

Cerebrovascular disorder is one of the 3 most common causes for death along with cardiovascular disorder and tumor. It occurs mainly among aged population and even though it can be cured through treatment, many cases end up with serious aftereffect so prevention is very important.



Figure 4: A 2D Image obtained through Neurocranium Angiography CT Scan

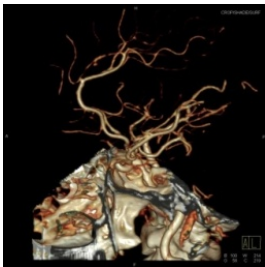


Figure 5: A 3D Image Obtained through Neurocranium Angiography CT Scan

B. The Result of Shielding Efficiency of Bismuth Shields in Neurocranium Angiography CT Scan

The melting point of bismuth shields is $T_m=271.3^{\circ}\text{C}$ and its boiling point is $T=1560(\pm 5)^{\circ}\text{C}$. Its density is $D=9.747\text{g/cm}^3$ in room temperature. It is heavy and fragile, and it is poor metal with white crystalline structure and pink tinge. Its diamagnetism is the strongest among metals, and its heat conduction quality is the second smallest after mercury.

Bismuth shields used in CT scan are radioparent materials and cause hindrance shading due to beam hardening effect. However, it absorbs radiation dose and reduces exposure dose. And for the purpose of reducing exposure dose, it has the advantage of being produced appropriately for organs^{22, 23}.

In order to produce light shields that are harmless to human body as they do not contain lead, this study had barium sulfate(BaSO_4) and bismuth oxide(Bi_2O_3) go through nano conversion, added silicone polymer, which has great mixability, and tourmaline, which increases binding force. Through this process, shields were produced with different thickness.

When 0.1mm bismuth shields were used, radiation dose after shielding was 14.79 ± 0.02 mGy in the right crystalline lens, shielding efficiency being 43%. Radiation dose in the left crystalline lens after shielding was 14.60 ± 0.03 mGy shielding efficiency being 46%. Radiation dose in the thyroid gland after shielding was 20.71 ± 0.03 mGy, shielding efficiency being 58%[Table 3].

Table 3: Shielding Efficiency Depending on the Thickness of 0.1mm Bismuth Shields

Body part	Entrance surface dose (mGy)	Radiation dose after shielding (mGy)	Shielding Rate(%)
Rt. Lens	26.12 ±0.03	14.79 ±0.02	43
Lt. Lens	27.43 ±0.04	14.60 ±0.03	46
Thyroid gland	49.66 ±0.16	20.71 ±0.03	58

When 0.25mm bismuth shields were used, radiation dose after shielding was 8.10 ± 0.02 mGy in the right crystalline lens, shielding efficiency being 68%. Radiation dose in the left crystalline lens after shielding was 8.06 ± 0.04 mGy shielding efficiency being 70%. Radiation dose in the thyroid gland after shielding was 18.73 ± 0.04 mGy, shielding efficiency being 62%[Table 4].

Table 4: Shielding Efficiency Depending on the Thickness of 0.25mm Bismuth Shields

Body part	Entrance surface dose (mGy)	Radiation dose after shielding (mGy)	Shielding Rate(%)
Rt. Lens	26.12 ±0.03	8.10 ±0.02	68
Lt. Lens	27.43 ±0.04	8.06 ±0.04	70
Thyroid gland	49.66 ±0.16	18.73 ±0.04	62

When 0.5mm bismuth shields were used, radiation dose after shielding was 6.36 ± 0.02 mGy in the right crystalline lens, shielding efficiency being 75%. Radiation dose in the left crystalline lens after shielding was 6.30 ± 0.02 mGy shielding efficiency being 77%. Radiation dose in the thyroid gland after shielding was 11.35 ± 0.02 mGy, shielding efficiency being 77%[Table 5].

Table 5: Shielding Efficiency Depending on the Thickness of 0.5mm Bismuth Shields

Body part	Entrance surface dose (mGy)	Radiation dose after shielding (mGy)	Shielding Rate(%)
Rt. Lens	26.12 ±0.03	6.36 ±0.02	75
Lt. Lens	27.43 ±0.04	6.30 ±0.02	77
Thyroid gland	49.66 ±0.16	11.35 ±0.02	77

The main ingredient used in radiation shields in medical environment is lead, which has the problem that it is harmful to human body and is heavy. For this reason, rare earth type oxide powder such as tungsten and bismuth, which are expensive materials, have been tried for replacing lead shields, but production cost is about 5 times higher so mass production and distribution of them is still hard⁸.

This experiment used the compound of barium, tourmaline silicone polymer that is 70% cheaper than imported products, produced radiation shields for crystalline lens and thyroid gland, and its usefulness was tested. The result showed that shielding efficiency was 43-58% with 0.1mm shield, 62-70% with 0.25mm shield, and 75-77% with 0.5mm shield. So it is considered that the shields can be used to reduce exposure dose in the future. The result corresponds with the findings of Kim⁸ and Gwan²¹.

In case of using low dose or radiation as in medical radiology, probabilistic effect is used and LNT(Linear Non Threshold) model is used as radiological protection. However, there is no threshold radiation dose that represents certain effect, which means there is no safe dose in using radiation, so it is very important to reduce radiation dose.

For this reason, by using radiation dose reduction shields made of bismuth, which are harmless to body and relatively light, in CT scan, it is expected to contribute to reducing the total exposure dose of the nation.

IV. CONCLUSION

This study used bismuth compound shields, which are harmless to human body as they do not contain lead and are light, and evaluated the entrance surface dose and shielding efficiency in neurocranium angiography 3D-MDCT.

In crystalline lens and thyroid gland, the efficiency of 0.1mm bismuth shield was 43-58%, 0.25mm shield being 62-70%, and 0.5mm shield being 75-77%.

In medical radiology tests including CT, the use of bismuth shields is effective in reducing exposure dose so it is expected to be used frequently. It is also expected to reduce the exposure dose of workers involved in radiology and patients and that of the whole nation.

ACKNOWLEDGMENT

This research was supported by Gimcheon University research grants in 2016.

REFERENCES

[1] C. G. Kim, Radiation dose reduction effectiveness of a male gonadal shield during 128-MDCT using Glass Detector, The Society of Digital Policy and Management. 11(7), 2013, pp. 237–242.

[2] C. G. Kim, The evaluation of the radiation dose and the image quality during MDCT using glass rod detector, The Korea Society of Digital Policy and Magement Journal, 10(2), 2012, pp. 249–254.

[3] Park Chan-Soo, Park Jong-Il, Kim Kwang-Gi, Cho Chang-No, AhnByung-Uk, Jae Hwan-Jun. "Select this result for bulk action A quantitative evaluation of abdominal aorta aneurysm by CT images", Technology and Health Care, Vol. 23, no. 1, 2015, pp. 37-45.

[4] C. G. Kim, The application of a water filter to reduce radiation during Bone Mineral Densitometry (BMD), Indian Journal of Science and Technology, 8(9), 2015, pp. 352–7.

[5] C. G. Kim, Spatial dose distribution and exposure dose during mammography, Indian Journal of Science and Technology, 8(8), 2015, pp. 133–8.

[6] Chang-Gyu Kim, "The Development of Bismuth Shielding to Protect the Thyroid Gland in Radiations Environment", Indian Journal of Science and Technology, Vol 9(25), 2016, pp.1-6.

[7] Joo Young-Cheol, Lim Chung-Hwan, Lee Chun-Yong, Jung Hong-Ryang, "A study on the correlation

- between patients'physical characteristics and effective dose of liver computed tomography", Technology and Health Care, vol. 22, no. 3, 2014, pp. 403-408.
- [8] S. H. Kim, Y. J. Kim, J. S. Kwak, "Development and Radiation Shield effects of Dose Reduction Fiber for Scatter ray in CT Exams", Journal of the Korea Academia-Industrial cooperation Society Vol. 14, No. 4,2013, pp. 1871-1876.
- [9] PyongKon Cho, BoKyungSeo, TaeKyu Choi, JangSeob Kim, YouHyun Kim, JongHak Choi et al,. The development of a diagnostic reference level on patient dose for CT examination in Korea, Radiation Protection Dosimetry, (Vol.)129, No. 4, 2008,pp.463-468.
- [10] PyongKon Cho, Patient Radiation Exposure Dose in Computed Tomography, J. Korean Soc. Radiol., Vol. 9, No. 2, 2015, pp. 109-115.
- [11] Yoo S, Han M, Lee S, Jeon M, Lee H, Seo S, Yang I, The analysis of exposure dose related factors in abdominal CT of general hospitals in Daejeon Area. Indian Journal of Science and Technology, 8(1), 2015, pp. 492-6.
- [12] L. T. Lawrence, A. C. Kevin, E. E. Yusuf, N. R. Lawrence., Radiation dose reduction at a price: the effectiveness of a male gonadal shield during helical CT scans, BMC Medical Imaging 7: 5, 2007.
- [13] M. C. Kim, "Doses of coronary study in 64-MDCT Reduced radiation dose according to varity of examination protocols", Radiological science, Vol 32(3), 2009.
- [14] S. C. Kim, M. H. Park, "Development of Radiation Shielding Sheet with Environmentally-Friendly Materials; II Evaluation of Barum, Tourmaline, Silicon Polymers in the Radiation Shielding Sheet", Journal of Radiological science, Vol. 34, No. 2, 2011.
- [15] Jae-Kwon Kim, Jong-Sik Lee, Dong-Kyun Park, Yong-Soo Lim, Young-Ho Lee, Eun-Young Jung, "Adaptive mining prediction model for content recommendation to coronary heart disease patients", Cluster Computing, Vol. 17, 2014, pp. 881-891.
- [16] Jeong-Eun Rah, Ju-Young Hong, Gwe-Ya Kim, Yon-Lae Kim, Dong-Oh Shin, Tae-Suk Suh, "A comparison of the dosimetric characteristics of a glass rod dosimeter and a themoluminescent dosimeter for mailed dosimeter, Radiation Measurements, Vol. 44, 2009, pp18.
- [17] C. G. Kim, Exposure dose reduction using Pb banding of own manufacturing. The Society of Digital Policy and Management. 11(6), 2013, pp. 269-73.
- [18] C. G. Kim, Measurement dose of dental panoramagraphy using a radiophoto-luminescent glass rod detector, The Korea Academia Industrial Cooperation Journal, 12(6), 2011, pp. 2624-8.
- [19] Jung M, Kweon D, Kwon S, Effectiveness of bismuth shield to reduce eye lens radiation dose using the photoluminescence dosimetry in computed tomography, RadiotechnologicalScience, 32(3), 2009, pp. 307-12.
- [20] Chang-Gyu Kim, "Exposure dose reduction during lateral spine test with water filter", Technology and Health Care, vol. 24, 2016, pp.429-438.
- [21] Yeong-GonKwak, Chong-YealKim,Seong-PyoJeong, Research on Dose Reduction During Computed Tomography Scanning by CARE kV System and Bismuth, Journal of Korea Content's Association, Vol. 14, No. 8, 2014, pp. 233-242.
- [22] Sang-Sik Kang, Kyo-Tae Kim, Si-CheolNoh, Bong-Jae Jung, Ji-KoonPark, The Study on Design of Customized Radiation Protective Layer for Medical Radiation Dose Reduction, "J. Korean Soc. Radiol., Vol. 8, No. 6, 2014, pp. 333-338.
- [23] Hoon-Hee Park, Juyoung Lee, Ji-Hyeon Kim, Sik Nam-Kung, Kwang-YeulLyu, Tae Soo Lee, Evaluation of the Usefulness of Bismuth Shields in PET/CT Examination, Radiological science, Vol37(1), 2014, pp.49-56.



ISSN
0975-6299

A Study on the Food Hygiene Knowledge, Attitude, and Practice of Directors and Teachers in the Home Day Care Centers

Joo-eun Lee*, Dept. of Food and Nutrition, Seowon University, Cheongju, Chungbuk, 361-742, South Korea.

E-mail:joody88@hanmail.net

Abstract---

Background/Objectives: This study investigated the food hygiene knowledge, attitude, and practice of the home day care center directors and teachers to see a necessity of safety management about the foodservice for the children.

Methods/Statistical Analysis: It targeted at directors and teachers of the home day care centers in Cheongju area, conducting a survey to the directors and teachers who participated in the job training held by joint conference of Cheongju-si home day care centers. It got the frequency and percentage of each answer to the questions about general aspects, food hygiene knowledge, attitude, and practices of the directors and teachers in the home day care centers.

Findings: The result of investigating the food hygiene knowledge shows that the rate of correct answers was low in items such as the proper temperature of the refrigerator (35.6%) and the freezer (31.3%), and the proper storage temperature for the hot cooked food (9.8%) and the cold food (36.2%). The result of crossover analysis of the answers for the food hygiene knowledge about the hygiene education shows that the distribution of the correct answer percentage between a group that has had hygiene education and one that has not showed a significant difference ($P < 0.001$). As for the food hygiene attitude, the rate of the hygiene attitude was low in "prohibition of wearing accessories when dealing with cooked food (57.1%)" and "the possibility of excrement germ contamination of the used diapers (62.0%)" and there was a significant difference in the distribution between a group that has had hygiene education and one that has not ($P < 0.05$, $P < 0.01$, $P < 0.001$). As for the food hygiene practice, there was a significant distribution difference between a group that has had hygiene education and one that has not ($P < 0.001$).

Improvements/Applications: Hygiene education is needed for all the staff members of the home child care centers, and there also needs to be field education for safe management of meals for the children.

Keywords--- Home Day Care Center, Food Hygiene, Knowledge, Attitude, Practice.

* Corresponding Author

I. INTRODUCTION

With economic development and an increase in women's participation in society, the child care has become an issue on a national level in Korea, and the role and the importance of the child care policy of the government to support women's economic activities and resolve the problem of low birth rate is getting bigger¹. Day care centers make up the most of the nursery schools in our country, with the number of home day care centers 23,318, accounting for 53.3% of 43,742 day care centers overall in 2014².

The home day care center is a day care center run by individuals in the smallest scale at home or a place equivalent to homes, with 5-20 infants and children on a regular basis³. According to the food sanitation law in Korea, only a non-profit group that provides meals for more than 50 people on a regular basis is regarded as institutional foodservice establishments, and for the home day care centers that provide food service for less than 20 children, there is no obligation to report as institutional foodservice establishments to the authority concerned based on food sanitation law, nor to hire food service management experts like dietitians^{4,5}. Also, the problems of poor cooking facilities and negligence of hygiene management can easily occur in the kitchens of the small-scale home day care centers due to the financial and structural problems and lack of professional food knowledge^{3,5}.

Children who go to day care centers are at higher risk of contracting intestine infection or respiratory diseases^{6,7}. Children are also more likely to contract food poisoning as the immune system of the children has not grown enough as adults and it is hard for them to protect themselves from the danger of foods⁸. But as for the researches on the food and safety of the children at day care centers, there were cases of analyzing the microbial harm of the kitchens and preparation places and places of meal distribution⁹⁻¹², hand sanitation¹¹⁻¹⁵, and the research on the food safety practices targeting at the directors and staff members¹⁶, but the researches on the knowledge, attitude, and practices about food safety were not done enough. Therefore, this study investigates the knowledge, attitude, and practices about food safety targeting at the directors and teachers in home day care centers, aiming to raise the necessity of the management, education, and PR about the safety of the food service provided for the children.

II. METHODS

A. Research Subjects and Duration

This study targeted at directors and teachers of the home day care centers in Cheongju area, conducting a survey to the directors and teachers who participated in the job training held by joint conference of Cheongju-si home day care centers. The questionnaires were distributed at the entrance of the training center before the training started. The researcher explained the meaning of the study and the method of filling out the questionnaires directly to the directors and teachers before the training, and collected them after the training finished at the exit. Among 208 questionnaires collected, 163 were used for statistical analysis after excluding the ones with insufficient answers.

B. Survey Contents and Method

The questionnaire used for this study was made with reference to the previous researches on the knowledge, attitude, and practices of the food handlers about food safety¹⁷⁻²³. The questionnaire is composed of 4 parts, including general aspects and knowledge, attitude, and practices about food safety. The general items included gender, age, position, education, period of working, experience of hygiene education, and the role in the food service. The position was to recognize directors and teachers, and the role in the food service presented 4 cases, such as a case of taking care of cooking, a case of helping with cooking only when things are busy, a case of only distributing food, and a case of not participating in cooking nor distributing food.

The questions about food hygiene knowledge had 8 questions including heating and cooking of food, diaper hygiene, food poisoning and digestive disorder. We gave 3 options of answers to the participants, "correct," "not correct," and "don't know," and for the questions about the temperature of the refrigerator and freezer and the storage temperature of the hot and cold foods, we had them mark among the temperatures presented or mark "don't know." The questions about food hygiene attitude had 7 questions including washing hands, crossover contamination, sanitary attire, wearing accessories, and diaper hygiene, while presenting 3 options of answers "yes", "no", and "uncertain". The questions about food hygiene practices had 6 questions including washing hands, wearing accessories, separate use of cooking utensils, confirmation of

expiration date, and wearing hygiene gloves, while presenting options of answers “always”, “sometimes”, “never”.

C. Data Analysis

For the statistical analysis, this study used SPSS ver. 18.0 for windows (Statistical Package for Social Science, SPSS Inc, Chicago, IL, USA). Also, the study got the frequency and percentage of each answer to the questions about general aspects, food hygiene knowledge, attitude, and practices of the directors and teachers in the home day care centers. We conducted crossover analysis of the food hygiene knowledge, attitude, and practice items regarding hygiene education, and conducted logistic regressive analysis of the food hygiene knowledge, attitude, and practice items while putting age, education, and period of working as independent variables among the general aspects. Here, to make answers of the knowledge, attitude, and practices dichotomous variables ('safevs.unsafe'), the answers were categorized and recorded as for knowledge, “correct vs. not correct/don't know”, for attitude “yes vs. no/uncertain”, and for practices “alwaysvs. Sometimes/never.”

III. RESULTS

A. General Aspects of Research Subjects

The general aspects of the surveyed directors and teachers in the home day care centers are as shown in Table 1. The gender of 163 people surveyed were all females, and people in their 40s made up the most with 91 (55.8%), followed by people in 30s (26.4%). As for the position, there were 107 teachers (65.6%), outnumbering directors with 56 (34.4%). For education, junior college graduates (80 people, 49.1%) and 4 year university graduates (61 people, 37.4%) took up the majority. For period of working, 3-5 years and 5-10 years made up the most with 45 people (27.6%) and 39 people (23.9%) respectively. As for the experience of hygiene education, 116 people (71.2%) answered “Yes”. The role in the food service for the children, 90 people were in charge of distributing food (55.2%), 23 were in charge of cooking (14.1%), and 19 (11.7%) were helping with cooking only when in hectic times.

Table 1: General Characteristics of the Respondents

<N=163>					
Gender	Male	N(%)	Experience of food hygiene education	Yes	N(%)
	Female	163(100.0)		No	47(28.8)
Age(yrs)	20 ~ 29	6(3.7)	Period of working (yrs)	< 1	22(13.5)
	30 ~ 39	43(26.4)		1 ≤ ~ < 3	30(18.4)
	40 ~ 49	91(55.8)		3 ≤ ~ < 5	45(27.6)
	50 ~ 59	19(11.7)		5 ≤ ~ < 10	39(23.9)
	60 ~ 69	4(2.5)		10 ≤ ~ < 15	17(10.4)
Position	Director	56(34.4)	Role in the food service	≥ 15	10(6.1)
	Teacher	107(65.6)		Cooking	23(14.1)
Education level	High school	15(9.2)		Helping cook when busy	19(11.7)
	Junior college	80(49.1)		Distributing food	90(55.2)
	4 year university	61(37.4)		Doing nothing	31(19.0)
	Graduate school	7(4.3)			
Total		163(100.0)	Total		163(100.0)

B. The Food Hygiene Knowledge of the Directors and Teachers in the Home Day Care Centers

Table 2 shows the results of the crossover analysis of the food hygiene knowledge answers against hygiene education of the directors and the teachers in the home day care centers. 89% of the directors and teachers in the home day care centers answered “cooking food in advance can cause food poisoning,” and 84% answered “the diapers used for the children can generate poisoning bacteria”. But for the “proper temperature of the refrigerator,” only 35.6% answered correctly, and 31.3% answered correctly for the “proper temperature of the freezer.”

As for the “storage temperature of the cooked food,” 9.8% answered correctly for the “hot food” while 36.2% answered correctly for the “cold food”.

The result of conducting crossover analysis of the answers to the food hygiene knowledge regarding hygiene education, a group with hygiene education showed a significant difference with one with no hygiene education ($P<0.001$) in the distribution of the correct answers for the items “the possibility of causing food poisoning by the cooks with digestive disorders,” “the proper temperature of the refrigerator and the freezer,” and “the proper storage temperature of the cooked food”.

Table 2: Respondent's Food Hygiene Knowledge

Statement	Food hygiene education	Respondents N (%)			χ^2
		Correct	Not correct	Don't know	
K1. Food poisoning (stomachache, diarrhea, etc.) can occur when food for dinner is cooked in the morning in advance.	Yes	102(87.9)	14(12.1)	0(0.0)	0.431
	No	43(91.5)	4(8.5)	0(0.0)	
	Total	145(89.0)	18(11.0)	0(0.0)	
K2. Food poisoning can occur when we eat food cooked in the morning for dinner without boiling it properly (higher than 75°C).	Yes	106(91.1)	10(8.9)	0(0.0)	0.001
	No	43(91.5)	4(8.5)	0(0.0)	
	Total	149(91.4)	14(8.6)	0(0.0)	
K3. Food poisoning bacteria (colon bacillus, etc.) can inhabit the diapers used for the children.	Yes	98(84.5)	7(6.0)	11(9.5)	0.347
	No	39(83.0)	4(8.5)	4(8.5)	
	Total	137(84.0)	11(6.7)	15(9.2)	
K4. Food poisoning can occur when participating in the cooking when having stomachache or diarrhea.	Yes	106(91.4)	6(5.2)	4(3.4)	18.850***
	No	32(68.1)	3(6.4)	12(25.5)	
	Total	138(84.7)	9(5.5)	16(9.8)	
K5. The proper temperature of the refrigerator is ()°C. (ex. 1~5°C, 6~10°C, 11~15°C, 16~20°C)	Yes	50(43.1)	41(35.3)	25(21.6)	12.718***
	No	8(17.0)	30(63.8)	9(19.1)	
	Total	58(35.6)	71(43.6)	34(20.9)	
K6. The proper temperature of the freezer is ()°C. (ex. <-18°C, -15~-10°C, -10~-5°C, -5~-1°C)	Yes	48(41.4)	40(34.5)	28(24.1)	21.669***
	No	3(6.4)	32(68.1)	12(25.5)	
	Total	51(31.3)	72(44.2)	40(24.5)	
K7. The hot cooked food needs to be kept at ()°C before distribution. (ex. 21~30°C, 31~40°C, 41~50°C, 51~60°C, 61~70°C)	Yes	14(12.1)	58(50.0)	44(37.9)	11.399***
	No	2(4.3)	37(78.7)	8(17.0)	
	Total	16(9.8)	95(58.3)	52(31.9)	
K8. The cold cooked food needs to be kept at ()°C before distribution. (ex. <1°C, 1-5°C, 10°C, 15°C, 20°C)	Yes	54(46.6)	24(20.7)	38(32.8)	31.525***
	No	5(10.6)	33(70.2)	9(19.1)	
	Total	59(36.2)	57(35.0)	47(28.8)	

*** $P < 0.001$

C. The Food Hygiene Attitude of the Directors and Teachers in the Home Day Care Centers

The results of conducting the crossover analysis of the food hygiene attitude of the directors and teachers in the home day care centers against the hygiene education are as shown in Table 3. More than 90% of the participants showed sanitarily safe attitude about the items such as occupational responsibility (95.7%), washing hands (99.4%), separate storage of raw food and cooked food (90.8%). But about the items "prohibition of wearing accessories when handling cooked food" and "the possibility of excrement contamination of the used diapers", only 57.1% and 62.0% answered "Yes". The result of conducting crossover analysis of the food hygiene attitude against hygiene education shows that for all the items except "washing hands", there was a significant difference in the distribution between a group with hygiene education and one with no hygiene education ($P < 0.05$, $P < 0.01$, $P < 0.001$).

Table 3: Respondent's Food Hygiene Attitudes

Statement	Food hygiene education	Respondents N (%)			χ^2
		Yes	No	Uncertain	
A1. Safe management of food is an important part in my job responsibilities.	Yes	115(99.1)	0(0.0)	1(0.9)	15.709***
	No	41(87.2)	6(12.8)	0(0.0)	
	Total	156(95.7)	6(3.7)	1(0.6)	
A2. It is important to have food hygiene education for my job (nursery staff member).	Yes	95(81.9)	1(0.9)	20(17.2)	26.252***
	No	7(14.9)	0(0.0)	40(85.1)	
	Total	102(62.6)	1(0.6)	60(36.8)	
A3. We must wash our hands before handling food to reduce the risk of food contamination.	Yes	115(99.1)	1(0.9)	0(0.0)	0.408
	No	47(100.0)	0(0.0)	0(0.0)	
	Total	162(99.4)	1(0.6)	0(0.0)	
A4. Raw food and cooked food need to be kept separately..	Yes	111(95.7)	5(4.5)	0(0.0)	11.523**
	No	37(78.7)	10(21.3)	0(0.0)	
	Total	148(90.8)	15(9.2)	0(0.0)	
A5. The risk of food contamination can be reduced if we wear hygiene gloves, masks, caps, and aprons when handling the cooked food such as distribution.	Yes	106(91.4)	6(5.2)	4(3.4)	7.480*
	No	39(83.0)	1(2.1)	7(14.9)	
	Total	145(89.0)	7(4.3)	11(6.7)	
A6. Foods can be exposed to contamination if we wear accessories such as rings and watches when handling the cooked food such as distribution..	Yes	90(77.6)	2(1.7)	24(20.7)	24.483***
	No	3(6.4)	13(27.7)	31(66.0)	
	Total	93(57.1)	15(9.2)	55(33.7)	
A7. We need to wash our hands after changing the diapers to reduce the contamination caused by excrement bacteria.	Yes	99(85.3)	0(0.0)	17(14.7)	28.682***
	No	2(4.3)	8(17.0)	37(78.7)	
	Total	101(62.0)	8(4.9)	54(33.1)	

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

D. The Food Hygiene Practices of the Directors and Teachers in the Home Day Care Centers

Table 4 shows the results of the crossover analysis of the food hygiene practice against hygiene education of the directors and the teachers in the home day care centers. For the practice of "washing hands", more than 90 % of the participants answered "always", while there were less answers of "always" for the items "not wearing accessories when handling cooked food(34.4%)", "separate use of the cooking utensils for the raw food and cooked food (14.7%)", "confirmation of expiration date (46.6%)", and "wearing hygiene gloves when distributing food(34.4%)".

The result of crossover analysis of the food hygiene practices against hygiene education shows that there was a significant distribution difference between a group with hygiene education and one with no hygiene education in the items "prohibition of wearing accessories", "separate use of the cooking utensils for the raw food and cooked food", and "not wearing accessories when handling cooked food" ($P < 0.001$).

Table 4: Respondent's Food Hygiene Practices

Statement	Food hygiene education	Respondents N (%)			χ^2
		Always	Sometimes	Never	
P1. I absolutely wash my hands before cooking or distributing food.	Yes	111(95.7)	5(4.3)	0(0.0)	2.090
	No	47(100.0)	0(0.0)	0(0.0)	
	Total	158(96.9)	5(3.1)	0(0.0)	
P2. I absolutely wash my hands after going to the bathroom or changing diapers.	Yes	111(95.7)	5(4.3)	0(0.0)	1.131
	No	43(91.5)	4(8.5)	0(0.0)	
	Total	154(94.5)	9(5.5)	0(0.0)	
P3. I do not wear rings or watches when cooking or distributing.	Yes	54(46.6)	58(50.0)	4(3.4)	26.798***
	No	22(4.3)	41(87.2)	4(8.5)	
	Total	56(34.4)	99(60.7)	8(4.9)	
P4. I separately use the dishes and utensils (knives, cutting boards) that handle the raw foods and cooked foods.	Yes	21(18.1)	47(40.5)	48(41.4)	28.706***
	No	3(6.4)	3(6.4)	41(87.2)	
	Total	24(14.7)	50(30.7)	89(54.6)	
P6. I absolutely check the expiration date on the wraps of the processed food..	Yes	53(45.7)	63(54.3)	0(0.0)	0.001
	No	23(48.9)	24(51.1)	0(0.0)	
	Total	76(46.6)	87(53.4)	0(0.0)	
P8. I absolutely wear hygiene gloves when distributing food.	Yes	53(45.7)	63(54.3)	0(0.0)	27.055***
	No	3(6.4)	23(48.9)	21(44.7)	
	Total	56(34.4)	86(52.8)	21(12.9)	

*** $P < 0.001$

E. The Effects of the Demographic Characteristics of the Participants on the Food Hygiene Knowledge, Attitude, and Practices

To examine the effects of the demographic characteristics of the participants on the food hygiene knowledge, attitude, and practices, the study conducted logistic regressive analysis while putting the age, period of working, and education as dependent variables and food hygiene knowledge, attitude, and practices as dependent variables(safe/unsafe), presenting only the results with statistical significance in table 5. Age had a significant effect on the knowledge about food poisoning bacteria contamination of the used diapers and on the practice of washing hands after using diapers.

The younger the age, the more knowledge they had about the existence of the food poisoning bacteria on diapers. But younger people had lower practice rate of washing hands after using diapers. Higher education and longer period of working had a significant relationship with the temperature of the refrigerator: as the education level was higher and the period of working was longer, they knew the temperature of the refrigerator more correctly. The period of working had a significant effect on the food hygiene attitude of 3 items; as the period of working was longer, they thought that the hygiene education for the nursery staff members was important, and showed safe food hygiene attitude toward washing hands after using diapers and wearing accessories.

Table 5: Effect of Demographic Characteristics on Knowledge, Attitude, and Practice (Logistic Regression Analysis)

Independent variables	Wald	P value	Adjusted odds ratio	95% CI
Knowledge(safe/unsafe)				
K3				
Age ¹⁾	5.286	0.021	1.927	1.102-3.370
K4				
Duration of work ²⁾	7.941	0.005	0.601	0.421-0.856
K5				
Education level ³⁾	5.121	0.024	0.568	0.348-0.927
Duration of work	11.931	0.001	0.630	0.480-0.829
Attitude(safe/unsafe)				
A2				
Duration of work	22.071	0.000	0.499	0.374-0.667
A6				
Duration of work	18.409	0.000	0.557	0.426-0.727
A7				
Duration of work	17.012	0.000	0.565	0.431-0.741
Practice(safe/unsafe)				
P2				
Age	7.745	0.005	0.253	0.096-0.666
¹⁾ ① 20s ② 30s ③ 40s ④ 50s ⑤ 60s ²⁾ ① <1 ② 1≤~<3 ③ 3≤~<5 ④ 5≤~<10 ⑤ 10≤~<15 ⑥ ≥15(yrs) ³⁾ ① high school ② college ③ university ④ graduate school				

IV. DISCUSSION

This study tried to examine the necessity of the hygiene education and the safety management of the food service provided for the children by investigating the knowledge, attitude, and practices of food safety, targeting at the directors and teachers of the home day care centers in Cheongju area. The directors and teachers of the home day care centers in Cheongju area had a relatively safe knowledge level about food poisoning, but they lacked knowledge about “the proper temperature of the refrigerator(35.6%) and the freezer(31.3%)” and “the proper storage temperature of the hot cooked food (9.8%) and cold food(36.2%), which was in line with the result of the researches by Buccheri et al.¹⁷ and Tokuç et al.¹⁹. The fact that the food handlers are not well aware of the food storage temperature shows that management of temperature, which is one of the important management methods for preventing food poisoning, is not properly done, suggesting the necessity of education related to food hygiene^{17,19,22}.

The group with hygiene education in this study showed significantly high knowledge about “the possibility of causing food poisoning by the cooks with digestive disorders,” “the proper temperature of the refrigerator and freezer,” and “the proper temperature of the cooked food.” This is similar to the result of research by Cunha and other researchers²³ who investigated the effects of the hygiene education and claimed that hygiene education has a significant effect on the food hygiene knowledge and that education should happen at least once every six months to one year to keep it remembered. There were many cases of unsafe attitude in the items “prohibition of wearing accessories when handling cooked food” and “the possibility of excrement bacteria contamination of the used diapers”. According to Cosby et al.⁹ and Li et al.¹², the possibility of excrement bacteria contamination caused by the diapers in day care centers can be reduced dramatically when the hygiene management is thoroughly performed. Therefore, if the hygiene education and practices about intense hygiene management of used diapers and washing hands are done in the home day care centers, hygiene safety for the children will be improved.

For the food hygiene practices, the group with no hygiene education showed less cases of hygiene practices in the items “prohibition of wearing accessories”, “prevention of crossover contamination”, and “wearing hygiene gloves when distributing food”. According to Staskel and other researchers¹⁰, after examination of the micro-organism in day care centers, bacteria was detected in 41% of the samples, and most of the microorganisms detected could do damage to the children with low immunity. As crossover contamination of food poisoning bacteria that exist in raw foods can occur in the course of cooking and distributing, intense hygiene management and education are needed^{9,10,23}.

V. CONCLUSION

Targeting at the directors and teachers of the home day care centers in Cheongju area, this study tried to examine the necessity of the hygiene education and the safety management of the food service provided for the children by investigating the knowledge, attitude, and practices of food safety. The result of the study shows that the directors and teachers had a relatively safe knowledge level about food poisoning but they lacked knowledge about the proper temperature of the refrigerator and freezer, and the proper storage temperature of the hot cooked food and cold food. As for the food hygiene attitude, they showed unsafe attitude toward the prohibition of wearing accessories when distributing food and the possibility of excrement bacteria contamination of the used diapers. As for the food hygiene practices, washing hands was satisfactory but the sanitary practices of wearing accessories, prevention of crossover contamination, confirmation of expiration date, and wearing hygiene gloves when distributing food were not satisfactory. Especially the group with no hygiene education showed lower hygiene level than the group with hygiene education in many items from food hygiene knowledge, attitude, and practices. Therefore, hygiene education for all the staff members including directors, teachers, and cooks of the home day care centers is needed and along with this, the field education needs to be conducted for the safe food service management for children.

REFERENCES

- [1] Song HJ, Woo SJ, A Macro Analysis of the Effect of Child-care Policy on Fertility and Female Labor Force Participation in Korea, *The Journal of Korean Public Policy*, 2015, 17(1), pp. 3-36.
- [2] Statistics Korea. 2016. Child care statistics.
http://www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1583
- [3] Kwon, KS, Park JY, A Study of the Directors' discourse on the Home Based Child care Facilities management, *The journal of Korea Early Childhood Education*, 2012, 19(3), pp.1-27.
- [4] Korean Food Sanitation Law, Article 2, 51, 52
- [5] Kwak DK, Current sanitation management practices of industrial foodservice operation for children and the improvement strategies. *Food Industry and Nutrition*, 2006, 11(1), pp. 41-54.
- [6] Lu N, Samuels ME, Shi L, Baker SL, Glover SH, Sanders JM. 2004. Child day care risks of common infectious diseases revisited. *Child Care Health Development*, 2004, 30(1), pp.361-368.
- [7] Akihara S, Phan TG, Nguyen TA, Hansman G, Okitsu S, Ushijima H, Existence of multiple outbreaks of viral gastroenteritis among infants in a day care center in Japan. *Archives of Virology*, 2005, 150(10), pp. 2061-2075.
- [8] Buzby JC, Children and microbial foodborne illness. *Food Review*, 2001, 24(2), pp. 32-37.
- [9] Cosby CM, Costello C, Morris W, Haughton B, Devereaux M, Harte F, et al. Microbiological analysis of food contact surfaces in child care centers. *Appl Environ Microbiol*, 2008,74(22), pp. 6918-6922.
- [10] Staskel DM, Briley ME, Field LH, Barth SS, Microbial evaluation of foodservicesurfaces in Texas child-care centers. *J Am Diet Assoc*, 2007,107(5), pp. 854-859.
- [11] Li Y, Jaykus LA, Cates S, Wohlgenant K, Chen X, Fraser AM, Hygienic conditions in child-carefacilities in North Carolina and South Carolina: an integrated microbial and observational study, *Am J InfectControl*, 2014, 42(7), pp. 781-786.
- [12] Li Y, Jaykus LA, Cates S, Wohlgenant K, Chen X, Fraser AM, Microbiological analysis of environmental samples collected from child care facilities in North and South Carolina. *American Journal of Infection Control*, 2014, 42(10), pp. 1049-1055.
- [13] Kotch JB, Isbell P, Weber DJ, Nguyen V, Savage E, Gunn E, et al. Hand-washing and diapering equipment reduces disease among children in out-of-home child care centers. *Pediatrics*, 2007, 120(1), pp. 29-36.
- [14] ZomerTP, Erasmus V, van BeeckEF, Tjon-A-TsienA, RichardusJH, VoetenHA, Hand hygiene compliance and environmental determinants in child day care centers: An observational study. *American Journal of Infection Control*, 2013, 41(6), pp. 497-502.
- [15] ZomerTP, Erasmus V, van EmpelenP, LoomanC, van BeeckEF,Tjon-A-Tsien A, Richardus JH, Voeten HA, Sociocognitive determinants of observed and self-reported compliance to hand hygiene guidelines in child day care centers. *American Journal of Infection Control*, 2013, 41(10), pp. 862-867.
- [16] Enke AA, Briley ME, Curtis SR, Greninger SA, Staskel DM, Quality managementprocedures influence the food safety practices at childcare centers. *Early Childhood Education Journal*, 2007, 35(1), pp. 75-

- 81.
- [17] Buccheri C, Mammina C, Giammanco S, Giammanco M, La Guardia M, Casuccio A, Knowledge, attitudes and self-reported practices of food service staff in nursing homes and long-term care facilities. *Food Control*, 2010, 21(10), pp. 1367–1373.
- [18] Abdul-Mutalib NA, Abdul-Rashid MF, Mustafa S, Amin-Nordin S, Hamat RA, Osman M, Knowledge, attitude and practices regarding food hygiene and sanitation of food handlers in Kuala Pilah, Malaysia. *Food Control*, 2012, 27(2), pp. 289-293.
- [19] Tokuç, B., Ekuklu, G., Berberoglu, U., Bilge, E., &Dedeler, H, Knowledge, attitudes and self-reported practices of food service staff regarding food hygiene in Edirne, Turkey. *Food Control*, 2009, 20(6), pp.565-568.
- [20] Parra PA, Kim HK, Shapiro MA, Gravani RB, Bradley SD, Home food safety knowledge, risk perception, and practices among Mexican-Americans. *Food Control*, 2014, 37(1), pp. 115-125.
- [21] Tan SL, Bakar FA, Karim MSA, Lee HY, Mahyudin NA, Hand hygiene knowledge, attitudes and practices among food handlers at primary schools in Hulu Langat district, Selangor(Malaysia), *Food Control*, 2013, 34(2), pp. 428-435.
- [22] Meysenburg R, Albrecht JA, Litchfield R, Ritter-Gooder PK, Food safety knowledge, practices and beliefs of primary food preparers in families with young children. A mixed methods study. *Appetite*, 2014, 73 (1), pp. 121–131.
- [23] Cunha DT, Stedefeldt E, Rosso VV, The role of theoretical food safety training on Brazilian food handlers' knowledge, attitude and practice. *Food Control*, 2014, 43(1), pp. 167-174.



ISSN
0975-6299

An Investigation of Self-Evaluated Performance on Foodservice Management among Directors and Teachers in Home Day Care Centers

Joo-eun Lee*, Dept. of Food and Nutrition, Seowon University, Cheongju, Chungbuk, South Korea.

E-mail:joody88@hanmail.net

Abstract---

Background/Objectives: This study examined food service management performance evaluated by directors and teachers themselves in home day care centers. And it aimed to compare averages depending on hygiene and nutrition education.

Methods/Statistical Analysis: This study targeted at directors and teachers of the home day care centers in Cheongju area, conducting a survey to the directors and teachers who participated in the job training held by joint conference of Cheongju-si home day care centers. The questionnaires were distributed at the entrance of the training center before the training started.

Findings: The analysis proved that directors and teachers showed significant differences in distribution on general characteristics ($P < 0.001$), that directors were more experienced in hygiene and nutrition educations, and that the former tended more to take charge of cooking and the latter tended more to take charge of distribute meals. There were significant differences in 'food service facilities and environment', 'food distribution', 'ingredients management', and 'individual hygiene' areas ($P < 0.05$, $P < 0.01$, $P < 0.001$), depending on positions and whether they received hygiene education or not. In nutrition management area, there were significant differences in average scores in four items depending on whether they received nutrition education or not ($P < 0.05$, $P < 0.01$, $P < 0.001$). And, there were significant differences in average scores in the 8 items in cooking, washing, and sterilization management ($P < 0.001$) depending on whether they received hygiene education or not.

Improvements/Applications: The hygiene and nutrition education has positive effects on foodservice management performance, and that it is especially necessary for teachers to receive hygiene and nutrition education related with guiding children to eat food properly and proper amounts per age.

Keywords--- Home Child Care Center, Food Service Management, Hygiene Education, Nutrition Education.

* Corresponding Author

I. INTRODUCTION

For double-income couples and working women who have children, it is very important to find places to care their children while they work. With the economic development and the increase of working women, child care is not only done in home, but also in facilities¹. After the Babies and Children Care Act was established in 1991, the number of day care centers has continuously increased. In 1995, the number of such centers was 9,085, which increased 4.8 times to 43,742 by 2014. The number of babies and children cared in such centers was 293,747 in 1995, which increased more than 5 times to 1,496,671 by 2014. Among day care centers, home day care centers take up the majority (53.3%)². Home day care center is small in size run by individual in his home or similar facility with 5 to 20 babies or children³. In particular, with high proportion of babies of 2 years old, the average age of babies and children in home day care centers is lower than comparatively big day care centers⁴.

As children with immature immune system are vulnerable to diseases, and are unable to discern and block risk factors when they ingest food, they are at risk to get food poisoning⁵. In particular, children at day care center are more at risk to get diarrheal illness and upper respiratory infection (URI) than home-care children⁶. And, there have been cases where microbes were detected in various places to provide food to day care centers, and most of them can cause danger to child health⁷. Pollutions of microbes in day care center facilities are mostly caused by unsanitary management of them, which is derived from lack of hygiene consciousness of directors and staff members of those centers. But such problems can be improved by preparing systematic food management standards and strengthening hygiene education^{8,9}.

This study, using directors and teachers of home day care centers as research objects, intends to examine hygiene education and nutrition education of them, and how they perform hygiene and nutrition management, and find out differences in performance depending on positions and whether they received hygiene and nutrition educations. The findings will serve as basic material to prepare for food management education and standards on food management for those directors and teachers of home day care center.

II. METHODS

A. Research Subjects and Duration

This study targeted at directors and teachers of the home day care centers in Cheongju area, conducting a survey to the directors and teachers who participated in the job training held by joint conference of Cheongju-si home day care centers. The questionnaires were distributed at the entrance of the training center before the training started. The researcher explained the meaning of the study and the method of filling out the questionnaires directly to the directors and teachers before the training, and collected them after the training finished at the exit. Among 208 questionnaires collected, 163 were used for statistical analysis after excluding the ones with insufficient answers.

B. Survey Contents and Method

The questionnaire for this research was made referring to the guidelines generated by the Center for Children's Foodservice Management¹⁰, which include 'Fact-finding Table on Children's Food Service Facilities', 'Checklist on Hygiene and Safety Management in Children's Food Service Facilities' and 'Checklist on Small-size Children's Food Service Facilities'. The questionnaire consists of two parts: general aspects and performance of food service management of day care center. Questions in general aspects include gender, age, position, education level, period of working, experience of hygiene and nutrition education, role in food service. Performance of food service management is composed of 7 areas ('foodservice facilities and environment'; 'personal hygiene'; 'cooking process management'; 'ingredients management'; 'food distribution management'; 'washing, disinfection management'; 'nutrition management') and 34 items. For general matters, nominal scale was applied, and for all the items in performance of food management, Likert 5-point scale (1 point: very poor to 5 points: very excellent) was used.

C. Data Analysis

Data were analyzed using SPSS ver. 18.0 for windows (Statistical Package for Social Science, SPSS Inc, Chicago, IL, USA). Frequencies and percentages were acquired for general matters for directors and teachers of home day care centers, and chi-square test was applied to find out the differences in distributions between

directors and teachers. After getting means and standard deviations on performance of food management, t-test was done per each area to know the differences in means.

III. RESULTS

A. General Aspects of Research Subjects

The general aspects for research subjects, directors and teachers, are shown in Table 1. All of them were females, and the proportion of those in their 40s(55.8%) was the largest among age groups. In schooling, the majority of directors(53.6%) were 4-year university graduates, and the majority of teachers (58.9%) were technical college graduates.

The largest proportion of them (27.6%) has duration of work of 3~5 years. 116 respondents (71.2%) said they had got hygiene education, and 96 (58.9%) said they had got nutrition education. 55.2% of respondents distribute food, and 14.1% take charge of cooking, and 11.7% participate in cooking only when they are needed.

In general matters, there were significant differences ($P<0.001$) in distribution between directors and teachers. In experiences of receiving hygiene education and nutrition education, proportions of directors who received such educations were higher than those of teachers. The former tended more to cook (39.3%), and teachers tended more to distribute food (69.2%).

Table 1: General Characteristics of the Respondents

<N=163>					
		Total (N=163)	Position		χ^2
			Director (N=56)	Teacher (N=107)	
Gender	Male	0(0.0)	0(0.0)	0(0.0)	-
	Female	163(100.0)	56(100.0)	107(100.0)	
Age(yrs)	20 ~ 29	6(3.7)	0(0.0)	5(5.6)	20.26***
	30 ~ 39	43(26.4)	5(8.9)	38(35.5)	
	40 ~ 49	91(55.8)	39(69.6)	52(48.6)	
	50 ~ 59	19(11.7)	9(16.1)	10(9.3)	
	60 ~ 69	4(2.5)	3(5.4)	1(0.9)	
Education level	High school	15(9.2)	3(5.4)	12(11.2)	21.60***
	College	80(49.1)	17(30.4)	63(58.9)	
	University	61(37.4)	30(53.6)	31(29.0)	
	Graduate school	7(4.3)	6(10.7)	1(0.9)	
Duration of work (yrs)	< 1	22(13.5)	0(0.0)	22(20.6)	34.61***
	1 ≤ ~ < 3	30(18.4)	4(7.1)	26(24.3)	
	3 ≤ ~ < 5	45(27.6)	18(32.1)	27(25.2)	
	5 ≤ ~ < 10	39(23.9)	15(26.8)	24(22.4)	
	10 ≤ ~ < 15	17(10.4)	13(23.2)	4(3.7)	
	≥ 15	10(6.1)	6(10.7)	4(3.7)	
Experience of food hygiene education	Yes	116(71.2)	56(100.0)	60(56.1)	34.57***
	No	47(28.8)	0(0.0)	47(43.9)	
Experience of nutrition education	Yes	96(58.9)	46(82.1)	50(46.7)	19.04***
	No	67(41.1)	10(17.9)	57(53.3)	
Work activity for lunch	Cooking	23(14.1)	22(39.3)	1(0.9)	49.61***
	Helping cook when busy	19(11.7)	6(10.7)	13(12.1)	
	Distributing food	90(55.2)	16(28.6)	74(69.2)	
	Doing nothing	31(19.0)	12(21.4)	19(17.8)	
Total		163(100.0)	56(100.0)	107(100.0)	

*** $P<0.001$

B. Mean Scores in Performance on Food Management in Day Care Centers

Mean and standard deviation per area in performance on food management among directors and teachers of day care centers are shown in Table 2.

The total mean score for all the 34 items was 3.34, and the means for each area was as follows: 3.55 on 'facilities and environment'; 3.34 on 'personal hygiene'; 3.35 on 'nutrition management'; 3.15 on 'cooking process management'; 3.54 on 'distribution management'; 3.44 on 'ingredients management'; 3.04 on 'washing, disinfection management'.

Table 2: Mean Scores of Food Service Hygiene Management in Child Care Centers

<N=163>			
<Facility and environment>	Mean±SD	<Personal hygiene>	Mean±SD
F1. Kitchen floor, walls, ceiling, and trash cans are cleaned periodically, and they are maintained cleanly	3.67±0.52	P1. Cook should get medical check-up once a year, and the record is kept.	3.69±0.61
F2. For comfortable atmosphere, mechanical ventilation facilities like hood, ventilator, and air cleaner are used	3.53±0.56	P2. Cooks should never fail to wear sanitary outfit (sanitary clothes, sanitary hat, and sanitary gloves)	3.10±0.81
F3. Insect nets are installed on windows, and they are maintained cleanly	3.18±0.51	P3. Personal accessories (earrings or rings) and manicure are prohibited	3.45±0.73
F4. Ultraviolet ray or electric disinfectant is installed in the kitchen, and used	3.61±0.66	P4. Before cooking and food distribution, and after using restroom, cook should never fail to wash her hands with soap.	3.87±0.65
F5. Drinking water is boiled, or, if water purifier is used, its filter should be changed and cleaned periodically.	3.58±0.61	P5. Before cooking, it should be checked whether any infectious disease or digestive organ disease, and, if anyone has, he should be excluded from cooking process.	2.89±0.82
F6. The temperature of refrigerator is set at 5°C or below, and that of freezer is set at -18°C or below	3.69±0.67	P6. Before cooking, it should be checked whether any cook has injury on hand, and, the injury should be wrapped with bandage and the cook should wear gloves.	3.02±0.81
Subtotal (Chronbach's α = 0.817)	3.55±0.43	Subtotal (Chronbach's α = 0.779)	3.34±0.51
<Nutrition management>		<Cooking process management> ¹⁾	
N1. We provide babies and children with meal and snacks matching the menu list composed by nutritionist	3.76±0.56	C1. Different knives and chopping boards should be used for vegetable, meat, and fish, or, if one use the same knife and chopping board, wash and disinfect them after using one ingredient	2.60±0.89
N2. We deliver the portion of food to each of babies and children according to the nutrition standards	3.06±0.70	C2. Ingredients should not be put on the kitchen floor, and food-making job done on the floor	3.12±0.83
N3. We provide substitute food to babies and children who have food allergy	3.51±0.62	C4. To thaw food, we put it in refrigerator, use microwave, or running cold water, and do not leave it in room temperature	2.79±0.61
N4. We display the monthly menu list, and open the list to parents of babies and children	3.87±0.55	C5. Boiling food should be done sufficiently until the temperature of the center of the food goes up to 74°C or above	3.79±0.61
N5. We provide fried meal twice or less a week	3.71±0.57	C6. Make sure that the cooked food is consumed within 2 hours	3.74±0.70
N6. We provide instant food twice or less a week	3.75±0.50	C7. There should be different dish-clothes, rubber gloves, and aprons for cooking and cleaning	2.86±0.90
N7. We cook food using standard recipe	1.78±0.72	Subtotal (Chronbach's α = 0.771)	3.15±0.51
Subtotal (Chronbach's α = 0.681)	3.35±0.36	<Ingredients management>	
<Distribution management>		I1. Food or ingredients not licensed, or unmarked should not be used	3.62±0.54
D1. When distributing food, sanitary gloves and apron should be worn	3.28±0.60	I2. Expiration date and the date ingredients entered should be checked	3.14±0.60
D2. Before and after distributing food, the desk or table should be wiped with dishcloth	3.62±0.63	I3. Food and non-food (detergent, disinfectant, etc.) should be stored separately	3.58±0.63
D3. Utensils (tongs and scoop, etc.) are used for distributing unwrapped food	3.63±0.59	Subtotal (Chronbach's α = 0.783)	3.44±0.49
D4. The food which remains after distributing never be reused	3.63±0.59	<Washing, disinfection management> ¹⁾	
Subtotal (Chronbach's α = 0.858)	3.54±0.51	Wd1. Utensils like dishes, chopping board, knife, and apron, etc should be washed and disinfected periodically	3.12±0.86
		Wd2. Cooking room and food storage room should be taken prevention measures against epidemics and disinfected periodically	2.95±0.85
		Subtotal (Chronbach's α = 0.845)	3.04±0.81

¹⁾ Only those who cook included. (N=42)

C. Comparison of Performance on Foodservice Management Depending on Positions and Whether they Received Hygiene Education

Using t-test, mean scores in performance levels on food management between directors and teachers of home day care centers on the following 4 areas were compared: 'foodservice facilities and environment', 'distribution management', 'ingredients management', 'personal hygiene', by t-test depending on positions and whether they received hygiene education or not (Table 3). In 'personal hygiene' area, there were no differences in mean scores depending on job positions or experiences of hygiene education in the item, 'Before starting cooking job, it should be checked whether any cook has any infectious disease or digestive organ disease', and there were no differences in mean scores depending on job positions in the item, 'if any cook has such a disease, she should be excluded from the cooking process', and there was no difference in means in 'before cooking, it should be checked whether any cook has injury on hand, and, the injury should be wrapped with bandage and the cook should wear gloves'. In all the other items in four areas, there were significant differences in means depending on positions and hygiene education ($P<0.05$, $P<0.01$, $P<0.001$).

Table 3: Comparison of Performance on Foodservice Management depending on Positions and Hygiene Education

	Position			Experience of food hygiene education		
	Director (N=56)	Teacher (N=107)	t-value	Yes (N=116)	No (N=47)	t-value
<Facility and environment>						
F1	3.93±0.26	3.54±0.57	5.927***	3.91±0.35	3.12±0.43	12.378***
F2	3.84±0.37	3.37±0.58	6.252***	3.76±0.47	2.98±0.33	12.041***
F3	3.32±0.51	3.11±0.50	2.508*	3.31±0.48	2.87±0.45	5.526***
F4	3.75±0.58	3.54±0.69	2.033*	3.88±0.44	2.96±0.66	8.836***
F5	3.89±0.31	3.41±0.66	6.331***	3.80±0.44	3.02±0.61	9.122***
F6	4.00±0.48	3.53±0.70	5.058***	3.98±0.49	2.99±0.49	11.807***
Subtotal	3.79±0.27	3.42±0.46	7.137***	3.77±0.21	2.99±0.29	16.746***
<Distributionmanagement>						
D1	3.48±0.50	3.18±0.63	3.142**	3.48±0.52	2.79±0.51	7.869***
D2	3.96±0.27	3.44±0.69	6.945***	3.94±0.27	2.83±0.56	12.890***
D3	3.91±0.35	3.48±0.63	5.655***	3.92±0.30	2.89±0.48	13.731***
D4	3.86±0.40	3.51±0.69	4.111***	3.90±0.38	2.96±0.62	9.614***
Subtotal	3.80±0.27	3.40±0.56	6.255***	3.81±0.25	2.87±0.36	16.574***
<Ingredientsmanagement>						
I1	3.91±0.29	3.47±0.57	6.587***	3.89±0.32	2.96±0.36	16.342***
I2	3.50±0.50	2.94±0.56	6.415***	3.34±0.51	2.64±0.53	7.834***
I3	3.89±0.41	3.41±0.66	5.722***	3.83±0.50	2.96±0.46	10.295***
Subtotal	3.77±0.30	3.27±0.49	7.922***	3.68±0.33	2.85±0.27	15.210***
<Personal hygiene>						
P1	4.04±0.42	3.51±0.62	6.320***	3.98±0.40	2.98±0.44	14.194***
P2	3.38±0.89	2.95±0.73	3.246**	3.27±0.82	2.68±0.63	4.417***
P3	3.71±0.71	3.32±0.71	3.397**	3.68±0.71	2.89±0.43	8.693***
P4	4.13±0.38	3.73±0.72	4.573***	4.16±0.44	3.13±0.49	13.212***
P5	2.91±0.88	2.88±0.80	0.236	2.94±0.88	2.77±0.70	1.221
P6	3.04±0.85	3.01±0.79	0.196	3.13±0.84	2.74±0.67	2.795**
Subtotal	3.53±0.46	3.23±0.51	3.666***	3.53±0.45	2.87±0.30	10.872***

* $P<0.05$, ** $P<0.01$, *** $P<0.001$

D. Comparison of Performance on Foodservice Management Depending on Positions and Whether they Received Nutrition Education

Comparison of mean scores in performance levels on food management between directors and teachers of home day care centers is in Table 4. There were significant differences in mean scores between directors and teachers in the following two items in 'nutrition management' area: 'we provide babies and children with meal and snacks matching the menu list composed by nutritionist' and 'we provide fried meal twice or less a week' ($P<0.01$, $P<0.001$), and there were significant differences in mean scores depending on whether they received nutrition education or not in the above two items and following two items (in 4 items): 'Deliver the

portion of food to each of infants and children according to the nutrition standards'; 'Provide substitute food to babies and children who have food allergy' ($P<0.05$, $P<0.01$, $P<0.001$).

Table 4: Comparison of Performance on Food Management depending on Positions and Nutrition Education

	Position			Experience of nutrition education		
	Director (N=56)	Teacher (N=107)	t-value	Yes (N=96)	No (N=67)	t-value
<Nutrition management>						
N1	4.02±1.34	3.63±0.65	5.980***	3.94±0.38	3.51±0.68	4.679***
N2	3.09±0.77	3.04±0.67	0.445	3.16±0.70	2.91±0.69	2.217*
N3	3.59±0.26	3.47±0.63	1.190	3.65±0.56	3.31±0.66	3.468**
N4	3.95±0.44	3.83±0.59	1.393	3.93±0.44	3.79±0.66	1.467
N5	3.86±0.35	3.64±0.65	2.820**	3.80±0.43	3.58±0.72	2.240*
N6	3.79±0.41	3.73±0.54	0.714	3.78±0.46	3.70±0.55	1.016
N7	1.80±0.82	1.77±0.67	0.312	1.81±0.77	1.73±0.64	0.707
Subtotal	3.44±0.21	3.39±0.40	2.941**	3.44±0.27	3.22±0.42	3.728***

* $P<0.05$, ** $P<0.01$, *** $P<0.001$

E. Comparison of Cooking, Washing, and Disinfection Management Depending on Cooking History and Whether they Received Hygiene Education

Comparison of means on cooking, washing, and disinfection management depending on cooking history and whether they received hygiene education between directors and teachers in home day care centers is shown in Table 5. In 'cooking process' area, there were significant differences in means between those who received hygiene education and those who did not in all the items ($P<0.001$) except for the following two items: 'Different knives and chopping boards should be used for vegetable, meat, and fish, or, if one use the same knife and chopping board, wash and disinfect them after using one ingredient'; 'To thaw food, we put it in refrigerator, use microwave, or running cold water, and do not leave it in room temperature'

Table 5: Comparison of Cooking, Washing, and Disinfection Management Depending on Cooking History and Hygiene Education

	Work activity for meal			Experience of food hygiene education		
	Cooking (N=23)	Helping cook when busy (N=19)	t-value	Yes (N=116)	No (N=47)	t-value
< Cooking process management>						
C1	2.83±1.03	2.42±0.69	1.462	2.72±0.90	2.64±0.64	0.685
C2	3.43±0.90	2.84±0.60	2.551*	3.28±0.99	2.66±0.56	5.061***
C3	3.13±0.34	2.37±0.60	4.926***	2.84±0.71	2.66±0.56	1.523
C4	4.00±0.30	3.58±0.84	2.082*	3.94±0.44	3.00±0.51	11.726***
C5	4.09±0.29	3.26±0.96	4.239***	3.97±0.38	2.83±0.56	12.763***
C6	3.13±0.92	2.63±0.96	1.720	3.05±0.94	2.55±0.58	4.092***
Subtotal	3.44±0.44	2.85±0.48	3.608**	3.30±0.48	2.72±0.32	7.393***
< Washing, disinfection management>						
Wd1	3.26±0.69	2.95±1.03	1.180	3.28±0.71	2.51±0.59	6.630***
Wd2	3.22±0.74	2.63±0.90	2.329*	3.07±0.68	2.30±0.46	7.113***
Subtotal	3.24±0.64	2.79±0.93	1.850	3.18±0.64	2.40±0.46	7.545***

* $P<0.05$, ** $P<0.01$, *** $P<0.001$

IV. DISCUSSION

This study, using directors and teachers of home day care centers in Cheongju area as research objects, intended to examine self-evaluated performance in foodservice management of them, compare means depending on positions and their experiences of hygiene and nutrition education, and raise the necessity of hygiene and nutrition education depending on positions. All the 34 items were divided into 7 areas, and performance levels on foodservice management were suggested. The mean value in 'washing, disinfection management' was the lowest, followed by that in 'cooking process' area. In the study of Lee et al¹¹ who examined foodservice performance among directors of kindergartens, the mean value in work process area including

washing, disinfection, and cooking was the lowest, and they ascribed it to lack of special knowledge and experiences in cooking and disinfection among them. Such a problem can be improved by supporting tools for practice and providing periodic repair education as well as education on food hygiene and safety¹²⁻¹⁴.

This analysis revealed that teachers had less experiences in hygiene and nutrition educations compared with directors. And, mean performance value in each item of teachers was significantly lower than that of directors. Teachers not only teach babies and children, but mainly take charge of distributing food at meal time. As they need special nutrition knowledge on proper portion of food per age and teaching on how to eat, it is necessary to provide those teachers with nutrition education and hygiene education needed for delivering food^{15,16}.

And, it was found that the performance values on the following items were lower than the average: 'Different knives and chopping boards should be used for vegetable, meat, and fish, or, if one use the same knife and chopping board, wash and disinfect them after using one ingredient'; 'There should be different dish-clothes, rubber gloves, and aprons for cooking and cleaning'. While it is important to learn cross contamination from hygiene education, it is necessary to provide various means of education and publicity to embody concrete practice for prevention of diseases^{17,18}.

In the 'personal hygiene' area, the performance levels of the following item were low: 'prohibition of cooks who have digestive diseases', and 'periodic preventive measures against diseases and disinfection'. Because of hardship of financial and human resources in home day care centers, it may be difficult to pay attention to personal diseases and sanitary management of cooking room and its facilities^{3,4}. But, considering that fact that those who use home day care centers are infants and children of 1~5 years old and they have weak immune system, it is necessary for those facilities to pay attention to more drastic personal hygiene and sanitary management of cooking room^{19,20}.

V. CONCLUSION

This study, using directors and teachers of home day care centers in Cheongjuarea as research subjects, intended to examine self-evaluated performance in food service management of them, compare means depending on positions and their experiences of hygiene and nutrition education, and raise the necessity of hygiene and nutrition education depending on positions. The analysis found out that those who had experiences of hygiene and nutrition educations are better in hygiene in food service and nutrition management than others, and directors are better than teachers in those aspects. For stricter management of foodservice in small-size home day care centers, it seems necessary to provide supportive management on them such as continuous education and systematic monitoring.

REFERENCES

- [1] Laughlin L, Who's Minding the Kids? Child Care Arrangements: Spring 2011, US Census Bureau. Accessed from: <http://www.census.gov/library/publications/2013/demo/p701-135.html>
- [2] Statistics Korea. 2016. Child care statistics. http://www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1583
- [3] Kwon, KS, Park JY, A Study of the Directors' discourse on the Home Based Child care Facilities management, The journal of Korea Early Childhood Education, 2012, 19(3), pp.1-27
- [4] Jeon SG, Lee DK, A Study on Difficulties and Joys of Teachers in Home Day-care Center. Journal of Children's Literature and Education, 2014, 15(1), pp. 253-282.
- [5] Buzby JC, Children and microbial foodborne illness. Food Review, 2001, 24(2), pp.32-37.
- [6] Lu N, Samuels ME, Shi L, Baker SL, Glover SH, Sanders JM, Child day care risks of common infectious diseases revisited. Child: Care, Health and Development, 2004, 30(4), pp. 361-368.
- [7] Staskel DM, Briley ME, Field LH, Barth SS, Microbial evaluation of foodservice surfaces in Texas child-care centers, Journal of American Dietetic Association, 2007, 107(5), pp. 854-859.
- [8] Cosby CM, Costello C, Morris W, Haughton B, Devereaux M, Harte F, Microbiological analysis of food contact surfaces in child care centers, Applied Environmental Microbiology, 2008, 74(22), pp. 6918-6922.
- [9] Li Y, Jaykus LA, Cates S, Wohlgenant K, Chen X, Fraser AM, Microbiological analysis of environmental samples collected from child care facilities in North and South Carolina. American Journal of Infection Control, 2014, 42(10), pp. 1049-1055
- [10] Korea's Ministry of Food and Drug Safety, Guideline of Center For Children's Foodservice

- Management, 2015, pp. 101-117
- [11] Lee JE, Choi KS, Kwak TK, Assessment of Kindergarten Principals and Teachers' Performance Degree of Foodservice Hygiene Management and Foodservice Employees' Hygiene Knowledge. *Journal Korean Dietetic Association*, 2012, 18(4), pp. 308-325.
 - [12] Soares K, García-Díez J, EstevesA, Oliveira I, Saraiva S, Evaluation of food safety training on hygienic conditions in food establishments. *Food Control*, 2013, 34(2), pp. 613-618.
 - [13] Adesokan HK, AkinseyeVO, Adesokan GA, Food Safety Training Is Associated with Improved Knowledge and Behaviours among Foodservice Establishments' Workers. *International Journal of Food Science*, 2015, Article ID 328761, 1-8. Accessed from :<http://dx.doi.org/10.1155/2015/328761>
 - [14] Pilling VK, Brannon LA., Shanklin CW, Roberts KR, Barrett BB, Howells AD. Food safety training requirements and food handlers' knowledge and behaviors. *Food Protection Trends*, 2008, 28(3), pp. 192-200.
 - [15] Yeoh, YJ, Kwon, SY. Analysis of the Importance-Performance Related service management and feeding practices of teachers at mealtime in childcare centers. *Journal of Nutrition and Health*, 2015, 48(3), pp. 289-297.
 - [16] Kwon SK, Park JY, Hong CJ. Current State and Demand of Young Children Nutrition Management. *Journal Young Child Studies*, 2014, 17(1): 5-13.
 - [17] Park NY, Park HK, Park HJ, Seo MK, Im HR, Lim HH, Jung JH, Yoon KS, Employee Food-hygiene and Nutrition Awareness and Performance at Child Care Centers and Kindergartens Located in Seoul. *J Korean Society of Food & Cookery Science*, 2011, 27(2), pp. 45-59
 - [18] Kim JA, Lee YM, The Effect of a Periodic Visiting Education Program on Food Safety Knowledge of Cooks in Children's Foodservice Facilities. *Journal Korean Dietetic Association*, 2014, 20(1), pp. 36-49.
 - [19] Song ES, Kim EG, The Foodservice Sanitation Status of the Child Care Centers at Asan City in Chungnam. *Korean Journal of Community Nutrition* , 2010, 15(6),pp, 806~819.
 - [20] Kim OS, Performance of Hygiene Management according to Capacity and Food Cost of Foodservice in Kindergartens. *Journal of the East Asian Society of Dietary Life*, 2014, 24(5), pp. 680-690.



ISSN
0975-6299

Influences of Patient-Healthcare Provider Communication and Diabetes Self-efficacy on Diabetes Self-Care Management

Yoon-Shin Hwang, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-guDaejeon, Republic of Korea.
E-mail:hyshin@cnuh.co.kr

Youngshin Song*, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-guDaejeon, Republic of Korea.
E-mail:yssong87@cnu.ac.kr

Chi-Hye Kim, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-guDaejeon, Republic of Korea.
E-mail:wisdom77@cnuh.co.kr

Kyeong-Hee Bossard, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-guDaejeon, Republic of Korea. E-mail:bossardkh@hotmail.com

Keumok Park, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-guDaejeon, Republic of Korea.
E-mail:epepk@cnu.ac.kr

Abstract---

Background/Objectives: The aim of this study was to identify the influences of communication between patients and healthcare providers (HCPs), and diabetes self-efficacy, on self-care management in patients with type 2 diabetes.

Methods/Statistical Analysis: This study used a descriptive cross-sectional method with 502 patients with type 2 diabetes. The main variables, i.e., patient-HCP communication, diabetes self-efficacy, and self-care management were assessed using reliable and validated measurements. Statistical analyses were performed using descriptive statistics to analyze the frequency and mean for patients' demographics, and the Pearson's correlation to calculate the *r*-value. To identify the predictors of diabetes self-care management, a multivariate model was tested.

Findings: 54.5% participants were male and their mean age was 59.87 years. About 93% of the participants were married, and 59.4% did not have a job. The average number of co-morbidities was 1.19 and the mean diabetes's duration was 10.69 years. Further, 60% of the participants did not have HbA1c levels within the normal range. Patient-HCP communication was positively correlated with diabetes self-efficacy ($r = .22, p < .001$). Further, diabetes self-care management and diabetes self-efficacy were also positively correlated ($r = .53, p < .001$). The multivariate analysis revealed that patient-HCP communication was associated with diabetes self-care management ($\beta = .15, p = .001$) in first model. However, when diabetes self-efficacy was entered in the final model, only diabetes self-efficacy was meaningfully associated with diabetes self-care management ($\beta = .52, p < .001$), after controlling for the impact of patient-HCP communication. Further, patient-HCP communication and diabetes self-efficacy explained 27.7% of the variance in diabetes self-care management. Thus, diabetes self-efficacy was identified as the main predicting factor of diabetes self-care management in this investigation.

Improvements/Applications: To encourage diabetes self-care management in patients with type 2 diabetes, HCPs should monitor and improve patients' self-efficacy and proper communication in Korea.

Keywords--- Healthcare Provider; Communication; Self-Efficacy; Self-Care; Diabetes Mellitus.

* Corresponding Author

I. INTRODUCTION

The diabetes patients are 108 million in 1980, has counted 422 million In 2014. The global prevalence of diabetes patients aged 18 and older has increased from 4.7% in 1980 to 8.5% in 2014¹. About 4.8 million Koreans (13.7%), aged 30 years or older, had diabetes and nearly a quarter of adults had pre-diabetes (impaired fasting glucose) in 2014². Healthcare providers (HCPs) in Korea are trying to reduce the prevalence of diabetes, and are making efforts to control the complications of diabetes in a better way.

Diabetes can cause complications such as macrovascular, microvascular disease (e.g. retinopathy, neuropathy, nephropathy). High blood glucose caused increasing the risks of cardiovascular and other diseases, additional 2.2 million deaths.

Diabetes is a significant chronic disease that requires self-care competence for managing the disease. Diabetes self-care management may be influenced by individual factors such as self-efficacy and support from healthcare providers^{3,4}. For improving diabetes self-care management, educational programs and counseling strategies need to be offered in healthcare settings, based on effective communication. Understanding the patients' perceptions regarding communication may help develop system-level interventions aimed at eliminating communication disparities between patients and HCPs and improving patients' health outcomes⁵. Effective communication between patients and HCPs is crucial in achieving a partnership in self-care⁶.

However, in the real world, effective patient-HCP communication is not enough because of limited interviewing time⁷. High patient load in clinics and limited time for communication may lead to low diabetes self-efficacy in patients⁵. This low self-efficacy can lead to low self-care management, because diabetes self-efficacy has been identified as one of the strong predictors of diabetes self-care in prior studies^{3,4}. Therefore, the present study aimed to identify the relationships among communication with health care providers, diabetes self-efficacy, and self-care management.

II. MATERIALS AND METHODS

A. Study Design

A cross-sectional descriptive study was performed with 502 patients with type 2 diabetes in Korea. The study sample was recruited from multisites in endocrinology outpatient departments of acute health care facilities. The participants who did not have any mental health problems. Before conducting the survey, we explained the study purpose, procedure, benefits, potential harm, confidentiality, and participants' right to discontinue anytime during the study. Participants agree to participate in survey were enrolled and then provided informed consent. After completing the questionnaire, a \$10 payment was provided. After completing the questionnaire, a \$10 payment was provided. This study was retified by the Institutional Review Board (IRB No.2-1046881-A-N-01-201410-HR-046).

B. Measures

The Interpersonal Processes of Care Survey, Korean version (IPC-12K), was used to assess the interpersonal care processes (namely communication components) with an HCP⁸. The IPC-12K contains 2 subdomains to account for the HCP and the HCP's helper, addressing the following components: communication, decision-making, and interpersonal style over the past 12 months. The scale consists of 12 items assessed on a 5 Likert scale. Total scores range from 12 to 60, whereby a higher score means better interpersonal care. The reliability of the scale was acceptable in this study (Cronbach's $\alpha = 0.90$).

Diabetes self-efficacy was measured by the Diabetes Self-efficacy Scale (DSES). This tool consists of the following 5 subscales assessed on a 6-point Likert scale: Diet (3 items), Self-treatment (5 items), Routine (4 items), Certainty (4 items), and Exercise (2 items). Higher scores indicate greater confidence regarding diabetes self-care. The reliability of the scale in the study in which it was developed was moderate (Cronbach's alpha was = 0.61–0.76), while that in the present study was Cronbach's alpha = 0.64–0.87.

Diabetes self-care scale (DSCS) was measured by the Summary of Diabetes Self-Care Activity (SDSCA). The SDSCA comprises 10 items across the following 5 subdomains: diet, exercise, glucose monitoring, foot care, and smoking. Among them, the subdomains of diet, exercise, glucose monitoring, and foot care were used in this study. The SDSCA examines how often patients they adhere to behaviors recommended in clinical guidelines such as maintaining a healthy diet, exercising, monitoring blood sugar levels, and foot care. A

higher score on the SDSCA indicates better diabetes self-care. The SDSCA Cronbach's alpha coefficient was .90 in this study.

C. Statistical Analyses

Descriptive statistics were analyzed the mean ($\pm$ SD) and frequency. The Pearson correlation was used to calculate the association among patient-HCP communication, diabetes self-efficacy, and diabetes self-care. A multivariate model was used to explain the effect of patient-HCP communication and diabetes self-efficacy on diabetes self-care. For all analyses, significance was declared at 5%.

III. RESULTS

A. Sample Characteristics

The participants demographic characteristics been shown in Table 1.

Majority of the participants were male (54.5%) and their mean age was 59.87 years. About 93% of the participants were married and 59.4% did not have a job. The average number of co-morbidities was 1.19 ($\pm$ 1.52) and the mean duration of diabetes was 10.69 ($\pm$ 8.61) years. Sixty percent of the participants did not have HbA1c levels in the normal range.

Table 1: General Characteristics of Participants (N=502)

Characteristics		n or Mean	(%) or $\pm$ SD
Gender	Male	165	54.5
	Female	138	45.5
Age, years		59.87	$\pm$ 12.61
Having religion	Yes	182	60.1
	No	118	38.9
Years of education, years		10.87	$\pm$ 3.80
Having spouse	Yes	281	92.7
	No	20	6.6
Having Job	Yes	123	40.6
	No	180	59.4
Types of complication	Heart disease	54	17.8
	Hypertension	99	32.7
	Cerebrovascular diseases	35	11.6
	Nephropathy	41	13.5
	Retinopathy	67	22.1
	Neuropathy	31	10.2
	Gastrointestinal problem	29	9.6
	Foot ulcers	10	3.3
Number of Comorbidities		1.19	$\pm$ 1.52
Duration of diabetes, years		10.69	$\pm$ 8.61
HbA1c, %	Unknown	36	11.9
	Less than 6.5	84	27.7
	6.5 and above	183	60.4
	Mean $\pm$ SD, %	7.41	$\pm$ 1.53
Experience of diabetes education	Yes	140	46.2
	No	163	53.8
Smoking	Yes	53	17.5
	No	250	82.5
Drinking	Yes	98	33.3
	No	205	66.7
Exercise	Yes	202	66.7
	No	101	33.3
Diabetes diet	Yes	148	48.8
	No	155	51.2
Subjective health status	Range 1-5	2.97	$\pm$ 0.81

B. Correlations among Variables

Table 2 presents the correlation coefficients among patient-HCP communication, diabetes self-efficacy, and self-care management. Patient-HCP communication was positively correlated with diabetes self-efficacy ($r=.22$, $p<.001$) and diabetes self-care ($r=.15$, $p=.001$). Further, diabetes self-efficacy was significantly positively correlated with diabetes self-care ($r=.52$, $p<.001$).

Table 2: Correlations among communication, self-efficacy, and self-care management

r-value	Communication	Diabetes Self-Efficacy	Diabetes Self-Care
Communication	1		
Diabetes Self-Efficacy	.22 ($p<.001$)	1	
Diabetes Self - Care	.15 ($p=.001$)	.53 ($p<.001$)	1

C. The effect of Communication and Diabetes Self-efficacy on Diabetes Self-care

Table 3 shows the findings of the multivariate analysis.

When patient-HCP communication was entered in the first model, it was associated with diabetes self-care management ($\beta=.15$, $p=.001$). However, in the final multivariate model, only diabetes self-efficacy was associated with diabetes self-care ($\beta=.52$, $p<.001$) after controlling for the effect of patient-HCP communication. This final model estimated for 27.7% of the variance in diabetes self-care.

Table 3: Factors Influencing Self-care Management

Model		β	t	p	R ²	F(p)
1	Communication	.15	2.65	.001	.021	11.60(.001)
2	Communication	.04	.56	.328	.277	96.91(<.001)
	Diabetes Self-Efficacy	.52	10.49	<.001		

IV. DISCUSSION

In this study, we focused on diabetes self-care management, which is considered to be influenced by patient-HCP communication and diabetes self-efficacy. The findings of this study revealed that patient-HCP communication was significantly positively correlated with diabetes self-efficacy and diabetes self-care management. A positive correlation between diabetes self-care and diabetes self-efficacy was also found, but the latter was found to be a determinant of diabetes self-care in the present study. These results were consistent with those reported by a prior study. Specifically, in patients with diabetes study by Nam et al., diabetes self-efficacy was identified as an important factor in the self-care activities⁴. Additionally, proper communication with HCPs was considered to play a mediating role⁴. As HCPs care for patients with diabetes, there has been a shift to a patient-centered approach⁹. A previous study has found that many aspects of diabetes management can be solved through better communication with patients' family, caregivers, doctors, nurses, and other HCPs¹⁰.

Patients with diabetes, who need continuous self-care, should understand the illness and its medication and treatment. Effective communication between patients and HCPs is therefore necessary for optimal self-management⁶. However, communication with HCPs does not always directly affect the patients' diabetes self-care activities. Communication has been shown to be more relevant in particular events, such as when patients need to start insulin therapy. In a study by Nam and Song¹¹, improper communication with HCPs was associated with barriers to insulin therapy when patients are receiving insulin recommendation by physicians. In the present study, communication with HCPs may not have appeared as a determinant of diabetes self-care because several of the participants may have been recommended insulin therapy due to failure to maintain an optimal glucose level.

Several studies have reported that diabetes self-efficacy has contributed to the successful management of diabetes^{12,13,14}. Diabetes self-efficacy was related to psychosocial and physical activities, support from family, and positive diabetes attitudes¹⁵. In particular, diabetes self-efficacy was strongly related with support from family, friends, and community resources¹⁴. In line with previous studies, the findings of the present study showed that communication with HCP score related with diabetes self-efficacy. Therefore, it is important to identify methods for effective patient-HCP communication to improve patients' self-care management. Several studies have researched the effect of the quality and quantity of communication between patients and

HCPs on effective self-care management.^{16,17,18} However, very few studies in South Korea have attempted to identify methods for facilitating effective communication. Therefore, future studies need to focus on the same.

Some limitations should be considered when interpreting and adapting our results in a practical setting. The limit of generalizability of our findings is obtained data from a convenience sample, using self-administered questionnaires.

V. CONCLUSION

This study found that patient-HCP communication did significantly correlated with diabetes self-efficacy and diabetes self-care. Further, self-care management and self-efficacy were correlated. It is concluded that optimal diabetes self-efficacy would contribute to improved self-care activity, after controlling for the effect of patient-HCP communication. Ultimately, better diabetes self-care activity help improve to better quality of life and health outcomes these patients. This study, however, found that patient-HCP communication did not significantly affect diabetes self-care management. Further research should be conducted to identify methods for facilitating effective communication between patients and HCPs, and for improving diabetes self-efficacy. Base on the findings, HCPs should monitor and encourage patient's self-efficacy to improve diabetes self-care management in patients with type 2 diabetes.

ACKNOWLEDGEMENT

This study was supported by Mid-career Researcher Program through a National Research Foundation (NRF) grant funded by the Ministry of Education, Science and Technology (MEST) (NRF-2015R1A2A 2A01002394).

REFERENCES

- [1] World Health Organization, Global report on diabetes 2016. Geneva, 2016.
- [2] Korean Diabetes Association, Diabetes Fact Sheet in Korea, 2016.
<http://www.diabetes.or.kr/pro/news/index.php?code=board&mode=view&number=1332>
- [3] Song Y, Song HJ, Han HR, Park SY, Nam S, Kim MT, Unmet needs for social support and effects on diabetes self-care activities in Korean Americans with type 2 diabetes. *The Diabetes Educator*, 2012, 38(1), pp. 77-85.
- [4] Nam S, Song HJ, Park SY, Song Y, Challenges of Diabetes Management in Immigrant Korean Americans. *The Diabetes Educator*, 2013, 39(2), pp. 213-221.
- [5] Calo WA, Ortiz AP, Colon V, Krasny S, Tortolero-Luna G, Factors associated with perceived patient-provider communication quality among Puerto Ricans. *Journal of Health Care for the Poor and Underserved*, 2014, 25(2), pp. 491-502.
- [6] Wilkinson A, Whitehead L, Ritchie L, Factors influencing the ability to self-manage diabetes for adults living with type 1 or 2 diabetes. *International Journal of Nursing Studies*, 2014, 51(1), pp. 111-122.
- [7] Cho J, Song Y, Jun Y, Lee Y, Kim JI, The Mediation Role of Unmet Need in Healthcare Providers' Support for Diabetes. *Indian Journal of Science and Technology*, 2016, 35(9), pp. 1-8.
- [8] Jun Y, Song Y, Cho J, Lee Y, Kim JI, Psychometric evaluation of Interpersonal Process of Care for Korean Version. *Indian Journal of Science and Technology*, 2016, 9(35), pp. 1-7.
- [9] American Diabetes Association, Foundations of Care: Education, Nutrition, Physical Activity, Smoking Cessation, Psychosocial Care, and Immunization. *Diabetes Care*, 2015, 38(Supplement 1), S20-30.
- [10] David Strain W, Time to do more for diabetes: Clinical inertia and how to beat it. *Diabetes Voice*, 2014, 59, pp. 36-39.
- [11] Nam S, Song Y, Role of Self-Efficacy in the Relationship between Patient-Provider Relationships and Psychological Insulin Resistance among Patients with Type 2 Diabetes. *Journal of Contemporary Diabetes Research*, 2014, 1(1), pp. 1-15.
- [12] Wynn Nyunt S, Howteerakul N, Suwannapong N, Rajatanun T, Self-efficacy, self-care behaviors and glycemic control among type-2 diabetes patients attending two private clinics in Yangon, Myanmar. *The Southeast Asian Journal of Tropical Medicine and Public Health*, 2010, 41(4), pp. 943-951.
- [13] Shi Q, Ostwald SK, Wang S, Improving glycaemic control self-efficacy and glycaemic control behaviour in Chinese patients with type 2 diabetes mellitus: Randomised Controlled Trial. *Journal of Clinical Nursing*, 2010, 19(3-4), pp. 398-404.

- [14] King DK, Glasgow RE, Toobert DJ, Strycker LA, Estabrooks PA, Osuna D, Faber AJ, Self-Efficacy, Problem Solving, and Social-Environmental Support are Associated With Diabetes Self Management Behaviors. *Diabetes Care*, 2010, 33(4), pp. 751-753.
- [15] Venkataraman K, Kannan AT, Kalra OP, Gambhir JK, Sharma AK, Sundaram KR, Mohan V, Diabetes Self-Efficacy Strongly Influences Actual Control of Diabetes in Patients Attending a Tertiary Hospital in India. *Journal of Community Health*, 2012, 37(3), pp. 653-662.
- [16] Ilioudi S, Lazakidou A, Tsironi M, Information and communication technologies for better patient selfmanagement and self-efficacy. *International Journal of Electronic Healthcare*, 2010, 5(4), pp. 327-339.
- [17] Calo WA, Ortiz AP, Colon-Lopez V, Krasny S, Tortolero-Luna G, Factors associated with perceived patient-provider communication quality among Puerto Ricans. *Journal of Health Care Poor Underserved*, 2014, 25(2), pp. 491-502.
- [18] Mulder BC, Lokhorst AM, Rutten GE, van Woerkum CM, Effective Nurse Communication With Type 2 Diabetes Patients: A Review. *Western Journal of Nursing Research*, 2015, 37(8), pp. 1100-1131.

The Associations among Diabetes Exercise Self-Efficacy, the Needs for Exercise and Perceived Health Status in Patients with Diabetes

Keumok Park, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-gu, Daejeon, Republic of Korea.
E-mail: epepk@cnu.ac.kr

Kawon Seo, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-gu, Daejeon, Republic of Korea.
E-mail: ania24@naver.com

Bohyun Kim, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-gu, Daejeon, Republic of Korea.
E-mail: bhkim@cnu.ac.kr

Yoonhee Lee, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-gu, Daejeon, Republic of Korea.
E-mail: feeljoa@hanmail.net

Ancho Lim, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-gu, Daejeon, Republic of Korea.
E-mail: limancho@cnu.ac.kr

Youngshin Song*, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-gu, Daejeon, Republic of Korea.
E-mail: yssong87@cnu.ac.kr

Abstract---

Background/Objectives: The objective of this study was to find the associations among diabetes exercise self-efficacy, the need for diabetes exercise, and perceived health status of patients with diabetes in Korea.

Methods/Statistical analysis: This study used a cross-sectional descriptive method. A total of 91 participants who could complete the self-reported questionnaire and permitted to take part in the study were recruited from among endocrinology outpatients at C university hospital. Descriptive statistics such as mean scores and frequencies were calculated in order to characterize the participant demographics. A multivariate analysis was performed to assess the relations among diabetes exercise self-efficacy, need for diabetes-exercise, and diabetes- health status.

Findings: The average age of the participants was 62.37 ± 10.56 years, and 54.9% were male. About half of the participants (48.3%) had co-morbid conditions such as cardiovascular disease. The mean period of diabetes was 10.89 ± 9.54 years. The participants reported exercising once (69%), twice (19.7%), or three times a week (11.3%). Among the participants, 59.2% satisfied the requirements for sufficiency of exercise. The majority of exercise time (42.3%) was 30 to 60 minutes. The need for exercise was positively correlated with self-efficacy ($r=0.230$, $p=0.028$). Diabetes exercise self-efficacy was also positively correlated with health status ($r=0.247$, $p=0.018$). However, the need for exercise was not meaningfully correlated with the perceived- health status ($r=0.122$, $p=0.248$). On multivariate analysis, diabetes exercise ($\beta=0.202$, $P=0.05$) and health status ($\beta=0.223$, $P=0.03$) were identified as the predictors of diabetes exercise self-efficacy, and these associations were significant. Two factors of predictor accounted for 8.1% of the total variance.

Improvements/Applications: The findings showed that diabetes exercise self-efficacy should be encouraged and empowered by improving the positive health perception and the need for exercise through healthcare providers.

Keywords--- Diabetes-Mellitus, Self-efficacy, Exercise, Health Status, Needs.

* Corresponding Author

I. INTRODUCTION

Diabetes is a chronic disease characterized by impaired blood glucose control, which can lead to disabilities in diverse organs¹. It has been increasing diabetes morbidity and mortality and it is identified as a major social problem. The management of the disease includes lifestyle changes such as exercise and a balanced diet, as well as medication, regular blood sugar monitoring, among others. More recently, self-management training and support have been critical for the prevention of acute complications and decreasing the risk of long-term complications in diabetes patients. Significant results suggest that such education and support may better facilitate lifestyle changes in patients with diabetes².

The American Diabetes Association was provided clinicians, patients, researchers, payers, and other interested units with the information of diabetes care, general therapeutic goals, and tools to assess the quality of self-management in "Standards of Medical Care in Diabetes"². Study findings have confirmed the association between self-efficacy and self-management activity such as regular exercise and adherence to medication³. A strong association between higher levels of self-efficacy and better diabetes self-management actions due to these topics embedded in self-care management intervention programs has been reported⁴. Patients with chronic diseases often experience notable changes in their usual daily exercise due to their chronic conditions⁵. In patients with diabetes, positively perceiving their individual health status is a challenge. However, positive health perception may influence their confidence in self-care. Daily self-care activities that include exercise activities and empowering their health perception may help to reduce or delay disease-related complications, leading to a better quality of life^{6,7}. Exercise needs can be an antecedent factor of exercise self-efficacy and exercise practice in diabetes. Increased needs for exercise may lead to greater exercise self-efficacy and this in turn can affect diabetes self-care behaviors. Despite these expectations, little is known about the association among exercise needs, exercise self-efficacy, and health perception. Education on self-management and active glycemic control is also required⁸. It was aimed at theory-based minimal intervention strategy each individually on enhancing regular physical activity, the intervention surveyee also perceived fewer barriers to regular physical activity⁹. Interventions to raise diabetic patient self-efficacy grade and self-care activity, diet and exercise were notably related to them, poor glycemic control needed to reduce^{10,11}. Studies of exercise self-efficacy in aged patients with diabetes were reported physical behaviors for all ethnic, person of any age, and gender groups effects to decrease the risk of cardiovascular disease, especially stroke^{12,13,14}. The present study aimed to identify the correlation between exercise self-efficacy, exercise needs, and health perception in patients with diabetes and to develop empowerment programs to improve diabetes exercise self-efficacy, self-care management, and positive support from healthcare providers^{15,16}.

II. MATERIALS AND METHODS

A. Study Design

This study was designed descriptive cross-sectional method to identify the relationships among the need for diabetes exercise, exercise self-efficacy, and perceived health status among Korean people with type 2 diabetes. Data were collected from 91 patients with diabetes at an outpatient endocrinology clinic of C hospital in Daejeon. The patients volunteered to participate in the study from July 22 to August 31, 2016.

B. Measurement

"The Diabetes Self-Efficacy Scale (DESE)" is based on "Hurley's 25-item Insulin Management Diabetes Self-Efficacy Scale (IMDSES)"¹⁷. The IMDSES was modified by Rapley in 2003, and the modified scale was called the Diabetes Self-Efficacy Scale (DSES)¹⁸. This tool consists of five subscales: diet (three items), self-treat (five items), routines (four items), certainty (four items), and exercise (two items). All subscales are assessed with a six-point Likert scale. The need for exercise was checked as "Yes" or "No". The subjective assessment of the participants' perceived health status was assessed using a 5-point Likert scale, with choices ranging from "Extremely good" to "Extremely bad". Higher perceived health status scores indicated positive perceptions.

C. Statistical Analysis

The collected data were analyzed using descriptive statistics. The sample demographics were summarized as frequencies, percentages, and means and standard deviations. The correlations among the needs for

exercise, exercise self-efficacy, and health status were calculated as Pearson's correlation r-values. Multivariate analysis was performed for determining the predictors of diabetes exercise self-efficacy.

D. Ethical consideration

The procedures of this study were allowed by the Institutional Review Board of C University (IRB No.2-1046881-A-N-01-201410-HR-046).

Before collecting the data of this survey, we explained purpose of the study, the procedures, benefits, and potential harm and full described the participants' right before they provided their written informed consent.

III. RESULTS AND DISCUSSION

A. Participant Demographics and Exercise Characteristics

Table 1 show the patient demographics and exercise characteristics.

The characteristics of the 91 patients with diabetes who took part in this study are summed up in Table1. Their mean age was 62.37 ± 10.56 years, and 54.9% were men; 48.3% had co-morbid diseases such as cardiovascular disease, nephropathy, retinopathy, neuropathy, gastric disease, foot ulcer, etc. The average duration of diabetes was 10.89 ± 9.54 years.

The participants exercised once (69%), twice (19.7%), or three (11.3%) times per week. Among the participants, 59.2% satisfied the criteria for sufficiency of exercise. The majority of exercise time (42.3%) was 30 to 60 minutes, followed by less than 30 minutes (26.8%), 61 to 90 minutes (7.0%), and 2 hours or more (8.5%).

The types of exercise included walking (58.8%), climbing (17.6%), and jogging (10.8%).

Table1: Demographics (N=91)

Variables	Categories	N(%)	Mean ($\pm$ SD)
Gender	Male	50(54.9)	
	Female	41(45.1)	
Age	30-59	37(41.6)	62.37($\pm$ 10.56)
	60-69	30(33.7)	
	70-79	20(22.5)	
	80 over	2(2.2)	
No. of co-morbidity*	0	48(52.7)	0.824($\pm$ 1.07)
	1	21(23.1)	
	2	14(15.4)	
	3	7(7.7)	
	4	0	
	5	1(1.1)	
Year of diabetes	Range(2mon.-42yrs)		10.89($\pm$ 9.54)
No. of exercise/week	1	49(69.0)	
	2	14(19.7)	
	3	8(11.3)	
Sufficiency of exercise	Yes	42(59.2)	
	No	29(40.8)	
Exercise time for each exercise	30min	19(26.8)	
	31min.-60min	30(42.2)	
	61min.-90min	11(15.5)	
	90min.-120min	5(7.0)	
Types of exercise	120min and over	6(8.5)	
	Swimming	2(3.0)	
	Jogging	7(10.3)	
	Climbing	12(17.6)	
	Badminton	3(4.4)	
	Gate ball	1(1.5)	
	Table tennis	3(4.4)	
	Walking	40(58.8)	

*co-morbidity: Heart-vascular disease, Nephropathy, Retinopathy, Neuropathy, Gastric disease, Foot ulcer

B. Correlations Among Variables

As shown in Table 2, the correlations among the needs for exercise, diabetes exercise self-efficacy, and health status were significant.

The need for diabetes exercise was positively correlated with self-efficacy ($r=0.230$, $p=0.028$), whereas a non-meaningful correlation was observed between the need for exercise and perceived health status ($r=0.122$, $p=0.248$). However, diabetes exercise self-efficacy was positively correlated with perceived health status ($r=0.247$, $p=0.018$).

Table 2: Correlations among Needs of Diabetes Exercise, Diabetes Exercise Self-efficacy and Perceived Health Status

r-values	1	2	3
1.Needs of diabetes exercise	1		
2.Diabetes exercise self-efficacy	0.230* ($p=0.028$)	1	
3. Perceived health status	0.122 ($p=0.248$)	0.247* ($p=0.018$)	1

* $p<0.05$

C. Predictors of Diabetes Exercise Self-efficacy

The results of the regression analysis of the predictors of diabetes exercise self-efficacy are presented in Table 3. The need for exercise ($\beta=0.202$, $P=0.05$) and health status ($\beta=0.223$, $P=0.03$) were significant predictors of diabetes exercise self-efficacy and was explained for 8.1% of the total variance.

Table 3: Predictors of Diabetes Exercise Self-efficacy

Predictors	β	t	P	R ²	F/p
Needs of diabetes exercise	0.202	1.989	0.05	0.081	4.976(0.009)
Perceived health status	0.223	2.187	0.03		

The results of this study emphasized the significant relationships among diabetes exercise self-efficacy, need for exercise, and perceived health status in patients with diabetes. Patients with diabetes who have positive health status and increased need for exercise were more favorable to have better exercise self-efficacy. The development of programs to encourage diabetes self-efficacy is recommended for self-management and lifestyle modifications including diet, medication, exercise, etc. in patients with diabetes. Increased self-efficacy and confidence will accelerate self-care management.

Alternatively, depression decreases glucose control due to a depressed mood that interferes with self-care management, including non-adherence to a low-glycemic index diet, neglect of prescribed medication, and lack of physical activity. Overall, the intervention participants expanded their duration of aerobic exercise more than the controls, had significantly increased mean diabetes management self-efficacy scores, and showed considerably refinements in measures of illness intrusiveness and systolic blood pressure. Diabetes education can promote self-management, metabolic control, and emotional condition; thus, self-esteem and diabetes mellitus self-efficacy is improved whereas anxiety and depression is moderated. The aspects of the exercise programs that contribute to diabetes self-efficacy require further elucidation. These methods may improve the quality of life of patients with diabetes mellitus patients and any other chronic disease.

The sample was not adequately representative of general diabetes population. It was the use of convenience sampling one of limitation of this study, which researcher selects based on samples conveniently. Consequently, the findings of this study are difficult that is generalized.

IV. CONCLUSION

The development of diabetes self-efficacy empowering program is requested for self-management, how to modifying life style diet, medication and exercise etc. for patients with diabetes. Increased self-efficacy and confidence will be accelerated self-care management. On the other hand, inactivity decreases glucose control due to a depressed behaviors that interferes with self-care management, as an irregularity in the low-glycemic index diet, includes neglect of prescribed medication and lack of physical activity and good life of diabetic patients. Diabetic-educator should stimulate powerful behavioral decision elements that can be aimed increasing confidence of diabetes self-care control and management.

The results of this study propose that diabetes exercise self-efficacy is affected by the need for exercise and positive health perception. Education programs to empower diabetes exercise self-efficacy should be provided for people with diabetes in Korea, and these programs should be continuously facilitated by healthcare providers.

ACKNOWLEDGMENT

This study was supported by a National Research Foundation of Korea (NRF) grant, funded by the Korean government (MSIP) (NRF-2015R1A2A2A01002394).

REFERENCES

- [1] Otunctemur A, Ozbek E, Sahin S, Dursun M, Huseyin B, Diabetes mellitus as a risk factor for high grade renal cell carcinoma. *Asian Pacific Journal of Cancer Prevention*, 2014, 15(9), pp.3993-6.
- [2] American Diabetes Association, Standard of medical care in diabetes-2016. *Diabetes Care*, 2016, 39(1) pp.S1-S2. doi:10.2337/dc16-S001.
- [3] Yoo H, Kim C J, Jang, Y, & You M A, Self-efficacy associated with self-management behaviours and health status of South Koreans with chronic disease. *International Journal of Nursing Practice*, 2011,17(6), pp.599-606.
- [4] Luo X, Liu T, Yuan X, Ge S, Yang J, Li C., & Sun W, Factors Influencing Self-Management in Chinese Adults with Type 2 Diabetes: A Systematic Review and Meta-Analysis. *International Journal of Environmental Research and Public Health*, 2015, 12(9), pp.11304-11327.
- [5] Kralik D, Koch T, Price K, Howard N, Chronic illness self-management: Taking action to create order. *Journal of Clinical Nursing*, 2004, 13, pp. 259-267.
- [6] Koch T, Jenkin P, Kralik D, Chronic illness self-management: Locating the 'self'. *Journal of Advanced Nursing*, 2004, 48(5), pp.484-492.
- [7] Holman H, Lorig K, Patient self-management: A key to effectiveness and efficiency in care of chronic disease. *Public Health Reports*, 2004, 119(3), pp.239-243.
- [8] Liu S, Bi A, Fu D, Fu H, Luo W, Ma X, & Zhuang L, Effectiveness of using group visit model to support diabetes patient self-management in rural communities of Shanghai: a randomized controlled trial. *Bio Med Central Public Health*, 2012, 12, pp.1043. doi:10.1186/1471-2458-12-1043.
- [9] Van Sluijs, E M, Van Poppel, M N, Twisk J W, Brug J, & Van Mechelen W, The positive effect on determinants of physical activity of a tailored, general practice-based physical activity intervention. *Health Education Research*, 2005, 20(3), pp.345-356. doi:10.1093/her/cyg129.
- [10] Nyunt S, Howteerakul N, Suwannapong & Rajatanun T, Self-efficacy, self-care behaviors and glycemic control among type-2 diabetes patients attending two private clinics in Yangon, Myanmar. *Southeast Asian Journal Tropical Medicine and Public Health*, 2010, 41(4), pp.943-951.
- [11] Kim S H, & Yu, X, The mediating effect of self-efficacy on the relationship between health literacy and health status in Korean older adults: a short report. *Aging and Mental Health*, 2010, 14(7), pp.870-873. doi:10.1080/13607861003801011.
- [12] Sacco R L, Adams R, Albers G, Alberts M J, Benavente O, Furie K, et al, Guidelines for prevention of stroke in patients with Ischemic stroke or transient ischemic attack: A statement for healthcare professionals from the American Heart Association/American Stroke Association Council on Stroke, Co-sponsored by the Council on Cardiovascular Radiology and Intervention. The American Academy of Neurology affirms the value of this guideline, *Circulation*, 2006, 113(10), pp. e409-e449.
- [13] Goldstein L B, Adams R, Alberts M J, Appel L J, Brass L M, Bushnell C D, et al, Primary prevention of ischemic stroke: A guideline from the American Heart Association/American Stroke Association Stroke Council: Cosponsored by the Atherosclerotic Peripheral Vascular Disease Interdisciplinary Working Group: Cardiovascular Nursing Council; Clinical Cardiology Council; Nutrition, Physical Activity, and Metabolism Council; and the Quality of Care and Outcomes. Research Interdisciplinary Working Group. *Circulation*, 2006, 113(24), pp. e873-e923.
- [14] Resnick B, Luisi D, & Vogel A, Testing the Senior Exercise Self-efficacy Project (SESEP) for use with urban dwelling minority older adults. *Public Health Nursing*, 2008, 25(3), pp. 221-234. doi:10.1111/j.1525-1446.2008.00699.x.
- [15] Anderson R M, Funnell M M, Aikens J E, Krein S L, Fitzgerald J T, et al, Evaluating the Efficacy of an Empowerment-Based Self-Management Consultant Intervention, Results of a Two-Year Randomized Controlled Trial. *Therapeutic patient education*, 2009, 1(1), pp.3-11. doi:10.1051/tpe/2009002.

- [16] Cho J, Song Y, Jun Y, Lee Y, & Kim J I, The Mediation Role of Unmet Need in Healthcare Providers' Support for Diabetes. *Indian Journal of Science and Technology*, 2016, 9(35),pp.1-8.
- [17] Hurley, Ann C, Measuring self-care ability in patients with diabetes: The insulin management diabetes self-efficacy scale. *Measurement of nursing outcomes: Measuring client self-care and coping skills*, 1990, 4, pp. 28-44.
- [18] Rapley P, Passmore A, Phillips M, Review of the psychometric properties of the diabetes self-efficacy scale: Australian longistudinal study. *Nursing Health Science*, 2003, 5(4), pp. 289-97.



ISSN
0975-6299

Psychometric Properties of the Korean Version of Barriers to Insulin Treatment Scale

Hyunjin Lee, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-gu, Daejeon, Republic of Korea.
E-mail:hjlee0815@hanmail.net

Heebum Yang, College of Medicine, Eulji University, 771-77 Gyeryongro Jung-gu, Daejeon, Republic of Korea.
E-mail:heebeom99@hanmail.net

Yoonhee Lee*, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-gu, Daejeon Republic of Korea.
E-mail:feeljoa@hanmail.net

Ancho Lim, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-gu, Daejeon, Republic of Korea.
E-mail:limancho@cnu.ac.kr

Youngshin Song, College of Nursing, Chungnam National University, 266 Munwha-ro Jung-gu, Daejeon, Republic of Korea.
E-mail:yssong87@cnu.ac.kr

Abstract---

Background/Objectives: The purpose of this study was to evaluate psychometric properties such as the reliability and validity and of the Korean version of Barriers to Insulin Treatment (BIT) scale.

Methods/Statistical Analysis: A total of 217 diabetes patients participated in this study, and this study used a cross-sectional design. Participants were recruited from endocrinology outpatient clinics. The original items of the BIT were reduced during item-analysis, and then an exploratory factor analysis was performed for the remaining items. During the exploratory factor analysis, factors were extracted, and its variance was calculated. The reliability was confirmed by internal consistency (Cronbach's alpha).

Findings: Participants' mean age was 61.74 years, and 112(51.6%) participants were males. About 83% of the participants were married, and 50.7% had a religion. Of the total participants, 55.8% were high school or university graduates. In the item analysis, four items were eliminated due to having a lower r-value in the item-total correlation analysis. The remaining 10 items were used for verifying the construct validity using exploratory factor analysis. The results showed a two-factor solution—"Misconceptions of insulin therapy" and "Practical difficulties on insulin therapy." Five items were located in each of the two factors. The Korean version of BIT accounted for 48.6% of the variance in this study. The reliability of the Korean version was Cronbach's alpha=0.80. The Cronbach's alpha for "Misconception of insulin therapy" factor and "Practical difficulties on insulin therapy" factor were 0.74, and 0.71, respectively. The findings showed that the 10-item BIT was an appropriate tool for assessing the reluctance to insulin therapy for patients with diabetes in Korea.

Improvements/Applications: Based on this psychometric evaluation, BIT can efficiently measure the psychological insulin resistance in Koreans, and its results can provide proper information to healthcare providers for patient care.

Keywords--- Diabetes Mellitus, Insulin, Reliability and Validity, Barriers to Insulin Treatment.

* Corresponding Author

I. INTRODUCTION

According to the "Korean Diabetes Fact Sheet," the prevalence of diabetes in adults aged ≥ 30 years has drastically increased from 5.6% in 2006 to 13.7% in 2014^{1,2}. Diabetes has considerably increased with age; among patient's aged ≥ 60 years, the prevalence of diabetes is about 30%¹. In addition, the prevalence of hypertension, hypercholesterolemia, and diabetic nephropathy in persons with diabetes was 54.8%, 31.6%, and 30.3%, respectively¹. Several studies have reported a high correlation between development of diabetic complications and blood sugar control in patients with type 2 diabetes^{3,4}. It is well known that a strict blood sugar control can help to reduce the onset of complications associated with diabetes effectively⁵. Therefore, patients with type 2 diabetes should be provided intensive treatment.

Despite the use of hypoglycemic agents and improvement in lifestyle for diabetes management, a lot of patients with type 2 diabetes should be recommended insulin treatment at any stage to maintain or achieve a good blood sugar control⁶.

According to the "Standards of Medical Care in Diabetes 2016," American Diabetes Association (ADA) stated that "lowering A1C (glycated hemoglobin) to $< 7\%$ has been shown to reduce micro vascular complications"⁷. This report states that if noninsulin anti-diabetic medication at maximal allowable dose does not maintain or achieve the goal of A1C for more than three months, secondary oral hypoglycemic agent or insulin should be added⁷. It is recommended not to delay insulin initiation in patients not achieving glycemic goals⁷.

In practice, however, the decision to start insulin treatment is often postponed due to various reasons including patients' barriers to accept insulin treatment^{8,9}. These reluctant attitudes toward insulin therapy contribute to extended periods of hyperglycemia. This attitude is known as "Psychological Insulin Resistance (PIR)" that includes several properties such as "failure to adequately self-manage their diabetes," "fears about social stigma," "perceiving insulin therapy as burdensome and too complex," "fear of injection," "hypoglycemia," and "anticipated weight gain"¹⁰. The unwillingness to start insulin therapy may be a result of viewpoints in personal range, including motional reactions or cognitive appraisal¹¹, which can be influenced by culture^{12,13,14}.

Many tools have been used and developed to evaluate patient attitudes towards insulin therapy, such as Problem Area In Diabetes (PAID), Insulin Treatment Appraisal Scale (ITAS), and A Survey for people who do not take Insulin (SPI). In particular, Barriers to Insulin Treatment (BIT) has been developed by Petraket al.¹⁵ and used as a psychometric questionnaire to measure psychological resistance to insulin treatment worldwide. The BIT (14-item) has been demonstrated good reliability and validity in several languages¹⁵, but not for Korean. The items in BIT can be easy to understand and intensively assesses in a short term, the reluctance to insulin therapy in diabetes patients. Despite this strong aspect of BIT, the psychometric evaluation for the Korean of BIT did performed. Therefore, the aim of this report was to evaluate the Korean version of BIT, which can assess the barriers and enablers to beginning insulin therapy in patients with type 2 diabetes.

II. MATERIALS AND METHODS

A. Study Design and Sample

This study was a descriptive cross-sectional design. It was used to test the psychometric properties of the Korean version of the BIT scale.

The participants were 217 patients with type 2 diabetes recruited from two endocrinology outpatient clinics in University hospital. The inclusion criteria were a) diagnosed type 2 diabetes, b) being mentally intact, c) consented to participate, and d) understood the study aims. The patients who had psychological disorders were excluded from this study.

Prior to recruitment, an informed consent form that included study aims, benefits/ potential harm, and confidentiality issues was provided for all participants. The Institutional Review Board C University (IRB No.2-1046881-A-N-01-201410-HR-046) approved all study procedures.

The sample size calculation was estimated by the number required to conduct the factor analysis for psychometric evaluation of the instrument. Based on the subject to item (14 items of this study) ratio of more than 10:1, a sample size¹⁶, a sample size of 217 subjects was enough.

B. Measures

Barriers to Insulin Treatment Scale

The BIT scale was used with permission by the authors as a tool developed by Petraket al.¹⁵. The BIT scale consists of 14 items that include five subscales: fear of injections and self-testing, expectations about positive insulin-related outcomes, expected hardships from insulin therapy, stigmatization of insulin injections, and fear of hypoglycemia. The responses are explained on a 10-point Likert-type scale. It is ranged from "1 (completely disagree)" to 10 "(agree)." The summation of the items scores provided a total score. Higher scores represent a higher negative attitude toward insulin therapy. The original BIT with five factors developed by Petraket al. explained 74.5% of the total variance¹⁵.

C. Translation Process

Before the psychometric evaluation, a double translation method was used for the BIT. Firstly, BIT was translated into Korean by a bilingual expert and then was back translated into English by another bilingual expert. The original and translated versions were compared in terms of each item's meaning by two nursing professionals. During this double translation process, no discrepancies were found between the two.

D. Statistical Analysis

Descriptive statistics was performed to identify the demographics of participants. So as to evaluate the psychometric properties of the Korean version of the BIT scale, the construct validity and reliability analyses were done. Item analysis and exploratory factor analysis (EFA) were done to confirm the construct validity. For the item analysis, the r-value of the item-total correlation was calculated, and the item was selected if r-value > 0.3 in item-total correlation¹⁷. After the completion of the item-analysis, an EFA was performed. The EFA was conducted to identify the structure of the tool and to classify the item into sub-scales. Before using the EFA, Barlett's Test of Sphericity (cut-off value $p < .001$) and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (cut-off value 0.5) was used to assure the appropriateness of the data set for the EFA. After confirming the appropriateness, EFA with varimax rotation was performed and a factor loading score ≥ 0.4 was selected¹⁸. In order to assess the internal consistency, Cronbach's alpha was calculated. The significant level of $\alpha = 0.5$ was applied.

III. RESULTS AND DISCUSSION

A. Demographics of Participants

Table 1 indicates the characteristics of participants. 217 patients with type 2 diabetes were included in this study. Of the total participants, 85(39.1%) patients received insulin therapy, and 36 were insulin-naïve patients. The mean age of the participants was 61.74 years, 112 participants (51.6%) were males. Most participants (82.5%) were married, and half of the participants (50.7%) had a religion. Of the total participants, 55.8% had graduated from high school, and 22.6% had graduated from elementary school. Further, 34.1% of the participants had a job, whereas the 65.9% were unemployed. The mean duration of diabetes was 11.97 years, and 56.2% of the total participants had one or more co morbidities.

Table 1: Demographics of Participants(N=217)

Characteristics		n(%) or Mean($\pm$ SD)
Gender	Male	112(51.6)
	Female	105(48.4)
Age	year	61.74($\pm$ 12.07)
Marital status	Married	179(82.5)
	Others(Single, divorce etc.)	38(17.5)
Educational level	Illiteracy	9(4.1)
	Elementary	49(22.6)
	Middle school	38(17.5)
	High school $\uparrow$	121(55.8)
Having religion	Yes	110(50.7)
	No	107(49.3)
Having job	Yes	74(34.1)
	No	143(65.9)
Insulin therapy	Yes	85(39.1)
	No	132(60.9)
Insulin therapy recommendation among 'No' answer(n=132)	Yes	36(27.3)
	No	96(72.7)
Co-morbidity	Yes	122(56.2)
	No	95(43.8)
Number of comorbidities		0.68($\pm$ 0.91)
Years of diabetes	year	11.97($\pm$ 9.28)

B. Construct Validity

The item analysis and exploratory factor analysis were conducted to verify the construct validity.

As shown in Table 2, an item analysis was performed using 14 items of the Korean version of BIT. From these 14 items, four items had a poor item-total correlation coefficient (< 0.3). Therefore those 4 items were omitted during the item analysis resulting in a 10-item scale. After eliminating the four items, the range of item-total correlations r-value was from 0.316 to 0.581. The deleted four items were as follows: "Insulin works better than pills," "People who get insulin feel better," "Insulin can reliably prevent long-term complications due to diabetes," and "I can't pay as close attention to my diet as insulin treatment requires."

complications due to diabetes, and I can't pay as close attention to my diet as insulin treatment requires.

Items		Mean ± SD		Corrected Item Total Correlation	Cronbach's Alpha if Item Deleted
Factor 1. Misperception on IT					
T11	Regular Insulin treatment causes feelings of dependence.	6.09	± 3.10	.475	.776
T14	An insulin overdose can lead to extremely low blood glucose levels(hypoglycemia). I have concerns about possible permanent damage to my health.	4.86	± 3.39	.509	.772
T13	An insulin overdose can lead to extremely low blood glucose levels (hypoglycemia). I am afraid of the unpleasant accompanying symptoms.	6.13	± 3.29	.510	.772
T12	When people inject insulin, it makes them feel like drug addicts.	6.03	± 3.41	.502	.773
T10	Injections in public are embarrassing to me. Pills are more discreet.	6.83	± 3.30	.442	.780
Factor 2. Practical difficulties on IT					
T1	I am afraid of the pain when injecting insulin.	4.46	± 3.24	.558	.766
T2	Besides the pain, I am just afraid of injections.	5.04	± 3.45	.581	.762
T3	I am afraid of the pain during regular blood-sugar checks.	3.68	± 2.97	.431	.781
T7	I just don't have enough time for regular doses of insulin.	2.86	± 2.66	.316	.793
T9	I can't organize my day as carefully as insulin treatment requires.	4.35	± 2.98	.321	.793
IT= Insulin therapy					

Prior to conducting the EFA, the appropriateness of the EFA was tested using the KMO measure and Bartlett's Test of Sphericity. The results showed that the KMO measure was 0.783 stating sampling acceptability, as well as for Bartlett's Test of Sphericity ($\chi^2=562.724$, $p<.001$), thereby confirming the availability for EFA.

The EFA with varimax rotation for 10 items were performed, and two factors with eigenvalues ≥ 1 were selected as indicated in Table 3. The extracted two factors on the screen plot were found. Two-factor solutions appeared to be the best representation of the structure and were named "Misconception on insulin therapy" for factor 1, and "Practical difficulties on insulin therapy" for factor 2. The two factors explained 48.6% of the total variance.

Factor 1 "Misconception on insulin therapy" consisted of 5 items, and explained 25.3% of the variance. Factor 2 "Practical difficulties on insulin therapy" included 5 items and accounted for 23.4% of the variance.

	Items	Commun alities	Factor 1	Factor 2
			Misperception on IT	Practical difficulties on IT
T11	Regular Insulin treatment causes feelings of dependence.	.574	.756	.059
T14	An insulin overdose can lead to extremely low blood glucose levels (hypoglycemia). I have concerns about possible permanent damage to my health.	.568	.741	.136
T13	An insulin overdose can lead to extremely low blood glucose levels (hypoglycemia). I am afraid of the unpleasant accompanying symptoms.	.556	.730	.150
T12	When people inject insulin, it makes them feel like drug addicts.	.438	.602	.274
T10	Injections in public are embarrassing to me. Pills are more discreet.	.367	.561	.229
T1	I am afraid of the pain when injecting insulin.	.662	.220	.783
T2	Besides the pain, I am just afraid of injections.	.661	.271	.767
T3	I am afraid of the pain during regular blood-sugar checks.	.554	.079	.740
T7	I just don't have enough time for regular doses of insulin.	.295	.067	.539
T9	I can't organize my day as carefully as insulin treatment requires.	.186	.247	.353
Eigen Value			2.525	2.336
variance, %			25.25	23.363
cumulative variance, %			25.25	48.613
Range of corrected item-total correlation			.427-.553	.282-.604
Cronbach's alpha, total: .795			0.74	0.71

IT= Insulin therapy

The findings of this study confirmed proper psychometric properties of the 10-item Korean version of the BIT in diabetes patients. Results from the item analysis and EFA confirmed that the structure of the Korean version of BIT is an acceptable valid and reliable scale to measure the barriers to taking insulin therapy. However, all the 14 items of the original scale were not fully accepted in this study. Among the 14 items, four items did not reflect the barriers to insulin therapy for Korean people with diabetes. The eliminated four items were positively associated with insulin therapy such as "Insulin works better than pills." 4 items did not appear to be regarded as barriers. Moreover, in this study, the Korean version of the BIT with 10 items was grouped into two factors. These two factors may easily assess the perception and behaviors toward insulin therapy among insulin-naïve patients in future studies on the Korean population. Cronbach's alpha was 0.78 for the BIT scale, 0.80 for K-BIT scale.

C. Reliability

Cronbach's alpha was used to verify the internal consistency of the 10 items. The results showed that Cronbach's alpha was 0.80 for the total 10-item scale. Cronbach's alpha was 0.74 for the 5 items in factor 1 "Misperception on insulin therapy," and 0.71 for the 5 items in factor 2 "Practical difficulties on insulin therapy."

IV. CONCLUSION

This paper suggests that the Korean version BIT is a valid and reliable instrument. This tool is short and easy to understand by both researchers and clinicians to assess psychological barriers to insulin therapy. Future coverage of this questionnaire will be useful for developing a psychological insulin resistance scale for Korean diabetic patients. This questionnaire is expected to contribute to the development of a tool for assessing psychological insulin resistance in Korea. Based on the proper assessment of the barriers to insulin therapy, healthcare providers can guide and educate patients who negatively perceive insulin therapy. Furthermore, the Korean version of BIT will be useful in the assessment of the outcomes of the tailored education implementation. In conclusion, this tool will lead to the development of effective programs to improve insulin compliance. Moreover, the Korean version of BIT would potentially improve the quality of life through successful blood glucose control in diabetics.

ACKNOWLEDGMENT

This study was supported by Mid-career Researcher Program through National Research Foundation (NRF) grant funded by the Ministry of Education, Science and Technology (MEST) (NRF-2015R1A2A2A01002394).

REFERENCES

- [1] Korean Diabetes Association. Korean diabetes fact sheet 2016. Seoul, 2016.
- [2] Korean Diabetes Association. Korean diabetes fact sheet 2015. Seoul, 2015.
- [3] Skyler JS, Bergenstal R, Bonow RO, Buse J, Deedwania P, Gale EA, Howard BV, Kirkman MS, Kosiborod M, Reaven P, Sherwin RS, Intensive glycemic control and the prevention of cardiovascular events: Implications of the ACCORD, ADVANCE, and VA diabetes trials: A position statement of the American diabetes association and a scientific statement of the American college of cardiology foundation and the American Heart Association. *Diabetes care*, 2009, 32(1), pp.187–192.
- [4] Roglic G, Unwin N, Bennett PH, Mathers C, Tuomilehto J, Nag S, Connolly V, King H, The burden of mortality attributable to diabetes: Realistic estimates for the year 2000. *Diabetes Care*, 2005, 28(9), pp. 2130–2135.
- [5] National Diabetes Information Clearinghouse DCCT (Diabetes Control and Complications Trial) and EDIC (Epidemiology of Diabetes Intervention and Complications). The diabetes control and complications trial and follow-up study. U.S. Department of Health and Human Services 2008. http://diabetes.niddk.nih.gov/dm/pubs/control/DCCT-EDIC_509.pdf.
- [6] Chan JL, Abrahamson MJ, Pharmacological management of type 2 diabetes mellitus: rationale for rational use of insulin. *Mayo Clinic Proceedings*, 2003, 78(4), pp.459-467.
- [7] American Diabetes Association. Standards of Medical Care in Diabetes-2016. *Diabetes care*, 2016, 39 (Supplement 1), S39-59.
- [8] Holman RR, Cull CA, Fox C, Turner RC, United Kingdom Prospective Diabetes Study (UKPDS) 13: Relative efficacy of randomly allocated diet, sulphonylurea, insulin, or metformin in patients with newly di

- agnosed non-insulin dependent diabetes followed for three years. *British Medical Journal*, 1995, 310(6972), pp.83–88.
- [9] Korytkowski M, When oral agents fail: practical barriers to starting insulin. *International Journal of Obesity*, 2002, 26(S3), S18–24.
- [10] Polonsky WH, Fisher L, Guzman S, Villa-Caballero L, Edelman SV, Psychological Insulin Resistance in Patients With Type 2 Diabetes. *Diabetes Care*, 2005, 28(10), pp.2543–2545. <http://dx.doi.org/10.2337/diacare.28.10.2543>
- [11] Wang HF, Yeh MC, Psychological resistance to insulin therapy in adults with type 2 diabetes: Mixed method systematic review. *Journal of Advanced Nursing*, 2012, 68(4), pp.743–757.
- [12] Ho EY, James J, Cultural barriers to initiating insulin therapy in chinese people with type 2 diabetes living in canada. *Canadian Journal of Diabetes*, 2006, 30(4), pp. 390–396.
- [13] Caballero AE, Building cultural bridges: Understanding ethnicity to improve acceptance of insulin therapy in patients with type 2 diabetes. *Ethn Dis*, 2006, 16(2), pp.559–568.
- [14] Nam S, Chesla C, Stotts NA, Kroon L, Janson SL, Factors associated with psychological insulin resistance in individuals with type 2 diabetes. *Diabetes Care*, 2010, 33(8), pp.1747–1749.
- [15] Petrak F, Stridde E, Leverkus F, Crispin AA, Forst T, Pfitzner A, Development and validation of a new measure to evaluate psychological resistance to insulin treatment. *Diabetes Care*, 2007, 30(9), pp.2199–2204. <http://dx.doi.org/10.2337/dc06-2042>
- [16] Lee YJ, Understanding of factor analysis. Seoul: Sukjungbooks; 2002.
- [17] Nunnally JC, Bernstein IH, Psychometric theory(3rd ed). New York: McGraw-Hill;1994, p 469.
- [18] Costello AB, Osborne JW, Best practice in exploratory factor analysis: Four Recommendations for getting the most from your analysis. *Practical Assessment Research & Evaluation*, 2005, 10(7), pp1–9.



ISSN
0975-6299

Effect of Psychomotor and Art Therapy Program on the Children with ADHD

Dae-heon Moon*, Dept. of Adapted Physical Education, Hanshin University, Korea. E-mail:dajigi19@naver.com

Bung-iL Kang, Dept. of Special Physical Education, Kaya University, Korea. E-mail:kbihhj@hanmail.net

Youn-tae Suh, Dept. of Adapted Physical Education, Hanshin University, Korea. E-mail:syt@hs.ac.kr

Abstract---

Background/Objectives: This study compared a psychomotor program group and an art therapy program group to discuss how the psychomotor program influences the inattention and impulsivity of children with ADHD and found a significant difference in the psychomotor program group.

Methods/Statistical Analysis: For this purpose, elementary school students showing attention deficit hyperactivity through the Advanced Test of Attention (ATA) to select 9 children for the psychomotor group and 9 children for the art therapy group for a total of 18 subjects. Each of the psychomotor group and art therapy group attended 20sessions 90-minutes once a week and took ATA in the first and last sessions. Paired T-test using means of pre and post visual and auditory test was used to compare inattention and impulsivity, sub domains of advanced attention. The data was comparatively analyzed by processing the pre- and post-test means of sub factors of the Advanced Test of Attention's visual and auditory tests through a t-test.

Findings: The following is concluded based on the influence of a psychomotor program on the inattention and impulsivity of children with ADHD: First, the influence on the inattention of children with ADHD led to more significant improvement of the psychomotor group in the visual and auditory sections compared to the art therapy group. Second, the impulsivity of children with ADHD improved more significantly with the psychomotor group in the auditory concentration section compared to the art therapy group. Third, the psychomotor group showed significant improvement in the consistency of response time and this means that the psychomotor group controls the consistency of response.

Application/Improvements: Finally, it is necessary to develop a system for children with ADHD to have early identification and to have educational service. And, it is also expected to activate psychomotor program for children with ADHD at school and local community

Keywords--- Psychomotor, Art, Inattention, Impulsivity, ADHD, ATA(Advanced Test of Attention).

* Corresponding Author

I. INTRODUCTION

In April 2016, a high school student set a fire at the music academy he was attending in Ansan-si, Gyeonggi-do and caused the death of one instructor and two children. The suspect "A (16 • 10th grade)" was diagnosed with attention deficit hyperactivity disorder (ADHD) two years before¹.

A fire in the Practical Music Academy in Bongo-dong in Ansan-si by a teenager which caused 9 casualties was actually caused by the safety blind spot and the indifference of the education authorities to the special education².

This case shows that the children with the symptoms ADHD need diagnosis and arrangement with special education at an early stage. In Korea, ADHD is defined as failure to pay attention, especially in class, or symptoms of aggressive or compulsive behaviors³. ADHD is a relatively frequent symptom at the childhood and its important problems are reported as medical support issues⁴.

Early diagnosis and intervention are very important for this symptom, and it is found not only in school age but also in infants, and may cause problems such as inattention, impulsivity and emotional instability⁵. If there is no early diagnosis and education, 40-70% of children with ADHD will be accompanied by hostile rebellious disorder⁶, making lie or aggression, and showing independence, social relations, reliability and responsibility problems⁷. These are the main symptom of ADHD, impulsiveness. Children with impulsiveness problems feel difficulties in delaying or suppressing their needs and suppressing or regulating behavior in social situations⁸.

According to Korea's 『Special Education Act for the Disabled Enforcement Decrees』, Identification test for early discovery of ADHD in younger Children shall be provided at no charge⁹.

When an abnormal symptom is detected in the screening test, an additional test will be carried out. But, most children with ADHD symptoms do not receive educational diagnosis and testing. If early diagnosis and treatment of infancy are not adequately addressed, ADHD problems will cause various adverse symptoms in the adulthood¹⁰.

According to a health insurance cost payment data from 2003 to 2009, patients with ADHD-related rehabilitation treatment increased more than 200%. This trend has been steadily increasing in the school age¹¹.

In particular, the annual average growth rate of teenagers in 2009-2013 is very high¹².

Various therapeutic interventions have been implemented to improve the maladjustment behaviors and reduce the problem behaviors of children with ADHD, including drug therapy^{13,14,15}, cognitive behavioral therapy^{16,17,18,19}, art therapy^{20,21}, and music therapy²². Among them, the most frequently used therapies are drug therapy and cognitive behavioral therapy²³.

Among recent diverse studies on ADHD, play therapy^{24,25} reported that children with ADHD improved self-control and school adaptability. Furthermore, previous studies for the improvement of attentiveness of children with ADHD^{26,27,28} reported that physical activity had a positive effect on psychological factors²⁹.

Psychomotor, which includes the characteristics of play and physical activity, is designed to promote the environment and motivation for children to participate happily beyond the achievement sport such as competition, and to provide self-regulation, sociality, emotion and integrated development of whole body³⁰. In addition, it is a physical activity that enables children to express themselves by developing self-confidence focusing on holistic and spontaneous experiences³¹.

Main symptoms of children with ADHD are inattention, impulsivity and hyperactivity. However, intervention programs for children with ADHD are mostly static activities such as play therapy, art therapy, music therapy, and cognitive behavior therapy.

Psychomotor involving play and exercise for children who exhibit the characteristics of hyperactivity would be a suitable program.

Psychomotor will control and improve inattention and impulsivity through spontaneous activities such as physical experience, substance experience and social experience.

The aim of this study is to examine the effects of psychomotor program on the attentiveness to children with ADHD and to suggest a necessity of Psychomotor for intervention of children with ADHD.

II. MATERIALS AND METHODS

A. Subjects

This study tested elementary school students showing attention deficit hyperactivity through the Advanced Test of Attention (ATA) to select nine children for the psychomotor group and nine children for the art therapy group for a total of 18 subjects.

B. Measuring Tools

The Advanced Test of Attention (ATA) is a computerized tool designed to evaluate continued working skills of children showing attention deficit or hyperactivity and suitable for children and adolescence between 5 and 15 years of age³².

The Advanced Test of Attention (ATA) is a computerized tool designed to evaluate the ability of the child to continuously perform attention deficit / hyperactivity disorder. It was revised using a diagnostic test developed by Kang Ui Hong, Min Seop Shin and Seong Jun Cho in 1999 and can be performed to children and youth between 5~15 years old³². It has been developed as a computer program by Brain Medic, and is currently being used as a diagnostic tool for ADHD at more than 400 hospitals. This test can be divided into visual test and auditory test to evaluate overall attention. The detailed evaluation indexes are missing error, false alarm, average of response time, standard deviation of response time, sensitivity, response criterion. The ADHD index is divided into 0-100 with normal 100-120 with suspicion and over 120 with ADHD.

Sub-categories of the test consist of visual and auditory tests, which use three shaped figures (triangle, square, and circle) and distinguish between target stimulus with triangle and non-target stimulus with square and circle. In the auditory test, 2, 3, and 4 times of beeps are used, and 2 or 4 non-target stimuli and 3 target stimuli are distinguished. Visual and auditory tests take 15 minutes respectively totaling 30 minutes.

Missing error is an indicator of inattention as a failure to respond to the target stimulus. False alarm is a response to non-target stimulus, which is measurement index of response inhibition disorder and impulsivity.

The response time mean is an average of the response time for the target stimulus and is an index for measuring the kinetic reaction rate or the information processing speed. Response time deviation is a measure of the consistency of response and the fluidity of attention as a standard deviation of the response time to the target stimulus. If a score of 70 or more on the standard deviation of missed errors and false alarms occurs, it shows an alarm initially or continual decrease of attention. Clinically, it is suspicious of ADHD initially³³.

C. Experiment Method

Psychological group consists of 9 students in K Elementary School and they were moved to D Lab, the research center by car. 9 students from N Welfare Center were in art therapy group and they had programs by visit to the welfare center in person. 20 sessions were conducted once a week for 90 minutes each. Precise attention test was performed at the first session and the last session.

Each of the psychomotor group and art therapy group attended 20 90-minute sessions once a week and took ATA in the first and last sessions.

Table 1: Psychomotor Program Group Daily Program			
Session	Program details		Time
1	Preparation	For children's interest • Trampoline activities (various trampoline activities) Mat activities (falling to the mat, running and jumping, jumping off the trampoline)	20m
	Main Activity	• Catching (rat and cat) • Hamburger play : One child enters the mat and the friends lie on the mat to make a hamburger shape and experience body and material King Dodge Ball : A group Dodge Ball activity. When children designate a king in order, the servants protect the king and two parties attach and defend to and from the ball.	50m
	Close Activity	• Parachuting (parachuting up and down, dropping a ball on top of a parachute, catching a mole) Sharing a story on activities	20m
Venue	D Psychomotor Lab		

Table 2: shows the Program by Session of Psychomotor Program by Session

session	Program details	Time
1	Area	90m
2 ~ 9	Physical experience -Preparation activity	
10 ~ 14	Substance experience - Main activity	
15 ~ 19	Social experience - Close activity	
20	Post ATA test	

The contents of the Psychomotor program was developed based on Psychomotor program²² and was reconstructed by reflecting characteristics of the subjects to improve the symptoms and attentiveness of ADHD

D. Data Analysis

Data of this study were statistically analyzed by using SPSS Ver. 18.0 program and the data processing is as follows. The mean and standard deviation per group of sub-variables on precision attention test were calculated and corresponding t-test was carried out to verify effects of attentiveness of 20 weeks. The significance level was set to $\alpha=.05$.

III. RESULTS AND DISCUSSION

A. Results of Inattention

The results of inattention test are as shown in Table 3, Figure1. The psychomotor group showed significant differences in the comparison of pre-test and post-test averages of the visual and auditory sections. The art therapy group did not show a significant difference as a result of comparing the pre-test and post-test averages of the visual and auditory sections.

Table 3: Test Results of Attentiveness

Factors	Group	Before		After		T	P
		M	SD	M	SD		
Visual	Psychomotor	7467	1370	5278	737	4530	0002**
	Art	6356	2151	6078	2290	1446	0186
Auditory	Psychomotor	7489	1648	5756	1323	4505	0002**
	Art	5644	1705	5222	136	1397	0200

**p<001

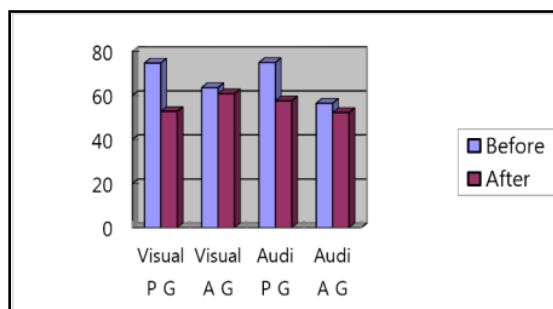


Figure 1: Example of Inattention Results

B. Results of Impulsivity

The results of impulsivity test results are as shown in Table 4, Figure2. The psychomotor group did not show a significant difference in concentration in the visual section, but no significant difference in the

auditory section. In the art therapy group, there was a significant difference in both the visual and auditory sections.

Table 4: Test Results of Concentration

Factors	Group	Before		After		<i>T</i>	<i>P</i>
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Visual	Psychomotor	7822	1760	6867	1760	1640	0088
	Art	6489	1933	6700	2461	1446	0186
Auditory	Psychomotor	7156	1818	5522	1568	4080	0004**
	Art	6489	2235	6700	2251	0577	0580

**p<001

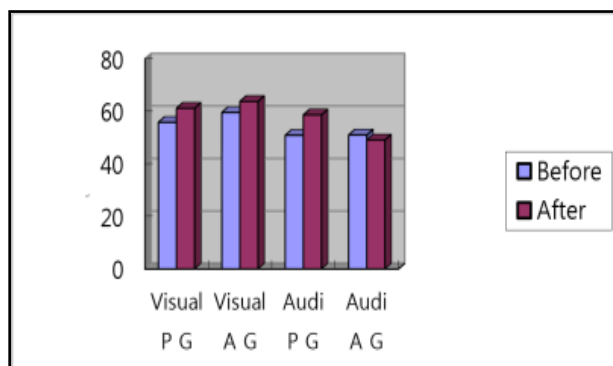


Figure 2: Example of Impulsivity Results

C. Results of Mean Response Time

The results of response time test are as shown in Table 5, Figure3. Response time, there was no significant difference in the forward response time of the psychomotor group and the art therapy group.

Table 5: Test Results of Response Time

Factors	Group	Before		After		<i>t</i>	<i>P</i>
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Visual	Psychomotor	5582	871	6118	1055	0264	0247
	Art	5956	1473	6378	1421	1245	0248
Aditory	Psychomotor	5089	1213	5867	1097	2037	0712
	Art	5100	636	4911	833	0985	0354

**p<001

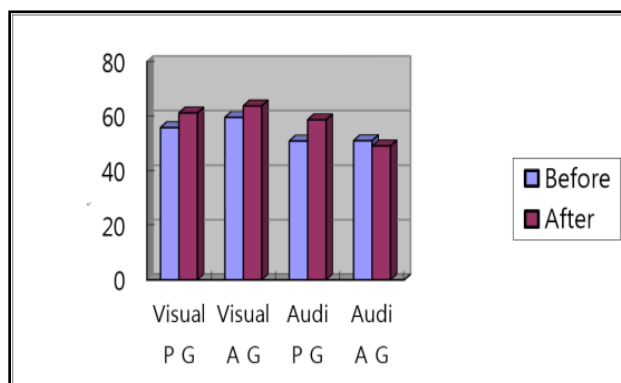


Figure 3: Example of Response Time Results

D. Results of Mean Standard Deviation

The results of mean standard deviation of response test are as shown in Table 6, Figure4. The standard deviation of response time, the psychomotor group showed a significant difference only in the visual section. The art therapy group did not show any significant difference in the visual and auditory sections.

Table 6: Test Results of Mean Standard Deviation

Factors	Group	Before		After		<i>t</i>	<i>P</i>
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Visual	Psychomotor	7211	1294	5889	1576	2581	0033*
	Art	6289	2311	6300	2467	0345	0974
Auditory	Psychomotor	5556	989	5278	1035	0756	0471
	Art	4678	833	4589	1209	0363	0726

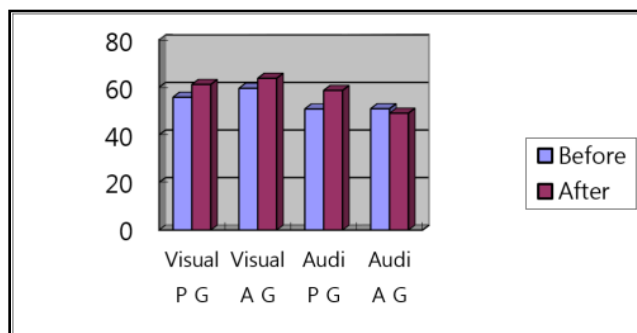
**p*<001

Figure 4: Example of Mean Standard Deviation Results

The aim of this study was to examine the effect of Psychomotor program on the inattention of children with ADHD who participated in the program of attentiveness for school maladjusted children.

The results of the study per sub-variables are as follows. First, the group that participated in psychomotor showed more positive change in regards to the visual and auditory inattention of children with ADHD compared to the art therapy group. This also corresponds with the results of the study³⁴ that the psychological therapy effectively reduced incautiousness and compulsiveness. These results support the argument of Kiphard³⁰ that experience-centered or personality-centered therapy to fulfill children's desires allows them to engage in play and act liberally for spontaneous expressions. According to³⁵ improving the attentiveness of children with ADHD is related to the visual imitation and the educational resources and facilities. It seems that the use of various resources to evoke the children's interests and attention during the psychological exercise was helpful for improving their attentiveness. In order to improve the attentiveness of children with ADHD, the physical activity was more influential when there were play activities and they were spontaneous^{27,29}. The major symptoms of children with ADHD influenced their incautiousness probably because the various movements and matters make them concentrate. When instructing children with ADHD, it would be helpful to encourage their spontaneity and give them no time to be tedious to improve their attentiveness and social skills. These results manifest that an educational approach based on physical activities is necessary for the cognition-behavior-centered intervention programs for children with ADHD³⁶.

Second, the false alarm variable to identify impulsivity is a very important indicator for reaction inhibition disorder and concentration as a response to non-target stimulus. Psychomotor group showed significant difference only in auditory area than art therapy group.

Among the symptoms of ADHD, the main problem of impulsivity is hitting, kicking, twitching, or suddenly hanging peer friends without reason. The results of the study of³⁷, which applied physical activity to these impulsive children, showed improvement of impulsivity control. Furthermore, it is a supportive result of³⁸ that Psychomotor is an effective intervention to reduce maladaptive behavior in children with ADHD.

It suggests that the relaxation activities during and after the program activities contributed to the decrease of impulsiveness in the Psychomotor program. The relaxation activities used in this study were revised and supplemented by³⁹ Tension and relaxation programs are included in the studies such as⁴⁰ that argues tension and relaxation principles would connect to physical change and psychological change that Psychomotor had positive effect of ego-system, social relation and aggressiveness of children before school age.

Third, Response time was no significant difference in Psychomotor group and art therapy groups at the time of the response time, but the decrease of the standard deviation of the auditory area was because of decrease of sensitivity by the controlling of impulsivity.

Fourth, The standard deviation of the response time is a variable that measures the consistency of the response. It can be interpreted that the consistency is improved by showing a significant difference in the standard deviation of the visual area in the Psychomotor group.

IV. CONCLUSION

As such, the Psychomotor program had a significant effect on the inattention and impulsiveness of children with ADHD.

The following suggestions are made for follow-up studies based on the findings of this study:

First, Korea still implements programs for children with ADHD mostly focused on chemical therapy or cognitive behavior, art, or play therapy. Psychological exercise focused on spontaneity and physical activities should be spread to more places.

Second, it is suggested that the psychological exercise program should be added to early identification of children with ADHD within the social service, which is a voucher system in Korea, and to the children/adolescence psychological support service which is a therapeutically intervention program.

Finally, systemized intervention programs should be provided at schools to prevent children with ADHD's growing into criminals.

V. SUGGESTIONS

Various psychomotor programs have not been developed as a manual in Korea yet. So, it is hoped to develop diverse programs on Attention and impulsiveness to be used extensively in the field. Secondly, children with ADHD can be divided into impulsive predominant type, careless predominant type, and mixed type. It is necessary to carry out follow-up studies in order to analyze and verify change of Attentiveness by means of psychomotor intervention to each group

REFERENCES

- [1] Seoul Shinmun, The teen who set an academy in Ansan on fire diagnosed with ADHD 2 years ago; "started the fire when others tried to stop him." <http://www.seoul.co.kr/April 4th, 2016>.
- [2] Gyeongin Daily Newspaper. ADHD (hyperactivity disorder) left on the sound absorbing music room as an 'ignition of crime' <http://www.kyeongin.com/April 4th, 2016>.
- [3] Choi B M, Lee BR, Characteristics of Attentiveness of Children with Attention Deficit and Hyperactivity. The Society of Neuropsychiatric Science, 2000, 39(5), pp. 870-878.
- [4] Kim Y O, Teaching-Learning Strategies for Children with Learning Disorders. Multinet: Seoul, 2003.
- [5] Scahill L, Schwab-Stone, M. Epidemiology of ADHD in school-age children. Child and adolescent psychiatric clinics of North America. Motorik, 2000, 9(S), pp.59-67.
- [6] Barkley R A, DuPaul G J, McMurray M B. Comprehensive evaluation of attention deficit disorder with and without hyperactivity as defined by research criteria. Journal of consulting and clinical psychology, 1990, 58(6), pp.775.
- [7] Murphy K R, Barkley R A, Parents of children with attention-deficit/hyper activity disorder. Psychological and attentional impairment. American Journal of Orthopsychiatry, 1996, 66(1), pp.93.
- [8] Corkum P V, Siegel L S, Isn't he continuous performance task a valuable research tool for use with children with ADHD? Journal of Child Psychology and Psychiatry, 1993, 34, pp.1217-1123.
- [9] Kim N J, Kim J E, Choi H S, Diagnosis and Evaluation of Children with Disability. Yangseongwon, 2014.
- [10] Owens E B, Hinshaw S P, Child hood conduct problems and young adult outcomes among women with childhood (ADHD). Journal of abnormal psychology, 2016, 125(2), pp.220.
- [11] Health Insurance Policy Institute, ADHD (Attention Deficit and Behavior Disorder) Number of patients increased by 238% in 6 years compared to 2003. Ministry of Health and Welfare's Press Release, 2010.
- [12] Health Insurance Policy Institute, 66% of Attention Deficit Hyperactivity Disorder (ADHD) patients out of 58121 health care patients in 2013 are teenagers. Ministry of Health and Welfare's Press Release, 2015.
- [13] Kim H C, Public Perspectives on Pharmacological Treatment of Attention-Deficit Hyperactivity Disorder. Korean College of Neuropsychopharmacology, 2014, 25(3), pp.134-140.
- [14] Bahn G H, Revisiting History of Treatment of Attention Deficit Hyperactivity Disorder: Pharmacologic Approach. Journal of Korean Society of Biological Psychiatry, 2014, pp.37-48.

- [15] Song M A, Use of Atypical Antipsychotics in Attention-Deficit Hyperactivity Disorder. Korean College of Neuropsychopharmacology, 2013, 24(1),pp.11-17.
- [16] Kim Y H, The Mediational Effect of Learning Strategies on the relationship between ADHD symptoms and Academic Achievement. Korean Association of Cognitive Behavior Therapy, 2015, 15(2), pp.247-267.
- [17] Park K A, Choi S O, Effects of Play-oriented Cognitive Behavior Programs on ADHD Children's Self-Control. Korean Psychological Service Association, 2014, 6(2), pp.94-111.
- [18] Eun K B, A Study on the Effectiveness of School Setting Cognitive behavioral Program for Children with the Propensity of ADHD, Parents and Teachers. Mental Health and Social Work, Vom,2013, 41(1), pp.169-198.
- [19] BaekE Y, The effects of cognitive-behavioral learning therapy program on attentional and self-regulated learning abilities for middle school students with ADHD tendencies. National Youth Policy Institute, 2015, 26(1), pp.245-268.
- [20] Shin J H, Kim E J, Lim J H, A Study on a Single Case of Art Therapy Using Play Therapy for Affection and Problem Behaviors of Children with ADHD. Special Education and Rehabilitation Science Research, 2015, 54(2).
- [21] Lim Y M, How Art Therapy Using Natural Objects Influence Attentiveness of Children with ADHD. The Korean Association for Children with Special Needs, 2015, 17(2), pp.257-284.
- [22] Kim C K, You J Y, The effects of the psychomotoric play therapy program on reducing problematic behaviors and improving social skills of the ADHD children. Korea Association For Play Therapy,2010, 14(1), pp.51-65.
- [23] McCarty C A, Myers K, Interventions developed for psychiatric and behavioral treatment in the Children's ADHD Telemental Health Treatment Study, 2015.
- [24] Kim Y S, The effect of the expressive arts therapy program using traditional play on sociality and self-expression of children with ADHD. The Journal of Play Therapy, 2014, 18(3), pp.107-122.
- [25] Choi E B, Jung M R, Aggressiveness and Rebellion of Children with ADHD and Case Study of Play Therapy for Mother-Child Interaction, 2015.
- [26] Kim M J, The Influence of Elementary School Visiting Teachers' Play Therapy on Self-Control, Adaptation, and Play Behaviors of Children with ADHD. Child Welfare Study, 2010, 8(2), pp.71-87.
- [27] Hong Q J, Effects of Tai Chi on Attention and Dynamic Balance in Children and Adolescent with ADHD. Korean Journal of Adapted Physical Activity, 2015, 23(3), pp.1-11.
- [28] Lee J G, Jung T W, Cho H G, Han D H, The Influence of Horseback Riding Program for Rehabilitation on the Psychology of Children with ADHD. Journal of Korea Society of Special Physical Education, 2015, 23(4), pp.141-152.
- [29] Lee S K,The Influence of Physical Program on the Brain Waves and Psychological Factors of Children with ADHD, 2014.
- [30] Kiphard E J,Motopädagogik, 1987.
- [31] Lee S J, Understanding Psychomotor. SeoulGeneral Welfare Center for the Disabled: Seoul, 2005.
- [32] Ah J K, Shin M S,The Comparison of the Neuropsychological Functions in Subtypes of Children with ADHD. Korean Journal of Psychology: General, 2010, 129(4), pp. 959-973.
- [33] Cho H I, Do J, Kim H W, Lim M H, Children's Behavior Evaluation Scale, Children's Personality Test, Attention Disorder Diagnostic System in Relation to Attention Deficit and Hyperactivity. Journal of Korean Academy of Anxiety Disorder, 2009, 5(2), pp.96-102.
- [34] Kim N Y, Go S Y,Affect of Factors on the ADHD Children's Attention and Imitation Skills In the Play Program. Korean Journal of Adapted Physical Activity, 2004, 12(2), pp.34.
- [35] Jung S K, Lee S J,The Influence of Psychomotorand Integrated Treatment of Senses on the Sensory Control and Attention of Children with Traits of ADHD. Special Education Study, 2011, 13(4), pp.331-356.
- [36] Lee S J, Children with ADHD and Psychomotor. Korea Society of Psychomotor Program Resources, 2010.
- [37] Lee J Y, The effects of music rope-skipping exercise on attention deficit hyperactivity disorder child, 2012.
- [38] Song H J, The Effects of Psychomotor Intervention using Self-Talk for Attention-Deficit Hyperactivity Disorder Children's Motor Coordination and Maladjustment Behaviors. KOREAN SOCIETY FOR THE EMOTIONAL & BEHAVIORAL DISORDERS, 2012, 28(1), pp.191-220.

- [39] Kim C K, You J Y, The effects of the psychomotoric play therapy program on reducing problematic behaviors and improving social skills of the ADHD children. Korea Association For Play Therapy, 2010, 14(1), pp.51-65.
- [40] Won S H, A Study on the Principle of Psychomotoric Depending on Tension and Relaxation of Muscle. KOREAN SOCIETY FOR THE EMOTIONAL & BEHAVIORAL DISORDERS, 2007, 23(4), pp.217-240.



ISSN
0975-6299

Factors Influencing Body Mass Index in the Elderly According to Hypertension Status

Young-Hee Kim, Dept. of Nursing, Hyrchonro 100 Seogu Daejeon, Korea. E-mail:kimyh@dst.ac.kr

Myoung-Jin Kwon*, Dept. of Nursing, Daehakro 62 Donggu Daejeon, Korea. E-mail:mjkwon@dju.kr

Abstract---

Background/Objectives: This descriptive research study examined the 2014 Korea National Health and Nutrition Examination Survey (KNHANES) data to identify factors influencing BMI in the elderly according to hypertension status.

Methods/Statistical Analysis: Of the 7,550 respondents who participated in the 2014 KNHANES, jointly conducted by the Ministry of Health and Welfare, a total of 1,340 elderly respondents who clearly indicated 'yes' (716) or 'no' (624) for the questionnaire item inquiring about medically diagnosed hypertension status were included in the study. Collected data were processed with IBM SPSS 21.0 to generate a complex sample design file for analysis

Findings: The results are as follows. 1) Regarding physical factors, a significant difference in BMI and systolic pressure was found between two groups. Significant group differences were also found for the psychological factors of subjective body awareness, subjective health status, and history of nutrition education ($p < .05$). 2) among the subjects with hypertension, BMI varied significantly according to age ($p < .001$), stress level ($p = .007$), subjective body type ($p < .001$), and frequency of eating out ($p = .003$). Among the non-hypertensive subjects, BMI varied significantly according to gender ($p = .013$), age ($p = .019$), subjective body awareness ($p < .001$), water intake ($p = .041$), and fat intake ($p = .018$).

Improvements/Applications: As part of the intervention, diet, exercise, and medication regimen, as factors influencing the BMI of each patient should be considered.

Keywords--- Hypertension, BMI, Elderly, Age, Subjective Body Awareness.

* Corresponding Author

I. INTRODUCTION

According to the 2014 Korea National Health and Nutrition Examination Survey (KNHANES), the leading cause of death per 100,000 Korean populations was cancer, followed by cerebrovascular disease and cardiovascular disease. Hypertension is a major risk factor for both cardiovascular and cerebrovascular diseases, and the condition poses a substantial healthcare burden on the nation as a whole. In Korea, the prevalence of hypertension is 25.5%. Of individuals with hypertension, 62.2% have been medically diagnosed for the condition by a physician, while 58.6% treat the condition by using anti-hypertensive drugs more than 20 days per month. The rate of hypertension management is a mere 43.1%¹, which demonstrates the need for more active control and management of the condition.

Major causes of hypertension include obesity, as well as high-fat diet and inactive lifestyle, smoking, excessive sodium intake, insufficient potassium and magnesium intake, excessive alcohol intake, and excessive stress. In addition, other chronic conditions, such as high cholesterol, diabetes, and renal disease, are believed to increase the risk of hypertension².

Obesity is an individual risk factor for hypertension, and when it is accompanied by hypertension, the risk of cardiovascular disease increases³. Yang et al.⁴, in their study that examined the correlation between BMI and borderline hypertension, found that the group of patients with a BMI exceeding 26 kg/m² was at a high risk of developing hypertension and cardiovascular disease. Kim⁵ analyzed the independent effect of obesity on hypertension risk, and found that obese individuals had a 38% higher likelihood of developing hypertension.

In contrast, a significant difference was found in terms of dietary and nutritional intake patterns. In the case of adult men, average calorie, fat, carbohydrate, and protein intake increased significantly as BMI increased. The increase in intake was particularly significant in men with a BMI of 30 and above⁶.

The growing rates of obesity and chronic illness caused in part by a westernized diet and lifestyle, demand effective management, which requires identification of the link between these conditions and dietary habits⁶. This study analyzed the KNHANES data to examine the nutritional intake patterns of elderly individuals according to BMI and hypertension status. Through identification of dietary habits among the elderly with hypertension, the study ultimately aims to provide foundational data to design an effective patient education program pertaining to BMI and hypertension management in elderly patients.

II. STUDY METHODS

A. Study Design

This descriptive research study was conducted to identify the correlation between BMI and nutritional intake among the elderly according to hypertension status.

B. Study Subjects

For the study, the second-year, raw data of the 6th KNHANES were used. The KNHANES is a nationally representative survey that assesses the health level, health behaviors, and dietary/nutritional intake patterns of the Korean population. Data acquired through the survey provide the basis for establishing and assessing national health policies, as well as health promotion goals and programs. The 2014 KNHANES, which was jointly conducted by the Ministry of Health and Welfare and the Korea Centers for Disease Control and Prevention, included a total of 7,550 respondents. In this study, a total of 1,340 elderly respondents, who clearly indicated 'yes or 'no' for the questionnaire item inquiring about medically diagnosed hypertension status (624 'no', 716 'yes'), were included.

C. Study Variables

a. General Characteristics

Variables considered general characteristics include age, gender, economic status, education level, marital status.

b. Physical Characteristics

- BMI: Calculated based on physical measurements of body weight and height. Expressed in units of body weight (kg)/height (m)². Underweight: <18.5 kg/m², normal weight: 18.5 kg/m²–23 kg/m², overweight: 23–25 kg/m², obese: >25 kg/m² [1].
- Systolic pressure(mmHg)
- Diastolic pressure(mmHg)

c. Psychological Characteristics

- Subjective health status: item pertaining to respondent's subjective opinion regarding his/her own health status. Scored on a 5-point scale, with 1 point indicating 'very good', and 5 points indicating 'very poor.'

- Subjective body awareness: item pertaining to respondent's subjective opinion regarding his/her own body type. Scored on a 5-point scale, with 1 point indicating 'very thin', and 5 points indicating 'very obese.'
- Stress: scored on a 4-point scale, with 1 point indicating 'very often', and 4 points indicating 'almost never.'

d. Diet-related Characteristics

Based on the average daily nutritional requirement for the elderly, recommended by the 2015 Dietary Reference Intakes for Koreans published by the Ministry of Health and Welfare and Korea Nutrition Society².

- Daily caloric intake (kcal): 2,000 kcal for men, 1,600 kcal for women
- Daily water intake (g): 2,100 g for men, 1,800 g for women
- Daily protein intake (g): 55 g for men, 45 g for women
- Daily fat intake(g): 15–30 g for men and women
- Daily carbohydrates intake (g): 100 g for men and women
- Frequency of eating out
- History of nutrition education

e. Data Analysis Method

From the second-year, raw data of the 6th KNHANES collected via a stratified cluster sampling method, the data pertaining to elderly respondents who clearly indicated whether or not they had been medically diagnosed with hypertension, were extracted. Subsequently, the extracted data were examined to evaluate if the influencing factors varied according to hypertension status, and to identify the correlation between BMI and other factors.

IBM SPSS 21.0 was used to generate a complex sample design file (stratified variable: variance estimation strata (kstrata), cluster variables: sampling unit (psu), and weighted variables: sampling weights (wt_itvex) for health interview survey and health exam), and the significance level was set at $p=.05$. General characteristics and differences in physical, psychological, and dietary factors according to hypertension status are expressed as percentage with standard deviation, and analyzed via Rao-scott chi-square test. Correlation between BMI and physical, psychological, and dietary factors according to hypertension status were analyzed via complex sampling cross analysis.

III. RESULTS

A. Demographic Characteristics of Study Subjects

As shown in table1, both groups consisted of more women than men. The majority of both groups were between 65 and 74 years of age (419 [58.5%] in the hypertension group and 435 [69.7%] in the healthy group).

A higher percentage of the hypertension group (360 subjects, 50.6%) reported 'low' economic status than the healthy group (273 subjects, 44.0%).

The majority of both groups (451 subjects, 65.1% in the hypertension group and 350 subjects, 57.4% in the healthy group) reported 'less than elementary school degree' for education level.

In terms of spousal cohabitation status, 460 subjects (64.7%) in the hypertension group and 448 subjects (72.3%) in the healthy group were living with a spouse. The group difference was significant in terms of gender and age. ($p<.05$)

Table 1: General Characteristics of Subjects

Characteristics		Hypertension(n=716)			Non Hypertension(n=624)			t(p)
		n	%	SE	n	%	SE	
Gender	Male	284	39.6	2.1	297	47.8	1.9	-2.51 (.013)
	Female	432	60.4	2.1	327	52.2	1.9	
Age(year)	65-74	419	58.5	2.3	435	69.7	2.3	-2.95 (.004)
	75-84	278	38.8	2.3	174	27.8	2.3	
	85≤	19	2.7	0.7	15	2.5	0.8	
Economic status	Low	360	50.6	2.7	273	44.0	2.7	0.79 (.431)
	Medium-low	168	23.6	2.0	184	29.6	2.4	
	Medium-high	106	14.9	1.7	88	14.1	1.5	
	High	77	10.9	1.7	75	12.3	1.7	
Education level	Elementary school	451	65.1	2.4	350	57.4	2.6	1.26 (.208)
	Middle school	74	10.7	1.3	101	16.5	2.0	
	High school	110	15.9	1.5	92	15.1	1.9	
	College≤	57	8.3	1.4	66	11	1.4	
Marital Status	With Spouse	460	64.7	2.4	448	72.3	2.1	-1.39 (.165)
	Others	250	35.3	2.4	171	27.7	2.1	

B. Physical, Psychological, and Dietary-related Characteristics

As shown in table2, in terms of physical factors, a majority of the hypertension group reported BMI ≥ 23 (313 subjects, 65.8%), while the majority (1,180 subjects, 50.5%) of the healthy group reported a BMI between 18.5–23.

Regarding systolic pressure, the majority in the hypertension group (355 subjects, 49.6%) had a systolic pressure between 120–139 mmHg, while the majority of the healthy group (285 subjects, 45.7%) had a pressure of less than 120 mmHg.

Of the psychological factors, subjects who replied ‘average’ for subjective health status and subjective body awareness accounted for the majority in both groups.

Subjects who had never received nutritional education accounted for the majority in both groups, 650 subjects (94.8%) and 278 subjects (94.3%) in the hypertension and healthy group, respectively.

Regarding physical factors, a significant difference in BMI and systolic pressure was found between two groups.

Significant group differences were also found for the psychological factors of subjective body awareness, subjective health status, and history of nutrition education ($p < .05$).

Table 2: Physical, Psychological and Diet-related Characteristics

Characteristics			Hypertension (n=716)			Non Hypertension(n=624)			t(p)
			n	%	SE	n	%	SE	
Physical characteristics	BMI	<18.5	11	1.8	0.6	30	4.9	1.0	-6.50 (.001)
		18.5-22.9	207	30.4	2.0	274	45.3	2.5	
		23-24.9	172	24.9	1.9	153	24.0	1.9	
		25 $\leq$	303	42.9	2.2	151	25.7	2.0	
	Systolic blood pressure	<120	215	30.0	1.8	285	45.7	2.4	-5.46 (.001)
		120-139	355	49.6	2.0	238	38.2	2.3	
		140 $\leq$	145	20.4	1.7	100	16.0	1.8	
	Diastolic blood pressure	<80	688	96.2	0.7	604	96.9	0.6	-0.60 (.548)
		80-89	25	3.4	0.7	15	2.4	0.6	
		90 $\leq$	2	2.4	0.1	4	0.7	0.3	
Psychological characteristics	Stress	So much feeling	28	4.1	0.9	13	2.1	0.6	-0.08 (.933)
		Feeling a lot	94	13.8	1.5	70	11.7	1.4	
		A little feeling	315	46.5	2.1	312	52.5	2.1	
		Not hardly notice	240	35.6	2.2	199	33.5	2.0	
	Subjective body awareness	Very thin	47	6.9	1.4	67	11.1	1.5	-5.08 (.001)
		Thin	76	11.1	1.4	104	17.3	1.6	
		Normal	309	45.4	2.0	284	47.4	2.1	
		Slightly overweight	198	29.1	2.1	122	20.3	1.8	
		Very overweight	50	7.5	1.1	22	3.9	0.9	
	Subjective health status	Very Good	24	3.3	0.8	41	6.5	0.9	-2.98 (.003)
		Good	112	15.6	1.5	117	18.7	1.7	
		Normal	319	44.6	2.3	303	48.6	2.2	
		Bad	168	23.4	1.8	107	17.1	1.6	
		Very Bad	92	13.1	1.4	55	9.1	1.3	
Diet related characteristics	Caloric intake (kcal)	Below	438	64.0	2.2	352	59.1	2.5	1.12 (.262)
		Excess	246	36.0	2.2	243	40.9	2.5	
	Water intake (average daily requirement, g)	Below	653	95.1	0.8	559	93.9	1.1	1.13 (.259)
		Excess	33	4.9	0.8	36	6.1	1.1	
	Protein intake (average daily requirement, g)	Below	352	52.6	2.2	297	50.5	2.3	-0.21 (.829)
		Excess	316	47.4	2.2	291	49.5	2.3	
	Fat intake(g)	<15	252	38.2	2.2	190	33.2	2.6	1.47 (.143)
		15-30	243	36.8	2.0	210	36.7	2.4	
		30<	164	25	2.0	171	30.1	2.4	
	Carbohydrate intake(g)	<100	12	1.7	0.8	9	1.5	0.6	0.66 (.510)
		100 $\leq$	673	98.3	0.8	585	98.5	0.6	
	Frequency of eat out	2 $\leq$ times/day	5	0.7	0.5	9	1.5	0.6	-1.70 (.091)
		1time/day	13	1.8	0.5	21	3.5	0.9	
		5-6times/week	38	5.5	1.1	31	5.2	1.0	
		3-4times/week	40	5.8	1.0	45	7.5	1.1	
		1-2times/week	172	25.0	1.9	155	26.0	1.9	
		1-3times/month	220	32.0	2.2	194	32.6	2.0	
		Almost never	198	29.2	2.3	140	23.7	2.1	
	History nutrition education	Yes	36	5.7	1.1	17	3.0	0.8	2.0 (.046)
		No	588	94.3	1.1	278	97.0	0.8	

C. Correlation between BMI and Other Variables

As shown in table 3, among the subjects with hypertension, BMI varied significantly according to age ($p<.001$), stress level ($p=.007$), subjective body type ($p<.001$), and frequency of eating out ($p=.003$). Among subjects with hypertension, 28.7% of those between 65–74 years of age and 43.6% of those 85 years and older had a BMI between 18.5 and 22.9. Among the same group of subjects, 48.8% of those who frequently felt stressed and 27.4% of those who almost never felt stressed had a BMI between 18.5 and 22.9. Among the hypertensive subjects who frequently felt stressed out, 30.4% had a BMI of ≥ 25 , while of those who almost never felt stressed out, 45.8% had a BMI of ≥ 25 , indicating that a lower BMI was associated with a higher level of stress. Among hypertensive subjects, 82.0% of those who perceived themselves to be 'very thin' and 2.4% of those who perceived themselves to be 'very obese' had a BMI between 18.5 and 22.9. Among the hypertensive subjects, 4.6% of those who perceived themselves to be 'very thin' and 94.1% of those who perceived themselves to be 'very obese' had a BMI ≥ 25 , indicating that perception of obesity was associated with a higher BMI. Among hypertensive subjects, of those who eat out twice or more daily and of those who eat out once daily, 81.6% and 50.1%, respectively, had a BMI between 23 and 24.9; of those who eat out 3–4 times per week, 11.9% had a BMI between 23 and 24.9, indicating a significant range of variance.

Among the non-hypertensive subjects, BMI varied significantly according to gender ($p=.013$), age ($p=.019$), subjective body awareness ($p<.001$), water intake ($p=.041$), and fat intake ($p=.018$). Of the healthy subjects, 20.0% of men and 30.7% of women had a BMI of 25 and above. Among healthy subjects, 42.9% between 65–74 years of age and 53.6% aged 85 years and older had a BMI between 18.5 and 22.9. Among healthy subjects who perceived themselves to be 'very thin', 73.8% had a BMI between 18.5–22.9, while 1.6% of those who perceived themselves to be 'very obese' had a BMI between 18.5 and 22.9. Among healthy subjects who perceived themselves to be 'very thin', 2.1% had a BMI ≥ 25 , while of those who perceived themselves to be 'very obese', 78.8% had a BMI ≥ 25 , indicating that BMI increased for subjects perceived themselves to be overweight. Among healthy subjects, the 47.3% who did not meet the daily water intake requirement, and the 27.9% who exceeded the requirement had a BMI between 18.5 and 22.9. As for daily fat intake amongst the same group of subjects, 54.9% consumed less than 15%, while 39.0% consumed between 15–30%, indicating variance.

Table 3: Correlation between BMI and Other Variables

Characteristics		Hypertension (n=624)					Non Hypertension (n=716)				
		BMI (kg/m ²)					BMI (kg/m ²)				
		0–18.4 %(SE)	18.5–22.9 %(SE)	23.0–24.9 %(SE)	≥ 25 %(SE)	X ² (p)	0–18.4 %(SE)	18.5–22.9 %(SE)	23.0–24.9 %(SE)	≥ 25 %(SE)	X ² (p)
Sex	Male	1.8(0.7)	32.2(3.3)	28.1(3.2)	38.0(3.2)	4.68	7.2(1.7)	48.6(3.2)	24.3(2.8)	20.0(2.6)	13.45
	Female	1.8(0.8)	29.3(2.7)	22.9(2.4)	46.0(2.9)	(.315)	3.0(1.1)	42.6(3.4)	23.8(2.6)	30.7(2.8)	(.013)
Age(year)	65–74	0.5(0.4)	28.7(2.7)	21.4(2.4)	49.3(2.6)	26.41	2.9(0.9)	42.9(2.8)	27.5(2.4)	26.7(2.5)	20.66
	75–84	3.4(1.3)	31.8(3.0)	30.6(3.3)	34.3(3.4)	(.001)	8.3(2.4)	49.9(4.4)	17.4(3.1)	24.5(3.7)	(.019)
	≥ 85	4.8(4.7)	43.6(12.2)	11.1(5.4)	40.5(13.5)		17.8(9.8)	53.6(14.3)	12.8(8.8)	15.8(10.8)	
Stress	So much feeling		48.8(11.1)	20.8(9.3)	30.4(9.8)	37.03	7.8(6.9)	35.1(14.5)	31.1(12.1)	26.0(11.7)	8.33
	Feeling a lot	0.6(0.6)	44.9(6.2)	19.3(4.3)	35.2(5.5)	(.007)	7.2(2.8)	46.6(6.0)	23.4(5.3)	22.7(6.8)	(.805)
	A little feeling	1.0(0.5)	28.0(3.3)	24.4(3.0)	46.7(3.3)		3.2(1.1)	45.0(3.3)	25.6(2.6)	26.1(2.9)	
	Not hardly notice	2.1(1.2)	27.4(3.5)	24.7(3.5)	45.8(4.1)		6.6(2.2)	44.6(4.3)	23.3(3.8)	25.5(3.5)	
Subjective body awareness	Very thin	7.9(4.5)	82.0(6.0)	5.5(3.4)	4.6(4.5)	388.05	22.4(5.3)	73.8(5.9)	1.7(1.2)	2.1(1.6)	283.03
	Thin	3.2(1.9)	78.3(5.4)	8.0(3.7)	10.5(4.2)	($<.001$)	6.9(2.2)	78.8(4.1)	11.7(3.2)	2.7(1.5)	($<.001$)
	Normal	0.3(0.3)	32.7(3.3)	39.0(3.3)	28.0(2.8)		2.5(1.2)	41.4(3.4)	34.9(3.0)	21.2(2.9)	
	Slightly overweight	0.6(0.6)	6.0(2.2)	16.5(3.0)	76.9(3.6)			14.2(3.7)	25.2(3.6)	60.6(4.8)	
	Very overweight		2.4(1.7)	3.5(3.4)	94.1(3.8)			1.6(1.7)	19.5(9.7)	78.8(9.9)	
Water intake (g)	Below	2.0(0.6)	30.3(2.2)	24.2(2.1)	43.6(2.3)	1.51	5.0(1.0)	47.3(2.4)	23.5(2.1)	24.2(2.0)	10.53
	Excess		29.3 (8.6)	29.9(8.5)	40.8(9.9)	(.726)		27.9(8.7)	41.0(8.1)	31.1(9.3)	(.041)
Fat intake(g)	<15	1.9(1.2)	27.9(3.2)	28.7(3.5)	41.6(3.8)	12.75	6.0(1.7)	54.9(4.0)	18.8(3.0)	20.3(3.2)	17.07
	15–30	2.2(1.1)	35.0(3.2)	24.8(2.9)	37.9(3.2)	(.108)	2.8(1.1)	39.0(3.9)	32.1(3.9)	26.0(3.1)	(.018)
	>30	0.5(0.5)	29.5(4.0)	18.4(3.1)	51.6(4.0)		4.7(1.8)	45.0(4.2)	23.4(3.5)	26.8(3.7)	
Eat out count	≥ 2 times/day			81.6(17.3)	18.4(17.3)	48.24	12.7(12.0)	36.8(17.8)		50.5(19.6)	29.81
	1 time/day			50.1(14.9)	49.9(14.9)	(.003)	4.7(4.7)	47.2(13.7)	37.1(13.2)	10.9(6.3)	(.124)
	5–6 times/week		36.6(8.3)	16.3(6.3)	47.1(8.8)			33.6(9.5)	33.4(9.4)	33.0(9.6)	
	3–4 times/week	2.9(2.9)	31.5(8.2)	11.9(5.0)	53.6(8.4)		2.2(2.2)	39.3(8.0)	31.5(6.9)	27.0(7.0)	
	1–2 times/week		30.5(4.1)	27.7(4.0)	41.8(3.9)		3.9(1.6)	40.3(4.0)	24.9(3.5)	30.9(3.9)	
	1–3 times/month	0.6(0.4)	30.5(3.3)	23.4(3.6)	45.5(3.8)		3.6(1.5)	52.5(4.5)	21.2(3.1)	22.7(3.6)	
	Almost never	5.3(1.9)	31.3(4.1)	23.1(3.5)	40.3(4.9)		7.9(2.5)	48.7(5.1)	24.7(3.9)	18.7(3.6)	

IV. DISCUSSION

The present study analyzed the KNHANES data to identify the nutritional intake patterns in the elderly according to BMI and hypertension status. The purpose of the study was to identify the dietary habits of hypertensive elderly patients in order to be able to provide foundational data to develop pertinent patient education. The study found that the group of subjects with hypertension had a higher BMI than the group of healthy patients. Seo et al.⁷ reported that, among their study's hypertensive subjects 60 years and older, 43.7% had abdominal obesity, and a high proportion, 62.4%, had a BMI of 23 or above. Lee et al.⁸ reported that the risk of developing hypertension is 2.65 times greater for obese individuals than for healthy individuals. Therefore, effective obesity management is crucial for prevention and management of hypertension.

Comparison of nutritional intake between hypertensive elderly and healthy elderly found no difference in terms of carbohydrates, protein, fat, and calorie intake. Koo et al.⁹ compared the nutritional intake patterns of hypertensive adults and healthy adults and found that the difference lies in their caloric intake, rather than their protein intake. Kim et al.¹⁰ reported that, among male workers, although no difference was found in caloric intake, carbohydrate intake was higher and fat intake lower in the hypertension group, which suggested that nutritional intake profile can vary depending on the group of hypertensive subjects.

In the present study, the BMI of hypertensive subjects varied significantly according to gender, stress level, subjective body type, and frequency of eating out. In comparison, the BMI of healthy subjects varied significantly according to gender, age, subjective body type, water intake, and fat intake. Among the hypertensive subjects, women, those who rarely experience stress, those whose subjective body awareness is 'obese', and those who frequently eat out had a higher BMI, suggesting that for effective BMI management, intervention programs reflecting the above factors are necessary.

As examined above, obesity is more prevalent among hypertensive individuals than among healthy individuals, and their BMI varies significantly according to gender, stress level, subjective body type, and frequency of eating out. Therefore, personalized hypertension management and obesity prevention programs, designed with consideration of specific factors influencing the BMI of each patient, must be developed and implemented.

V. CONCLUSION

The present study found that the group of subjects with hypertension had a higher BMI than the group of subjects without the condition. The factors affecting BMI differ between the two groups. Therefore, nursing intervention strategies designed to effectively manage the BMI of patients with hypertension are needed. As part of the effort, diet, exercise, and medication regimens reflecting the specific factors influencing the BMI of each patient should be considered.

REFERENCES

- [1] Ministry of Health & Welfare and The Korean Nutrition Society, Dietary Reference Intakes for Koreans, 2015, http://www.mohw.go.kr/front_new/jb/sjb030301vw.jsp?PAR_MENU_ID=03&MENU_ID=0329&CONT_SEQ=329490&page=1
- [2] Sandmaier M, The Health Heart Handbook for Women National Heart, Lung, and Blood Institute, US Department of Health and Human Services, 2007, NIH, USA.
- [3] Alexander C, Landsman P, Teutsch S, Haffner S, NECP define metabolic syndrome, diabetes and prevalence of coronary heart disease among NHANES III participants age 50 years and older, Diabetes, 2003, 52(2), pp. 1210-1214.
- [4] Yang SW, Chang MJ, Choi HM, Relationship between Body Mass Index and Borderline Hypertension in Elderly Overweighted Women by Age, The Korean Journal of Physical Education, 2015, 54(6), pp. 547-554. <http://www.dbpia.co.kr/Journal/PDFViewNew?id=NODE07039728&prevPathCode=>
- [5] Kim H, Effects of Community Based Participatory Obesity Intervention Program in Middle-Aged Women. Journal of Korean Public Health Nursing, 2015, 29(1), pp. 79-89. <http://www.dbpia.co.kr/Journal/PDFViewNew?id=NODE06297503&prevPathCode=>
- [6] Um AY, Influencing Factors on Health Related to Quality of Life in Hypertension Patients, Journal of Korean Biology Nursing Science, 2009, 11(2), pp. 136-142. <http://www.newnonmun.com/article=53959>
- [7] Seo KH, Lee HJ, Lim BD, Choi YJ, Oh HM, Yoon JS, Association of Nutritional Status with Obesity by

- Body Mass Index and Waist Circumference among Hypertensive Elderly Patients, Korean Journal of community Nutrition, 2009, 14(6), pp. 831-845.
<http://www.dbpia.co.kr/Journal/ArticleDetail/NODE06238527>
- [8] Lee HS, Kwun IS, Kwon CS, Prevalence of Hypertension and Related Risk Factors of the Older Residents in Andong Rural Area, Journal of the Korean Society of Food Science and Nutrition, 2009, 38(7), pp. 852-861, <http://www.dbpia.co.kr/Article/NODE01222955>
- [9] Koo S, Kim YO, Kim MK, Yoon JS, Park KP, Nutrient Intake, Lifestyle Factors and Prevalent Hypertension in Korean Adults: Results from 2007-2008 Korean National Health and Nutrition Examination Survey, Korean Journal of community Nutrition, 2012, 17(3), pp. 329-340, <http://dx.doi.org/doi:10.5720/kjcn.2012.17.3.329>
- [10] Kim YJ, Kim SG, Paek YM, Kim MK, Comparison of Energy Nutrient and Fat Intake Between the Hypertensive and Normotensive Male Workers, Occupational and Environmental Medicine, 2006, 18(4), pp. 263-271.
<http://www.dbpia.co.kr/Journal/PDFViewNew?id=NODE01156318&prevPathCode=>



ISSN
0975-6299

Effects of Physical and Psychological Factors on Stress in Patients with Hypertension

Myoung-Jin Kwon, Department of Nursing, Daejeon University, Daejeon, Dong-gu, Korea. E-mail:mjkwon@dju.ac.kr

Sung-Yun Ahn*, Department of Nursing, PaiChai University, Daejeon, Seo-gu, Korea. E-mail:syahn@pcu.ac.kr

Abstract---

Background/Objectives: The purpose of this study was to evaluate the factors influencing stress in patients with hypertension.

Methods/Statistical Analysis: This study examined the raw materials of "The 6th, 2nd year Korea National Health & Nutrition Examination Survey" in which 1149 participants identified themselves as being diagnosed with hypertension out of a total 7550 individuals who participated in the survey. IBM SPSS 23.0 was used to analyze the data.

Findings: There was a significant difference in the stress of hypertensive patients based on age, education, sleeping hours, and subjective health status. Age, economic status, BMI, and subjective health status had an influence on stress levels with an explanatory power of 18.5%.

Improvements/Applications: There is a need to develop a program that considers economic status, BMI, and subjective health status to decrease stress in hypertensive patients.

Keywords--- Hypertension, Stress, BMI, Subjective Health Status, Sleeping Hours.

* Corresponding Author

I. INTRODUCTION

A. Necessity of Research

Stress is unavoidable in humans but an appropriate amount of stress is also essential to our survival and well-being. The level of job-related stress in modern society, however, has increased with the constant delivery of information and demand for immediate responses to that information¹. Compared to the past, the diversity and complexity of social relationships today has also resulted in more opportunities for stressors to invade and continuously influence our lives. Long-term persistent stress, compared to temporary, short-term stress, can become a serious issue through its destructive impact and potential to deplete one's ability to adapt. The stress of modern society is already related to an increasing in a variety of cardiovascular disorders².

Responses to stress can differ between people³ but a failure to manage blood pressure in situations of psychological pressure, increased conflict, and tension can result in physiological changes that can affect anyone. Stress excites sympathetic nerves followed by a fight or flight response and increased blood pressure. This is a normal physiological response to counteract the environment of the body². Therefore, it is essential to discover the primary physical and psychological factors that influence stress in hypertensive patients and to understand the relationships between those factors in order to develop a stress management program that controls blood pressure in these patients.

Recent studies contain numerous reports on responses to stress, such as cognitive evaluation, coping behaviors, and perceived stress, which cause individual variation⁴. These studies, however, are inadequate in determining which variables are most strongly related to blood pressure and what their correlation is with causing stress. There are studies that seek to understand personality types that are vulnerable to stress, and studies that employ psychometric instruments to understand and manage the psychosocial factors that become stressors^{5,6}. Stress, however, is not a phenomenon that occurs because of a single factor, but arises due to a complex set of factors³. Therefore, it is necessary to examine an extensive set of factors in recent population groups.

Accordingly, this study seeks to elucidate the factors influencing stress in hypertensive patients by utilizing extensive nation-wide data recently gathered throughout Korea. Additionally, by verifying the relationships between those factors, this study will provide foundational data for a stress management program, which assists hypertensive patients in controlling their blood pressure.

B. Purpose of Study

The purpose of this study is to evaluate the factors influencing stress in hypertensive patients. The specific goals of this study are as follows:

- a. Understand the socio-demographic, physical, and psychological characteristics of the research participants.
- b. Understand differences in stress based on the socio-demographic, physical, and psychological characteristics of the research participants.
- c. Discern the characteristics influencing stress in the research participants.

II. MATERIALS AND METHODS

A. Study Design

The present study is a descriptive correlational study designed to examine the factors influencing stress among hypertensive patients.

B. Participants and Tools

The original data of "The 6th, 2nd year Korea National Health & Nutrition Examination Survey" were used for this study. The national health and nutrition examination survey is a representative and reliable nation- and province-wide survey, which produces statistics about fitness level, awareness of health-related facts and behaviors, and actual condition of food and nutrition. The 2014 Korea National Health & Nutrition

Examination Survey conducted by the Ministry of Health and Welfare and Centers for Disease Control and Prevention had a total of 7550 participants.

This study was conducted with 1149 participants who answered "yes" to the question about currently having hypertension. Permission to use the original data was granted before conducting this study.

C. Study Variables

This study's variables, including general characteristics, physical factors, and psychological factors, were as follows:

1) General characteristics:

Sex, age, economic status, education level, family size, marital status.

2) Physical factors:

BMI: anthropometric results calculated as $\text{weight(kg)}/\text{height (m)}^2$.

Number of days engaging in walking per week

Duration (minutes) of each walking session

Systolic blood pressure(mmHg)

Diastolic blood pressure(mmHg)

Sleeping time (hours)

3) Psychological factors:

Subjective health status: questions about participants' subjective understanding of their own health measured using a 5-point Likert scale where 1 = "very good" and 5 = "very bad."

Subjective body perception: questions about participants' subjective understanding of their body measured using a 5-point Likert scale where 1 = "very skinny" and 5 = "obese."

Stress: results measured using a 4-point Likert scale where 1 = "I feel a lot of stress" and 4 = "I feel almost no stress."

D. Statistical Analysis

The data in this study were analyzed using SPSS 23.0 program, which generated and analyzed Complex Sample Plan files including (stratification variable: variance estimation (kstrata), clustering variable: enumeration district (psu), weight variable: health survey and weighted correlation (wt_itvex) of health examination, which had a significance level of .05.

- Complex sample frequency analysis was used to examine general, physical, and psychological characteristic levels in participants.
- Complex sample cross analysis was used to examine stress differences in participants based on socio-demographic, physical, and psychological characteristics.
- Complex sample general linear models were used to understand the characteristics influencing stress in participants.

III. RESULTS AND DISCUSSION

A. Demographic Characteristics of Participants

The general characteristics of the participants are as follows: 398 participants were 70–79 years old (32.8%), and 377 participants were 60–69 years old (28.9%).

Females accounted for 671 (90.9%) of the participants. With respect to education, 584 people had less than 6 years (52.1%) of formal education. In terms of family, the majority of people ($n = 519$; 45.2%) had 2 family members. In terms of marital status, 1129 people (93.3%) were married (see Table 1).

Table 1: Demographic Characteristics of Participants

Characteristics	n(%)
Gender	
Male	478(41.6)
Female	671(58.4)
Age(years)	
≤ 40	22(1.9)
41-50	64(5.7)
51-60	186(16.1)
61-70	377(28.9)
71-80	398(32.8)
81≤	102(8.8)
Economic status	
Low	439(38.4)
Medium-Low	294(25.7)
Medium-High	225(19.7)
High	186(16.3)
Education level	
Elementary school	584(52.1)
Middle school	149(13.3)
High school	250(22.3)
College≤	138(12.3)
Number of family members	
1	198(17.2)
2	519(45.2)
3-4	335(29.2)
5≤	97(8.4)
Marital Status	
Single	20(1.7)
Married	1129(98.3)

B. Physical and Psychological Characteristics of Participants

In terms of physical characteristics, 528 people (47.3%) had a BMI over 25, 431 people (55.9%) walked less than 3 days a week, and 725 people (63.1%) had a walking duration of less than 30 minutes. 547 people (47.6%) slept 6–7 hours per night, 580 people (50.5%) had a systolic blood pressure of 121–140mmHg, and 1061 people (92.4%) had a diastolic blood pressure of 90mmHg.

In terms of emotional characteristics, 556 people (48.4%) answered “normal” regarding their subjective health status, 430 people (38.8%) answered “normal” regarding their subjective body perception, and 408 people (36.9%) answered “slightly obese.” In terms of stress, 581 people (52.7%) said they were “slightly stressed,” and 328 people (29.7%) said they were “very stressed”(see Table 2).

Table 2: Physical and Psychological Characteristics of Participants

Characteristics	n(%)
Physical characteristics	
BMI	
≤18.5	14(1.3)
18.6-22.9	305(27.3)
23-24.9	269(24.1)
25≤	528(47.3)
Walking days(/week)	
≤3	431(55.9)
4-5	178(23.1)
6-7	162(21.0)
Walking time(minutes)	
≤30	725(63.1)
31-60	107(9.3)
61≤	317(27.6)
Sleeping hours	
≤5	256(22.3)
6-7	547(47.6)
8-9	254(22.1)
10≤	92(8.0)
Systolic blood pressure(mmHg)	
≤120	354(30.8)
121-140	580(50.5)
141-160	171(14.9)
161≤	43(3.7)
Diastolic blood pressure(mmHg)	
≤90	1061(92.4)
91-100	76(6.6)
101≤	11(1.0)
Psychological characteristics	
Subjective health status	
Very good	33(2.9)
Good	189(16.4)
Normal	556(48.4)
Bad	248(21.6)
Very bad	122(10.6)
Subjective body awareness	
Very thin	56(5.1)
Thin	108(9.8)
Normal	430(38.8)
Slightly overweight	408(36.9)
Very overweight	105(9.5)
Stress	
Feeling a lot	44(4.0)
Feeling quite a lot	150(13.6)
Feeling a little	581(52.7)
Hardly notice	328(29.7)

C. Differences in Stress based on Socio-demographic, Physical, and Psychological Characteristics

There was a significant difference in stress based on age, education, sleeping hours, and subjective health. Most participants ranging in age from 40 to 70 years said they “feel a little” stress, and most participants in their 80s said they “feel almost none.” In all categories of education and sleeping hours, most participants said they “feel a little” stress. Participants who answered “very good” regarding subjective health felt almost no stress at all but the majority of participants answered that they were “feel a little” stress (see Table 3).

Table 3: Differences in Stress based on Socio-demographic, Physical, and Psychological Characteristics

Characteristics		Feeling a lot		Feeling quite a lot		Feeling a little		Hardly notice		F
		N(%)	SE(%)	N(%)	SE(%)	N(%)	SE(%)	N(%)	SE(%)	
Age	≤ 40			4(18.1)	9.4	16(72.7)	11.1	2(9.0)	7.5	3.55**
	41-50	4(6.2)	3.2	14(21.8)	5.6	41(64.0)	6.4	5(7.8)	2.9	
	51-60	5(2.7)	1.8	21(11.5)	2.8	119(65.3)	4.1	37(20.3)	3.2	
	61-70	19(2.0)	1.5	47(12.6)	1.8	202(54.3)	2.7	104(27.9)	2.4	
	71-80	14(3.7)	1.2	49(13.1)	2.0	170(45.6)	2.9	139(37.3)	2.9	
	81≤	2(2.1)	1.3	15(16.4)	4.2	33(36.2)	5.8	41(45.0)	7.1	
Education	Elementary school	30(5.3)	1.4	86(15.2)	1.6	259(46.0)	2.4	188(33.3)	2.4	3.08*
	Middle school	1(0.6)	0.2	14(9.3)	2.3	93(62.4)	4.6	41(27.5)	4.1	
	High school	7(2.8)	1.4	35(14.1)	2.9	147(59.2)	3.9	59(23.7)	2.7	
	College≤	6(4.3)	1.3	13(9.4)	3.4	79(57.2)	5.1	40(28.9)	4.2	
Sleeping hours	5≥	18(7.0)	2.1	57(22.3)	3.2	99(38.8)	3.7	81(31.7)	3.4	3.73**
	6-7	14(2.5)	1.0	68(12.4)	1.8	319(58.3)	2.5	146(26.6)	2.1	
	8-9	9(3.5)	1.1	20(7.8)	2.0	140(55.1)	3.7	85(33.4)	3.3	
	10≤	3(6.3)	3.6	5(10.6)	6.2	23(48.9)	8.9	16(34.0)	7.7	
Subjective health status	Very good	2(6.0)	8.6			12(36.3)	10.0	19(57.5)	10.2	3.86**
	Good	5(2.6)	1.5	13(6.9)	2.3	90(48.3)	4.5	78(41.9)	4.2	
	Normal	14(2.5)	0.8	60(11.0)	1.8	309(56.9)	2.6	160(29.4)	2.1	
	Bad	11(4.7)	1.9	45(19.3)	3.2	121(52.1)	3.9	55(23.7)	2.7	
	Very bad	12(11.1)	3.4	32(29.6)	4.5	48(44.4)	5.9	16(14.8)	3.6	

* $p < .05$, ** $p < .001$

D. Factors Influencing Stress

Age, economic status, BMI, and subjective health status had an influence on stress levels with an explanatory power of 18.5% ($p < .01$; see Table 4).

Table 4: Factors Influencing Stress

Model		β	SE	t	R^2	F
Age	≤ 40	-.81	.18	-4.41**	.185	2.61**
	41-50	-.94	.17	-5.37**		
	51-60	-.56	.14	-3.87**		
	61-70	-.49	.13	-3.74**		
	71-80	-.30	.12	-2.56*		
	81≤	1.0				
Economic status	Low	-.06	.11	-0.52	.185	2.61**
	Medium-low	.06	.12	0.50		
	Medium-high	.21	.11	1.91*		
	High	1.0				
BMI	18.5≤	.81	.21	3.72**	.185	2.61**
	18.6-22.9	-.04	.10	-0.45		
	23-24.9	-.01	.08	-0.11		
	25≤	1.0				
Subjective health status	Very good	.80	.40	1.99*	.185	2.61**
	Good	.73	.14	5.18**		
	Normal	.58	.13	4.37**		
	Bad	.39	.13	2.92*		
	Very bad	1.0				

* $p < .05$, ** $p < .01$

E. Discussion

The results of this study revealed that hypertensive patients who slept less than 5 hours per night felt more stress than those who slept 6 or more hours per night. These results are consistent with earlier research showing a higher risk for pathologically high blood pressure in groups with shorter sleeping hours⁷, and preceding research showing that intervention methods to decrease stress also improve sleep quality⁸. The basis for these results can be found in earlier research showing that negative emotions such as depression are related to stress^{9,10}, and that stress increases negative emotions and influences sleeping hours¹¹. Sufficient sleep is necessary for stress management and to control blood pressure in hypertensive patients, but increasing sleeping hours alone is not enough. Negative emotions from stress can influence sleeping hours and cause a cycle that exacerbates stress. Psychological intervention methods such as meditation may also need to be implemented to combat stress.

This study showed that younger people experienced more stress and that stress decreased in older people. The results of this study are consistent with the results of preceding research that examined nurses and found that perceived level of stress was higher among the younger age group⁴.

Preceding research⁴ found that younger age groups had higher depression scores, and increased depression was related to higher levels of perceived stress. The correlation between age and emotional characteristics was not verified in this study and further research may be necessary regarding higher levels of stress in younger age groups.

In this study, groups that felt good about their health status had lower levels of stress, which is consistent with the results of earlier research¹². The subjective aspect of health status raises questions of validity and reliability, but this is recognized as a trust worthy index that reports correlation with chronic disease¹³. In accordance with this, an intervention that improves subjective health status is necessary to decrease stress in hypertensive patients.

The factors that influenced stress in hypertensive patients in this study were age, economic status, BMI, and subjective health status. The explanatory power of this was 18.5%. These results are considered in the same context as preceding research¹² that showed groups with higher incomes also had a higher subjective health status. The results are also consistent with preceding research¹⁴ about obesity and stress in female college students where there was a positive correlation ($r=.40, p<.001$) with BMI, and a negative correlation ($r=-.16, p=.004$) with perceived stress. Based on the results of this research, there is need to consider measures that can improve economic status, BMI, and subjective health status when developing an intervention program that targets stress in hypertensive patients. These results have significance in suggesting baseline data that can be used in the development of stress management programs to control blood pressure in hypertensive patients.

IV. CONCLUSION

In this study age, economic status, BMI, and subjective health status were shown to influence stress in hypertensive patients. Hypertension is the most common chronic disease in which incidence rates increase with age. The disorders that can arise from complications associated with hypertension are more cause for concern than hypertension as a disease itself. The causes for hypertension still are not clearly defined, but socio-environmental factors are assumed to be part of those causes. Among those factors, psychological stress is known as a factor that negatively influences hypertension in much the same way it negatively influences all diseases.

Therefore, it is important to reflect this in intervention programs that are developed to determine stress levels and decrease stress in hypertensive patients. It is impossible to have a life without stress. However, efforts are needed to proactively and efficiently lower stress level and to utilize it as a positive driving force in our lives. Well-being is the primary area of care. The results of this study, which researched baseline data to increase well-being and decrease stress, can become a meaningful reference when implementing clinical nursing interventions.

REFERENCES

- [1] Cho J J. Job Stress and Cardiovascular Disease. *J Korean AcadFam Med*, 2002, 23(7), pp.841-854.
- [2] Cho J J. Stress and Cardiovascular Disease. *J Korean Med Assoc*, 2013, June, 56(6), pp.462-470. <http://dx.doi.org/10.5124/jkma.2013.56.6.462>
- [3] Kim B S. Hypertension and Stress, *The Korean Journal of Stress Research*, 2006, 14(2), pp.69-76.<http://www.dbpia.co.kr/Article/NODE02025097>
- [4] Lee W H, Kim C J. The Relationship between Depression, Perceived Stress, Fatigue and Anger in Clinical Nurses. *J Korean AcadNurs*, 2006,Oct, 36(6), pp.925-933.
- [5] Kuper H, Marmot M, Hemingway H. Systematic Review of Prospective Cohort Studies of Psychosocial Factors in the Etiology and Prognosis of Coronary Heart Disease. *SeminVasc Med*, 2002, 2, pp.267-314.
- [6] Lee P S, Han K S. Effect of Stress Management Program on Blood Pressure, Mood State, Psychophysiological Response of the Patient with Essential Hypertension. *The Korean Journal of Stress Research*, 1998, 6(1), pp.25-37.
- [7] Choi S J, Park E O. The Association of Sleep Duration and Hypertension in Adults in Korea. *Korean J Health Promot*, 2013, 13(4), pp.141-149.
- [8] Park K, Jun J S, Jung S Y. The Effects of the Korean Mindfulness Based Stress Reduction Program on the Psychological Symptoms, Sleep and Quality of Life, in Korean Breast Cancer Patients. *The Korean Journal of Stress Research*, 2013, 21(3), pp.249-262. <http://www.dbpia.co.kr/Journal/ArticleDetail/NODE02250443>
- [9] Kim M J, Moon W H. Relationship between Depression from Self-esteem, Stress, and Verbal Anger Behavior in Korean University Students. *Indian Journal of Science and Technology*, 2016, 9(44), pp.1-5.
- [10] Lee C S, Jang E S. The Effects of Stress, Depression, and Family System Perception on the Well-being of Immigrant Women: The Mediating Effect of Mental Violence. *Indian Journal of Science and Technology*, 2016, 9(26), pp.1-6
- [11] Mezick E J, Matthews K A, Hall M, Kamarck T W, Buysse D J, Owen J F, Reis S E. Intra-individual variability in sleep duration and fragmentation: associations with stress, *Psychoneuroendocrinology*, 2009, 34(9), pp.1346-1354. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2743778/>
- [12] Kim M K, Chung W J, Lim S J, Yoon S J, Lee J K, Kim E K, Ko L J. Socioeconomic Inequity in Self-Rated Health Status and Contribution of Health Behavioral Factors in Korea. *Journal of Preventive Medicine and Public Health*, 2010, Jan, 43(1), pp. 50-61.
- [13] Otiniano M E, Du X L, Ottenbacher K, Markides K S. The Effect of Diabetes Combined with Stroke on Disability, Self-rated Health, and Mortality in Older Mexican Americans: Results from the Hispanic EPESE. *Arch Phys Med Rehabil*, 2003, 84(5), pp.725-730.
- [14] Kwon, Y S. A Study on Obesity Stress and Related Factors among Female College Students. *Journal of Korean Academy of Community Health Nursing*, 2008, 19(3), pp.431-442.



ISSN
0975-6299

A Study on the Postpartum Depression after Delivery

Hyun-Jung Jang*, Department of Nursing, Kkottongnae Univ., 133 sangsam-gil, Hyundo-myeon, Seowon-gu, Cheonju-si, Chungbuk, South Korea. E-mail:janghj@kkot.ac.kr

Abstract---

Background/Objectives: This study was conducted to examine the relationship between perineal discomfort, a physiological element that mothers experience immediately after delivery, and postpartum depression.

Methods/Statistical Analysis: Structured questionnaire was given on 165 women within 3 days of natural birth, and data was analyzed using SPSS/WIN 22.0.

Findings: The discomfort that the subjects experienced immediately after delivery due to episiotomy was 5.86 ± 2.01 . Specifically, sitting discomfort was 6.31 ± 2.16 , walking discomfort was 5.74 ± 2.24 , and moving discomfort was 5.56 ± 2.24 . physical fatigue was 5.76 ± 2.10 , and level of depression was 6.67 ± 4.34 ; however, 26.1% of mothers (43) experienced mild postpartum depression. Postpartum depression measured immediately after delivery and physical fatigue ($r=.202$) showed significant positive correlation.

Improvements/Applications: This study reconfirmed that mothers that are prone to intensified postpartum depression need to be selected for separate care in postpartum care.

Keywords--- Postpartum Depression, Perineal Discomfort, Physical Fatigue, Episiotomy, Postpartum Psychosis.

* Corresponding Author

I. INTRODUCTION

Postpartum depression is the kind of depressive disorder that women experience after delivery, and is known to occur in 10~15% of women in the US¹, and in 10~20% of women in Korea a year². Also, a recent study in Korea reported that 7.5%~44.5% of postpartum depression occurs between 2 weeks to 6 weeks of delivery, and 14.3% occur within 6 months. Postpartum depression occurs among 80% of women after delivery and is defined as a relatively mild mood change that can occur frequently; its symptoms are temporary but women get easily sad and cry, and disappear naturally within 2 weeks of delivery³. 45~65% of female depression patients are known to first develop it within 1 year of delivery⁴ that postpartum depression management is urgently needed and occurrence of postpartum depression need to be continuously monitored and managed from immediately after delivery to late postpartum stage. Symptoms may be common in early stage, but without proper care, it can develop to postpartum psychosis⁵ that the psychological changes of mothers right after delivery should be thoroughly observed and managed.

Postpartum depression has negative effects on the role of mother by deteriorating quality of life and altering self-esteem and self-efficacy⁶. This affects child's cognitive and emotional developments, and interferes with the adaptation to the role of mother⁷. It also affects the family function that it causes discord with spouse and gives negative effect on husband's mental health⁸.

The major factors of postpartum depression discovered until now are divided into psychosocial factors and biological factors. Psychosocial factors that affect postpartum depression include marital status, social support, socioeconomic level, self-respect, antepartum anxiety, pregnancy intention, history of depression, marriage satisfaction and life stress⁹, and biological factors include health status, quality of sleep, type of delivery and ante-postpartum physical changes such as hormonal change and infection^{10,11}. It is reported outside the country that mood disorders like postpartum depression develop due to perineal injury¹², but in Korea, studies have mostly been conducted to examine the relationship between postpartum depression and psychosocial factors such as pregnancy stress¹³, emotional status during pregnancy¹⁴, marriage satisfaction¹⁵, family support/parenting stress¹⁶, etc., and studies on the relationship between postpartum depression and biological factors like perineal injury were difficult to find. Most women under natural birth in Korea receive episiotomy that mothers complain of pain and discomfort related to perineal suture. Discomfort related to perineal suture is a postpartum factor and may cause postpartum depression. Therefore, this study is to examine the predictors of postpartum depression in consideration of culture and situation that mothers face following delivery in Korea, and provide basic data in early discovery of mothers with risks of postpartum depression and prevention.

This study was conducted in an attempt to examine the relationship between postpartum depression and mother's biological factor following delivery, which is the cause of postpartum depression, and focuses on understanding subject's general characteristics and postpartum depression factors and correlation between discomfort due to perineal injury and postpartum depression.

II. MATERIALS AND METHODS

A. Study Design

This study examines the correlation between discomfort that occurs after episiotomy during delivery and postpartum depression.

B. Study Subject

Subject includes 165 women at 3 days after delivery, with gestational age of 37 weeks or more, who gave birth to children over 2.500mg in weight through natural birth, that voluntarily participated and gave written consent to the participation.

C. Study Tool

Postpartum depression uses EPDS (Edinburgh postnatal depression scale)¹⁷, and the tool translated into Korean was used EPDS¹⁸. It is a self-reporting tool developed to discover postpartum depression relatively easily. It consists of 10 questions asking about the level of depression in the past week, and each question is based on 4-level scale, from "Strongly agree" 0 point to "Strongly disagree" 3 points. Score can range from 0 to 30, and scores over 9 are evaluated as more severe depression for higher score. The reliability of this study was .84.

Perineal discomfort and physical fatigue were measured on a subjective 10-point scale. Perineal discomfort was classified into sitting, walking and moving, and higher score signified more discomfort related to episiotomy and physical fatigue.

D. Data Analysis

Collected data was analyzed using SPSS/WIN 22.0. Real numbers and percentage, and mean and standard deviation were used for subject's general characteristics and level of postpartum depression, and correlation between postpartum depression and variables used Pearson correlation coefficient.

III. RESULTS AND DISCUSSION

A. Physical Discomfort Related to Perineal Injury

As shown in table 1, Subject's discomfort due to episiotomy after delivery was 5.86 ± 2.01 ; specifically, sitting discomfort was 6.31 ± 2.16 , walking discomfort was 5.74 ± 2.24 , and moving discomfort was 5.56 ± 2.24 . Physical fatigue was 5.76 ± 2.10 , and level of depression was 6.67 ± 4.34 , which is not too high, but 26.1% (43) had 9.5[9] points or more on EPDS, which can be defined as mild postpartum depression [Table 1].

Table 1: Subject's Perineal Symptoms and Physical Discomfort (N=165)

Characteristics		N(%)	M $\pm$ SD
Degree of Perineal Discomfort			5.86 $\pm$ 2.01
Sitting			6.31 $\pm$ 2.16
Walking			5.74 $\pm$ 2.24
Moving			5.56 $\pm$ 2.43
Type of Perineal Discomfort			
Soreness	Yes	92(55.8)	
	No	73(44.2)	
Shooting pain	Yes	85(51.5)	
	No	80(48.5)	
Redness & swelling	Yes	29(17.6)	
	No	136(82.4)	
Discharge	Yes	25(15.2)	
	No	140(84.8)	
Physical Fatigue			5.78 $\pm$ 2.10
Level of Postpartum Depression			6.67 $\pm$ 4.34
<9.5		122(73.9)	
$\geq$ 9.5		43(26.1)	

B. Subject's General Characteristics

As shown in table 2, Subject's mean age was 31.5 ± 3.52 , and 87.9% (145) had college degree or more. 52.7% (87) were housewives, the monthly income was 3.5 million won in 46.1% (76), and 67.3% (111) was on their first childbirth[Table 2].

Table 2: General Characteristics of Participants(N=165)

Characteristics	N(%)	M $\pm$ SD
Age(yr)	23~39	31.55 $\pm$ 3.52
Education		
High school	20(12.1)	
$\geq$ College	145(87.9)	
Religion		
Yes	88(53.3)	
No	77(46.7)	
Occupation		
Yes	78(47.3)	
No	87(52.7)	
Household income (thousand won/month)		
<1,500	4(2.4)	
1,500-2,499	27(16.4)	
2,500-3,499	58(35.2)	
$\geq$ 3,500	76(46.1)	
The number of delivery		
One	111(67.3)	
Two	48(29.1)	
three	6(6)	

C. Correlation Between Postpartum Depression and Variables

As shown in table 3, Postpartum depression and perineal discomfort measured immediately after delivery did not show a direct correlation, but physical fatigue ($r=.202$) showed a significant positive correlation [Table 3].

Table 3: Correlation between Postpartum Mood Disorder and Some Variables (N=165)

	Sitting discomfort	Walking discomfort	Moving discomfort	Physical fatigue	Postpartum depression
Sitting discomfort	1				
Walking discomfort	.567**	1			
Moving discomfort	.644**	.896**	1		
Physical fatigue	.214**	.280**	.320**	1	
Postpartum depression	.076	.089	.096	.202**	1

IV. CONCLUSION

This study was conducted to evaluate the level of postpartum depression 3 days after the delivery among 165 mothers, and examine the correlation between perineal injury during delivery and postpartum depression. As a result, level of depression at 3 days after delivery was 6.67 ± 4.34 , showing a relatively low level, but 26.1% women showed mild postpartum depression ($EPDS > 9.5$), implying the need to screen mothers that may intensify the symptoms into postpartum depression in postpartum care. It also supported the correlation between postpartum depression and fatigue¹⁹, and therefore, the influence factors of mothers' fatigue need to be examined. Although the result did not show a direct correlation between discomfort due to episiotomy and postpartum depression, but perineal discomfort and physical fatigue showed a significant correlation, verifying that it is an important element that indirectly affects postpartum depression, so management of discomfort due to episiotomy, which is performed in most deliveries, should be handled by priority in terms of postpartum depression prevention.

REFERENCES

- [1] Centers for Disease Control and Prevention. Prevalence of self-reported postpartum depressive symptoms-17 states, 2004-2005. MMWR: Morbidity and Mortality Weekly Report. 2008; 57(14):361-366.
- [2] Jung, M. H. & Kim, J. I. (2005). A Study on the Relationship among Prenatal Emotional Status, Preparation for Delivery, Postpartum Social Support and Postpartum Blues. Korean J Women Health Nurs, 11(1), 38-45.
- [3] Nonacs, R. (2005). Postpartum depression overview. Health, Retrieved March 5.
- [4] Righetti-Veltma, M., Bousquet, A., & Manzano, J. (2003). Impact of postpartum depressive symptoms on mother and her 18-month-old infant. European Child & Adolescent Psychiatry, 12, 75-83.
- [5] Beck, C. T. (2002). Theoretical perspectives of postpartum depression and their treatment implications. American J Maternal/Child Nurs, 27(5), 282-287.
- [6] Lee, D. T., Yip, A. S., Chan, S. S., Tsui, M. H., Wong, W. S., & Chung, T. K. (2003). Post delivery screening for postpartum depression. Psychosomatic Medicine, 65, 357-361
- [7] Barr JA. (2008). Postpartum depression delayed maternal adaptation, and mechanical infant caring : A phenomenological hermeneutic study. International Journal of Nursing Studies, 45(3), 362-369.
- [8] Meadows, S. O., McLanahan, S. S., & Brooks-Gunn, J. (2007). Parental depression and anxiety and early childhood behavior problems across family types. Journal of Marriage and Family, 69(5), 1162-1177.
- [9] Beck, C.T. (2001). Predictors of postpartum depression predictors inventory. Journal of Obstetric, Gynecologic, and Neonatal Nursing, 31(4), 394-402.
- [10] Corwin, Kohen, Jarrett, & Stafford, B. (2010). The heritability of postpartum depression. Biological Research for Nursing, 12(1), 73-83.
- [11] Yoon & Jeong. (2013). Predictive validity of the postpartum depression predictors inventory-revised. Asian Nursing Research, 5(4), 210-215.

- [12] McGovern, P., Dowd, B., Gjerdingen, D., Gross, C. R., Kenney, S., & Ukestad, L., et al. (2006). Postpartum health of employed mothers 5 weeks after childbirth. *Annals Family of Medicine*, 4, 159-167.
- [13] Kim, J. W., Kim, J. H., & Kim, B. J. (2005). Psychosocial and obstetric factors associated with postpartum depressive symptoms. *Journal of Korean Neuropsychiatric Association*, 44(2), 213-220.
- [14] Jung, M. H., & Kim, J. I. (2005). A study on the relationship among prenatal emotional status, preparation for delivery, postpartum social support and postpartum blues. *Korean Journal of Women Health Nursing*, 11(1), 38-45.
- [15] Jang, E. J. (2008). Psychosocial and obstetric factors associated with postpartum depressive symptoms. Unpublished master's thesis, Dongguk University, Gyeongju.
- [16] Park, Y. J., Shin, H. J., Ryu, H. S., Cheon, S. H. & Moon, S. H. (2004). The predictors of postpartum depression. *Journal of Korean Academy of Nursing*, 34(5), 722-728.
- [17] Cox, J., Holden, J., Sagovsky, R. (1987). Detection of postnatal depression : development of the 10-item Edinburgh Postnatal Depression Scale. *Br J Psychiatry*, 154, 813-817.
- [18] Han, K. W., Kim, M. Y., Kim, Y. J. (2004). The Edinburgh Postnatal Depression Scale, Korean Version : Reliability and Validity. *Journal of the Korean Society of Biological Therapies in Psychiatry*, 10(2), 201-207.
- [19] Choi S. Y., Gu H. J., Ryu E. J. (2011). Effects of fatigue and postpartum depression on maternal perceived quality of life (MAPP-QOL) in early postpartum mothers. *Korean Journal of Women Health Nursing*, 17(2), 118-125



ISSN
0975-6299

A Study on Reducing Exposure Dose of Radiographer Assistants during CT Scan of Injury Patients without Spontaneous Breath

Chang-Gyu Kim* Department of Radiological Science, Gimcheon University, Gimcheon City, Gyung-buk, Korea.
E-mail:radkcg@hanmail.net

Sun-Youl Seo, Department of Radiologic Technology, Eulji University, Seongnam, Korea. E-mail:atom@eulji.ac.kr

Abstract---

Background/Objectives: During CT scan of patients without spontaneous breath, doctors or emergency medical technicians who conduct artificial respiration near radiation source with an Ambu-bag receive unnecessary radiation.

Methods/Statistical Analysis: This study made a transformed Ambu-bag by attaching an air line between endotracheal tube and an Ambu-bag, and evaluated its usefulness in reducing radiation exposure dose.

Findings: During the CT scan of neurocranium, exposure dose decreased as the distance from the radiation source got farther. When 50~200cm air lines were attached between an endotracheal tube and an Ambu-bag and respiration volume was measured, the average was 0.71L.

Improvements/Applications: The use of transformed Ambu-bag made by attaching an air line between an endotracheal tube and an air pocket is expected to contribute to reducing the total exposure dose of the nation as well as the unnecessary exposure dose of doctors and emergency medical technicians.

Keywords--- CT, Artificial Respiration, Ambu-bag, Dose Reduction, Usability.

* Corresponding Author

I. INTRODUCTION

Unconsciousness of injury patients, no spontaneous breathing due to chest injury, and facial injury and damaged mouth can increase secretion and can cause closure of airway. When airway is closed, breathing is impossible. In breathing, the ventilation and perfusion that O₂ absorbed in pulmonary alveoli moves through blood vessels to tissues, where cells produce CO₂, which moves through blood vessels and lungs to outside of the body¹⁻³. However, if a problem occurs in this process, one can die due to respiratory failure.

70% of chest damage is blunt trauma. The most common cause of blunt trauma is car accidents, which takes 2/3 of all chest damage-related deaths. Chest damage is the second most frequent cause for death following head and spine damage caused by injury. Mechanisms related to chest damage are falling accident, pressure injuries, gun use, pierced wounds, and accidents of pedestrians by cars.

As for tests to detect respiratory obstruction and other conditions that can cause death such as heart trauma, great vessel injury, head injury, spine injury, pulmonary contusion, pneumothorax, hemothorax, liver and spleen damage at an early stage, non-invasive Computed Tomography(CT) and Magnetic Resonance Imaging(MRI) are used⁴⁻⁷.

For patients who have pulse but no spontaneous breathing, CT scan is impossible and airway and breathing should be checked through prior measures at an early stage. For patients with cardiac arrest, respiratory failure, severe upper respiratory obstruction, head and neck injury, severe facial burn, and inhalation of gastric contents, who do not have spontaneous breathing, for the provision of oxygen, an Ambu bag is connected to translaryngeal tube or to endotracheal tube for ventilation and CT scan is conducted⁷⁻¹³.

As of 2014, 223,552 cases of car accidents, the most common cause of blunt trauma, occurred, killing 4,762 and wounding 337,497. It was a 3.8% increase in total number(8,198 cases) and 2.7% rise in the number of injuries(8,786 cases)¹⁴.

As of 2011, the radiography test ratio per person was 75% for general radiography and 2.8% for CT, and the ratio of exposure dose was 56% for CT and 32% for general radiography. The number of general radiography tests far exceeded CT but as for exposure dose, CT surpassed general radiography tests.

The exposure dose absorbed by tissues due to CT scan is known to be the highest among the exposure doses known to diagnostic radiology(10~100mGy), and considering CT scans tend to be repeated, this level of dose is known to approach or surpass the level that can directly cause cancer^{15, 16}.

To conduct radiology test for patients without spontaneous breathing, mechanical ventilation or Ambubagging should be conducted. In this process, in case of MRI test, the structure of equipment makes it hard to conduct artificial respiration next to the patient so there have been studies to overcome this problem¹⁷. However, in case of CT scan in emergency, the structure of the equipment or short test time makes it hard for doctors or emergency medical technicians to take specific measures for the problem so they just perform the test with manual artificial respiration. So doctors and emergency medical technicians who perform artificial respiration in CT scan near patients without spontaneous respiration get to receive unnecessary radiation exposure. This study will evaluate the usefulness of transformed Ambu-bags, which are made by connecting an Ambu-bag and an endotracheal tube, in reducing unnecessary radiation exposure dose for doctors or emergency medical technicians who perform artificial respiration for patients without spontaneous respiration during CT scan.

II. STUDY OBJECT AND METHOD

A. Material and Equipment

As for the CT scanner that was used for neurocranium angiography was SOMATOM Definition AS+ (Siemens, Germany) CT scanner, which can obtain 128 slides with a single turn. As for scanning conditions, the generally used conditions that are used for the neurocranium test of emergency patients were used and exposure dose was measured by distinguishing distance and direction[Figure 1]. To measure the exposure dose of the subjects, whole body human phantom (Model PBU-31, Kyoto Kagaku, Japan) that was made of materials equivalent to human body was used.



Figure 1: CT Scanner

B. Measurement of Exposure Dose with Glass Dosimeter

Glass dosimeter, Dose Ace (Model GD-352M and FGD-1000, Asahi Techno Glass Cooperation, Shizuoka, Japan), was used [Figure 2].

As for the calibration of glass dosimeter, ^{137}Cs standard source was used in Japanese Agency for Radiation Standards and calibration was conducted using glass element that was radiated with 6mGy.

Considering the characteristics of element, through Annealing process before radiation, it was heated at 400°C for an hour and cooled, and background value was measured and 10-20 μGy was calculated. After conducting panorama scan, it was heated at 70°C for an hour for pre-heating and then cooled. The added amount of radiation in the element was measured 10 times through a reader, and mean and deviation standard were calculated. From the calculated number, the background figure was subtracted and exposure dose was deduced¹⁸⁻²³.

To measure the exposure dose of the person who conducts manual artificial respiration during CT scan of neurocranium, considering the distance and direction from the radiation source, 2 glass dosimeter devices were placed in front and at the back at 0cm, 50cm, 100cm, 200cm distance, and the distribution of exposure dose in each position was measured. To reduce error of measurement, CT scan was repeated 5 times.



Figure 2: Glass Dosimeter

C. Production of a Transformed Ambu-bag and Evaluation of its Usefulness

Ambu-bags are emergency resuscitation bags used for apnea, and they are artificial respiration equipment with comparatively simple structure.

Ambu-bag is composed of the endotracheal part and an air bag that pushes oxygen artificially. Between the endotracheal part and the air bag, an air-line was attached in different length-50cm, 100cm, and 200cm- and respiration volume was analyzed [Figure 3, 4].



Figure 3: A General Ambu-bag



Figure 4: A Transformed Ambu-bag with an Attached Air Line

To evaluate the displacement of the Ambu-bag, Aisys CS 2 of GE was used and the result was analyzed[Figure 5].



Figure 5: The Equipment to Evaluate the Displacement of the Ambu-bag

III. STUDY RESULTS AND CONSIDERATIONS

A. The Measurement Result of Exposure Dose Depending on Distances Inneurocranium CT Scan

In neurocranium CT scan, even if the use of radiation is justified, it is essential to manage the exposure dose of patients to be examined.

In neurocranium CT scan, the conditions that are actually used in clinical setting were used as conditions of scanning, and scanning length was set as 252 mm by using Topo program. Tube voltage was 100kVp and effective dose was 369mAs.

In the CT scan of neurocranium, surface entrance dose in front was 49.706 ± 0.04 mGy, the dose from 50cm away was 0.332 ± 0.02 mGy, from 100cm away was 0.046 ± 0.01 mGy, and from 200cm away was 0.012 ± 0.00 mGy. The surface entrance dose from 200m away at the back was 0.350 ± 0.02 mGy[Table 1].

Table 1: In Neurocranium CT Scan, Exposure Dose Depending on Distance

Distance[cm]	Exposure dose measured in front[mGy]	Exposure dose measured at the back[mGy]
0	49.706 ± 0.04	49.706 ± 0.05
50	0.332 ± 0.02	0.350 ± 0.02
100	0.046 ± 0.01	
200	0.012 ± 0.00	

The rate of exposure dose reduction depending on the distance from radiation source in neurocranium CT scan showed that the rate was 99.30% at 50m in front and 99.29% at the back, showing reductions of exposure dose as the distance from the radiation source got longer regardless of front or back.

At 100cm in front, the rate of exposure dose reduction was 99.90% and at 200cm, it was 99.97%[Table 2].

Table 2: In Neurocranium CT Scan, the Rate of Exposure Dose Reduction Depending on Distance

Distance [cm]	Exposure dose measured in front[%]	Exposure dose measured at the back[%]
0	0	0
50	99.30	99.29
100	99.90	
200	99.97	

Doctors and emergency medical technicians who work at emergency medical centers are highly likely to be exposed to radiation due to the nature of their work that requires quick diagnosis and treatment of emergency patients. However, they have not been recognized as professions that are exposed to the danger of radiation, and have not been the objects of evaluation and management for professional radiation exposure². Through evaluation and management for professional radiation exposure of doctors and emergency medical technicians, which are blind spot of prevention and management of radiation exposure, and regular education to prevent exposure to radiation, it is believed that awareness about the danger of radiation should be raised^{2,3}.

In neurocranium CT scan of emergency patients, doctors and emergency medical technicians conduct artificial respiration and radiography. In this situation, if emergency medical technicians can stay away from the radiation source and provide medical service, it will reduce unnecessary radiation exposure dose.

B. The Evaluation Result of the Usefulness of Transformed Ambu-bag

Artificial respiration is a means to mechanically assist or replace spontaneous respiration. Mechanical ventilator is a machine that is contrived to artificially provide air and oxygen to lungs so patients who cannot breathe physically or patients with insufficient spontaneous breathing will be able to breathe.

Generally, Ambu-bags replace mechanical respirator and are used when moving patients during short period of time or in emergency situations such as CPR.

An Ambu-bag is composed of an endotracheal tube and an air bag that pushes air and oxygen inside. When attaching an air line between the endotracheal tube and the Ambu-bag with different length of 50cm, 100cm, 150cm, and 200cm, and respiration volume was measured, the result was as shown in [Table 3].

When no airline was attached between the endotracheal tube and the Ambu-bag, respiration volume was 0.71L on average; with 50cm long airline, it was 0.71L on average; with 100cm long airline, 0.71L on average; with 150cm and 20cm long airlines, 0.71L on average.

The result shows that even though an airline is attached between an endotracheal tube and an Ambu-bag, the oxygen respiration volume provided to patients shows no difference. It shows that the result can be applied when more than a certain distance should be kept from the radiation source during radiography.

Table 3: The Evaluation Result of Respiration Volume of a Transformed Ambu-bag

	0cm [L]	50cm [L]	100 cm [L]	150 cm [L]	200 cm [L]
1	0.70	0.71	0.71	0.71	0.72
2	0.71	0.69	0.70	0.70	0.72
3	0.74	0.71	0.70	0.70	0.70
4	0.71	0.70	0.72	0.72	0.71
5	0.70	0.72	0.71	0.71	0.71
Average	0.71	0.71	0.71	0.71	0.71

According to the 60 recommendations of ICRP(International Committee Radiation Protection), the protection rule from radiation says that any behaviors that accompany radiation exposure should not be adopted unless they bring practical and enough benefits that will offset the radiation damage to individuals or society. Also, even when the behaviors that accompany radiation exposure are justified, considering exposure dose to individuals, the number of people to be exposed, and in case of uncertain exposure, economic and social factors, the level of radiation should be kept at the lowest reasonably possible(ALARA).

For such reasons, in the CT scan of patients without spontaneous respiration, doctors and emergency medical technicians can use an Ambu-bag and effectively conduct artificial respiration without changing

respiration volume. Also, as a certain distance can be kept, exposure dose can be reduced, which is thought to reduce the exposure dose in the nation in the future.

IV. CONCLUSION

This study evaluated the usefulness of a transformed Ambu-bag in reducing radiation exposure dose to prevent unnecessary radiation exposure to doctors and emergency medical technicians who perform artificial respiration near patients without spontaneous respiration during CT scan and it led to the following results.

The rate of radiation exposure reduction during CT scan was 99.30% when the distance from the center of the radiation source was 50cm in front, 99.29% when the distance was 50cm at the back, 99.90% when the distance was 100cm in front, and 99.97% when the distance was 200cm in front.

When no airline was attached between the endotracheal tube and the Ambu-bag, respiration volume was 0.71L on average; with 50cm, 100cm, 150cm, and 200cm long airline, respiration volume was all 0.71L on average.

The result shows that an airline can be attached between an endotracheal tube and an Ambu-bag and medical service can be provided away from the radiation source without changing respiration volume. Therefore, in tests using medical radiation, the study result is expected to contribute to reducing exposure dose for doctors and emergency medical technicians and furthermore reduce the total exposure dose of the nation.

ACKNOWLEDGMENT

This research was supported by Gimcheon University research grants in 2016.

REFERENCES

- [1] Patrick Davey, *Medicine at a Glance*, 2013, pp. 243–245..
- [2] Hyun-Kyung Lee, *Occupational radiation exposure and risk awareness of emergency rescue*, thesis (Ph.d.), soonchunhyang University, 2015.
- [3] Seung-Man Chun, Joo-Yeon Choi, and Jong-Tae Park, *An Emergency Management Architecture Using Personalized Emergency Policy for Smart Healthcare*, *Journal of The Institute of Electronics Engineers of Korea* Vol. 50, NO. 11, 2013, pp. 2707-2715
- [4] Sang Gil Jeong, Ki Soon Kim, SooHyung Cho, MyungGeun Kang, Mi Ah Han, *The Contents of Emergency Treatment Practice Conducted by Emergency Medical Technician and Related Factors*, *J Agri Med & Community Health*, 34(3), 2009, pp. 346-358.
- [5] Mi-Lye Baek, *Factors Affecting the Satisfaction of Simulation Education about Emergency Delivery for Paramedic Students*, *Fire Sci. Eng.*, Vol. 28, No. 5, 2014, pp. 98-103.
- [6] Park Chan-Soo, Park Jong-Il, Kim Kwang-Gi, Cho Chang-No, AhnByung-Uk, Jae Hwan-Jun. "Select this result for bulk action A quantitative evaluation of abdominal aorta aneurysm by CT images", *Technology and Health Care*, Vol. 23, no. 1, 2015, pp. 37-45.
- [7] Joo Young-Cheol, Lim Chung-Hwan, Lee Chun-Yong, Jung Hong-Ryang, "A study on the correlation between patients' physical characteristics and effective dose of liver computed tomography", *Technology and Health Care*, vol. 22, no. 3, 2014, pp. 403-408.
- [8] S. H. Kim, Y. J. Kim, J. S. Kwak, "Development and Radiation Shield effects of Dose Reduction Fiber for Scatter ray in CT Exams", *Journal of the Korea Academia-Industrial cooperation Society* Vol. 14, No. 4, 2013, pp. 1871-1876.
- [9] PyongKon Cho, BoKyungSeo, TaeKyu Choi, JangSeob Kim, YouHyun Kim, JongHak Choi et al., *The development of a diagnostic reference level on patient dose for CT examination in Korea*, *Radiation Protection Dosimetry*, (Vol.)129, No. 4, 2008, , pp.463–468.
- [10] PyongKon Cho, *Patient Radiation Exposure Dose in Computed Tomography*, *J. Korean Soc. Radiol.*, Vol. 9, No. 2, 2015, pp. 109-115.
- [11] Yoo S, Han M, Lee S, Jeon M, Lee H, Seo S, Yang I, *The analysis of exposure dose related factors in abdominal CT of general hospitals in Daejeon Area*. *Indian Journal of Science and Technology*, 8(1), 2015, pp. 492–6.
- [12] L. T. Lawrence, A. C. Kevin, E. E. Yusuf, N. R. Lawrence., *Radiation dose reduction at a price: the effectiveness of a male gonadal shield during helical CT scans*, *BMC Medical Imaging* 7: 5, 2007.
- [13] M. C. Kim, "Doses of coronary study in 64-MDCT Reduced radiation dose according to variety of

- examination protocols", Radiological science, Vol 32(3), 2009.
- [14] K.N.S, Korea National Statistical Office data, Korea National Statistical Office, 2016.
- [15] Sang-Sik Kang, Kyo-Tae Kim, Si-Cheol Noh, Bong-Jae Jung, Ji-Koon Park, The Study on Design of Customized Radiation Protective Layer for Medical Radiation Dose Reduction, "J. Korean Soc. Radiol., Vol. 8, No. 6, 2014, pp. 333-338.
- [16] Hoon-Hee Park, Juyoung Lee, Ji-Hyeon Kim, Sik Nam-Kung, Kwang-YeulLyu, Tae Soo Lee, Evaluation of the Usefulness of Bismuth Shields in PET/CT Examination, Radiological science, Vol37(1), 2014, pp.49-56.
- [17] KeeSoo Ha, Il Hong Moon, Hee Sun Lee, Dong Han Shin, So HeeEun, Baik-Lin Eun, Young Sook Hong, Joo Won Lee, Usefulness of modified ambu® in patients who need artificial ventilation, Korean Journal Pediatric Society, 49(11), 2006, pp. 1194-1201.
- [18] C. G. Kim, The application of a water filter to reduce radiation during Bone Mineral Densitometry (BMD), Indian Journal of Science and Technology, 8(9), 2015, pp. 352-7.
- [19] C. G. Kim, Spatial dose distribution and exposure dose during mammography, Indian Journal of Science and Technology, 8(8), 2015, pp. 133-8.
- [20] Chang-Gyu Kim, "The Development of Bismuth Shielding to Protect the Thyroid Gland in Radiations Environment", Indian Journal of Science and Technology, Vol 9(25), 2016, pp.1-6.
- [21] Chang-Gyu Kim, "Exposure dose reduction during lateral spine test with water filter", Technology and Health Care, vol. 24, 2016, pp.429-438.
- [22] C. G. Kim, Exposure dose reduction using Pb banding of own manufacturing. The Society of Digital Policy and Management. 11(6), 2013, pp. 269-73.
- [23] C. G. Kim, Measurement dose of dental panoramagraphy using a radiophoto- luminescent glass rod detector, The Korea Academia Industrial Cooperation Journal, 12(6), 2011, pp. 2624-8.



ISSN
0975-6299

An Efficient Healthcare Service Model Using IoT Device and RFID Technique in the Hospital Environment

Yoon-Su Jeong, Dept. of Information Communication Engineering, Mokwon University, 88, Doanbuk-ro, Seo-gu, Daejeon, Republic of Korea. E-mail: bukmunro@mokwon.ac.kr

Seung-Soo Shin*, Dept. of Information Security, Tongmyong University, 428, Sinseon-ro, Nam-gu, Busan, Republic of Korea. E-mail: shinss@tu.ac.kr

Abstract---

Background/Objectives: Over the last several years, Internet of Things (IoT) technology has been extensively grafted on hospital healthcare services leading to the development of diverse new and interesting healthcare services. However, the number of patients provided with IoT healthcare services has not been increasing very much because IoT based healthcare service systems are different by hospital.

Methods/Statistical Analysis: The paper proposes an efficient healthcare service model using IoT device and RFID technique in the hospital environment. In particular, proposed paper can support IoT based integrated healthcare service structure using in wireless personal area networks of low power such as RFID and WSN. To solve the problem of existing studies that cannot provide healthcare service using IoT devices, proposed model fused IoT devices with RFID technology to guarantee the provision of healthcare services to patients.

Findings: The proposed model provided guidance information such as the health condition of patients connected to the hospital service center and the situation of provision of healthcare services to those patients using the IoT equipment established in the hospital thereby improving the quality of healthcare services for patients. In particular, the proposed model has a characteristic of being able to minimize the time and procedures for healthcare services for and treatment of patients and administrative processing using the data and resources sensed through RFID devices. For integrated information management services for IoT devices and RFID devices used at hospitals, the proposed model, generated and used union IDs thereby improving the efficiency of IoT devices established in hospital.

Improvements/Applications: In the results of performance evaluation, the proposed model showed 28.2% higher patient and staff tracking and monitoring efficiency than existing models. The Efficiency of communication between IoT devices is higher average 14.1% than existing models. The communication overhead between IoT devices was lower average 5.5% than existing models.

Keywords--- Healthcare, Internet of Things (IoT), Hospital Service, RFID, Healthcare Device, Privacy.

** Corresponding Author*

Special Issue on "Medical Science"

I. INTRODUCTION

As Internet of Things(IoT, Internet of Things) services that connect all things based on the Internet to support information exchanges and communication have been increasing, Internet of Things services have been in the limelight in the area of hospital healthcare services too for improvement of the quality of healthcare services^{1,2,3}. In particular, the improvement of the efficiency of IoT based healthcare service infrastructures and biomedical systems is considered to be one of the largest challenge goals of modern hospital society^{4,5}. In existing hospital systems, patient management, supervision, and monitoring procedures are often manually implemented by nursing staff. This practice of hospitals becomes a cause of the occurrence of efficiency bottleneck. Recently, researches related to wireless technique for provision of hospital healthcare services have been steadily conducted^{6,7,8}.

Phunchongharn conducted a study on the electromagnetic interference in the wireless local area network environment for hospital healthcare applications^{6,7}. However, this paper has a problem because mobile hospital services are not supported wireless local area network service in small vehicles not with hospital equipment.

Shen conducted a research on power transmission to create a state for smooth communication with the medical sensor attached body⁸. However, this technique has a shortcoming as the problem of adverse effects of RF transmission on medical sensor operations has not been solved.

In the paper, we is proposed an IoT based integrated healthcare service structure model that can quickly receive information on patients' conditions using in-hospital IoT equipment that uses wireless personal area networks such as RFID and WSN among those low power wireless protocols that are provided by different healthcare service systems to provide healthcare services (e.g., diagnosis, treatment) to patients. To guarantee the provision of healthcare services to patients by fusing IoT devices and RFID technology together the proposed model has the following three purposes.

First, the proposed model can check the health condition of patients in real time using the IoT equipment installed in the hospital, so that the medical service can be provided promptly according to the condition of the patient. Second, if the patient is transferred to another hospital, the proposal model immediately sends the treatment to the hospital for the medical service that has been provided so that the patient can be supported without any disruption. Third, the proposed model can minimize the time and procedures for healthcare services, treatment, and administrative processing using the data and resources sensed through equipment (e.g. bracelet, heart rate measuring sensor, smart band, smart shoes services, etc.) loaded with tracking sensors carried by inpatients and outpatients.

For real-time integrated management of information that is generated by medical sensors through IoT devices and RFID devices installed in the hospital, the proposed model generates and uses union IDs. Here, the unions IDs are used as identifiers that enable medical teams to accurately identify patients and understand patients' health conditions and play the role of enhancing the efficiency of IoT devices established in the hospital.

This paper is composed as follows. In chapter 2, IoT based healthcare service models and existing studies are examined. In chapter 3, an integrated healthcare service model that fused IoT devices and RFID technology together using union IDs is proposed, in chapter 4, the proposed model and existing models are compared and evaluated, and finally, in chapter 5, conclusions are drawn.

II. RELATED WORKS

A. Healthcare Service based on IoT

IoT healthcare services are aimed to introduce Internet of Things services into hospital systems for provision of healthcare services with a view to reducing medical expenses and improving services. IoT healthcare services can change the paradigm of existing healthcare services and can go beyond the area of healthcare service to become applicable to diagnosis, surgery, and treatment too hereafter^{1,2,3}.

Over the last several years, hospitals and medical device suppliers have been attempting to graft IoT related diverse platforms and wearable devices on hospital healthcare services with a view to supporting patient-centered healthcare services⁴.

However, to graft IoT devices on hospital healthcare services, those pieces of biometric information that have been measured through diverse kinds of different wearable sensors should be transmitted to smartphones, Body Composition Monitors, Activity Monitors, Blood Pressure Monitor, Medication, Oxygen Saturation Monitors, Blood Sugar Monitors to provide personalized healthcare services such as heart disease management, diabetes management, hypertension management, and exercise amount tracking⁸.

To solve problems in existing IoT healthcare services, recent IoT related medical studies presented scenarios for construction of new forms of healthcare services aimed to graft IoT equipment on hospital medical systems as shown in Figure 15. As you can see in Figure 1, there are two main types of scenarios for a new healthcare service that wants to apply IoT devices to hospital medical systems. First, there are scenarios in which manufacturers, telecommunications service providers, and healthcare-related organizations work together to provide health services. Second, there are scenarios in which telecom service providers and medical equipment/service provider's work together to provide health services.

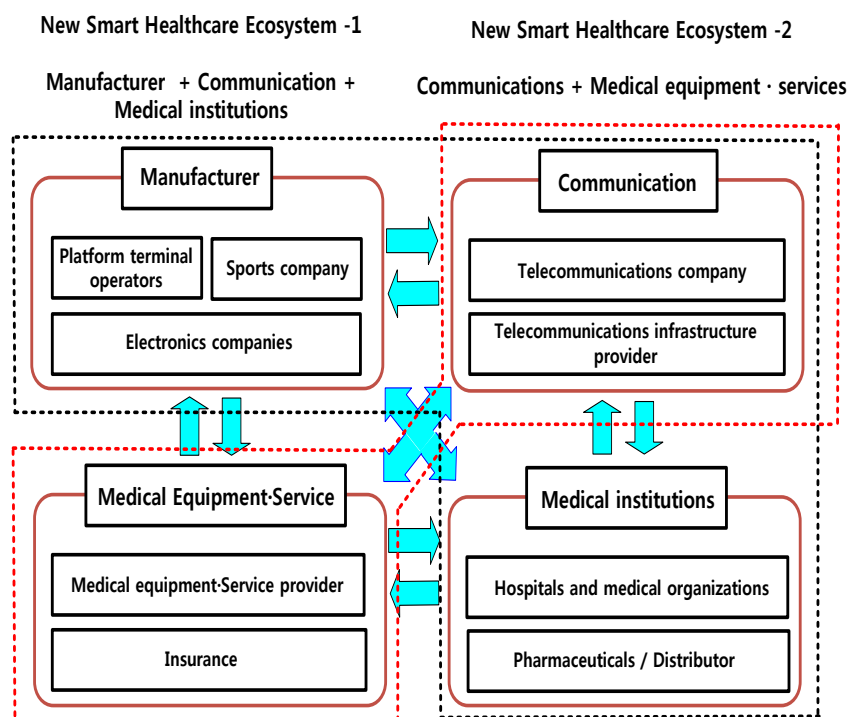


Figure 1: Possible Scenarios of New Health Care Ecosystem

As shown in Figure 1, some healthcare systems can connect patients to medical institutions over a communications network. In these systems, diabetics measure blood glucose levels and blood pressure weekly, deliver the results to the family doctor, and then they can use the video phone to communicate diagnosis results and e-mail prescriptions.

IoT healthcare services can be used for not only healthcare for general people but also management of chronic diseases such as hypertension and diabetes, healthcare for special occupational groups such as transportation business workers such as bus and truck drivers, and air force pilots, youth obesity management and fitness promotion, emergency alert, hospital link service such as remote patient monitoring, and global consultation^{9,10}. Table 1 shows measures to utilize IoT healthcare services including problems in current services, solutions, and major contents divided into six items; general healthcare, chronic disease management, special occupational healthcare, youth obesity management and fitness promotion, emergency alert and global consultation.

Table 1: Problem and Solution for IoT Healthcare Service of Current Hospital

IoT Healthcare Service	problem with the current service	Solutions and Highlights
General Health Care	-Continued lack of motivation -Simple and monotonous numerical services of the measured momentum (momentum / sleep patterns)	- Continuous motivation through certain compensation payments (payment points / insurance linked with, etc.) - Health information and integrated sensing provides personalized content through a single device
Chronic disease management	-Solitary health through a calibrated device Measuring levels -Systematic data management members -Give members of the chronically ill individual	-regular mode using wearable devices Monitoring -Provide personalized exercise / diet / medication information -It provides objective and systematic ensure achievement
Special occupational health care	-Chronic disease of the professional experience -Health Management through a simple treatment -Member of the specialized skills, the system	-Systematic health management with biometric information -Occupation-specific content / systems offer
Promote youth fitness and weight management	-The challenges of sustainable management systems based on the lack of -Personalized management challenges	-Using the wearable device built systematic service delivery and management system -Personalized service to leverage Data PAPS
Emergency alert	-Difficult to deal with emergency situations early -Lack of systematic management during normal -Notification provided for in the limited circumstances	-The initial response through an associated 119 -An integrated information collection beyond time and space Provided through safety management -Guardian Emergency Notification Service
Global consultation	-ideoconference center -It depends only solitary patient information	-Always be monitored for overseas patients -Increasing health effects through advanced medical technology sharing

B. Union ID Management System

Most union ID management system models that have been studied thus far are Kerveros, Liberty Alliance, OPENID, and Windows Live ID. Kerveros is an inter-domain network authentication system. Kerveros security society based infrastructures are based on symmetric key cryptography to share long-term secret keys along with an authentication server for all users and service providers to perform cryptography operations that have privacy risks.

Kerveros is not efficient for password estimation due to its request for trusted paths against internal attacks such as the Trojan horse and man-in-the-middle attacks. Liberty Alliance is composed of at least 140 companies united together. Nokia demonstrates that Liberty Alliance is vulnerable to man-in-the-middle attacks on clients and proxy profiles^{11,12}. In Liberty Alliance, to protect user privacy, the recognizer provider knows the recognizers of all users and the service provider conspires with the recognizer provider to connect user anonymity. The service provider can connect with possible user network address based single sign on recognizers. The TCG (Trusted Computing Group) initializes the TPM (Trusted Platform Module) that provides the attributes of reliable hardware equipment or software in distributed environments. Since the TCG uses trusted hardware, the security and privacy of united system components can be improved.

C. Union ID management system

Recently, as the number of patients that were attached with IoT devices at hospital has been increasing, the necessity of studies of union ID models for IoT devices has been also increasing. Z. A. Khattak et al. presented a security model that can safely manage union IDs in the union ID management system when an adversary attempts access to implantable devices depending on the types of attacks on union IDs and proposed a mutual platform for trustful establishment between clients and recognizer providers based on security models for ID management systems¹³. H. Gao et al. proposed a dynamic trust model for union ID management. In this model, trust relationships are expressed through dynamic trust policy languages to politically express dynamic trust relationships¹⁴.

Y. Zhou et al. showed that authentication certificates can firsthand generate power of attorneys using proxy signature keys to make proxy signatures using the keys in terms of the delegation verifiability of proxy signature techniques based on RSA and integer factorization problems¹⁵. M. Mambo et al. proposed a discrete logarithm problem based proxy signature technique. However, this technique has shortcomings of the necessity to use dual signature algorithms because RSA electronic signature algorithms are used in public key structures in most cases and failure to satisfy the strong forgery impossibility, which is basic stability¹⁶.

R. Lu et al. proposed modified Rabin based proxy signatures. This technique is based on the difficulty of integer factorization problems¹⁷. In this technique, the original signatory transmits a power of attorney and relevant signature and the proxy signatory check the validity of the authentication certificate.

III. INTEGRATED HEALTHCARE SERVICE MANAGEMENT MODEL FOR IN-HOSPITAL IoT DEVICES USING UNION IDS

In the case of those IoT based healthcare platforms and services that have been released thus far for patients, since services are provided through different platforms unique to individual services, hospitals cannot provide fused integrated services to patients. In this section, to solve the problem of existing studies that cannot provide healthcare service management and control, an IoT based healthcare service model that fuses IoT devices and RFID technology is proposed. The proposed model performs integrated management of IoT devices to minimize the time for patient treatment and administrative processing in low power wireless personal area networks.

A. Overview

Recently, hospitals have been gradually providing IoT devices attached with various sensors to minimize difficulties in patient management, supervision, and monitoring procedures and medical expense reduction in relation to hospital operation. Sensors built into IoT devices used in hospitals such as cameras, microphones, accelerometers and gyroscopes are all used for patient healthcare-related values or diagnostic measurements. In addition, IoT devices allow hospitals to measure patient biometrics such as step count, activity, calorie consumption and sleep patterns, as well as help medical teams identify clinically significant medical data such as body temperature, oxygen saturation; you can monitor blood pressure and electrocardiogram in real time.

However, since IoT device related devices used in hospitals cannot continuously detect patient's health information, IoT equipment installed in a hospital cannot continuously identify patient information. In order to provide continuous patient care to the patient, in addition to the function of the IoT equipment installed in the hospital, skills are required to communicate with the medical sensors attached to the patient's body.

In the present paper, an integrated healthcare service model is proposed that can identify the locations of IoT devices used in hospitals to deliver patients' health conditions to medical teams in real time through equipment (e.g bracelet, heart rate measuring sensor, smart band, smart shoes services, etc.) loaded with tracking sensors to improve the quality of healthcare services. To support those low power wireless networks that are provided by different healthcare service systems, the proposed model fuses IoT devices with RFID technology. In particular, to improve network efficiency, the proposed model composes and uses union IDs that guarantee the priorities of medical sensors' multiple attribute information and medical sensor information as hierarchical pairs.

In addition, the proposed model has a characteristic of delivering the data and resources sensed through devices attached to patients to medical team in real time using IoT equipment installed in hospitals thereby minimizing the time and procedures for healthcare services, treatment, and administrative processing.

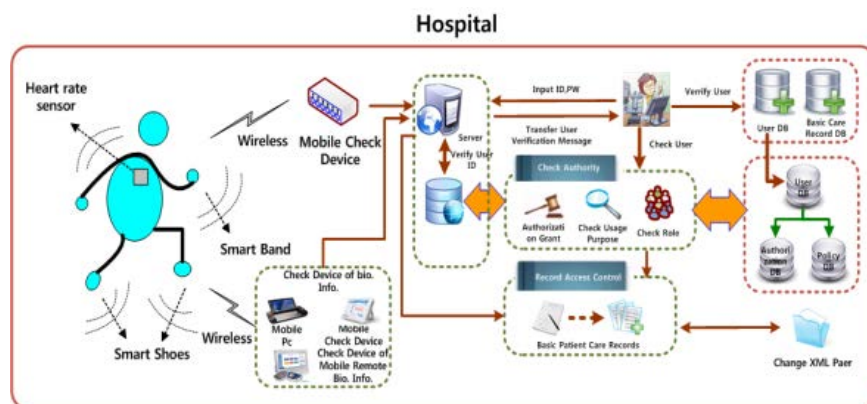


Figure 2: Overall Process of Proposed Scheme

Figure 2 shows the overall structure of the proposed model that provides IoT-based health services in hospitals. As shown in Figure 2, when patients visit the hospital or stay at the hospital, the patients' biometric information obtained using the IoT devices (e.g. bracelet, heart rate measuring sensor, smart band, smart shoes services, etc.) worn by the patients is delivered to medical teams in real time through IoT devices installed at hospitals so that treatment time can be shortened and administrative processing can be minimized.

As can be seen in Figure 2, to efficiently provide IoT healthcare services to patients, the proposed model operates separately in two parts; an IoT device part and a server part. The IoT device part transmits the sensing data information measured by sensors to the gateway and the server part utilizes users' personal information to efficiently manage sensed data and resources.

B. Notations

The notations used in the present paper are as shown in Table 2.

Table 2: Notations

Parameter	Notation
OID	One-time Identification Information
$\bar{B}$	Bio-information Group of Patient
b_i	i^{th} Bio-information of Patient
p_i	i^{th} Property Information
rn	The random number generated by the patient
srn	The random number generated by the server
DDL	IoT devices classified information

C. Recognition Process Using IoT devices

This section describes the process through which patients are automatically recognized by identifying the biometrics RFID tags or IoT based RFID tags attached to patients using IoT devices installed in hospitals, which is composed of largely four stages as follows.

Stage 1: IoT device checking

In this stage, various kinds of IoT devices installed in the hospital are interlocked with the database in the hospital healthcare service center in real time to check the IoT devices. The hospital healthcare service center stores those pieces of information that will enable identifying individual IoT devices as shown in Table 3 in advance to check whether the IoT devices are normal or not.

Table 3: IoT Device Information

IoT DeviceID	IoT Detail Information			Timestamp
	IoT Serial Number	IoT Location	Date of IoT Manufacture	

Stage 2: patient information checking

In this stage, patients' biometrics RFID tags or IoT based RFID tags are recognized through the IoT devices installed in the hospital and information in the RFID tags are compared and analyzed with the patient information stored in the hospital server. In this case, when the RFID tag information delivered to the hospital server is verified by the hospital, if the patient information matches, One-time Identification Information (OID, One-time Identification Information) will be issued and if not, the patient recognition process will be implemented again.

Stage 3: Collection of patient information generated in the RFID tags

In this stage, the patients' biometric information generated in the RFID tags is collected by the IoT device. The patients' biometric information $\bar{B}$ generated in the patients' biometric RFID tags or IoT based RFID tags is collected as shown by equation (1).

$$\text{Gathering } \bar{B} = (b_1, b_2, \dots, b_n) \quad (1)$$

Stage 4: Creation of attribute values of the biometric information

In this stage, attribute values are given to the biometric information values generated in the biometric RFID tags or IoT based RFID tags. The patients' biometric information b_i stored in the server generates the attribute values as shown by equation (2).

$$Generate b_i = (p_1, p_2, \dots, p_n) \quad (2)$$

Where, p_n refers to the attribute values for the biometric information and n is an element of set $Z(n \in Z)$.

D. Biometric information transmission process

This section describes the process through which patients' biometric information is delivered to the server using the one-time recognition information OID. In this process, it is assumed that at least one biometric RFID device was attached to each patient.

This process is composed of four stages.

Stage 1: Encryption of the biometric information using the one-time recognition information OID and random numbers

The patient's one-time recognition information OID and random number r_n are combined to encrypt patient's biometric information and biometric RFID device information and the resultant information is delivered to the database along with IoT device classification information DDL.

Stage 2: Checking the IoT device information

The biometric information delivered from the patients is decrypted by combining patients' one-time recognition information OID and random number r_n .

The database compares the IoT device classification information DDL in the decrypted information with the DDL information stored in the database. If the IoT device classification information DDL matches, the patients' biometric information will be renewed and if not, biometric information will be requested again to the patients.

Stage 3: Delivery of patients' information to the hospital server

In this stage, the classified biometric information is delivered to the database of the treatment department of the hospital.

In this case, the database is assumed to have the patients' biometric RFID tag device classification information stored in advance.

The communication channels between the IoT devices and the hospital server generate and share random number sr_n related with patient recognizers. The shared random number is generated and shared in the hospital server in advance. The random number sr_n generated in this stage is used to encrypt/decrypt biometric information before delivering the biometric information.

Stage 4: Delivery of patient information to medical teams

In this stage, guidance information such as the health conditions of patients connected to the hospital healthcare service center and the present situation of provision of healthcare services to those patients is delivered to the doctor in real time using the IoT equipment installed in the hospital. In particular, this process minimizes the time and procedures for patient healthcare service, treatment and administrative processing.

E. User Authentication Process

The user authentication process is composed of a union ID generation process, authority identification and control process, and a process to control access to patient records.

a. Union ID Generation

When the hospital staff requests the biometric information of patients attached with IoT devices, the hospital staff combines users' anonymous information ID, hospital staff information (employee number, authority level, and random number, etc.) and time stamps as shown in Table 4 to generate a union ID that can be used in the hospital.

Table 4: Union ID Generation Information

User AnonymousID	Hospital Staff			Timestamp
	Employee number	Authority level	Random number	

Figure 3 shows the union ID generation process. Union IDs are generated by combining the anonymous recognizer used by the patient and the hospital staff information.

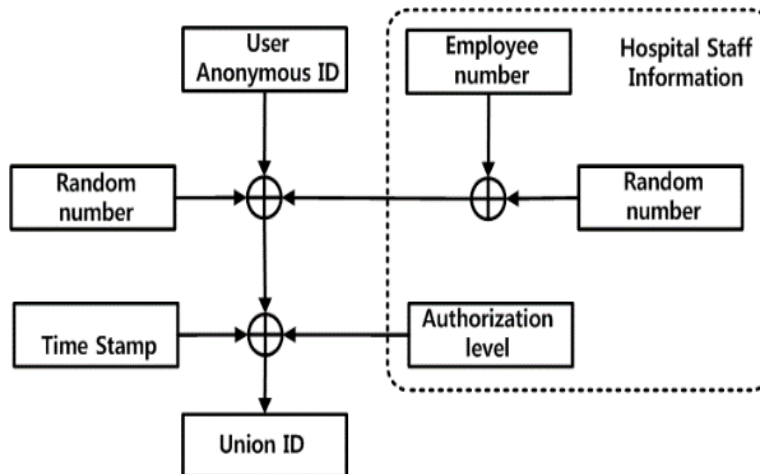


Figure 3: Union ID Generation Process

As shown in Figure 3, union IDs that can be used in the hospital are generated by combining hospital staff ID and patients' anonymous IDs and applying the generated authority level of the hospital staff. As shown in Figure 3, the random number is used by hospital staff to respond to attacks such as replay attacks and the authority level is used to limit users that can access patients' biometric information according to staff's authority levels. The time stamp is used to check the term of validity of signatures out of the information used by hospital staff to access user's biometric information.

b. Authority Checking and Control

In the proposed model, when a hospital staff member requests patient's biometric information, the patients agrees to the use of his/her biometric information, and the hospital staff collects the patient's biometric information according to the hospital staff's access level.

When hospital staff members access patients' biometric information; their authority for business is limited according to their roles for the hospital (doctor, nurse, pharmacist, etc.) and for patients. In this case, hospital staff members' authority levels are given based on the roles of the staff members according to their medical work levels and the authority to access patients' biometric information is limited based on the assigned authority levels. Through this process, hospital staff members that use the user union ID management information database are provided with a function to be easily provided with healthcare services while reducing working time and costs.

Those hospital staff members that access patients' biometric information can have their roles and authority confirmed by the authentication server and when they have requested for patients' biometric information; they can access patients' biometric information only when their roles are consistent with the purpose of use and hospital policies. In the proposed model, patients' biometric information leaks and medical information losses are prevented through work division among hospital staff and minimization of authorities.

c. Control of Access to Patient Records

Figure 4 shows access control processes of patient records in hospital staff. For hospital staff members to access patients' biometric information, they should first access the user union ID management information database to be given authority levels based on their roles. When the authority levels have been given, the hospital staff members access patients' biometric information according to their authority levels and perform work. The authority levels given to hospital staff members are divided into 10 levels and higher authority levels are given higher authorities. When a hospital staff member with a low authority level accesses the basic medical record database in which patients' examination records are stored, the hospital staff member cannot access patients' biometric information that requires high authority levels and can see only low level patients' personal information such as patients' disease name and medical records.

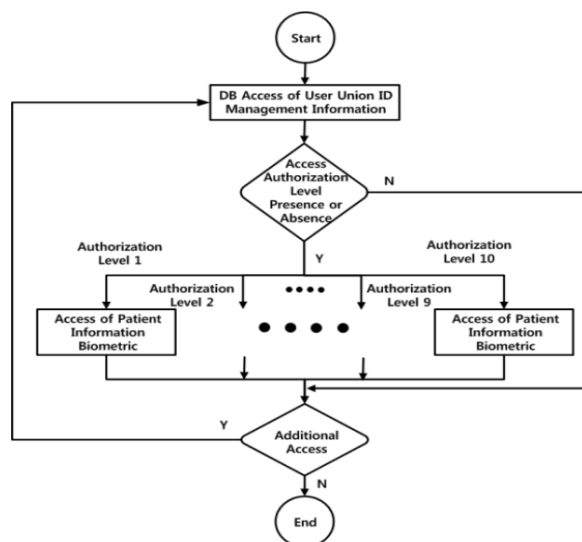


Figure 4: Access Control Processes of Patient Records

When patients' biometric information includes medical records for treatment at other hospitals or information on any specific disease with high access level such as figure 4, hospital staff members request the other hospitals to share the patients' information. In this case, the assigned union ID should be used to prevent hospital staff members' illegal abuse of authority. In addition, in the proposed model, hospital staff members' jobs are divided and only minimum authority to access patients' medical records is given according to the security level policy determined by the hospital so that leaks of patients' personal information and losses of medical information can be prevented.

IV. EVALUATION

The performance evaluation in the proposed model includes the evaluation of the efficiency of patient and staff tracking and monitoring, the efficiency of communication between IoT devices and medical sensors, and the overhead of IoT devices and the security evaluation include the evaluation of security levels against internal attacks and external attacks.

A. Environment Setup

Table 5 and Figure 5 show the parameters and experimental environment used in the simulation of the proposed model. To evaluate the performance of the proposed model, we set the number nu of medical sensors to $\{1, 2, 5, 10\}$ and the number of biometric information nd of patient is $\{50, 100, 250, 500, 1000\}$. The number of attributes between the IoT device and the medical sensor used for the communication strength of the network is set to $\{1, 2, 3, 4, 5\}$. The time that the health sensor is used to set up the data before the service is requested is set to 300 seconds. The threshold value th is set to $\{1, 3, 5\}$. The size of the data compressed through the IoT device nn is set to $\{20, 30, 50, 60$ and $180\}$ and the average encryption/decryption time is set to 40ms and 35ms. The simulated network in Figure 5 consisted of medical sensors, IoT devices, IoT devices and IoT gateways, IoT gateways, and healthcare service servers to enable the proposed model to work

Table 5: Parameter Setup

Parameter	Setting
Number of Medical Sensor Devices	$nu = \{1, 2, 5, 10\}$
Number of Bioinformatics Data	$nd = \{50, 100, 250, 500, 1000\}$
Number of Property	$p = \{1, 2, 3, 4, 5\}$
Threshold	$th = \{1, 3, 5\}$
Transmission of Medical Sensor Device	3m
Bioinformatics Data generation interval	0.01 ms
Initial self data set time	300 s
Compressed data size(Bytes) through number of IoT devices	$nn = \{20, 30, 50, 60, 180\}$
Average Compress time(ms)	40
Average Decompression time(ms)	35

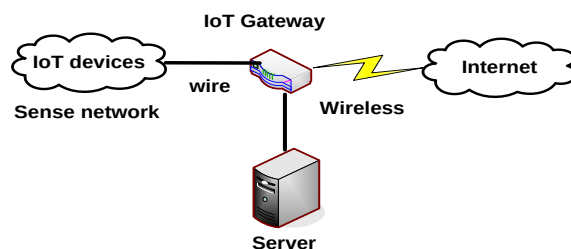


Figure 5: Simulation Experiment Environment

B. Performance Analysis

a. Efficiency of Patient and Staff Tracking and Monitoring

Figure 6 shows the evaluation of the patient and staff tracking and monitoring efficiency of representative union ID model related studies recently conducted to improve patient healthcare services using IoT devices. According to the results shown in Fig. 6, the proposed model shows a 28.2% higher efficiency in tracking and monitoring patients and employees than the existing models. These results appeared because the proposed model used union IDs that enable integrated management of those pieces of information that are used in IoT devices when the biometric information collected by sensors is delivered to the server through IoT devices regardless of medical sensors. In addition, whereas the efficiency of the proposed model increased in proportion to the number of patients and staff members because the patients' biometric information delivered through union IDs enabled using the network in more optimal conditions than existing models, the efficiency of existing model did not increased in proportion to the number of patients and staff members even when the number of patients and staff members increased.

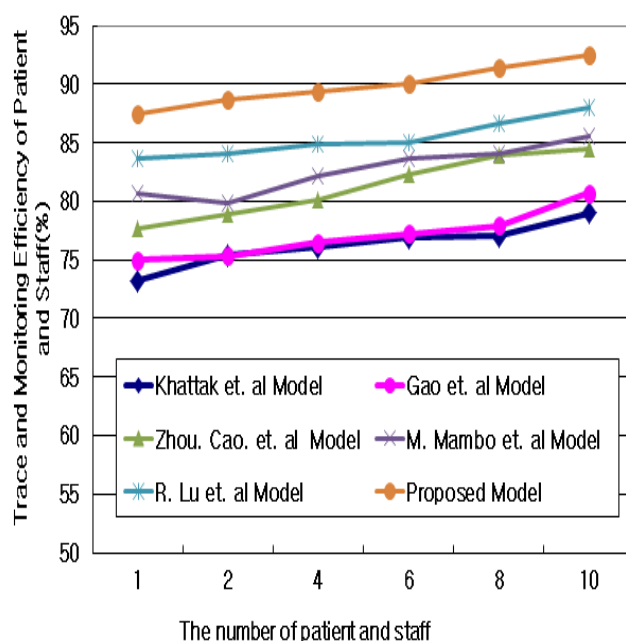


Figure 6: Trace and Monitoring Efficiency of Patient and Staff

b. Efficiency of Communication between IoT Devices and RFID Medical Sensors

Figure 7 shows the communication efficiency between the IoT device and the medical sensor using the biometric information transmitted and received between the hospital-installed IoT device and the medical sensor. As shown in Fig. 7, the proposed model shows that the communication efficiency between the IoT device and the medical sensor is 14.1% higher than that of the existing model. The results show that the proposed model is designed to handle the information of the IoT device attached to the hospital and the information of the RFID sensor attached to the patient body in a coordinated manner.

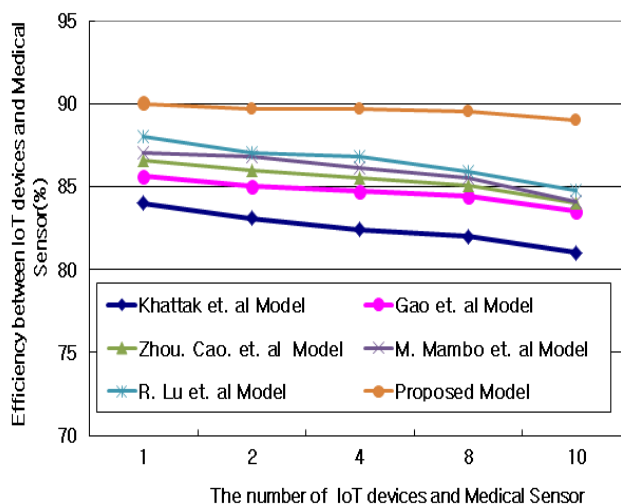


Figure 7: Efficiency between IoT Devices and Medical Sensor

As shown in Figure 7, the efficiency of the proposed model decreases as the number of IoT devices and RFID medical sensors increase, but the overall reduction rate is very small. However, as the number of IoT devices and RFID medical sensors increased, the efficiency of existing models was greatly reduced.

c. IoT Devices' Communication Overhead

Figure 8 shows the Communication overhead according to the number of IoT devices installed in the hospital. According to the results of experiments as shown in Figure 8, the communication overhead between the IoT device installed in the hospital and the RFID medical sensor attached to the patient body was 5.5% lower than the conventional model. These results are attributable to the fact that, in the case of the proposed model, the union ID values given to RFID medical sensors enable adjusting network conditions to be optimal so that communication overhead decreases as the number of IoT device increases except for a certain time at the beginning when the network condition values are analyzed through union IDs.

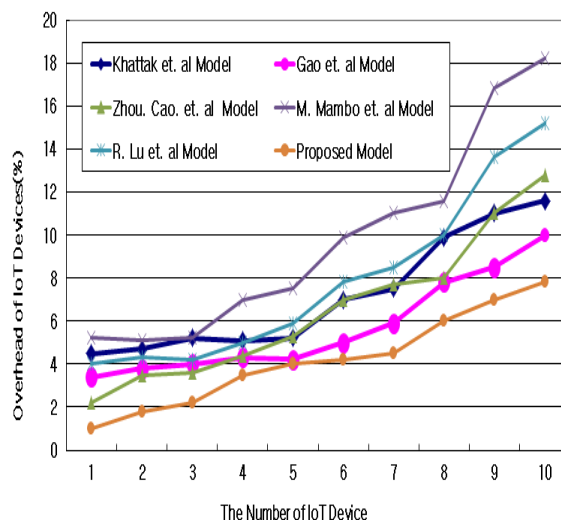


Figure 8: Overhead of IoT Devices

d. Security Analysis

In this section, security problems in hospital healthcare services using IoT equipment are found in existing studies to evaluate the security of the proposed model separately for internal attacks and external attacks¹⁸⁻²¹.

e. Internal Attack

In the proposed model, to prevent patients' privacy attacks, union IDs are generated through the recognition provider. Union IDs XOR users' anonymous IDs hospital staff members' information together with time stamps to guarantee the availability of patients' information without exposing patients' so that patients' privacy can be protected.

As for reuse attacks that enable third parties to obtain patients' biometric information, since the union ID generated are provided by the recognition provider and used by hospital staff members, security is guaranteed even if the union ID is wiretapped. Union ID = user anonymous ID $\oplus$ h(employee number $\oplus$ random number $\oplus$ authority level) $\oplus$ time stamp. In addition, the propose technique is safe against reuse attacks because union IDs are generated by hospital staff members using the time stamp delivered from the recognition provider.

The proposed technique allows services according to access authority when hospital staff members try to access patients' biometric information. When a user with no authority accesses patients' biometric information, the proposed technique judges the access as illegal and stops the service. The proposed model is highly reliable because services are normally provided only when the registration and request for authentication according to access authority, key exchange, device authentication information transmission, and authentication result transmission have been completed.

To prevent service denial attacks, the proposed technique gives priorities to control of access to patients' biometric information. This method is intended to easily manage hospital staff members that access the server and when any illegal access attack has occurred, encryption technique is used to reinforce the service authentication system.

f. External Attack

Among those attack types that can easily occur in U-healthcare, spoofing attacks can occur when the information necessary to generate union IDs between hospital staff members and patients has been obtained by the attacker. However, in the case of the proposed technique, since the information transmitted between the recognition provider and hospital staff members is limited to union IDs, no 3rd party can extract information in union ID information so that no spoofing attack can occur. Even if a 3rd party has obtained hospital staff member information in the union ID, the 3rd party cannot make spoofing attack because the 3rd party does not know the random number out of the hospital staff member's information h(employee number $\oplus$ random number $\oplus$ authority level).

In the case of the proposed technique, even when hospital staff members' information has been exposed to a 3rd party, the 3rd party cannot illegally generate and use any union ID because hospital staff members use random numbers newly generated by the recognition provider every time when they access patients' biometric information.

When the user union ID management information database has been spilt to a 3rd party, the 3rd party can easily obtain database files that have not been encrypted. However, in the case of the proposed technique, 3rd parties cannot use union IDs because the union ID stored in user union ID management information database is newly generated every time by hashing the random number generated by the recognition provider and time stamps. Even if the 3rd part requests authentication to the authentication server with the information spilt from the database, the authentication cannot be conducted lawfully so that the proposed technique can guarantee security.

V. CONCLUSION

As IT technology has developed recently, hospitals have used implantable devices for intractable diseases such as artificial heart, electronic identification tags, hemodialysis devices, and hearing aids to provide medical care for patients. In this paper, we proposed an integrated medical service structure model based on IoT that can support various protocols provided in various medical service systems, especially low power wireless personal area networks such as RFID and WSN. The proposed model fuses IoT devices using RFID technology to ensure the provision of healthcare services to patients to address the problems of existing research that cannot provide health care management and control. Performance evaluation results show that the proposed model improves patient and employee tracking and monitoring by an average of 28.2%, and the communication efficiency between IoT devices and medical sensors is improved by an average of 14.1% over

the previous model. In addition, the overhead of IoT devices is reduced by an average of 5.5% over the previous model. Based on the results of this study, future research will examine the performance and efficiency of real IoT devices and biometric RFID sensors in many hospitals.

ACKNOWLEDGMENT

This Research was supported by the Tongmyong University Research Grants 2017.

REFERENCES

- [1] Weber R H, Internet of Things: New Security and Privacy Challenges. *Computer Law & Security Review*, 2010, 26(1), pp. 23-30.
- [2] Choi S C, Ryu M W, Jin M, Kim J H, Internet of Things platform and service trends. *Information and Communications Magazine (Information and Communication)*, 2014, 31(4), pp. 20-27.
- [3] Haller S, Karnouskos S, Schroth C, The Internet of Things in an Enterprise Context. in *Future Internet – FIS 2008 Lecture Notes in Computer Science*, 2009, 5468, pp. 14-28.
- [4] Raza S, Shafagh H, Hewage K, Hummen R, Voigt T, Lithe: Lightweight Secure CoAP for the Internet of Things. *IEEE Sensors Journal*, 2013, 13(10), pp. 3711-3720.
- [5] Jeong YS, Lee SH, A protocol for protection of the privacy of U-healthcare patients attached with implantable devices according to condition information. *The Journal of Korea Information and Communications Society*, 2012, 37(4), pp. 277-353.
- [6] Phunchongharn P, Niyato D, Hossain E, Camorlinga S, An EMI-Aware Prioritized Wireless Access Scheme for e-Health Application in Hospital Environments. *IEEE transactions on information technology in biomedicine*, 2009, 14(5), pp. 1247-1258.
- [7] Phunchongharn P, Hossain E, Camorlinga S, Electromagnetic Interference-Aware Transmission Scheduling and Power Control for Dynamic Wireless Access in Hospital Environments. *IEEE Transactions on Information Technology in Biomedicine*, 2011, 15(6), pp. 890-899.
- [8] Shen Q, Liang X, Shen X, Lin X, Luo H Y, Exploiting Geo-Distributed Clouds for a E-health Monitoring System With Minimum Service Delay and Privacy Preservation. *IEEE Journal of Biomedical and Health Informatics*, 2004, 18(2), pp. 430-439.
- [9] Shen X, Emerging technologies for e-healthcare. *IEEE Network*, 2012, 26(5), pp. 2-3.
- [10] Burns A, Greene B R, McGrath M J, O'Shea T J, Kuris B, Ayer S M, Stroiescu F, Cionca V, SHIMMERTM - A Wireless Sensor Platform for Noninvasive Biomedical Research. *IEEE Sensor Journal*, 2010, 10(9), pp. 1527-1534.
- [11] Liverty alliance, Identity Federation and Web services – technical use cases for mobile operators. http://www.fridu.org/download/publications/Nokia_Sun_A4_2312.pdf, 2016.
- [12] Nokia, Identity management in mobile services. <http://www.nokia.com/>, 2004.
- [13] Khattak Z A, Sulaiman S, Manan J A, A study on threat model for federated identities in federated identity management system. *2010 International Symposium in Information Technology*, 2010, 2, pp. 618-623.
- [14] Gao H, Yan J, Mu Y, Dynamic Trust Model for Federated Identity Management. *2010 4th International Conference on Network and System Security*, 2010, pp. 55-61.
- [15] Zhou Y, Cao Z, Lu R, Provably secure proxy-protected signature schemes based on factoring. *Applied Mathematics and Computation*. 2005, 164(1), pp. 83-98.
- [16] Mambo M, Usuda K, Okamoto E, Proxy signatures for delegating signing operation. *Proceeding of third ACM Conference on Computer and Communications Security*, 1996, pp. 48-57.
- [17] Lu R, Cao Z, Zhou Y, A simple efficient proxy-protected signature scheme based on factoring. *Proceedings of the 2005 international conference on Parallel and Distributed Processing and Applications*, 2005, pp. 332-341.
- [18] Roman R, Najera P, Lopez J, Securing the Internet of Things. *Computer*, 2011, 44(9), pp. 51-58.
- [19] Prajit K D, Sandeep N, Nitin K S, Anupam J, Karuna J, Tim F, Context-Sensitive Policy Based Security in Internet of Things. *2016 IEEE International Conference on Smart Computing*, 2016, pp. 1-6.
- [20] Tobias H, Oscar G M, Rene H, Sye L K, Sandeep S K, Klaus W, Security challenges in the ipbased internet of things. *Wireless Personal Communications*, 2011, 61(3), pp. 527-542.
- [21] Raymond D R, Midkiff S F, Denial of service in wireless sensor Networks: Attacks and Defenses. *Pervasive Computing*, 2008, 7(1), pp. 74-81.



ISSN
0975-6299

The Effects of Gami-Shinkiwihan On Aging-Related Osteoporosis and Muscle Atrophy

Sun-Young Park, Dept. of Physiology, College of Korean Medicine, Semyung University, Jecheon, Chungcheongbuk-do, KS001, Republic of Korea. E-mail:Sue-7@daum.net

Ho-Hyun Kim*, Dept. of Physiology, College of Korean Medicine, Semyung University, Jecheon, Chungcheongbuk-do, KS001, Republic of Korea. E-mail:binbae@semyung.ac.kr

Ki-Bong Kim, Dept. of Pediatrics, Hospital of Korean Medicine, Pusan National University, Busan, KS012, Republic of Korea. E-mail:kkg@pusan.ac.kr

Sang-Hyun Ahn, Dept. of Anatomy, College of Korean Medicine, Semyung University, Jecheon, Chungcheongbuk-do, KS001, Republic of Korea. E-mail:dongana@hanmail.net

Abstract---

Background/Objectives: To identify the effects of Gami-Shinkiwihan (GS) on aging-related osteoporosis and muscle atrophy

Methods/Statistical analysis: The mice were divided into control, aging-elicited (AE), and Gami-Shinkiwihan treatment (GS) groups. The control group consisted of 8-week-ICR mice and the AE and GS groups consisted of 24-month-ICR mice. GS was administered at 0.56 g/kg/day for 10 weeks in the GS group and Masson's trichrome and Immunohistochemical staining was performed to investigate aging-related osteoporosis and muscle atrophy.

Findings: Histochemical analysis revealed that the spongy bone in the femur became significantly denser and fat deposition significantly decreased in the GS group compared to the AE group. Immunohistochemical analysis revealed that OPN level significantly increased in the GS group when compared to that of the AE group.

Improvements/Applications: The results of this study show that GS has the potential to be used in an aging-related osteoporosis and muscle atrophy treatment

Keywords--- Gami-shinkiwihan (GS), Osteoporosis, Muscle Atrophy, Osteopontin(OPN), Aging.

* Corresponding Author

I. INTRODUCTION

Advances in medicine and science have prolonged the human lifespan with a subsequent rise in the elderly population that has accelerated societies' transitions into aged societies. Korea's elderly population is rising at an unprecedented rate. However, unlike advanced countries that have addressed the problems generated by an aging population over a long period of time, Korea lacks the preparation and countermeasures for the imminent problems of an aging society¹⁻².

Some of the problems of an aging society are economic downturn as a result of a decline in the economically active population, increased incidence of geriatric diseases, and the subsequent increase in healthcare costs. With the rapid aging of societies, these problems have come to be perceived as important social problems and aging-related diseases have progressively attracted attention³.

Aging describes the process of deterioration of the body's tissues and functions. It brings about functional impairment, dysfunction, and pathological changes². Marked physical weakness reduces motor functions and physical fitness, which in turn weakens the musculoskeletal system and body composition, diminishes cardiopulmonary functions and immunity. This increases one's vulnerability to diseases, eventually inducing osteoporosis, muscle atrophy, and loss of muscle mass⁴.

Osteoporosis, one of the typical complications of aging, is an important disease that develops in almost half of the elderly population. It refers to a systemic metabolic bone disease in which reduced bone mass and bone microstructure impairment make the bones brittle and fragile⁵⁻⁶. Among the several types of osteoporosis, those that develop in late adulthood are induced by a loss of bone mass caused by the impairment in the microstructures of bones, which leads to increased vulnerability of bone structures and increased sensitivity for fractures. The risk for fracture is further heightened by aging-related muscle atrophy and the loss of muscle mass⁷⁻⁹. Osteoporosis has traditionally been viewed to predominantly affect women, but there are recent reports of the growing prevalence of bone fractures, caused by osteoporosis, among men¹⁰⁻¹². This highlights the importance of studying osteoporosis in men as well. Further, despite the fact that muscle atrophy caused by aging is an important geriatric musculoskeletal problem, little research is being conducted on the topic.

The currently available medications for osteoporosis are mostly bone resorption inhibitors that inhibit the loss of bone components. However, these agents are known for their low absorption rate, uncomfortable administration, and side effects, such as gastrointestinal disturbances and cardiovascular disorders¹³⁻¹⁴. Currently, there are no specific medications used to treat aging-related muscle atrophy. Thus, it is essential to discover natural medications that are safer, efficacious, and also effective for muscle atrophy.

Shinkiwihan, made of yookmijihwangwon and schisandra, is described in the Dongui Bogam as a treatment for body fatigue and the kidney. Based on the theory of oriental medicine, aging weakens the shin-qi (kidney-qi) and Shinkiwihan is speculated to ameliorate aging-related symptoms through its recuperative actions¹⁵.

Moreover, *Eucommia*¹⁶, *amomiamari fructus*¹⁷, *batryticatus bombycis*¹⁸, *acanthopanax*¹⁹, *rubus coreanus*²⁰, and *lycii fructus*²¹ are herbal medicines that improve the fatigue of the kidney. Therefore, the addition of these herbal medicines to Shinkiwihan would further improve the restoration of the body and aging-related osteoporosis and muscle atrophy.

In the present study, we used a mixture of Gami-Shinkiwihan (GS) with eucommi, amomiamarifructus, batryticatusbombycis, acanthopanax, rubuscoreanus, and lyciifructus on experimental animals and performed histochemical/immunohistochemical studies on fragments of their femurs and quadriceps muscles in order to investigate the effects of GS on aging-related osteoporosis and muscle atrophy.

II. MATERIALS AND METHODS

A. Experimental Animals

Eight-week old male ICR mice and 24-month old male ICR mice (Samtako, Korea) were used in this study. For 1 week prior to the study, the experimental animals were allowed to adapt to the lab environment and provided with sufficient feed and water. They were divided into control (8-week old ICR mice without any treatment), aging-elicited (AE; 24-month-ICR mice without any treatment), and Gami-Shinkiwihan treatment (GS; samples were treated with GS ([0.56 g/kg/day] for 10 weeks) groups.

This study was conducted with approval from the Semyung University Institutional Animal Care and Use Committee (smecac 16-05-05).

B. Preparation of the GS

For the extract, 658 g of GS in table 1, components per 94 g shown in Table 1, were mixed with 3000 ml of distilled water. The mixture was heated to 100 °C for 3 hours in a round flask and then extracted. The extract was concentrated under reduced pressure using a rotator evaporator (Eyela, Japan) and dried, which yielded 35.2 g of extract powder.

Table 1: Prescription of Gami-Shinkiwihan (GS) per Pack

Name of Herb	Pharmacognostic Name	Weight (g)
Sukjihwang	RhizomaRehmanniae	16
Sanyak	RhizomaDiscoreae	8
Sansuyu	FructusCorni	8
Omija	SchisandrachinensisFructus	8
Taeksa	RhizomaAlismatis	6
Mokdanpi	Cortex MoutanRadici	6
Baekbokryung	Poria Cocos	6
Duchoong	Eucommiae Cortex	6
Ikjiin	AmomiAmariFructus	6
Baekgamjang	BombycisBatryticatus	6
Ogapi	Acanthopanax Cortex	6
Bokbunja	RubusCoreanus	6
Gugija	LyciiFructus	6
Total		94

C. Measurement of the Effects of GS on Osteoporosis

a. Preparation of Femur Tissue Samples

The mice were anesthetized using ether and their thighs were incised to remove their femurs, which were then placed on 10% NBF for 24 hours at 36.5°C. The tissue samples were treated with decalcification solution for 12 hours and subsequently embedded into paraffin and sliced into 5 μ m-thick films.

b. Histochemistry for Evaluation of Osteoporosis

Masson's trichrome staining was conducted to observe changes in the spongy bone of the femur. The femur was mordanted in Bouin solution at 50-60 °C for an hour and picric acid was removed using 70% ethanol. The sample was subsequently placed in Weigert iron hematoxylin for 10 minutes to dye the nucleus, followed by 15 minutes in Biebrich scarlet-acid fuchsin and phosphomolybdic-phosphotungstic acid. Finally, the sample was treated with aniline blue for 5 minutes to stain the sponge (red) and the bone (blue). Images were acquired and analyzed using an optical microscope (BX50. Olympus, Japan) to determine the sponge density of femur.

c. Immunohistochemistry for the Evaluation of Osteoblasts

To investigate the distribution of osteopontin (OPN) in the osteoblasts, immune histochemical staining was performed. For proteolysis, femur fragments were placed in proteinase K (20 μ g/ml) for 5 minutes, then 10% normal goat serum was added for blocking. The sample was then allowed to react with primary antibodies (mouse anti-OPN, 1:50; Santa Cruz Biotech, USA) in a humidified chamber for 24 hours at 4 °C. The sample was then linked to a secondary antibody (biotinylated goat anti-mouse IgG₁, 1:100; DAKO, USA) for 24 hours at room temperature, followed by a reaction with the avidin-biotin complex kit (VectorLab, USA) for an hour at room temperature. Finally, the sample was dyed with a 0.05 M tris-HCl buffer (pH 7.4) that contained 0.05% 3,3'-diaminobenzidine and 0.01% HCl, followed by a hematoxylin contrast dye. The magnitude of positive OPN reactions was measured using image analysis.

D. Measurement of the Effects of GS on Muscle Atrophy

a. Preparation of Femur Tissue Samples

The mice were anesthetized using ether and their thighs were incised to remove their quadriceps muscle, which were then placed on 10% NBF for 24 hours at 36.5°C. The tissue samples were then embedded with paraffin and sliced into 5 μ m-thick films.

b. Histochemistry of Quadriceps Muscle

Phloxine-tartrazine staining was performed in order to evaluate the changes of fat deposition in the quadriceps muscle. To dye the nucleus, the muscle was placed in Mayer's hematoxylin for 5 minutes, followed by a reaction with phloxine saline for 30 minutes. Finally, the sample was divided using tartrazine saline. Image analysis was conducted on the images acquired using an optical microscope (BX50, Olympus, Japan) in order to determine the fat disposition in the quadriceps muscle.

E. Image and Statistical Analysis

In order to quantify the results of the histochemical and immunohistochemical staining, image analyses were conducted using Image pro Plus (Media Cybernetic, USA). The results were compared using a one-way analysis of variance (ANOVA) with Duncan's multiple range tests for post-test analysis in Statistical Package for Social Sciences software (SPSS 20, SPSS Inc., USA).

III. RESULTS AND DISCUSSION

A. Changes in Spongy in the Femur

Histochemical analysis revealed that spongy bone in the femur became significantly more dense in the GS group when compared to that of the AE group as shown in figure 1.

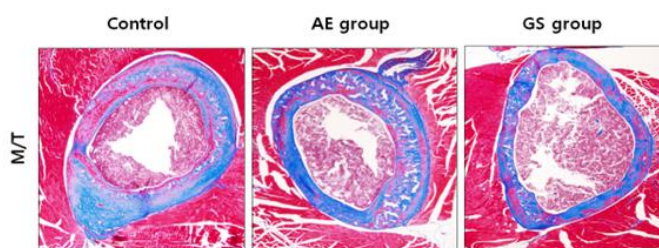


Figure 1: Changes in the Spongy Bone of the Femur

B. Changes in the Distribution of Osteopontin (OPN) in the Osteoblasts

Immunohistochemical analysis revealed that osteopontin (OPN) was significantly increased in the GS group when compared to that of the AE group in table 2, figure 2.

Table 2: Analysis of Osteopontin (OPN) Distribution

Objective	Group		
	Control	AE group	GS group
OPN	21.448±1.637	4.255±388	16.858±1.457*

Values are expressed as mean±standard deviation ($n = 6$). Image analysis for 20,000,000 pixel cells.* $p < 0.05$ compared to the aging-elicited (AE) group.

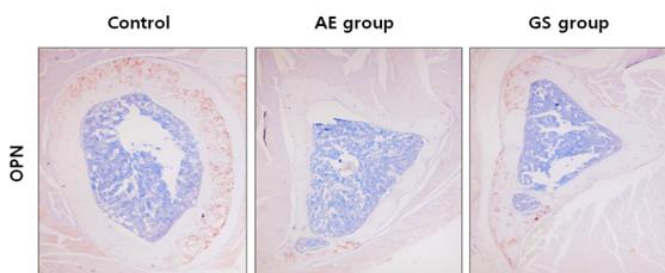


Figure 2: Changes in the Distribution of Osteopontin (OPN) in the Osteoblasts

C. Changes in fat Deposition in the Quadriceps Muscle

Histochemical analysis revealed that fat deposition in the quadriceps muscle was significantly decreased in the GS group when compared to that of the AE group as shown in figure 3.

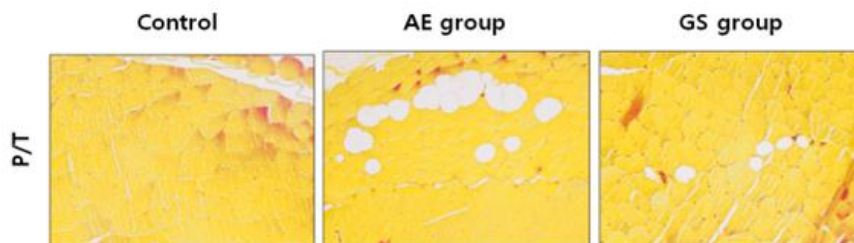


Figure 3: Changes in Fat Deposition in the Quadriceps Muscle

IV. DISCUSSION

A Korean person's average lifespan is 78.5 years (85.5 years for women and 75.1 years for men), which is ranked as the 21st oldest among the 30 Organization for Economic Cooperation and Development (OECD) countries, and is gradually increasing. In general, a society is considered an aging and aged society when its population of elderly, aged 65 years or older, reaches 7% and 14% of its total population, respectively. Since becoming an aging society with its elderly population exceeding 7.2% in 2000, South Korea's elderly population continued to rise to 9.1% in 2005 and is expected to reach 14.3% in 2018 (aged society) and 20.8% in 2026 (super-aged society). The rate at which Korea has progressed from an aging society into an aged society is unprecedented worldwide. This rise in the elderly population has ensued in a heightened prevalence of aging-related diseases, as well as the subsequent increase in healthcare costs, and is urging for societal measures to address these issues^{1,22-23}.

Aging diminishes motor functions and physical fitness, which in turn weakens the musculoskeletal system and body composition. The deterioration of cardiopulmonary functions and immune capacity leaves the elderly susceptible to various chronic diseases, including osteoporosis, muscle atrophy, loss of muscle mass, hypertension, and diabetes⁴.

Osteoporosis is the second-most prevalent disease worldwide, following cardiovascular diseases, and is induced by an imbalance between the osteoblasts and osteoclasts within the bones²⁴. Bone is a special tissue comprised of a firm, calcified surface and inner cellular components called the bone marrow. Bone mass is steadily maintained by a balance between the activities of osteoblasts, which synthesizes the bone matrix, and osteoclasts, which absorbs bone tissue at the surface. Activities of these cells continuously regenerate bones, but when osteoclast activity outpaces the osteoblast activity, bone mass is reduced, resulting in osteoporosis²⁵⁻²⁸. Osteoclasts, which are usually found on the surface of bones, calcifies bone surface by releasing bone matrix substances, such as OCN, OPN, bone sialoprotein, and BSP²⁹.

Osteopontin, a non-collagenous protein, is a marker for osteoclast differentiation; it is produced by osteoblasts and is involved in the anchoring and migration of osteoclasts in the bone through the action of $\alpha V\beta 3$ integrin. It is generally synthesized by osteoblasts and chondrocytes and potentially binds with calcification substances³⁰⁻³².

Osteoporosis that develops in late adulthood is caused by the loss of bone structure as a result of increased decomposition of bone structure, reduced vitamin D production, reduced calcium absorption, and increased parathyroid hormones. It occurs as small losses accumulate over a long period³³⁻³⁴. The increased susceptibility to fracture is more dangerous than the disease. Incidence of osteoporosis increases with advancing age and muscle atrophy. Muscle weakness caused by aging further heightens the risk for fractures and the resulting mortality³⁵⁻³⁶.

Women generally manifest osteoporotic symptoms following menopause. Whereas much research on osteoporosis and fracture in women are ongoing, research on osteoporosis in men is lacking due to the low level of awareness and lack of specific symptoms³⁷⁻³⁸. Nevertheless, in 1990, Cooper et al. reported that 30% of the cases of femoral fractures worldwide ($n = 1.7$ million) occurred in men¹². An epidemiological survey conducted in Canada estimated that the fracture rate in men will match that in women by 2025³⁹. Therefore, the incidence of fractures caused by osteoporosis in men is rising, underscoring the need for increased awareness and vigorous research on the matter.

Medications currently used for osteoporosis can be broadly categorized into bone resorption inhibitors and bone stimulators; most of current medications belong to the former category. Estrogen, selective

estrogen-receptor modulators (SERM), bisphosphonate, calcitonin, vitamin D, and calcium are some of the agents currently used; however, these drugs are associated with digestive symptoms such as heartburn, nausea, vomiting, and ulcer, as well as an increased risk for hot flashes, coronary heart disease, breast cancer, and stroke. Some of these agents have yet to be sufficiently studied in order to determine the appropriate treatment duration and dose.¹³⁻¹⁴ Furthermore, these agents are merely treatments for a single condition, i.e., osteoporosis, and not a treatment for the overall impairment of the musculoskeletal system caused by aging.

The authors speculated that the recuperative effects of GS, a safe natural substance with little side effects and high efficacy, would be effective for improving aging-related osteoporosis and muscle atrophy, which, from the perspective of oriental medicine, are caused by *shin-huh* (kidney deficiency).

First, changes in femoral spongy bone were examined to determine the effects of GS on aging-related osteoporosis. The results revealed that the GS group showed a discernibly denser femoral spongy bone compared to that of the AE group, suggesting that GS inhibited osteoporosis caused by aging.

Immunohistochemical staining was performed to identify the roles of OPN, which is produced by osteoblasts, in the process of GS inhibiting aging-related osteoporosis. The distribution of OPN was significantly increased (by 296%) in the GS group when compared to that of the AE group, suggesting that GS inhibits aging-related osteoporosis by increasing OPN activity.

Finally, changes in the distribution of fat deposition in the quadriceps muscle were examined to determine the effects of GS on muscle atrophy caused by aging. Fat deposition was lower in the GS group than in the AE group, indicating that GS inhibits aging-induced muscle atrophy by reducing fat deposition.

These findings suggest that GS inhibits aging-related osteoporosis, by increasing the density of the femoral spongy bone as well as the activity of OPN, and aging-related muscle atrophy, by reducing fat deposition in the quadriceps muscle. These results suggest that GS is effective for musculoskeletal diseases caused by aging.

V. CONCLUSION

GS, a safe and efficacious natural substance, was injected in ICR mice and histochemical and immune histochemical studies were performed in order to determine the inhibitory effects of GS on aging-related osteoporosis and muscle atrophy. The following results were obtained:

- i. There was a greater increase in the density of the spongy bone within the femur in the GS group when compared to that of AE.
- ii. There was a greater increase in the concentration of OPN in the GS group when compared to that of AE.
- iii. There was a greater reduction in the fat deposition in the quadriceps muscle in the GS group when compared to that of AE.

Based on these results, it is speculated that GS inhibits aging-related osteoporosis by increasing the density of femoral spongy bone and the activity of OPN produced by osteoblasts and it inhibits aging-related muscle atrophy by reducing fat deposition in the quadriceps muscle. These results suggest that it is effective for musculoskeletal diseases caused by aging.

ACKNOWLEDGMENT

* This study has been sponsored by the Korea Health Industry Development Institute, with funding from the Ministry of Health and Welfare (HI16C-0469-010016).

REFERENCES

- [1] Seo SC, Homebound elderly welfare. Donam Publishing co:Seoul, 2001, p.13.
- [2] Han GY, Study of nutritional support for disease which can appear as a result of physiological changes in the elderly. Dongduk University Graduate school, 2010.
(http://www.riss.kr/search/detail/DetailView.do?p_mat_type=be54d9b8bc7cdb09&control_no=adcebeb4b9f9dfc0ffe0bdc3ef48d419)
- [3] Yang EJ, Bang HM, Nutritional Status and Health Risks of Low Income Elderly Women in Gwangju Area. Korean Journal of Nutrition, 2008, 41(1), pp. 65-76.
- [4] Rhee SJ, A model for elderly health care management. Journal of Korean Academy of Public Health

- Nursing, 1994, 8(2), pp. 71-82.
- [5] Park KH, The effect of testosterone on prevention of bone loss in orchietomized rats. Inje University Graduate School, 2003. (http://www.riss.kr/search/detail/DetailView.do?p_mat_type=be54d9b8bc7cdb09&control_no=d6bbf6f5a137a14e)
- [6] Shaw JM, Witzke KA, Exercise for skeletal health and osteoporosis prevention: In ACSM'S Resource manual(3rd edition). Williams& Wilkins, 2001,3, pp. 288-93.
- [7] Nguyen ND, Ahlborg HG, Center JR, Eisman JA, Nguyen TV, Residual lifetime risk of fractures in women and men. Journal of Bone and Mineral Research, 2007, 22(6), pp. 781-8.
- [8] Rene D, Adaptive human. EwhaWomans University press: Seoul, 1987. (<http://www.ewhappress.com/subpage.asp?code=section&subp=01&cate=9&mode=&gbn=viewok&ps=10&sp=&sw=&gp=1&ix=314>)
- [9] The Korean Geriatrics Society. Textbook of geriatric medicine. EuiHak press: Seoul, 2000, pp.669-79. (<http://www.kyobobook.co.kr/product/detailViewKor.laf?mallGb=KOR&ejkGb=KOR&barcode=9791185305929>)
- [10] Eastell R, Boyle IT, Compston J, Cooper C, Fogelman I, Francis RM, Hosking DJ, Purdie DW, Ralston S, Reeve J, Reid DM, Russell RG, Stevenson JC, Management of male osteoporosis: report of the UK Consensus Group. An International Journal of Medicine, 1998, 91(2), pp. 71-92.
- [11] Orwoll ES, Osteoporosis in men. Endocrinology Metabolism Clinics of North America, 1998, 27(2), pp. 349-67.
- [12] Cooper C, Campion G, Melton LJ 3rd, Hip fractures in the elderly: a world-wide projection. Osteoporosis International, 1992, 2(6), pp. 285-9.
- [13] Choi WH, Medical treatment of osteoporosis: non-hormonal therapy. Hanyang Journal of Medicine, 2002, 22(1), pp. 19-26.
- [14] Lim SK, The recent trend in osteoporosis research. Biochemistry News, 2002, 22(3), pp. 207-6. (http://kiss.kstudy.com/journal/thesis_name.asp?key=1970052)
- [15] Heo J, Donguibogam. Namsandang: Seoul, 1999, p.1183.
- [16] Wang YS, Pharmacological applications of chinese medicine. Beijing, People's medical publishing house: Beijing, 1983, pp.485-6.
- [17] The Jointly Published Textbook Compilation Committee of Oriental College of Medicine Nationwide Department, Herbology. Younglimpress: Seoul, 2004, pp.610-2.
- [18] Whang KT, Han JH, Kang SY, Effect of Batryticatusbombycis on the cerebral hemodynamics of rats. The Korean Journal of Oriental Medical Prescription, 1999, 7(2), pp. 121-30.
- [19] Shin MK, Clinical Herbology. Younglim press: Seoul, 2002, pp.224-5.
- [20] Kim HC, Lee SI, A Comparative Study on the Effectiveness of Rubella. The Korea Association of Herbology, 2008, 6(1), pp. 3-12.
- [21] Jung SH, Kim JH, Oh HG, Shin EH, Lee BG, Park SH, Moon DI, Park YM, Han JH, Han JH, Park KH, Park JS, Han SJ, Ryu DG, Gwon GB, Lee YR, Kim OJ, Lee HY, Effects of Lyciifructus extracts on the erectile dysfunction by chronic ethanol consumption in rats. Korean Journal of Oriental Physiology & Pathology, 2013, 27(5), pp. 625-30.
- [22] Ministry of Health and Welfare. Analysis of health care status in Korea.
- [23] Cho GJ, Park HT, Shin JH, Kim T, Hur JY, Kim YT, Lee KW, Kim SH, The relationship between reproductive factors and metabolic syndrome in Korean postmenopausal women: Korea National Health and Nutrition Survey 2005. Menopause, 2009, 16(5), pp. 998-1003.
- [24] Franceschi RT, Iyer BS, Relationship between collagen synthesis and expression of the osteoblast phenotype in MC3T3-E1 cells. Journal of Bone and Mineral Research, 1992, 7(2), pp. 235-46.
- [25] Grigoriadis AE, Wang ZQ, Cecchini MG, Hofstetter W, Felix R, Fleisch HA, Wagner EF, c-Fos: a key regulator of osteoclast-macrophage lineage determination and bone remodeling. Science, 1994, 266(5184), pp. 443-8.
- [26] Hwang KK, Huh NK, Lee JH, Studies on the signaling molecules in RANK, an osteoclast differentiation receptor. Oral Biology Research, 2000, 24(3), pp. 245-55.
- [27] Väänänen HK, Zhao H, Mulari M, Halleen JM, The cell biology of osteoclast function. Journal of Cell Science, 2000, 113(Pt3), pp. 377-81.
- [28] Maeda T, Matsunuma A, Kawane T, Horiuchi N, Simvastatin promotes osteoblast differentiation and mineralization in MC3T3-E1 cells. Biochemical and Biophysical Research Communications, 2001,

- 280(3), pp. 874-7.
- [29] Rousseau F, Saugier P, Le Merrer M, Munnich A, Delezoide AL, Maroteaux P, Bonaventure J, Narcy F, Sanak M, Stop codon FGFR3 mutations in thanatophoric dwarfism type 1. *Nature Genetics*, 1995, 10(1), pp. 11-2.
- [30] Mundy GR, Martin TJ, *Physiology and pharmacology of bone*. Springer-verlag: New York, 1993, pp.397-418.
- [31] Belezikian JP, Raisz LG, Rodan GA, *Principles of bone biology*. Academic press: California, 1996, pp.1037-52.
- [32] Fujita T, Calcium and aging. *Calcified Tissue International*, 1985, 37(1), pp. 1-2.
- [33] Riggs BL, Overview of osteoporosis. *The Western Journal of Medicine*, 1991, 154(1), pp. 63-77.
- [34] Bluic D, Nguyen ND, Milch VE, Nguyen TV, Eisman JA, Center JR, Mortality risk associated with low-trauma osteoporotic fracture and subsequent fracture in men and women. *JAMA*, 2009, 301(5), pp. 513-21.
- [35] VanStaa TP, Leufkens HG, Cooper C, Does a fracture at one site predict later fractures at other sites? A British cohort study. *Osteoporosis International*, 2002, 13(8), pp. 624-9.
- [36] Seo KY, *Morbidity and practical patterns on male osteoporosis in Korea*. Konyang University Graduate School, 2012.
(http://www.riss.kr/search/detail/DetailView.do?p_mat_type=be54d9b8bc7cdb09&control_no=99d08a3ed6f4cfecffe0bdc3ef48d419)
- [37] Byun YS, Shin KB, *Osteoporosis*. Jungdam publishing co.:Seoul, 1997, pp.15-20, 43, 49-50.
(<http://www.kyobobook.co.kr/product/detailViewKor.laf?mallGb=KOR&ejkGb=KOR&barcode=9788980850112>)
- [38] Martin AD, Silverthorn KG, Houston CS, Bernhardson S, Wajda A, Roos LL, The incidence of fracture of the proximal femur in two million Canadians from 1972 to 1984. Projections for Canada in the year 2006. *Clinical Orthopaedics and Related Research*, 1991, (266), pp. 111-8.



ISSN
0975-6299

Effect of Ankle Stabilization Exercise on the Balance of Ankle Instability Patients after Using Two Taping Methods

Bum-Chul Jung, Dept. of Physical Therapy, Namseoul University, Korea. E-mail:jbc0406@naver.com

Kyung-Tae Yoo*Dept. of Physical Therapy, Namseoul University, Korea. E-mail:taeyoo88@nsu.ac.kr

You-Na Woo, Dept. of Physical Therapy, Namseoul University, Korea. E-mail:qazwsx-dbsk@hanmail.net

Hye-Ri Kim, Dept. of Physical Therapy, Namseoul University, Korea. E-mail:cjtk1018@naver.com

Abstract---

Background/Objectives: The purpose of this study is to analyze the effect of ankle stabilization exercise after taping on the balance of patients with ankle instability.

Methods/Statistical Analysis: Twenty-nine subjects in their 20s with ankle instability were included in the study. They were divided into the inelastic taping, elastic taping, and placebo groups to measure their balance ability after the one-time balance exercise with taping and the maximum contractile force of muscles. The values measured in this study were analyzed by SPSS v.20.

Findings: No significant difference was found between the elastic taping group and placebo group in balance ability and the maximum contractile force of muscles. A significant difference was observed on static balance(trace length) and the maximum contractile force of muscles(tibialis anterior) in the inelastic taping group before and after the intervention. Similar results were found in both the dominant leg and the non-dominant leg. A significant difference was found in the maximum contractile force of the non-dominant leg (tibialis posterior) before and after the intervention.

Improvements/Applications: In the elastic taping group, patients with ankle instability would benefit from performing functional exercises with proprioception training and integrated balance training.

Keywords--- Ankle, Exercise, Taping, MVC, EMG, Balance.

* Corresponding Author

I. INTRODUCTION

Balance is a complex exercise control task involving the detection and integration of sensory information to assess the position and movement of the body in space and to perform appropriate musculoskeletal responses to adjust the body position within the context of the environment and task.

Proprioceptive senses are located inside the muscles, tendons, and joints and play an important role in postural reflexes, joint stabilization, and exercise control¹. It also performs the largest role in postural balance control² and provides physical information related to the supporting base. The ankle strategy is activated as a proprietary input. If an ankle strategy cannot be used effectively, proprioception may be reduced or lost³.

Ankle instability refers to functional instability, such as mechanical instability, muscle weakness, delay in muscle reaction, and pain, caused by ankle damage due to repeated ankle injury or to repetitive irritation and static or dynamic structural damage⁴.

Taping is used as an auxiliary means to help players with injury prevention or functional ankle instability by restricting excessive movement that may occur in the ankle joints. The effect of ankle taping has been reported to improve the ankle's mechanical support and proprioception⁵⁻⁷. In addition, taping is an adjunctive therapeutic technique used by therapists to promote or inhibit the function of joints or muscles during exercise, or to improve stability. The types of tapes can be divided into elastic and inelastic⁸.

Kinesio tape developed by KaseKenzo is the most common elastic tape⁹. The mechanism of Kinesio taping plays an auxiliary role in the movement of muscles to improve lymph and blood circulation, to reduce pain caused by nerve suppression, to relieve abnormal muscle tension, and to reposition joints¹⁰. Inelastic tape plays a role in increasing dynamic stability and relieving pain, so that the body can function well¹¹.

Several case studies have suggested the role of the belief that taping will protect against external damage, as taping has a placebo effect. The placebo effect will have a positive influence on taping and can be expected to have an important role in improving exercise performance and preventing injuries¹².

Many rehabilitation programs have been proposed for the treatment of ankle injuries and prevention of re-injury. In addition to the positive effects on balance and coordination, proprioceptive movements also have a positive effect on pain reduction, improvement of the range of motion (ROM) of the joint and static-dynamic stability, thus proving to be a crucial exercise for rehabilitation after ankle injury and for the prevention of recurrence¹³.

One of the proposed exercises to prevent reattachment of ankle joints is the Biomechanical Ankle Platform System (BAPS) board exercise. The BAPS board exercise requires balance to be maintained on top of an unstable plate, and it is effective in improving leg strength and proprioception^{14, 15}.

The purpose of this study is to investigate the exercise effect and function of different types of taping, namely, elastic and inelastic, and the effect of ankle stabilization exercise on the balance of patients with chronic ankle instability. By establishing a placebo group using cotton bandages, this study also hopes to compare the results of the three groups to discern a more effective method of taping for increased ankle stability and proprioception. Furthermore, the dominant and non-dominant legs of the subjects are taken into account and the results are compared to determine which side is more pronounced before and after the experiment.

II. MATERIALS AND METHODS

A. Subject

In this study, 30 students in their 20s were chosen as subjects with ankle instability using the Cumberland Ankle Instability Tool (CAIT). The subjects were divided into three groups of 10: elastic taping, inelastic taping, and control (placebo using cotton bandages). The subjects gave their consent through a written consent form detailing the aims of the study.

Ankle instability is described as the feeling of the ankle giving way after a sprain and having a CAIT score of 24 and lower.

Before the exercise, one subject suffered an injury and had to leave the study, thus reducing the total number of subjects to 29 (Table 1).

Table 1: General Characteristics of the Subjects (n=29)

	Age(year)	Height(cm)	Weight(kg)	BMI
N.E.T	23.23±2.98	161.98±6.12	61.21±10.26	23.23±2.98
E.T	22.37±3.15	164.5±7.08	60.6±9.86	22.37±3.15
C	23.97±23.97	166.96±9.35	67.81±20.69	23.19±5.33
P	0.674	0.386	0.489	0.674

B. Apparatus

In this study, we used a body composition analyzer (Inbody720, Bio Space, Korea) to investigate the general characteristics of the subjects. To measure the maximum voluntary contraction (MVC) of the subject, a wireless electromyography(EMG) system (Free EMG, BTS, Italy) was used. A professional balance assessment and training system (BT4, HUR Labs Oy, and Finland) was also used to measure balance ability. After reducing the ROM of the ankle and stabilizing the ankle, a non-elastic tape with a width of 3.8 cm was used to begin the exercise. Kinesio tape (Benepec Tape, NIPPON SIGMAX, and Japan) with a width of 5 cm was taped around the muscles of the ankle after having exercised it and the muscles had been excited. The 10 cm wide cotton bandage (Cotton Bandage, Korean Medical Supplier, Korea) was used for the placebo effect.

C. Research Method

a. Taping Method

Inelastic taping should be applied to the ankle while it is at 90° dorsiflexion, and the tape should interlock with vertical and horizontal strips. One or more heel-lock strips were applied on the inside and outside of the ankle. In the case of inner ankle sprains, the vertical tape starts from the inside of the lower leg and is pulled outward. In the case of the outer ankle sprains, the vertical tape starts from the outside of the lower leg and is pulled inward. The horizontal and vertical tapes were applied on the anatomical location of the human body (Figure 1). Kinesio tape manufactured for use in the neck and ankle was used for elastic taping (Benepektape, NIPPON SIGMAX, JAPAN). The method of ankle taping is the one specified by the International Balance Taping Association. First, the middle of a tape strip with a width of 5cm and a length of 30cm is applied to the center of the metatarsal arch until the malleolus. Then, with the ankle in dorsiflexion, the middle of a 5 cm wide and 15 cm long tape was applied to the Achilles tendon until the anterior portion of the ankle joint without stretching the tape (Figure 2). In the placebo method, a 5 cm wide and 8cm thick cotton band was applied generously, mimicking the feeling of taping, to the anterior portion of the ankle placed in dorsiflexion (Figure 3).



Figure 1: Elastic Taping



Figure 2: Non-Elastic Taping



Figure 3: Placebo

b. Exercise Program

All subjects underwent the 40-minute program three times a week for four weeks. The exercise program consisted of the main exercise and pre- and post-exercise stretching (Table 2). The stretching involved flexion of the sole and instep of the foot as well as inversion and eversion, which are the main operations of the ankle. The main exercise consisted of the BAPS board training, which was used as an exercise method in previous studies¹⁶, and modified in this study to be performed just once (Table 3 and Figure 4).

Table 2: Stability Exercise

Stabilization exercise for four weeks (BAPS board and bosu ball)			
	BAPS board	Stretching	
Time	30 min (including break)	10 min (pre, post)	Total: 40 min
Frequency	1 time		

Table 3: BAPS Board Exercise

Warm up		Stretching (5 min)		
Method		Intensity	Repetition	Break time between sets
Main	1 time	Two-leg balance exercise 4 min One-leg balance exercise (one side) 4 min	3 sets	30 s
Cool down		Stretching 5 min		



Figure 4: BAPS Board Exercise

c. Measurement Method

To measure the MVC, an electrode was attached to each main muscle that controls ankle movement using a wireless electrode EMG system (Free EMG, BTS, Italy). Dorsiflexion and inversion are performed by the tibialis anterior (TA). The medial part of the gastrocnemius (GCM) and the soleus (Sol) perform plantar flexion. Eversion and plantar flexion are performed by the peroneus longus (PL) muscle, and inversion and plantar flexion are performed by the tibialis posterior (TP). The MVC was obtained using verbal cues, such as "ready", "start," and "power" which implied holding the tension for 5s.

To measure balance ability, a professional balance evaluation and training system (BT4, HUR Labs Oy, Finland) was used while the subject stood on one leg with eyes open. With both hands resting comfortably, the subject used one leg follow the front and back axes of the balance plate, bending the knee joint to 30°, and the other leg to stand and maintain as much stability as possible. For 30s, the barefoot subject kept his/her eyes focused on a point on a monitor at a distance of 65cm¹⁷. The auditory indication was provided in a countdown starting from 4s until 1s. After the measurement, the word "stop" was used. All aspects of the experiment were conducted in a quiet environment.

D. Statistical Analysis

All data measured in this study were analyzed using SPSS v.20. ANOVA was performed to examine the homogeneity of the subjects. A repeated two-way ANOVA was conducted to compare the MVC and the balance of TA, TP, GCM, Sol, and PL according to group (inelastic taping, elastic taping, and control) and time (pre- and post-exercise). For the variables with significant differences, the Scheffe, least significant difference, and Tukey post-tests were performed. The corresponding sample T-test was used when time is the only difference to determine which group had a significant difference. A repeated two-way ANOVA was again used to compare the before and after of the dominant and non-dominant legs. The significance level (α) for all statistical treatments was set to 0.05, and a value of $p < 0.05$ was considered significant. This study was approved by the Institutional Review Board of Namseoul University (Cheonan, Korea, NSU-161220-04).

III. RESULTS AND DISCUSSION

The MVC of the taping group showed a significant difference in the before and after of the tibialis anterior; thus, all three groups were determined to have a notable before and after change. The results of the T-test showed that the effect of exercise was significant in the inelastic taping group and that no difference was found in the other groups in the before and after. Therefore, inelastic taping was effective. No significant difference was observed among all groups (Table 4).

The MVC of the dominant and non-dominant leg groups showed significant differences in the tibialis anterior and posterior in the before and after. The results of the T-test indicated that both groups had a significant effect from the exercise. The tibialis anterior as the non-dominant leg exhibited an especially significant difference, but no significant difference between the groups was observed in the before and after. The tibialis posterior as a dominant leg had a significant difference, but no change was found between the groups (Table 5).

The trace length (TL) measured during static balance with eyes closed in the taping group showed a significant difference in the results of the before and after. The results of the T-test indicated that the inelastic taping group had a significant effect on balance stabilization. In the other groups, no significant difference was found in the before and after, thus indicating that the inelastic taping was effective. However, as no significant difference could be found among the groups, statistically determining that one taping method was more effective than the other was not possible (Table 6).

During static balance in which the measurement of the TL was taken with closed eyes, the dominant and non-dominant groups had a significant difference in the before and after, but the T-test results proved that the difference was not statistically significant (Table 7).

Using the T-test indicated that before and after exercise, the tibialis anterior muscle in the inelastic group had a significant difference in the maximum muscle contraction force. This result is consistent with those of reports indicating that balance training on unstable surfaces improves balance and ankle muscle strength more efficiently than conventional exercise therapy methods¹⁸. However, no significant difference was observed in muscle contraction in the remaining group, and this result was considered to be caused by muscle fatigue after 40 min of exercise; the decrease in muscle activity could be due to the improvement in balance ability¹⁹. In addition, the maximum muscle contraction force showed the most significant difference in only the tibialis anterior muscle during the ankle balance exercise. These results indicated that the walking speed decreased to the point that even while standing, the foot flexing muscles (tibialis anterior, etc.) contracted to move forward²⁰.

Comparing the dominant and non-dominant groups, the tibialis anterior and tibialis posterior showed a difference in the before and after, but the change was not statistically significant. The corresponding T-test conducted on the tibialis anterior showed a significant difference in the dominant and non-dominant groups.

For the tibialis posterior, a significant difference was found only in the dominant group. These results are consistent with those of Woo²¹, who found that for individuals with chronic ankle instability, visual information influences the dominant leg, which uses the ankle joint strategically, while standing on one leg, and the non-dominant leg uses the hip joint strategically to control the standing posture. The dominant leg is considered more dependent on the ankle joint during exercising, which increases the muscle contraction force of the posterior tibial muscle.

In the Romberg one-leg test, four balance results were measured for the taping groups and the dominant and non-dominant leg groups. When the measurement of the TL was taken with the eyes closed, the difference in the before and after was significant. The T-test that followed showed that the inelastic taping group also had a notable difference. These results indicated that the inelastic taping limited the extensive range of movement in the joint and provided the joint with maximum assistance to enhance balance²². The BAPS board, which moves in front-to-back and side-to-side motions, was an effective exercise for training equilibrium and maintaining balance. These results were in agreement with those of a report in which balance training on a motion disc or a trampoline with one or both legs was found to be effective in improving balance capabilities and enhancing the functional stability of the ankle²³.

No statistically significant difference between the elastic taping group and the placebo effect group was observed. This result could be explained by the fact that, when the kinetic taping was applied and followed with exercise, the mechanical stability of the ankle before and after exercise was continuously maintained and the joint ROM experienced no significant change.

Unlike previous studies²⁴ indicating that the Kinesio taping treatment method for ankle muscle and joint improves reaction capacity and stability, this study only had duration of exercise for 40 min, which is not enough to examine the effect of taping. With this limitation, further multidimensional studies are required. The belief that the placebo effect would affect injury prevention was not proved in this study because no significant difference was found. However, the effect of feeling safe and relief in posture control was dependent on the individual psyche¹² and thus appeared to have no difference.

Table 4: Changes in the Taping Group MVC

	Group	Pre	Post	P	
GCM	N.E.T	152.68±98.29	157.82±88.34	Tm	.121
	E.T	151.86±28.94	156.83±37.36	Gr	.402
	C	115.14±23.44	134.97±32.14	T*G	.537
Soleus	N.E.T	119.54±54.04	108.70±41.71	Tm	.528
	E.T	135.65±40.37	124.79±26.5	Gr	.597
	C	117.98±26.52	128.71±30.91	T*G	.219
Tibialis anterior	N.E.T	180.93±88.47	226.93±75.85	Tm	.000*
	E.T	193.25±77.36	230.32±71.68	Gr	.583
	C	174.57±48.58	187.99±57.39	T*G	.247
Peroneus longus	N.E.T	95.33±30.59	138.97±37	Tm	.098
	E.T	150±49.02	143.73±52.04	Gr	.018*
	C	101.87±25.45	102.6±28.56	T*G	.025*
Tibialis posterior	N.E.T	34.97±17.56	53.31±33.87	Tm	.112
	E.T	38.04±29.25	43.25±32.1	Gr	.815
	C	47.51±31.01	49.51±36.49	T*G	.418

*: p<0.05

Table 5: Changes in the MVC of the Dominant and Non-dominant Groups

	Group	Pre	Post	P	
GCM	Dominant	138.17±34.8	145.68±22.76	Tm	0.193
	Non-dominant	139.94±67.19	151.09±64.72	Gr	0.879
				T*G	0.797
Soleus	Dominant	125.98±41.56	111.26±21.62	Tm	0.295
	Non-dominant	124.01±41.31	124.91±36.46	Gr	0.684
				T*G	0.238
Tibialis anterior	Dominant	188.32±90.97	223.06±78.36	Tm	0.002*
	Non-dominant	180.95±63.74	211.48±66.73	Gr	0.737
				T*G	0.822
Peroneus longus	Dominant	119.6±36.87	134.78±21.63	Tm	0.185
	Non-dominant	115.23±46.21	125.52±49.45	Gr	0.667
				T*G	0.796
Tibialis posterior	Dominant	35.36±29.05	59.62±40.79	Tm	0.023*
	Non-dominant	42.26±25.94	44.31±29.94	Gr	0.712
				T*G	0.052

*: p<0.05

Table 6: Changes in The Static Balance of the Taping Group

	Group	Pre		Post		P		
		E O	E C	E O	E C		E O	E C
TL*	N.E.T	749.53±312.37	1574.31±378.75	1111.37±1397.98	1332.36±360.97	Tm	0.528	0.026 ⁺
	E.T	759.32±238.62	1468.6±222.98	766.79±186.97	1365.86±327.83	Gr	0.648	0.748
	C	816.91±246.76	1572.21±370.92	743.56±233.33	1483.34±491.53	T*G	0.494	0.547
C90*	N.E.T	73.93±20.55	75.52±25.71	61.01±29.06	66.41±31.98	Tm	0.972	0.216
	E.T	69.16±29.43	74.04±18.63	82.36±6.04	64.15±28.03	Gr	0.576	0.926
	C	74±19.01	70.47±19.21	73.12±25.45	64.89±25.97	T*G	0.177	0.958
C90A*	N.E.T	735.25±547.59	471.24±237.26	2090.19±781.9	1263.98±715.90	Tm	0.21	0.36
	E.T	619.36±455.29	534.43±192.38	1545.06±429.15	1546.624±683.94	Gr	0.245	0.389
	C	920.57±891.59	768.85±432.12	2012.62±609.49	1951.47±1291.18	T*G	0.855	0.35
V*	N.E.T	24.98±10.41	51.36±12.7	37.04±46.6	44.44±12	Tm	0.52	0.489
	E.T	25.31±7.95	48.95±7.43	25.76±6.07	43.24±8.9	Gr	0.654	0.308
	C	27.22±8.22	52.9±11.94	24.78±7.77	110.44±192.27	T*G	0.497	0.376

*TL: Trace length, C90: Center of position, *: p<0.05, EO:eyes open, EC:eyes closed
C90A: Center of the position angle, V:Velocity

Table 7: Changes in the Static Balance of the Dominant and Non-dominant Groups

	Group	Pre		Post		P		
		E O	E C	E O	E C		E O	E C
TL*	Dominant	829.98±314.83	1628.9±378.67	769.02±165.66	1344.19±375.11	Tm	0.805	0.009*
	Non-dominant	755.63±238.85	1502.18±300.69	902.56±920.17	1415.7±405.67	Gr	0.867	0.84
						T*G	0.552	0.144
C90*	Dominant	75.16±17.73	78.64±17.09	75.42±17.87	72.97±25.18	Tm	0.97	0.306
	Non-dominant	71.22±24.79	71.22±21.8	71.45±25.25	62.11±28.49	Gr	0.59	0.219
						T*G	0.998	0.81
C90A*	Dominant	719.58±601.06	1820.55±596.13	511.7±312.6	1367.9±642.45	Tm	0.226	0.055
	Non-dominant	774.28±683.14	1896.38±673.26	627.63±330.06	1686.36±1051.60	Gr	0.605	0.516
						T*G	0.832	0.469
V*	Dominant	27.66±10.49	54.92±11.97	25.63±5.52	121.04±216.39	Tm	0.799	0.191
	Non-dominant	25.18±7.96	49.59±9.95	30.18±30.64	46.12±13.02	Gr	0.861	0.091
						T*G	0.547	0.147

* *: p<0.05

IV. CONCLUSION

Although inelastic taping is used to limit the joint motion angle, it can encourage joint stabilization during exercise. Moreover, in the case of static exercise, it may reduce muscle fatigue more effectively than Kinesiotape while still achieving the effects of exercise. Consistent regular exercise should also result in a better effect. Further studies on muscular fatigue and maximum muscle contraction in the muscles surrounding the ankle after taping during exercise are necessary.

REFERENCES

- [1] JungYS, Kim YE, Hong JH, Yu JH, Kim JS, Lee DY, The Effect of Auditory and Vibration Stimulation on Proprioception of the Lower Extremity, Indian Journal of Science and Technology, Vol 9(44), 2016
- [2] Park HJ, Kim YK, Joo S, Hong Y, The effects of core-focused yoga and yoga- stabilization combined exercise on isokinetic trunk strength and body balance. Indian Journal of Science and Technology. Vol. 8(33), 2015, pp.1-6.
- [3] Patricia C. Montgomery, Clinical Applications for Motor Control, 2008, pp340-341.
- [4] Freeman M, Instability of the foot after injuries to the lateral ligaments of the ankle. J Bone Joint Surg [Br]. Vol.47(4), 1965, pp.669-77.
- [5] Barkoukis V, Sykaras E, Costar F, Tsorbatzoudis H, Effectiveness of taping and bracing in balance. Perceptual and Motor skills, Vol.94(2), 2002, pp. 566-74
- [6] Hume PA, Gerrad DF, Effectiveness of external ankle support: bracing and taping in Rugby Union. Sports Medicine, Vol. 25, 1998, pp.285-312.
- [7] Wilkerson GB, Biomechanical and Neuromuscular Effects of Ankle Taping and Bracing. Journal of Athletic Training, Vol.37(4), 2002, pp.436-445.
- [8] Kim SY, Kim HB, McConnell taping method for the shoulder dysfunction. Korean Academy of

- Orthopedic Manual Physical Therapy. Vol.11(2), 2005, pp.96–107.
- [9] Kwon OS, Effects of non-stretchable tapes and stretchable tapes for strapping in stroke patients with shoulder subluxation. Korean Journal of Health Promotion. Vol.10, 2010, pp.139–46.
- [10] Halseth T, McChesney JW, DeBelsio M, Vaughn R, Lien J, The effects of kinesio taping on proprioception at the ankle. Journal of sports science and medicine. Vol.3, 2004, pp.1-7
- [11] McCaw ST, Cerullo JF, Prophylactic ankle stabilizers affect ankle joint kinematics during drop landings. Medical Science Sports Exercise. Vol.31(5), 1999, pp.702–707.
- [12] Hwang JH, Kim CH, Kim JK, Effects of Ankle Taping on Range of Motion, Postural Stability, and Placebo Effect Before and After Exercise. Korean Journal of Sports Science, Vol.20(2), 2011, 793-803
- [13] Hale SA, Hertel J, Olmsted-Kramer LC, The effect of a 4-week comprehensive rehabilitation program on postural control and lower extremity function in individuals with chronic ankle instability. Journal of orthopedic and sports physical therapy, Vol.37(6), 2007, pp.303-311.
- [14] Peter V, William D, Bart VC, Peroneal reaction time and eversion motor response in healthy and unstable ankles. Journal of Athletic training, Vol.37(4), 2002, pp.475-480.
- [15] Osborne MD, Chou LS, Laskowski ER, Smith J, Kaufman KR, The effect of ankle disk training on muscle reaction time in subjects with a history of ankle sprain. The American journal of sports medicine, Vol.29(5), 2001, pp.627-632
- [16] Bernier JN, David HP, Effect of coordination training on proprioception of the functionally unstable ankle. Journal of Orthopaedic & Sports Physical Therapy, Vol.27(4), 1998, 264-275.
- [17] Lee AJ, Lin WH, Twelve-week biomechanical ankle platform system training on postural stability and ankle proprioception in subjects with unilateral functional ankle instability. Clinical Biomechanics, Vol.23(8), 2008, pp.1065-1072.
- [18] Yu JH, Jeong SM, Park HS, The Effect of 3 Balance Training Programs on Improving Capabilities of Balancing among Some Female Students. The Korea Institute of Electronic Communication Science. Volume 8, Issue 4, 2013, pp.619-629.
- [19] Lim SW, Kim SH, Kim YN, Doo YT, Seo SK, Hwang TY, Yoon SW, The Effect of Balance Training on Balance Ability and Ankle Joint Muscle Activity. The Korean Academy of Clinical Electrophysiology. Vol.8(2), 2010, pp.13-18.
- [20] Kim TH, Jang LK, Whang BM, Park SH, The Change of Electromyography Activities of Tibialis Anterior and Gastrocnemius According to the Shoe Type and the Gait Speed in Young Women. The Society of Christian Health. Vol.1 (1), 2011, pp.89-96
- [21] Woo JW, Effect of chronic ankle instability on postural control ability in Taekwondo athletes. Major in Physical education, Graduate school of education, Dong-A University. 2015
- [22] David H. Perrin. Athletic taping and bracing, 2007, pp.21
- [23] Cha SH, Kim JS, The Effects of Balance Exercises on Functional Ankle Stability with Ankle Sprained Patients. Journal of the Korean Association of Certified Exercise Professionals. Vol 11(2), No.27, 2009, pp.73-83
- [24] Kim H, Kang HJ, Effects of Kinesio Taping for One Week on Proprioception of the Ankle. Journal of the Korean Association of Certified Exercise Professionals. Vol. 16(4), No.48, 2014, pp.93-99



ISSN
0975-6299

Evaluation on the Dose Distribution According to the Use of Flattening Filter(FF) or Flattening Filter Free(FFF) Portal Dosimetry in a Linear Accelerator

Gha-Jung Kim, Department of Radiological Science, Far East University, 76-32, Daehak-gil, Gamgok-myeon, Eumsung-gun, Chungcheongbuk-do, gj4269/27601, Korea. E-mail:gjms1225@hanmail.net

Joon-Koo Choi, Department of Radiological Science, Far East University, 76-32, Daehak-gil, Gamgok-myeon, Eumsung-gun, Chungcheongbuk-do, jk2434/27601, Korea. E-mail:rsllaser@hanmail.net

Geum-mun Back*, Department of Radiological Science, Kangwon National University, Kangwon, gm9130/27601, Korea 346 Hwangjo-gil, Dogye-eup, Samcheok-si, Kangwon-do, gm9130/245905, Korea. E-mail:gmb9478@amc.seoul.kr

Tae-Hyung Kim, Department of Radiological Science, Kangwon National University, Kangwon, gm9130/27601, Korea 346 Hwangjo-gil, Dogye-eup, Samcheok-si, Kangwon-do, th7264/245905, Korea. E-mail:thkim@kangwon.ac.kr

Abstract---

Background/Objectives: In this study used the radiation treatment plans of patients that were treated with SBRT to evaluate the dose distribution according to whether or not a flattening filter for a linear accelerator is used based on the EPIDs that use portal dosimetry.

Methods/Statistical analysis: The treatment plans of 20 patients that had been previously treated with SBRT into QA plans and by investigating EPIDs in dosimetry mode in the linear accelerator, portal dosimetry was conducted. Dose distribution was analyzed using the gamma index method based on the difference between the dose distribution of the dose acquisition image measured using EPID. The gamma index method was being used based on a pass-fail evaluation. The dose difference was set to 3 % and the DTA was set to 3mm to evaluate the dose distribution.

Findings: The results of analyzing the dose distribution using the portal dosimetry was confirmed that the Gamma passing rate for when a flattening filter beam was used and when a flattening filter free beam was used were measured to be 99.91% and 99.89%, respectively, and that the mean absolute dose differences were measured to be 0.62% and 0.61%, respectively, which confirmed that there were no statistically significant differences ($p>0.764$). The CI (Conformity Index), which is a comparison of the DVH for the two treatment plans, were confirmed to be 0.99(FF) and 1.01(FFF), respectively, which confirmed that they showed similar values ($p>0.0898$), and the HI (Homogeneity Index) for the two treatment plants were confirmed to be 1.07(FF) and 1.07(FFF), respectively, which was also confirmed to not show a statistically significant similarity($p>0.6783$).

Improvements/Applications: The research result of evaluation on dose distribution of SBRT radiation according to whether or not a flattening filter is used by using EPIDs Portal dosimetry shows there wasn't significant difference.

Keywords--- Flattening Filter Free, Portal Dosimetry, SBRT(Stereotactic Body Radiation Therapy), Gamma Index, CI(Conformity Index), HI(Homogeneity Index).

* Corresponding Author

I. INTRODUCTION

Previous flattening filter for clinical linear accelerators we placed between the primary collimator and the monitor chamber to compensate for the non-uniformity of the beam of the photon. Because the flattening filter which, is made out of absorbent metallic material, creates a uniform dose distribution within the wide radiation field, it is used as one of the main methods to transmit a uniform dose distribution within a target. Conventional radiation treatment plans used a flattening filter to address the important issue of transmitting a uniform dose distribution¹⁻³.

But new treatment technologies such as IMRT(Intensity-Modulated Radiation Therapy), VMAT (Volumetric Modulated Arc Radiotherapy) and helical IMRT etc., are being used in clinical applications, and these advanced treatment technologies apply the characteristics of non-flattened beams that do not require a uniform beam to be directly created on the surface to radiation treatment methods.

By performing radiation treatment with a high dose rate using flattening filter free beams in clinical applications, the intrafraction setup error are decreasing due to the shortened treatment time and increases in both the efficiency of the MU(Monitor Unit) value and also the biological effects. High dose rate radiation treatment that uses a flattening filter free beam is applied to SBRT(Stereotactic Body Radiation Therapy) to achieve improved results⁴⁻⁶.

SBRT is a method that provides radiation does to local tumors using IGRT and target tracking to deal with treating tumors with a minimum margin and also to guarantee accuracy. One advantage of the SBRT(Stereotactic Body Radiation Therapy) is that treatment time is shortened when compared with other regular radiation treatment methods. But it also has the disadvantage that the dose distribution treatment times for each individual treatment session are increased. This causes inconvenience for patient who needs to be stabilized for prolonged periods of time and this is also inefficient for the operator. The high dose treatment can also cause an increase in the intrafraction motion of the patients. This increase in the treatment time is causes several different phenomenon, but the dose rate limitation of the linear accelerator is the most significant. Conventional LINACs (linear accelerators) generated photon beams at a rate between 100~600MU per minute, but when the flattening filter free beam is used, this dose increases by about 4 fold, while decreasing the previous clinical treatment times by more than 50%⁷⁻⁹.

By leveraging these advantages of the flattening filter free beam, high dose rate SBRT is increasing. Also the verification of radiation treatment plans according to non-flattened beams are also being considered as being significant. Therefore this study used the radiation treatment plans of patients that were treated with SBRT to evaluate the dose distribution according to whether or not a flattening filter for a linear accelerator is used based on the EPIDs that use portal dosimetry.

II. MATERIALS AND METHODS

When a flattening filter was not used with the TrueBeamSTx™ (Varian, Palo Alto, USA) linear accelerator used in this study, the dose rate (MU/min) of the 6MV photon beam was possible to be selected to be used from 400 to 1200 MU/min in 200 MU/min increment units, and the dose rate (MU/min) of the 10MV photon beam was possible to be selected to be used from 400 to 2400 MU/min in 400 MU/min increment units. The test was conducted against 10 liver cancer patients that had had SBRT performed, and as can be seen in Figure 1. that shows the images obtained from the CT Simulation (Philips, Netherlands) that was taken in 2.5 mm intervals, and the CI (Conformity Index) value and the HI(Homogeneity Index) values were analyzing using DVH by individually planning flattening filter beam SBRT and flattening filter free beam SBRT radiation treatment plans using the inverse planning method by using Eclipse RTPs (Ver.10, Varian, USA).

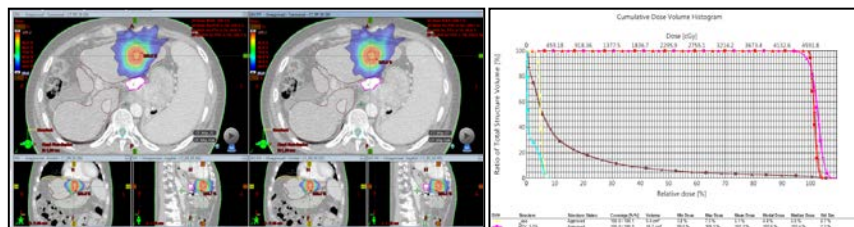


Figure 1: Radiation Treatment Plans Using the Inverse Planning Method by Using Eclipse RTPs

Also to compare the dose distribution of the radiation treatment plans of the flattening filter beam SBRT and flattening filter free beam SBRT, Portal dosimetry using EPIDs was conducted.

Portal dosimetry (Varian Medical Systems VMS, Palo Alto, CA) using EPIDs has the advantages of having an efficient resolution and having a small time required for verification, and is used for IMRT or VMAT field verification¹⁰⁻¹¹.

The resolution of the Portal Vision aS1000 imager panel of the TrueBeam LINAC used in portal dosimetry is 1024 × 768 with a pixel pitch of 0.395 mm.

The portal dosimetry of Varian is made up of 3 steps as shown in the flow chart of Figure 2. The first step is to use the PDIP (Portal Dose Image Prediction) algorithm to establish as Dose Prediction treatment plan. (QA Plan) (Eclipse TPS, Varian, USA) The second step is to conduct Dose Acquisition using LINAC EPIDs. Finally the Dose Prediction image and the Dose Acquisition image are comparatively analyzed¹²⁻¹³.

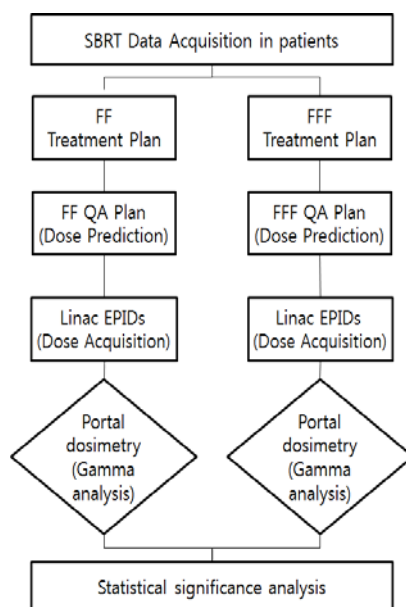


Figure 2: Workflow of Portal Dosimetry Verification

This study converted the treatment plans of 10 patients that had been previously treated with SBRT into QA plans and by investigating EPIDs in dosimetry mode in the linear accelerator, portal dosimetry was conducted. As shown in Figure 3, the dose distribution was analyzed using the gamma index method based on the difference between the dose distribution of the dose acquisition image measured using EPID. The gamma index method analyzed the dose difference and the DTA(distance to agreement). Because portal dosimetry is not adequate to be used as the exclusive tool to evaluate the dose difference and the DTA, a method that is combined with the gamma index method is being used based on a pass-fail evaluation. The dose difference was set to 3 % and the DTA was set to 3mm to evaluate the dose distribution¹⁴.

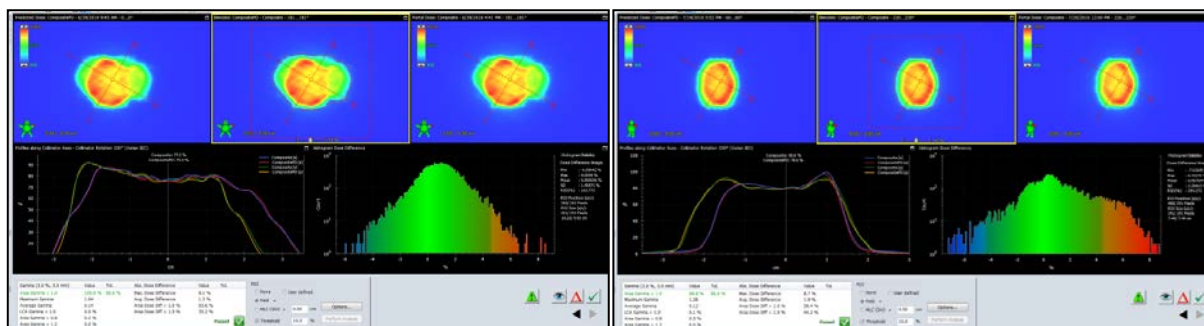


Figure 3: Compare the Dose Distribution of the Radiation Treatment Plans of the Flattening Filter Beam and Flattening Filter Free Beam, Portal Dosimetry Using EPIDs was Conducted

By comparing the total MU and BOT (Beam on Time) according to whether or not a flattening filter for a linear accelerator is used, the utility of SBRT that used a flattening filter free beam was evaluated in this study.

III. RESULTS

The results of analyzing the dose distribution using the portal dosimetry according to whether or not a flattening filter for a linear accelerator was used against 10 liver cancer patients is shown in Table 1., it was confirmed that the Gamma passing rate for when a flattening filter beam was used and when a flattening filter free beam was used were measured to be 99.91% and 99.89%, respectively, and that the mean absolute dose differences were measured to be 0.62% and 0.61%, respectively, which confirmed that there were no statistically significant differences ($p>0.764$). The CI (Conformity Index) value, which is a comparison of the DVH (Dose Volume Histogram) values for the two treatment plans, were confirmed to be 0.99(FF) and 1.01(FFF), respectively, which confirmed that they showed similar values ($p>0.0898$), and the HI(Homogeneity Index) for the two treatment plants were confirmed to be 1.07(FF) and 1.07(FFF), respectively, which was also confirmed to not show a statistically significant similarity($p>0.6783$).

Table 1: The Result of Evaluating the Improvement of the Gamma-index(Pass/fail) Flattening Filter Beam SBRT and Flattening Filter Free Beam SBRT

No	Mode	Gamma passing rate(%)	Absolute Dose Difference	V_{TV}	V_{PTV}	CI	$D_{5\%}$	$D_{95\%}$	HI
1	FF	99.8	0.75	44.81	43.06	1.04	3202	3023	1.06
	FFF	100	0.89	45.07	43.06	1.05	3201	3031	1.06
2	FF	100	0.53	20.22	20.4	0.99	4841	4521	1.07
	FFF	100	0.71	21.13	20.4	1.04	4808	4583	1.05
3	FF	99.8	0.62	44.26	45.18	0.98	4874	4504	1.08
	FFF	100	0.65	44.2	45.18	0.98	4866	4504	1.08
4	FF	100	0.86	11.83	11.89	0.99	4711	4466	1.05
	FFF	99.8	0.97	11.83	11.89	0.99	4770	4516	1.06
5	FF	100	0.26	25.78	25.5	1.01	4804	4528	1.06
	FFF	100	0.56	26.69	25.5	1.05	4834	4563	1.06
6	FF	99.7	0.78	43.49	46.15	0.94	4793	4471	1.07
	FFF	100	0.48	45.1	46.15	0.98	4822	4511	1.07
7	FF	100	0.75	38.36	38.13	1.01	4892	4537	1.08
	FFF	99.8	0.68	3844	3813	1.01	4892	4540	1.08
8	FF	100	0.57	14.54	14.24	1.02	4824	4528	1.07
	FFF	99.8	0.43	14.59	14.24	1.02	4830	4528	1.07
9	FF	100	0.48	15.96	16.77	0.95	4840	4492	1.08
	FFF	99.7	0.46	15.87	16.77	0.95	4822	4485	1.08
10	FF	99.8	0.56	16.67	16.66	1.00	4852	4518	1.07
	FFF	99.8	0.3	16.56	16.66	0.99	4849	4511	1.07
Average	FF	99.91	0.62	-	-	0.99	-	-	1.07
	FFF	99.89	0.61	-	-	1.01	-	-	1.07
p-value		0.764	-	-	-	0.0898	-	-	0.6783

Table 2 shows the results of measuring the total MU and BOT(Beam on Time) according to whether or not a flattening filter for a linear accelerator was used. The values for when a flattening filter beam was used compared to when a flattening filter free beam was used for the total MU were confirmed to be an average of 1616 MU and 1723 MU, respectively, which confirmed a value that that was higher by 107 MU when the flattening filter free beam was used($p>0.0749$). But when the actual BOT (Beam on Time) of the SBRT used the flattening filter beam was compared to when a flattening filter free beam was used, the average times

were confirmed to be 2.69 minutes and 1.40 minutes, respectively, which confirmed that the SBRT that used a flattening filter beam saved an average of 1.29 minutes($p>0.0001$).

Table 2: Comparison of total MU and Beam on Time between Flattening Filter-free and Flattening Filter Beam

No	Dose/fx	MU (Monitor Unit)			Beam on time (min)		
		FF	FFF	differences	FF	FFF	differences
1	30Gy/3fx	1218	1303	85	2.03	1.09	-0.95
2	45Gy/3fx	1797	2358	561	3.00	1.59	-1.42
3	45Gy/3fx	1742	1854	112	2.91	1.57	-1.34
4	45Gy/3fx	1614	1600	-14	2.69	1.33	-1.36
5	45Gy/3fx	1601	1595	-6	2.67	1.34	-1.33
6	45Gy/3fx	1743	1844	101	2.85	1.54	-1.31
7	45Gy/3fx	1468	1536	68	2.45	1.28	-1.17
8	45Gy/3fx	1661	1663	2	2.77	1.39	-1.39
9	45Gy/3fx	1542	1678	136	2.57	1.40	-1.17
10	45Gy/3fx	1772	1797	26	2.95	1.50	-1.45
Average		1616	1723	107	2.69	1.40	-1.29
p-value		0.0749			<.0001		

IV. CONCLUSION

IMRT(Intensity-Modulated Radiation Therapy) andVMAT(Volumetric Modulated Arc Radiotherapy) are strongly recommended in regard to quality guaranteed before treatment which can reduce potential errors of treatment plans. 2D array detector is widely used for IMRT QA, but it's not appropriate for verification of SBRT due to its small field size. Portal dosimetry(Varian Medical System. Palo Alto, CA) which used EPID as an alternative has simple way of setup and data acquisition, and QA of IMRT is possible as resolution. This research analyzed SBRT treatment data on 10 liver cancer patients through portal dosimetry by using EPIDs, and dose distribution's gamma index of flattening filter(passing rate 99.89%) and flattening filter free beam(Passing Rate 99.91%) weren't different($p>0.764$). Moreover, total MU of flattening filter-free beams increased, whereas beam on time and gantry rotation time decreased. By applying high dose rate radiation treatment which uses flattening filter-free beam during SBRT which has comparatively longer time of treatment, both the efficiency of the MU value and also the biological effects increased and treatment time reduced, thus enabling to reduce intrafraction setup error.

V. DISCUSSION

The research result of evaluation on dose distribution of SBRT radiation according to whether or not a flattening filter is used by using EPIDs Portal dosimetry shows there wasn't significant difference. The result of advanced research, which was compared by CI(conformity Index) and HI(Homogeneity index) using VMAT radiation treatment plan, didn't have much difference either. This supplements the disadvantages of the SBRT, which are the increase in the single session dose distribution and also longer individual treatment sessions, and will verify the usefulness of the flattening filter-free beam that can increase the efficacy of radiation treatment. Moreover, as suggested by researches such as PardoE(2016), portal dosimetry which uses EPID is also evaluated as useful quality control method for treatment plan of IMRT and VMAT on this research. The verification of radiation treatment plan using portal dosimetry clinically is also expected to expend.

ACKNOWLEDGMENT

This work was supported by the Far East University Research Grant(FEU 2016S11)

REFERENCES

- [1] Izewska J, Shaping of photon beams from electron linear accelerators in radiation therapy, Med Phys, 1993, 20, pp.171-177.
- [2] Georg D, Knoos T, McClean B, Current status and future perspective of flattening filter free photon beams. Med Phys, 2011 Mar, 38(3), pp.1280-93.
- [3] Jaffray DA, Battista JJ, Fenster A, Munro P, X-ray sources of medical linear accelerators: Focal and extra-focal radiation, Med Phys, 1993, 20, pp.1417-1427.
- [4] Prendergast BM, Fiveash JB, Popple RA, Clark GM, Thomas EM, Minnich DJ, Jacob R, Spencer SA, Bonner JA, Dobelbower MC, Flattening filter-free linac improves treatment delivery efficiency in

- stereotactic body radiation therapy, *Journal of Applied Clinical Medical Physics*, 2013 May, 14(3), pp.64-71.
- [5] Lohse I, Lang S, Hrbacek J, Scheidegger S, Bodis S, Macedo NS, Feng J, Lutolf UM, Zaugg K, Effect of high dose per pulse flattening filter-free beams on cancer cell survival, *RadiotherOncol*, 2011,101, pp.226–232.
- [6] Vassiliev ON, Kry SF, Chang JY, Balter PA, Titt U, Mohan R, Stereotactic radiotherapy for lung cancer using a flattening filter free Clinac, *Journal of Applied Clinical Medical Physics*, 2009, 10(1), pp.14-21.
- [7] Fu W, Dai J, Hu Y, Han D, Song Y, Delivery time comparison for intensity-modulated radiation therapy with/without flattening filter: a planning study,*Phys Med Biol*, 2004, 49(8), pp.1535-47.
- [8] Kragl G, Baier F, Lutz S, Albrich D, Dalaryd M, Kroupa B, Wiezorek T, Knoos T, Georg D, Flattening filter free beams in SBRT and IMRT: Dosimetric assessment of peripheral doses, *Med Phys*, 2011May, 21(2), pp.91–101.
- [9] Stathakis S, Esquivel C, Gutierrez A, Buckey CR, Papanikolaou N, Treatment planning and delivery of IMRT using 6 and 18MV photon beams without flattening filter,*ApplRadiatIsot*, 2009, 67(9), pp.1629–37.
- [10] Nicolini G, Clivio A, Vanetti E, Vanetti E, Krauss H, Fenoglietto P, CozziL, Fogliata A, Evaluation of an aSi-EPID with flattening filter free beams: applicability to the GLAaS algorithm for portal dosimetry and first experience for pretreatment QA of RapidArc, *Med Phys*, 2013, 40(11), pp.111719
- [11] Podesta M, Nijsten SM, Persoon LC, Scheib SG, Baltes C, Verhaegen F, Time dependent pre-treatment EPID dosimetry for standard and FFF VMAT,*Phys Med Biol*, 2014, 59, pp.4749–4768.
- [12] Chuter RW, Rixham PA, Weston SJ, Cosgrove VP, Feasibility of portal dosimetry for flattening filter-free radiotherapy, *Journal of Applied Clinical Medical Physics*, 2016, 17(1), pp.112-120.
- [13] Pardo E, Novais JC, López MYM, Maqueda SR, On flattening filter-free portal dosimetry, *Journal of Applied Clinical Medical Physics*, 2016, 17(4), pp.132-145.
- [14] Min Sk, Choi YE , Kwak JW, Cho BC, Practical approach for pretreatment verification of IMRT with flattening filter-free (FFF) beams using Varian portal dosimetry, *Journal of Applied Clinical Medical Physics*, 2015, 16(1), pp.40-50.



ISSN
0975-6299

Effects of Communal Exercise with 'Parkinson Home Exercise' Application on Gait Ability for Parkinson's Disease Patients

Yunjin Park, Dept. of Sports Medicine, Korea University, Sejong, Republic of Korea.

Jaeho Yu, Dept. of Physical therapy, SunMoon University, Asan, Republic of Korea.

Younghwa Song, Dept. of Physical therapy, Dongnam Health University, Suwon, Republic of Korea.

Ryng Hwang, Dept. of Physical therapy, Dongnam Health University, Suwon, Republic of Korea.

Sungwon Kim, Dept. of Physical therapy, Dongnam Health University, Suwon, Republic of Korea.

Hyunghun Moon, Dept. of Sports Medicine, Korea University, Sejong, Republic of Korea.

Sungki Lee, Dept. of Sports Medicine, CHA University, Pocheon, Republic of Korea.

Sukyool Jung, Dept. of Sports Medicine, CHA University, Pocheon, Republic of Korea.

Hyeyoung Cho*, Dept. of Sports Medicine, Korea University, Sejong, Republic of Korea.

Abstract---

Objectives: The purpose of this study was to invest the effect of communal exercise with ' Parkinson home exercise' application on gait ability.

Methods/Statistical analysis: Twenty nine subjects were randomly divided into three groups; CSG (Communal Exercise with Smart app Group), ISG (Individual Communal Exercise with Smart app Group) and CG (Control Group). The subjects were instructed to carry out 10 weeks exercise program. Values were measured before and after the exercise program and the differences were analyzed by two-way repeated measures ANOVA and Scheffe post-hoc test ($P < .05$).

Findings: In the present result, ambulation time and single leg support (%) were significantly increased among groups; CSG was the most significant among groups ($P < .001$). Double leg support (%) and distance time were significantly difference among time ($P < .001$).

Application/Improvements: These findings indicate that communal exercise with smart app. can be effective in gait ability for PD patients.

Keywords--- Parkinson's Disease, Communal Exercise, 'Parkinson home exercise' Application, Spatial Parameters, Temporal Parameters.

* Corresponding Author

I. INTRODUCTION

Exercise is an important therapeutic intervention for patients with Parkinson's disease because of its beneficial effects such as gait ability improvement, fall prevention, and improvement in physical performance¹

However, although exercise is an essential therapeutic intervention for such patients, it is realistically difficult for patients to participate in voluntary and constant physical exercise as the lesion progresses, because they lose confidence, avoid interpersonal relationships, and are unable to lead an independent life^{1,2}.

Accordingly, the Association of Physical Therapists in Parkinson's Disease(ADDP) developed the Parkinson home exercise application for smart phones so that patients can receive visual and auditory feedback whenever and wherever they are. However, regardless of the quality of the program, its effect is limited if patient participation is low. It is important to motivate patients to participate in programs consistently. Such motivation can be provided through active recommendations for participation from supervisors and development of an environment where patients can work out with other patients in a similar situation³. In particular, communal exercise improves interpersonal relationships and enhances social functioning. This greatly contributes to improvement in physical performance⁴.

Thus the aim of this study is to prove the effects on gait ability of group exercise program with external stimuli of smart app., which feeds a visual and auditory signal back to the patients of PD.

II. MATERIALS AND METHODS

A. Subjects

The participants of this study were twenty-nine patients diagnosed with non-demented PD in a community-dwelling in South Korea. The participants were randomly divided into the Communal Exercise with Smart app. Group (n=10, CSG), Individual Exercise with Smart app Group(n=10, ISG) and Control Group(n=9, CG). Selection criteria were a diagnosis of PD according to department of neurosurgery of Y Hospital, classification at modified Hoehn and Yahr(H&Y) stage 1 through 3 and able to gait of independence.

Subjects were excluded if they had other neurologic problem such as acute medical problems that could affect gait, a score below 23 on the Mini-Mental State Examination and fallen more than once in the prior year. The physical characteristics of the subjects are shown in Table 1.

Table 1: Physical Characteristics

Groups	Gender	Age (yrs)	Hoehn & Yahr stage	BMI (kg/m ²)	Duration of disease(yrs)	MMSE-K
CSG (n=10)	M1, F9	71.10±5.10	2.71±.48	23.62±1.42	6.22±.78	20.70±.94
ISG (n=10)	M1, F9	73.50±6.93	2.42±.51	22.45±1.61	5.90±.87	21.40±1.07
CG(n=9)	M1, F8	72.75±7.94	2.53±.53	25.12±2.13	6.25±7.70	20.75±1.03

Communal Exercise with Smart app Group (CSG), Individual Communal Exercise with Smart app Group(ISG), Control Group (CG),. Values are mean± SD.

B. Study Design

Subjects were randomly separated into CSG, ISG and CG in order to evaluate single limb support(%), double limb support(%), ambulation time and distance time before and after the 10 weeks exercise intervention. The process of this study is as following figure 1.

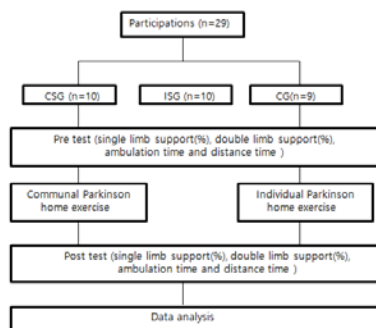


Figure 1: The Screening Process

C. Measures of Gait Parameters

The GAITRite system(GAITRite, CIR systems Inc., Clifton, NJ, USA, 2008) is made of 5m length walkway and 16,128 sensors. Over the walking of the subject, the system automatically detect pressures through the sensors, and delivers the data to the computer to calculate gait parameters. The subjects walk three times and the calculated average of the three trials was used to analyze the data.

D. Exercise Intervention

Subjects performed a communal exercise program using a smart application for 60 min, three times per week, for a period of 10 weeks, which focused on improving their deep breathing, relaxation levels, flexibility, strength, balance, and gait pattern. The subjects and caregivers were instructed how to use the smart application and how to perform the exercise program. As shown in table 2, the exercise program used a smart application named "Parkinson home exercise application", which has been developed by the Association of Physiotherapists in Parkinson's Disease Europe⁵.

Table 2: Parkinson Home Exercise Program

Week	Order	Exercise type(time)	Contents	Intensity	Frequency
Week 1-3	Smart app. program	Relaxing exercise(5min)	Relaxing arms, leg	RPE 13-15	3days /week
		Relaxation using breathing(5min)	Feel your breathing Experience deep breathing		
		Flexibility(10min)	Stretching on lying, sitting		
		Balance & coordination training(10min)	Standing up Stepping away		
		Walking(10min)	Walking straight		
Week 4-6		Relaxing exercise(5min)	Moving and relaxing back		3days /week
		Relaxation using breathing(5min)	Relaxation using breathing		
		Flexibility(10min)	Stretching on sitting, standing		
		Walking with rhythms(10min)	Walking with rhythms		
		Balance & coordination training(10min)	Lunge, reaching Chair forward, backward		
Week 7-10		Relaxing exercise(5min)	Tensing and relaxing neck & trunk	RPE 8-9	3days /week
		Relaxation using breathing(5min)	Relaxation using breathing		
		Flexibility(10min)	Stretching on sitting, standing		
		Starting/Freezing(10min)	let go 1,2,3' start, stop, turn, back, forward, big steps.		
		Balance & coordination training(10min)	Stepping away		
	Cool down (10min)	Breathing exercise	Segmental, diaphragmatic and deep breathing		

III. DATE ANALYSIS

With all data obtained from this study, we calculated Mean (M) and Standard Deviation (SD) using SPSS/PC 18.0 statistic program for Windows. We carried out two-way repeated measures ANOVA analysis

used to demonstrate the differences among values from the experimental groups (CSG, ISG, and CG) and measuring period (before/ after 10-weeks intervention). In addition, when the statistical significance in the data was shown, post-verification of Scheffe post-hoc test analysis was conducted. Statistical significance was adopted at $P < 0.05$ in this study.

IV. RESULTS

The Change of Temporal Parameters

As shown in table 3, after 10-weeks intervention, CSG and ISG groups showed the significant improvement in single limb support(%), double limb support(%) and ambulation time; ambulation time change of CSG was the most remarkable among three groups($P < .01$).

Table 3: Change of Temporal Gait Ability

Item	Groups	Pre test	Post test	2-way ANOVA	F	P	post-hoc
Ambulation	CSG	6.66±1.42	3.00±0.78	Group	7.078	0.004**	a>b a>c
	ISG	6.48±1.09	5.68±1.27	Time	130.531	0.000***	
	CG	6.47±0.86	6.50±0.84	Group*Time	74.951	0.000***	
Single limb support(%)	Left	CSG	30.25±2.77	Group	3.019	.066	a>c
		ISG	31.66±3.32	Time	84.977	0.000***	
		CG	34.94±2.12	Group*Time	22.640	0.000***	
	Right	CSG	30.71±2.62	Group	3.723	0.038*	
		ISG	31.95±2.97	Time	95.747	0.000***	
		CG	35.16±1.99	Group*Time	23.828	0.000***	
Double limb support(%)	Left	CSG	39.26±2.56	Group	2.898	0.073	
		ISG	40.08±2.45	Time	79.370	0.000***	
		CG	40.09±1.22	Group*Time	25.960	0.000***	
	Right	CSG	39.97±2.18	Group	1.795	0.186	
		ISG	40.04±2.55	Time	61.706	0.000***	
		CG	40.38±1.48	Group*Time	16.343	0.000***	

CSG: Communal Exercise with Smart app Group, ISG: Individual communal Exercise with Smart app Group
CG: Control Group. Values are mean± SD. * $P < 0.5$ ** $P < .01$, *** $P < .001$. a: CSG, b: ISG, c: CG

The Change of Spatial Parameters

As shown in table 4, after 10-weeks intervention, CSG and ISG groups showed the significant improvement in distance time. Distance time showed significant differences among groups($P < .05$).

Table 4: Change of Spatial Gait Ability

Item	Groups	Pre test	Post test	2-way ANOVA	F	P
Distance time	CSG	303.02±37.83	361.69±25.48	Group	3.536	0.044*
	ISG	304.03±29.00	309.94±28.01	Time	74.691	0.000***
	CG	302.01±19.87	303.28±18.66	Group*Time	53.277	0.000***

CSG: Communal Exercise with Smart app Group, ISG: Individual communal Exercise with Smart app Group
CG: Control Group. Values are mean± SD. * $P < 0.5$ ** $P < .01$, *** $P < .001$. a: CSG, b: ISG, c: CG

V. DISCUSSION

Gait disability, reduced mobility, falls risk and social isolation affect bad influences on PD patients' physical and mental health, social interaction, and quality of life⁶. Most of all, gait disability is associated with increased risk of falls and hospitalization, decrease of independence and even higher risk of mortality^{7,8,9}. Therefore gait disability is the best barrier for them to restrict physical performance and to reduce the mental health, social interaction and health-related quality of life^{1,10,10,11}.

Most useful method to improve gait ability is regular exercise¹². But it is very hard for them due to complex symptoms representing disorders of cognition, language, depression and fatigue, self-care, communication as well as motor disorder. Therefore, recent researches are reported that communal exercise improved physical performance and emotional stability by enhanced familiarity and social integrity function⁴.

The social interaction and physical performance were improved as a consequence of the communal exercise undertaken by the PD patients¹³. On the other hand, Association of Physiotherapists in Parkinson's Disease (APPDE) released 'Parkinson home exercise' which provides easy exercise guide and audio-video stimulus. It makes PDs easy to exercise⁵.

The spatiotemporal parameters of gait in PD patients were improved by the external audio-video stimulus^{3,14}. Besides, they felt similarity during the communal exercise and it made better social integrity function³. The aforementioned social facilitation effect from communal exercise motivated their willing to overcome the physical disorder, competitive spirit and can-do attitude^{3,4}.

Thus, we have investigated the effect of a communal exercise program with the smart phone app. on gait ability by comparing with the effect of an individual exercise group and a control group.

As a result of this study, communal exercise program with smart phone app. for PDs was effective to improve gait ability. After 10-weeks exercise, temporal parameters of CSG and ISG groups showed the significant improvement in single limb support(%), double limb support(%) and ambulation time. Especially the change of ambulation time in CSG was the most remarkable among three groups ($P<.01$). And spatial parameters of CSG and ISG groups showed the significant improvement in distance time, which was showed significant differences among groups ($P<.05$). These finding indicates that the communal exercise with smart phone app. have benefit on gait ability comparing to individual exercise. According to recent research reported that outcomes relating to gait significantly improved in walking speed and balance of PD following the exercise intervention¹⁵. But it was very difficult to find any precedent study and similar research using smart application for PDs' communal exercise. Therefore comparison result and conclusion could not be drawn. The present study examines community-dwelling patients, who tend to have weaker socioemotional relationships with families, relatives, neighbors, etc. These patients could improve their gait ability more when they worked out with peers than when they worked out alone because a group workout actively motivated them.

As a conclusion, this communal exercise using audio-video feedback by smart phone application has positive effect on gait ability. The communal exercise motivated PD patients' emotional stability by enhanced familiarity and social integrity function and the audio-video feedback helped their physical performance of the exercise.

ACKNOWLEDGEMENT

This study was supported by the Research Program funded by the Korea University.

REFERENCES

- [1] Giladi N, & Balash Y. The clinical approach to gait disturbances in Parkinson's Disease ; Maintaining independent mobility. *Journal of Neural Transmission*. 2006; 70: 327-332.
- [2] Kwakkel G, de Goede CJT, van Wegen EEH. Impact of physical therapy for Parkinson's disease: A critical review of the literature. *Parkinsonism & Related Disorders*. 2007;13(3):S478-S487.
- [3] Morris ME, Martin CL, Schenkman ML. Striding out with Parkinson disease: evidence-based physical therapy for gait disorder. *Physical Therapy*. 2010 February;90(2):280-288.
- [4] Caglar AT, Gurses HN, Mutluay FK & Kiziltan G. Effects of home exercises on motor performance in patients with Parkinson's disease. *Clinical Rehabilitation*. 2005; 19: 870-877.
- [5] Article title. [http:// www.appe. eu/EN/resources](http://www.appe.eu/EN/resources). Datd assdssde: 07/25/2015.
- [6] Allen NE, Canning CG, Sherrington C, Lord SR, Latt MD, Fracp, Close JCT, O'Rourke SD, Murray SM, Fung VSC. The effect of an exercise program on fall risk factors in people with Parkinson's disease: A randomized controlled trial. *Movement Disorder*. 2010 April; 25(9),1217-1225.
- [7] Bloem B.R, Hausdorff J.M, Visser J.E. & Giladi N. Falls and freezing of gait in Parkinson's disease: A review of two interconnected, episodic phenomena. *Movement Disorder*. 2004 April; 19(8): 871-884.
- [8] Cubo, E., Leurgans, S., & Goetz, C.G. Short-term and practice effects of metronome pacing in Parkinson's disease patients with gait freezing while in the 'on' state: randomized single blind evaluation. *Parkinsonism & Related Disorders*. 2004 December; 10(8): 507-510.
- [9] Giladi, N., Treves, T.A., Simon, E.S., Shabtai, H., Orlov, Y., Kandinov, B., Paleacu, D., & Korczyn, A.D. Freezing of gait in patients with advanced Parkinson's disease. *Journal of Neural Transmission*. 2001 June; 108(1): 53-61.

- [10] Dibble LE, Hale TF, Marcus RL, Gerber JP & LaStayo PC. High intensity eccentric resistance training decreases bradykinesia and improves quality of life in persons with Parkinson's disease: A preliminary study. *Parkinsonism & Related Disorders*. 2009 December;15(10): 752-757.
- [11] Lee SH. Identifying People with Parkinson's Disease using Foot Pressure Data. *Indian Journal of Science and Technology*. 2015 July; 8(13). DOI: 10.17485/ijst/2015/v8i13/73195
- [12] Ehab Georgy, Susan Barsnley, Rajesh Chellappa. "Effect of physical exercise-movement strategies program on mobility, falls, and quality of life in Parkinson's disease". *International Journal of Therapy & Rehabilitation*. 2012 February; 19(2): 88-96.
- [13] de Paula FR, Teixeira-Salmela LF, Faria CD, de Brito PR, Cardoso F. Impact of an exercise program on physical, emotional, and social aspects of quality of life of individuals with Parkinson's disease. *Movement Disorder*. 2006 August; 21(8), 1073-1077.
- [14] Elsinger C.L, Harrington D.L, Rao SM. "From preparation to online control, reappraisal of neural circuitry mediating internally generated and externally guided actions". *Neuroimage*. 2006 July; 31(3): 1177-1187.
- [15] Mark B, Denis B, & Jill M. Do people with Parkinson's disease change strategy during unplanned gait termination? *Neuroscience Letters*, 2006 April; 397(3), 240-244.



ISSN
0975-6299

Effect of MAD (Mandibular Advancement Device) on Obstructive Sleep Apnea and Quality of Sleep

Chung-Poong Hwang, College of Medical Sciences, Jeonju University, Korea. E-mail:ideal1@naver.com

Ka-Eun Kim, College of Medical Sciences, Jeonju University, Korea. E-mail:kecam07@jj.ac.kr

Soon-Kwon Park*, College of Medical Sciences, Jeonju University, Korea. E-mail:sopark@jj.ac.kr

Il-Young Cho, College of Medical Sciences, Jeonju University, Korea. E-mail:chirotrust@jj.ac.kr

Abstract---

Background/Objectives: This study is intended to verify the efficacy of oral airway dilatation using MAD for the treatment of sleep apnea and quality of sleep compare to surgical treatment.

Methods/Statistical analysis: The study performed an obstructive sleep apnea evaluation (polysomnography, endoscopy, degree of tonsillar hypertrophy, sleep apnea-related questionnaires, and radiation inspection) with patients visiting sleep centers or otorhinolaryngology of three medical institutions due to sleep apnea. A total of 62 hospitalized patients with a chief complaint of snoring or sleep apnea were recruited. 3 participants could not complete the study and dropped out; 59 participants completed the study as planned.

Findings: In the primary analysis of efficacy evaluation, the difference between the findings at baseline and visit 5 and the analysis for each medical institution were analyzed for AHI, PSQI, ESS, and SaO₂. The mean AHI, indicating level of sleep apnea, at week 5 after treatment decreased. For PSQI for measuring the sleep quality, the measured value at visit 5 after treatment was increase. For ESS for measuring daytime sleepiness, the value also decreased. SaO₂ during sleep also increased and all of these results were statistically significant. In the secondary analysis of comparison of success rate, there was no statistical difference between the success rate of airway dilation using MAD and the success rate of UPPP. The difference in the success rates among the medical institutions was also not statistically significant.

Application/Improvements: These findings indicate that this product has the comparative advantage to the surgery in terms of less complications and the low cost.

Keywords--- MAD, Obstructive Sleep Apnea, Quality of Sleep.

* Corresponding Author

I. INTRODUCTION

Obstructive sleep apnea (OSA) is a sleep disorder and generally occurs in 2–7% of adults, especially 2% of middle-aged women and 4% of men, with the risk of incidence in men being nearly more than 2 times as that in women^{1,2,3}. It is known that the causes of this disease are anatomical and neuromuscular factors causing the imbalance between the forces required to open and close the upper airway^{4,5}, which results in respiratory depression through partial or complete obstruction of the upper airway during sleep^{6,7,8}. One of the symptoms, frequent awakening during sleep, can occur owing to the change in the chemical environment such as decreased blood oxygen or excessive carbonic acid, which causes the respiratory muscle to overcome the reflex or obstruction of upper airway⁹; this is also recognized as a common cause of frequent sleepiness during daytime, which can damage cognitive function and cause a traffic accidents^{2,10}. Moreover, it is known as one of the causes of cardiovascular diseases such as hypertension, stroke, acute myocardial infarction, and other metabolic disorders^{6,11,12,13,14} and can be a risk factor for increased mortality in severe cases¹⁵. The currently known treatment for OSA is surgical and non-surgical treatment^{5,8,16,17,18,19}. The basic principle of surgical treatment is to prevent snoring and airway obstruction by removing a part of the area causing snoring and apnea due to a narrowed airway, based on the diagnostic findings of the nasal cavity and laryngopharynx^{16,20}. However, this treatment has limitations because of drawbacks including hemorrhage and pain caused by surgery, discomfort due to post-surgical scars, complications, recurrence of symptoms and irreversibility, and adverse effects of post-surgical medications^{20,21,22}. Non-surgical treatment includes continuous positive airway pressure (CPAP), which is a 'gold standard'¹⁰, and use of oral appliances^{23,24}. Oral appliances include mandibular advancement devices (MAD) that position mandible forward, tongue retaining devices (TRD) that pull only the tongue forward, and soft palatal lifters²⁵. Among these, soft palatal lifter and TRD are rarely used owing to inconvenience, and currently MAD is the most commonly used appliance²⁵. The principle of its action is to indirectly pull the tongue and its base by placing the mandible forward, leading to the expansion of the space behind the tongue and the stabilization of pharyngeal wall^{16,25}. Its merits include convenient usage, no noise, reversible placement, and noninvasiveness, owing to which, patient compliance is high^{3,26,27,28}; its effect is better especially for patients with moderate to severe sleep apnea²⁹. Oral appliances have been used for the treatment of sleep-related breathing disorders in the United States since the early 1990's, and currently there are about 30 kinds of appliances approved by the FDA^{30,31}.

However, intraoral devices made overseas were being imported for use, as there were no intraoral devices being manufactured in Korea until a few years ago. A reliance on imported goods results in financial issues such as high costs while also complicating the process in clinical use, giving rise to procedural problems that can lead to longer periods required for treatment procedures. Therefore, this study will verify the effects of the device through clinical trials using MAD, which was originally developed in Korea, and establish an airway expanding treatment using MAD by standardizing the treatment process.

II. METHOD

A. Study Subjects

In this study, a total of 62 hospitalized patients with a chief complaint of snoring or sleep apnea were screened (31 from Seoul National University Bundang Hospital (SNUBH), 21 from Seoul National University Hospital (SNUH), and 10 from Chonbuk National University Hospital (CNUH). Mean age of them (53 males and 9 females) was 52.71 ± 9.74 . Sixty-two participants started the study by wearing MAD, but 3 could not complete the study and dropped out; 59 participants completed the study as planned. Additional 1 participant, however, did not complete two questionnaires (PSQI and ESS).

B. Manufacture of MAD

While the mandibular advancement measuring device (George Gauge) is placed inside the mouth, the device is induced to the normal mandible position (the general occlusion) and the moved level is recorded. Further, after inducing the mandible to the maximum position in front, the moved value is recorded. Then, after removing the device from the oral cavity, the baseline value and the maximum moved value are calculated. The movement of the mandible to the front needs to be within 60% of the maximum moved value, and the range of mandibular advancement is determined within 60% based on a physician's judgment or the degree of a patient's inconvenience considering the difference in temporomandibular joints between patients. After determining the amount of mandibular advancement through the aforementioned procedure, resin casts of the maxilla and the mandible are taken to produce a mandibular advancement device suitable for the

oral structure of each individual [Figure 1]. In this study, 'Bio-Guard' designed and manufactured by Sleep & Health, Co. (Jeonju, Korea), was used in order to prevent snoring and OSA caused by airway obstruction during sleep from various causes [Figure 2].



Figure1: Measuring Mandibular Positions using George Gauge

George Gauge is consisted of 2 bite forks and a gauge (left). Middle panel shows George Gauge inserted in the mouth to measure mandibular position. The scale of the gauge marked as a rectangular was recorded after protruding mandible maximally (right).

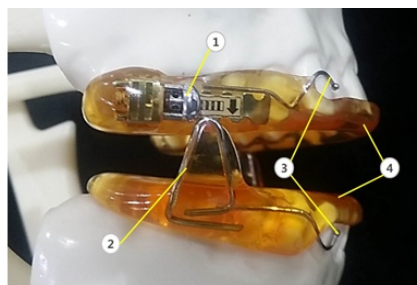


Figure 2: Structural Elements

① Adjustment screw: The screw adjusts the advancing distance of the mandible. ② Projecting inclined-plate: When the mouth is closed, the plate touches the adjustment screw of the maxilla and pushes forward. ③ Hook: It keeps the main body at the proper position; if necessary, elastic strings can be hung on the hook to prevent the mouth from opening. ④ Main body: It is a pair of acrylic resin structures shaped like a bruxism splint. Each of a pair is placed on the upper and lower teeth, respectively. Element 1, 2, and 3 are installed on the main body.

C. Experimental Procedures

At visit 1, the evaluation of OSA (polysomnography and surveys related to the symptoms of sleep apnea) was conducted in the patients hospitalized for sleep apnea at 3 university hospitals. The MAD customized at visit 1 was first worn at visit 2, and the moved value of mandibular advancement was adjusted as needed after checking if it was worn without temporomandibular joint inconvenience. Participants visited the hospitals every 1-2 weeks (visit 3-visit 4) 3 weeks after the first wearing for additional fine adjustment until they adapted to the MAD and felt comfortable. However, if there was no need for additional adjustment without discomfort, then phone consultation was conducted instead of hospital visit. If the subjects properly adjusted to the device during the adjustment period, by visit 5 (week 5), polysomnography was scheduled at week 5 and they visited the hospital to receive the evaluation about OSA by using polysomnography, as during screening.

D. Accessment Related to Sleep Apnea

AHI (Apnea/Hypopnea Index)

AHI is the number of incidences of apnea and hypopnea during 1 hour of sleep; apnea in AHI is defined as complete cease of breathing for more than 10 seconds, and hypopnea is defined as more than 4% decrease of oxygen saturation in addition to more than 30% decrease of respiratory signal from the baseline.

SaO₂(Oxygen Saturation)

Oxygen saturation is the ratio (%) of dissolved oxygen in the blood, and it declines as repetitive upper airway obstruction occurs and thus the airflow is not smooth in OSA patients. Therefore, the degree of alleviation of upper airway stricture after MAD installation was evaluated by comparing the SaO₂ before and after the treatment in this study.

PSQI (Pittsburgh Sleep Quality Index) Questionnaire

PSQI is a questionnaire consisting of 7 items (subjective sleep quality, sleep latency, sleep time, sleep efficiency, degree of sleep disturbance, taking sleeping pills, and presence of daytime disturbances) to evaluate sleep quality, and the total score of PSQI is from 0 to 21, with the classification of poor sleep quality if the score is more than 5.

ESS (Epworth Sleepiness Scale) Questionnaire

ESS consists of items regarding 8 situations in which one feels sleepy in daily life, and the classification of daytime sleepiness was made if the total score was more than 10.

E. Evaluation Standard of Treatment Success Rate

Definition of treatment success was less than 10 in AHI at visit 5 and more than 50% decrease of AHI from the baseline. Treatment success rate was the ratio of the number of successfully treated patients to the number of participants who received the treatment with the experimental device.

III. RESULTS**A. The Difference between the Findings at Baseline and Visit 5**

The difference between the findings at baseline and visit 5 and the analysis for each facility were analyzed for AHI, PSQI, ESS, and SaO₂. Total 58 subjects involved in PSQI and ESS test[Table1].

The baseline AHI was 34.78 on average, indicating very severe level of sleep apnea, but the mean AHI at week 5 after treatment decreased to 14.74, showing about 20.04 point decline, and this was statistically significant ($t=10.63$, $df=58$, $p<.01$). For PSQI for measuring the sleep quality, the baseline was 5.98 but the measured value at visit 5 after treatment was 4.14, showing about 1.84 point increase ($t=8.50$, $df=57$, $p<.01$). For ESS for measuring daytime sleepiness, the value also decreased by about 2.86 points ($t=6.15$, $df=57$, $p<.01$). SaO₂ during sleep also increased by 5.16% ($t=-3.29$, $df=58$, $p<.01$). The difference of each evaluation variable between medical facilities was not statistically significant, as shown by one-way ANOVA.

B. Comparison of Success Rates

This study compared the success rates of MAD and the current surgical treatment for OSA. To accomplish this, we referred to the results of a meta-analysis on 54 articles that studied the effects of the surgical treatment³². They found that 77 of 171 participants had an apnea index of less than 10 and their post-treatment AHIs decreased by more than 50% from baseline, reporting 45% success rate of surgery. The success rates of the surgical procedure and the success rates that used MAD in this study are compared using a chi-squared test [Table2].

The estimated success rate of MAD was 54.2%, showing that the difference from that of surgical treatment was about 9.2%, and there was no statistical difference between the success rate of oral dilation using MAD and the success rate of UPPP as shown by the chi-square test ($\chi^2=1.49$, $df=1$, $p>.05$). The difference in the success rates among the medical facilities was also not statistically significant ($\chi^2=4.70$, $df=2$, $p>.05$).

Table 1: OSA-Related Indices Improved by MAD Treatment

		n	Mean±S.D	t
AHI	Baseline	59	34.78±17.00	10.63**
	Visit 5	59	14.74±14.47	
PSQI	Baseline	58	5.98±2.24	8.50**
	Visit 5	58	4.14±1.81	
ESS	Baseline	58	8.36±4.03	6.15**
	Visit 5	58	5.50±3.08	
SaO ₂	Baseline	59	78.01±12.07	3.29**
	Visit 5	59	83.17±7.40	
**p<.01.				

Table 2: Comparison of MAD and Operation Methods

	MAD	Surgery	χ^2
Success	32	77	1.49 (p=.222)
Fail	27	94	
Success rate (%)	54.2	45	

IV. DISCUSSION

Currently, the known treatments for snoring and OSA include surgical treatment, CPAP, and OA^{5,8,17,18,19}. Each treatment has merits and drawbacks: surgical treatment has a definite therapeutic effect by removing the causal area in cases in which symptoms are caused by anatomical reasons^{33,34}, but it is irreversible and has the risk of complications related to anesthesia^{10,21,22}. CPAP is effective but low patient compliance due to severe discomfort when patients wear it^{8,29}, and OA has several merits to displace other treatments^{3,26,27,28,29}, but has been used as an industrial product or a dental technology product without approval for its efficacy and safety in Korea.

This study was intended to verify the clinical efficacy of MAD manufactured in Korea and to evaluate its feasibility as a standard treatment to replace other treatment methods including surgery for OSA. The result showed that MAD treatment increased AHI, PSQI, ESS, and SaO₂. This result is consistent with the study that compared the effects of MAD, a tongue retaining device and a soft palatal lifter and reported that AHI was decreased only in the MAD treatment, thereby showing an effect on sleep apnea³⁵. Moreover, the results of the studies examining the effects of MAD treatment using AHI and magnetic resonance imaging³⁶, AHI and oxygen saturation¹⁰, and AHI and ESS³⁷ were also consistent with this study. The success rate of MAD treatment in this study was not different from that of the surgical treatment provided in a meta-analysis³². Furthermore, the success rates (55% and 53.8%) reported by studies using MAD^{26, 38}, that were similar to the one used in this study were almost the same as the success rate observed in this study (54.2%). This reveals that MAD, a non-surgical procedure, may show a similar success rate to a surgical procedure. It indicates that, unless the case requires a surgical procedure due to anatomically unusual issues, MAD, which is relatively inexpensive and rarely has side effects, can be effectively used in treating obstructive sleep apnea. The success rate of MAD developed in Korea was almost equivalent to that of overseas products, which implies that this product can achieve the effect of import substitution. The clinical logic of using MAD is that obstructive sleep apnea is caused by respiratory obstruction, and thus it can be improved by expanding the narrow airway. The treatment goal of this study was to advance the mandible within 60% of the maximum amount of mandibular advancement. However, the amount of advancement was adequately adjusted in the process of treatment since each patient had different anatomical features of the oral cavity and different responses in terms of their discomfort in using MAD. Therefore, a correlation analysis was conducted on the two factors, since it is likely that there is certain relevance between the actual amount of advancement and the therapeutic effect. The result of the analysis showed that the correlation between the two factors was significant ($r=.374$, $df=39$, $p=.016$), but not high. This result is consistent with the view that it is desirable to keep the amount of advancement at 6.0mm or lower³⁹, since there was no direct correlation between the amount of mandibular advancement and the therapeutic effects. It seems that an amount of advancement that falls short of the predetermined amount that may also improve sleep apnea, while an amount that exceeds it may not proportionately increase the therapeutic effect either. This implies that it is necessary to conduct extensive research, as there may be various causes for a narrow airway in obstructive sleep apnea. This study also assessed the extraordinary reaction that occurred during the experiment every visit from Visit 2 to after 3 months in order to assess the safety of MAD in addition to its effectiveness. Moreover, it examined anatomical variations by conducting a radiographic inspection on Visit 1 and on Visit 5 and after 3 months. The result showed that 91.8% of the participants showed slight discomfort, which is toothache or temporomandibular pain caused by the forward movement of the mandible. Only one participant showed a severe extraordinary reaction, but this turned out to be irrelevant to the treatment in this study, and was cured with proper treatment. The radiographic inspection also did not reveal any anatomical abnormality of the maxilla and mandible.

On the other hand, this study showed positive results in various evaluations but also had limitations. The possibility of placebo effect could not be ignored as this study was intended to explore the effect of airway

dilatation without including a control group. Further research including not only a group receiving a similar intervention but also a control group without any intervention is required for accurate verification.

V. CONCLUSION

The results of this study showed that the MAD, 'Bio-Guard' designed and manufactured by Sleep & Health, Co. in Korea, could be used effectively to improve sleep apnea. Moreover, this product, for which efficacy has been proved through this study, can be used in the future as an alternative treatment to the conventional irreversible surgical treatment, thereby preventing surgical complications and reducing medical cost.

ACKNOWLEDGMENT

This research was supported by a grant of the Korea Health technology R&D Project through the Korea Health Industry Development Institute(KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea. (Grant Number : HI12C0037)

REFERENCES

- [1] Sharples LS, Clutterbuck-James AL, Glover MJ, Bennett MS, Chadwick R, Pittman MA, et al. Meta-analysis of randomised controlled trials of oral mandibular advancement devices and continuous positive airway pressure for obstructive sleep apnoea-hypopnoea. *Sleep Med Rev*. 2016; 27: 108–124.
- [2] Bhamrah G, Dhir A, Cash A, Ahmad S, Winchester LJ. Patient's experience of treatment for sleep apnoea with a mandibular advancement splint. *Surgeon*. 2015; 13(5): 256–262.
- [3] Ferguson KA, Ono T, Lowe AA, Keenan SP, Fleetham JA. A randomized crossover study of an oral appliance vs nasal-continuous positive airway pressure in the treatment of mild-moderate obstructive sleep apnea. *Chest*. 1996; 109: 1269–1275.
- [4] Gakwaya S, Melo-Silva CA, Borel JC, Rousseau E, Masse JF, Sériès F. Impact of stepwise mandibular advancement on upper airway mechanics in obstructive sleep apnea using phrenic nervemagnetic stimulation. *Respir Physiol Neurobiol*. 2014; 190: 131–136.
- [5] Gerbino G, Bianchi FA, Verzé L, Ramieri G. Soft tissue changes after maxillo-mandibular advancement in OSAS patients: A three-dimensional study. *J Craniomaxillofac Surg*. 2014; 42: 66–72.
- [6] Islam S, Taylor CJ, Ormiston IW. Effects of maxillomandibular advancement on systemic blood pressure in patients with obstructive sleep apnoea. *Br J Oral Maxillofac Surg*. 2015; 53: 34–38.
- [7] Wang X, Gong X, Yu Z, Gao X, Zhao Y. Follow-up study of dental and skeletal changes in patients with obstructive sleep apnea and hypopnea syndrome with long-term treatment with the Silensor appliance. *Am J Orthod Dentofacial Orthop*. 2015; 147: 559–565.
- [8] Martinez-Gomis J, Willaert E, Nogues L, Pascual M, Somoza M, Monasterio C. Five years of sleep apnea treatment with a mandibular advancement device; side effects and technical complications. *Angle Orthod*. 2010; 80(1): 30–39.
- [9] Charbonneau M, Marin JM, Olha A, Kimoff J, Levy RD, Cosio MG. Changes in obstructive sleep apnea characteristics through the night. *Chest*. 1994; 106: 1695–1701.
- [10] Ciavarella A, Sabatucci A, Mastrovincenzo M, Parziale V, Sabato R, Barbaro MP, et al. Obstructive sleep apnea treatment with a new oral appliance: Somnodent. *The Open Otorhinolaryngology Journal*. 2009; 3: 34–38.
- [11] Hoffmann M, Bybee K, Accurso V, Somers VK. Sleep apnea and hypertension. *Minerva Med*. 2004; 95(4): 281–290.
- [12] Sánchez-de-la-Torre M, Khalyfa A, Sánchez-de-la-Torre A, Martínez-Alonso M, Ángel Martínez-García M, Barceló A, et al. Precision medicine in patients with resistant hypertension and obstructive sleep apnea. *J Am Coll Cardiol*. 2015; 66(9): 1023–1032.
- [13] Zamarron C, Thorpe RD, Otero YO, Rodríguez-Suarez JR. Snoring and myocardial infarction: a 4-year follow-up study. *Respir Med*. 1999; 93: 108–112.
- [14] Cadilhac DA, Thorpe RD, Pearce DC, Barnes M, Rochford PD, Tarquinio N, et al. Sleep disordered breathing in chronic stroke survivors. A study of the long term follow-up of the SCOPES cohort using home based polysomnography. *J Clin Neurosci*. 2005; 12(6): 632–637.
- [15] Borel JC, Gakwaya S, Masse J, Melo-Silva CA, Sériès F. Impact of CPAP interface and mandibular advancement device on upper airway mechanical properties assessed with phrenic nerve stimulation in sleep apnea patients. *Respir Physiol Neurobiol*. 2012; 183: 170–176.

- [16] Epstein LJ, Kristo D, Strollo PJ, Friedman N, Malhotra A, Patil SP, et al. Clinical guideline for the evaluation, management and long-term care of obstructive sleep apnea in adults. *J Clin Sleep Med*. 2009; 5(3): 263–276.
- [17] Gay P, Weaver T, Loube D, Iber C. Evaluation of positive airway pressure treatment for sleep related breathing disorders in adults; a review by the positive airway pressure task force of the standards of practice committee of the American Academy of Sleep Medicine. *Sleep*. 2006; 29(3): 381–401.
- [18] Levendowski DJ, Morgan TD, Patrickus JE, Westbrook PR, Berka C, Zavora T, et al. In-home evaluation of efficacy and titration of a mandibular advancement device for obstructive sleep apnea. *Sleep Breath*. 2007; 11: 139–147.
- [19] Faria AC, Xavier SP, Silva Jr. SN, VoiTrawitzkia, LV, de Mello-Filhoa FV. Cephalometric analysis of modifications of the pharynx due to maxillo-mandibular advancement surgery in patients with obstructive sleep apnea. *Int J Oral Maxillofac Surg*. 2013; 42: 579–584.
- [20] Riley RW, Powell NB, Guilleminault C. Obstructive sleep apnea syndrome: a review of 306 consecutively treated surgical patients. *Otolaryngol Head Neck Surg*. 1993; 108(2): 117–125.
- [21] Esclamado RM, Glenn MG, Mcculloch TM, Cummings CW. Perioperative complications and risk factors in the surgical treatment of obstructive sleep apnea syndrome. *Laryngoscope*. 1989; 99(11): 1125–1129.
- [22] Katsantonis GP, Friedman WH, Krebs FJ III, Walsh JK. Nasopharyngeal complications following uvulopalatopharyngoplasty. *Laryngoscope*. 1987; 97(3): 309–314.
- [23] Hsieh YJ, Liaoa YF, Chend NH, Chen YR. Changes in the calibre of the upper airway and the surrounding structures after maxillomandibular advancement for obstructive sleep apnoea. *Br J Oral Maxillofac Surg*. 2014; 52: 445–451.
- [24] Guimaraes TM, Colen S, Cunali PA, Rossi R, Dal-Fabbro C, Ferraz O, et al. Treatment of obstructive sleep apnea with mandibular advancement appliance over prostheses: *A case report*. *Sleep Sci*. 2015; 8(2): 103–106.
- [25] Hoffstein V. Review of oral appliances for treatment of sleep-disordered breathing. *Sleep Breath*. 2007; 11: 1–22.
- [26] Ferguson KA, Ono T, Lowe AA, Al-Majed S, Love LL, Fleetham JA. A short term controlled trial of an adjustable oral appliance for the treatment of mild to moderate obstructive sleep apnoea. *Thorax*. 1997; 52: 362–368.
- [27] Clark GT, Blumenfeld I, Yoffe N, Peled E, Lavie P. A crossover study comparing the efficacy of continuous positive airway pressure with anterior mandibular positioning devices on patients with obstructive sleep apnea. *Chest*. 1996; 109(6): 1477–1483.
- [28] Pitsis AJ, Darendeliler MA, Gotsopoulos H, Petocz P, Cistulli PA. Effect of vertical dimension on efficacy of oral appliance therapy in obstructive sleep apnea. *Am J Respir Crit Care Med*. 2002; 166: 860–864.
- [29] Mehta A, Qian J, Petocz P, Darendeliler MA, Cistulli PA. A randomized, controlled study of a mandibular advancement splint for obstructive sleep apnea. *Am J Respir Crit Care Med*. 2001; 163: 1457–1461.
- [30] U.S. Food and Drug Administration. <http://www.fda.gov/>.
- [31] American Sleep Association. <https://www.sleepassociation.org/>.
- [32] Aaron ES, Kenneth BS, Jay FP. The efficacy of surgical modifications of the upper airway in adult with obstructive sleep apnea syndrome. *Sleep*. 1996; 19(2): 156–177.
- [33] Walker-Engstroëm M-L, Wilhelmsson B, Dimenas E, Ringqvist I. Quality of life assessment of treatment with dental appliance or UPPP in patients with mild to moderate obstructive sleep apnoea. A prospective randomized 1-year follow-up study. *J Sleep Res*. 2000; 9: 303–308.
- [34] Nelson LM. Combined temperature-controlled radiofrequency tongue reduction and UPPP in apnea surgery. *Ear Nose Throat J*. 2001; 6: 485–492.
- [35] Barthlen GM, Brown LK, Wiland MR, Sadeha JS, Patwaria J, Zimmerman M. Comparison of three oral appliances for treatment of severe obstructive sleep apnea syndrome. *Sleep Med*. 2000; 1: 299–305.
- [36] Chan AS, Lee RW, Srinivasan VK, Darendeliler MA, Grunstein RR, Cistulli PA. Nasopharyngoscopic evaluation of oral appliance therapy for obstructive sleep apnoea. *Eur Respir J*. 2010; 35: 836–842.
- [37] Deane SA, Cistulli PA, Ng AT, Zeng B, Petocz P, Darendeliler MA. Comparison of mandibular advancement splint and tongue stabilizing device in obstructive sleep apnea: a randomized controlled trial. *Sleep*. 2009; 32(5): 648–653.

- [38] Sanner BM, Heise M, Knoblen B, Machnick M, Laufer U, Kikuth R, et al. MRI of the pharynx and treatment efficacy of a mandibular advancement device in obstructive sleep apnoea syndrome. *Eur Respir J*. 2002; 20: 143–150.
- [39] Kim YK, Yoon IY, Kim JW, Lee CH, Yun PY. The influence of the amount of mandibular advancement in the application of mandibular advancement device for obstructive sleep apnea patients. *Sleep Med Psychophysiol*. 2011; 18(1): 29–34.



ISSN
0975-6299

Effect of a Combined Aerobic and Resistance Exercise Program on Cardiovascular Disease Risk Factors in Hypertensive Patients

Young-Ho Ko, Faculty of Exercise & Sport Science, College of Natural Science, Jeju National University, Jeju, Korea.
E-mail:jko6511@lycos.co.kr

Doug-Soo Shin*, Faculty of Exercise & Sport Science, College of Natural Science, Jeju National University, Jeju, Korea.
E-mail:jesuschsds@naver.com

Abstract---

Objectives: The purpose of this study was to examine the effect of a combined exercise program of aerobic and resistance exercises on the cardiovascular risk factors in hypertensive patients.

Methods/Statistical analysis: The study subjects were 20 elderly women with hypertension, randomly assigned to the control group (n=10) or the combined exercise group (n=10). The 16-week combined exercise program included aerobic and resistance exercises. Body composition, blood pressure, blood lipids, insulin resistance, and C-reactive protein levels were measured before and after the intervention. Paired t-test was used to analyze the differences in variables, before and after the training program.

Findings: In the exercise group, post-intervention values were significantly better than the baseline values for body weight, percentage body fat, waist circumference, lean body mass, systolic blood pressure, diastolic blood pressure, and serum levels of triglycerides, total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol. There was no such difference observed in the control group at the end of the 16-week period. There was no significant difference in insulin resistance following the 16-week period within either of the groups. The values for C-reactive protein were significantly lesser in the exercise group after following the 16-week combined exercise intervention, compared to the baseline values. Given the above outcomes, our study demonstrated that a combined aerobic and resistance exercise program was associated with significant benefits in terms of improvement in body composition, blood pressure, serum lipid, and C-reactive protein levels in elderly women with hypertension.

Improvements/Applications: In conclusion, combined exercise training appears to play a critical role in reducing the risk factors of cardiovascular diseases in elderly women with hypertension.

Keywords--- Aerobic Exercise, Resistance Exercise, Cardiovascular Risk Factors, Elderly Women, Hypertensive Patients.

* Corresponding Author

I. INTRODUCTION

Obesity is a chronic disease and growing threat globally today¹. Excess weight gain is the best predictor that we have for the development of hypertension, and the relationship between BMI, waist circumference, systolic and diastolic blood pressure is nearly linear in diverse populations throughout the world². The risk of stroke and coronary artery disease increases with higher levels of blood pressures (BP). There is a two-fold increase in the risk of death from cardiovascular diseases for a 20/10 mmHg increase in BP (systolic blood pressure [SBP]/diastolic blood pressure [DBP]) over a baseline value of 115/75 mmHg. Conversely, the risk of death from stroke can be decreased by 10%, and the risk of death from ischemic heart disease can be lowered by approximately 7% with a reduction in SBP by just 2 mm Hg. The risk of death from stroke reduces by about 40% when SBP is decreased by 10 mmHg, or DBP is decreased by 5 mm Hg. Thus, the significance of blood pressure management in healthcare, in general, is considerable³.

The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7 report) laid stress on improving eating habits, including consumption of low-salt diet, and lifestyle interventions such as regular exercise, ahead of drug treatment in the management of hypertension⁴. Regular exercise can reduce the BP of hypertensive patients on drug treatment, and can contribute to the reduction of dosage of antihypertensive medication or its stoppage, in addition to decreasing the risk of adverse cardiovascular events⁵. Cornelissen and Fagard, in a meta-analysis, reported that aerobic exercise lowered BP, and the reduction was more obvious in hypertensive patients (-6.9/-4.9 mmHg) than in non-hypertensive (-2.4/-1.6 mmHg) and pre-hypertensive subjects (-1.7/-1.7 mmHg). Exercise training affects the renin-angiotensin system and the sympathetic nervous system, resulting in the observed reduction in BP in addition to its beneficial influences on other cardiovascular risk factors⁶. While resistance exercise is known to prevent and treat musculoskeletal disease, recent research has also established its role in increasing muscle volume and reducing the risk of cardiovascular diseases⁷. The American Heart Association (AHA) and the American College of Sports Medicine (ACSM) recommend inclusion of resistance exercise in the exercise programs for hypertensive patients^{8,9}. Studies have demonstrated significant reduction in SBP (3-4 mm Hg) and DBP (2-3 mm Hg) following resistance exercise programs^{10,11}. In addition, a combined exercise program composed of aerobic and resistance exercises for 20 minutes each, significantly decreased the SBP of elderly women with hypertension along with a significant reduction in cardiovascular risk factors including fibrinogen, total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), triglycerides (TG), and C-reactive protein (CRP), compared to the group that performed aerobic exercise alone for 40 minutes¹².

Although exercise has equal importance in the management of hypertensive patients compared to pharmacologic treatment, this has not been adequately highlighted. While medical students spend considerable time in learning antihypertensive prescription, they are not educated on the value, or method of exercise prescription¹³. This study aimed to analyze the effects of a 16-week combined exercise program of aerobic and resistance exercises on the cardiovascular risk factors and the general health of elderly hypertensive women.

II. METHODS

A. Subjects

Twenty elderly women from the Gyeonggi Province in the Republic of Korea, suffering from the stage 1 hypertension and not on any hypotensive agents, were randomly assigned to either a control group (n = 10) or an exercise group (n = 10). The subjects were obese, hypertensive patients who were confirmed as lacking in adequate exercise (Physical Activity Readiness Questionnaire) and were recommended by doctors to participate in regular exercise. None of the subjects had participated in any regular exercise program for more than a year prior to the study. An exercise group participated in the combined exercise program and a control group received no exercise training. The objectives and risks of the study were explained to all subjects, and the informed consent was obtained from each subjects. Initial subject characteristics for the control and exercise groups are shown in Table 1.

Table 1: Initial Characteristics of Subjects

Variables	Control Group (n = 10)	Exercise Group (n = 10)
Age (yr)	63.5 ± 3.4	64.2 ± 3.5
Height (cm)	155.5 ± 5.1	155.4 ± 8.0
Weight (kg)	62.6 ± 4.7	63.9 ± 4.8
Body fat (%)	32.6 ± 3.9	33.7 ± 2.8
SBP (mmHg)	147.8 ± 5.3	150.9 ± 6.5
DBP (mmHg)	88.8 ± 7.6	89.8 ± 9.2

SBP, systolic blood pressure; DBP, diastolic blood pressure.

All values are expressed as mean ± SD.

B. Combined Exercise Program

The combined exercise program included aerobic exercise followed by resistance exercise according to the ACSM guidelines. The intensity of aerobic exercise (walking on a treadmill for 30-40 minutes, five days a week, on Monday, Tuesday, Thursday, Friday, and Saturday) was incrementally increased over 16 weeks with reference to their maximal heart rate (HR_{max}, calculated as 220 minus age in years). The heart rate targets were set as 50% of HR_{max} during the 1st to 4th weeks, 51-60% of HR_{max} during the 5th to 10th weeks, and 61-69% of HR_{max} during the 11th to 16th weeks. The intensity of exercise was monitored every five minutes by using a wireless heart rate monitor (Polar Electro, Finland). Aerobic exercise was performed under the supervision of professional trainers. All subjects performed stretching and joint injury prevention exercises for 10 minutes each for warming-up and cooling-down. Resistance exercises, by using elastic bands, were performed for 30-40 minutes each day, thrice a week (Monday, Thursday, Saturday), following the scheduled aerobic exercise for that day. Keeping in view the age of the participants, and their level of physical fitness, sufficient time was provided for participants to adopt correct posture, and adjust exercise intensity. The intensity of the resistance elastic band exercise program was adjusted by using the rating of perceived exertion (RPE) described by ¹⁴. Hip and lower body exercises were performed first, followed by upper body exercises, with a rest-break provided in between. The specific resistance exercise program is shown in Table 2.

Table 2: Resistance Exercise Program

Component	Training period (weeks)	Intensity	Duration (min)	Contents
Main exercise	1-4	RPE 11-12 (10 repetitions × 2 sets)	30	Leg press Leg extension Leg curl
	5-8	RPE 11-12 (10 repetitions × 3 sets)	40	Calf raise Hip flexion Hip extension Hip adduction
	9-16	RPE 13-14 (10 repetitions × 3 sets)	40	Trunk extension Chest press Seated rows Shoulder flexion to 90 ° Biceps curl Triceps extension

RPE, rating of perceived exertion.

C. Measurements

All measurements of the representative cardiovascular risk factors including body composition, BP, blood lipids, insulin resistance, and CRP ¹⁵ were performed before and after the exercise intervention. Body weight, percentage body fat, and lean body mass were measured by using a body composition analyzer (InBody 720, Biospace Co., Korea) as measures of body composition. Waist circumference was measured at the mid-point between the 12th rib and the iliac crest, during exhalation in the erect posture, by using a tapeline. All subjects rested for a minimum of ten minutes before blood pressures were measured by using an upper arm automatic tonometer (MD-650, Meditec, Korea). Subjects avoided caffeine, heavy exercise, and smoking for

four hours preceding blood pressure measurement. An automatic chemistry analyzer (ADVIA 1650, Bayer, USA) was used for the measurement of serum levels of TG, TC, LDL-C, high-density lipoprotein cholesterol (HDL-C). Fasting glucose concentrations were analyzed by using an enzymatic colorimetric method (Roche Diagnostics, USA). An ELISA method (ALPCO Diagnostics, USA) was used to determine the serum insulin levels. The insulin resistance index, Homeostasis Model Assessment-Insulin Resistance (HOMA-IR), was calculated by the following formula, $HOMA-IR = (\text{fasting insulin [IU/mL]} \times \text{fasting glucose [mg/dL]}) / 405$ ¹⁶. CRP levels were measured by using the immune turbid metric method with an automatic chemistry analyzer (Hitachi 7180, Japan).

D. Statistical Analysis

Study data were summarized as mean and standard deviation. Paired t-test was used to analyze the differences in variables, before and after the training program. All statistical analyses were performed with a statistical software program (SPSS program, ver. 18.0, Chicago, USA). Statistical significance was assessed at the level of $p < 0.05$.

III. RESULTS

The changes in the cardiovascular disease risk factors in subjects undergoing the 16-week combined exercise program are shown in Table 3. In the exercise group, post-intervention values were significantly better than the baseline values for body weight (60.9 ± 5.7 kg vs. 63.9 ± 4.8 kg, $p < 0.001$), percentage body fat ($29.8 \pm 3.0\%$ vs. $33.7 \pm 2.8\%$, $p < 0.001$), waist circumference (84.4 ± 4.3 cm vs. 90.2 ± 4.7 cm, $p < 0.01$), lean body mass (42.1 ± 4.2 kg vs. 39.5 ± 5.2 kg, $p < 0.001$), SBP (137.0 ± 7.2 mmHg vs. 150.9 ± 6.5 mmHg, $p < 0.001$), DBP (82.4 ± 6.1 mmHg vs. 89.8 ± 9.2 mmHg, $p < 0.01$), TG (132.0 ± 10.0 mg/dL vs. 144.7 ± 12.5 mg/dL; $p < 0.001$), TC (164.2 ± 16.9 mg/dL vs. 184.2 ± 24.1 mg/dL, $p < 0.05$), LDL-C (118.0 ± 13.2 mg/dL vs. 135.5 ± 13.3 mg/dL, $p < 0.01$), and HDL-C (48.1 ± 3.1 mg/dL vs. 45.0 ± 4.4 mg/dL, $p < 0.05$). There was no such difference observed in the control group at the end of the 16-week period. There was no significant difference in insulin resistance following the 16-week period within either of the groups. The values for CRP were significantly lesser in the exercise group after following the 16-week combined exercise intervention, compared to the baseline (1.3 ± 0.4 mg/L vs. 1.5 ± 0.7 mg/L, $p < 0.05$).

Table 3: Comparison of Cardiovascular Risk Factors before and after 16 Weeks

Variables	Control		Exercise	
	Baseline	Post	Baseline	Post
Body weight (kg)	62.5 ± 4.7	63.1 ± 3.9	63.9 ± 4.8	60.9 ± 5.7^a
Body fat (%)	32.6 ± 3.9	33.4 ± 3.7	33.7 ± 2.8	29.8 ± 3.0^a
Waist circumference (cm)	89.7 ± 4.9	90.0 ± 3.9	90.2 ± 4.7	84.4 ± 4.3^b
Lean body mass (kg)	38.3 ± 5.2	37.6 ± 4.8	39.5 ± 5.2	42.1 ± 4.2^a
SBP (mmHg)	147.8 ± 5.3	147.6 ± 5.5	150.9 ± 6.5	137.0 ± 7.2^a
DBP (mmHg)	88.8 ± 7.6	91.6 ± 4.6	89.8 ± 9.2	82.4 ± 6.1^b
TG (mg/dL)	147.1 ± 28.6	148.8 ± 23.0	144.7 ± 12.5	132.0 ± 10.0^a
TC (mg/dL)	185.3 ± 23.3	191.2 ± 31.7	184.2 ± 24.1	164.2 ± 16.9^c
LDL-C (mg/dL)	134.2 ± 14.3	134.3 ± 19.3	135.5 ± 13.3	118.0 ± 13.2^b
HDL-C (mg/dL)	45.6 ± 5.4	43.0 ± 4.8	45.0 ± 4.4	48.1 ± 3.1^c
Glucose (mg/dL)	111.2 ± 9.5	105.9 ± 9.8	114.5 ± 15.1	106.8 ± 8.3
Insulin (IU/mL)	5.6 ± 2.2	4.9 ± 0.9	6.0 ± 2.7	4.8 ± 1.4
HOMA-IR	1.6 ± 0.7	1.3 ± 0.3	1.8 ± 1.0	1.3 ± 0.4
CRP (mg/L)	1.6 ± 0.5	1.6 ± 0.5	1.5 ± 0.7	1.3 ± 0.4^c

^a $p < 0.001$; ^b $p < 0.01$; ^c $p < 0.05$ (paired t-test).

SBP, systolic blood pressure; DBP, diastolic blood pressure; TG, triglycerides; TC, total cholesterol; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; HOMA-IR, Homeostasis Model Assessment-Insulin Resistance; CRP, C-reactive protein.

IV. DISCUSSION

This study aimed to determine the effect of a 16-week combined exercise training program of aerobic and resistance exercises on the representative cardiovascular risk factors in elderly hypertensive women.

The incidence of cardiovascular diseases is closely dependent on risk factors such as obesity, insulin resistance, and hypertension, which also have an effect on the related mortality rates ¹⁷. Obesity and reduced

muscle volume related to aging or lack of physical activity can result in insulin resistance, type 2 diabetes mellitus, dyslipidemia, and hypertension¹⁸. Therefore, the risk of cardiovascular diseases may be reduced by weight control and adequate exercise to recondition the body. Our study demonstrated that body weight, percentage body fat and waist circumference were significantly lesser, while lean body mass was significantly increased, following 16 weeks of exercise intervention. While aerobic exercise is known to reduce body weight and percentage body fat¹⁹, resistance exercise training was demonstrated to be effective in increasing lean body mass and decreasing body fat, abdominal fat, and visceral fat²⁰. This is confirmed by several other studies: In²¹ reported that a combined exercise program of aerobic and resistance exercises had a positive effect on body composition of elderly women; In²² suggested that resistance exercise reduces fat mass and increases lean body mass; and an ACSM²³ study recommended a combination of aerobic and resistance exercises for improving lean body mass. In addition, In^{24,25} reported the positive effect of combined programs of aerobic and resistance exercises on body composition. Their methods and results were similar to our study in demonstrating the benefits of combined exercise in increasing lean body mass. The kinetic energy requirements generated by walking are met by lipolysis, resulting in reduced body fat and weight, while resistance exercise, by increasing muscle volume, leads to increased basal metabolic rate (BMR). Therefore, in the long term, a combined exercise program of resistance and aerobic exercises has the potential to improve body composition and reduce the risk of cardiovascular diseases.

Regular exercise plays an important role in preventing and treating chronic diseases including hypertension²⁶. It is reported that people with normal BP involve themselves in greater amount of physical activities and have a higher cardiorespiratory ability²⁷ compared to hypertensive patients. Regular exercise is known to lower the BP of adult hypertensive patients²⁸ as well as improve several factors involved in the pathophysiology of hypertension²⁹. The ACSM report on exercise and hypertension observed that moderate intensity aerobic exercise reduced the SBP and DBP of patients with refractory hypertension by an average of 7.4/5.8 mmHg. In addition, even hypertensive patients on good control with anti-hypertensive medications were found to have an average BP reduction of 2.6/1.8 mmHg following exercise. Aerobic exercise can reduce BP in hypertensive patients by suppressing the accelerated activation of the sympathetic nervous system, and decrease the heart rate by activation of the parasympathetic nervous system. Resistance exercise, on the other hand, has a lesser effect in decreasing the BP of hypertensive patients and is often not recommended as it may cause an excessive increase of the BP compared to aerobic exercise. Although resistance exercise is useful in the rehabilitation treatment of musculoskeletal diseases, it is considered unsuitable for hypertensive patients³⁰ owing to the potential risk of myocardial ischemia or arrhythmia secondary to excessive increase in SBP. Recent studies, however, suggest that combining aerobic and resistance exercises are effective in controlling hypertension³¹. The AHA and the ACSM have both recognized the importance of resistance exercise in the management of hypertensive patients. A meta-analysis demonstrated that resistance exercise was responsible for a 2-4 mmHg reduction in the SBP and DBP in stable patients³². Although the quantum of reduction in BP with resistance exercise is lesser than with aerobic exercise (6.9/4.9 mm Hg), it is important to recognize that even a 3 mm Hg reduction in the systolic blood pressure can result in a 5-9% reduction in the incidence of cardiovascular diseases, 8-14% reduction in stroke, and 4% reduction in the rate of all-cause-mortality³³. In³⁴ suggested that a decrease in endothelin-1, a vasoconstrictor, and an increase in nitric oxide, a vasodilator, may be the basis for exercise-induced reduction in blood pressure. This study supports the role of exercise in reducing the risk of atherosclerosis since pulse pressure, a key cardiovascular disease risk factor, was found to be lesser following the combined exercise program. The resulting reduction in the pressure on the arterial vessel wall may increase arterial wall elasticity. This study demonstrates that a combined aerobic and resistance exercise program reduces cardiac workload by reducing BP, a risk factor for cardiovascular diseases, in hypertensive patients.

Increased fat mass, as seen in obese elderly women, is regarded as an important cause of cardiovascular diseases or stroke. The serum levels of TC, LDL-C are higher and the levels of HDL-C, lower, due to the plasma lipoprotein metabolic disorder in these women. Exercise is known to reduce body fat and weight, and improve serum lipid levels³⁵. In our study, a significant change was demonstrated in the serum levels of TG, TC, HDL-C, and LDL-C in the exercise group following the 16-week combined training program. TG are the main energy source for adenosine triphosphate (ATP) production by aerobic metabolism, and are stored in fat cells and skeletal muscles. However, increased TG levels are important risk factors for obesity as well as cardiovascular diseases. Exercise-associated-weight control contributes to a 16-19% reduction in the levels of TG, owing to the decline in TG synthesis in liver due to the activation of steatolytic enzymes³⁶. Our study

results are consistent with literature. Several studies recommend combined aerobic and resistance exercises as a means of reducing serum LDL-C in addition to reducing TG in elderly women ³⁷. In³⁸ reported a decrease in the levels of LDL-C, and increase in the levels of HDL-C, following a resistance exercise program. Clapp and In³⁹ reported that aerobic exercise maintained lean body mass by reducing weight, increasing HDL-C, and decreasing the levels of TC, LDL-C, TC/HDL-C, and TG, thus contributing to the prevention of cardiovascular diseases as well as reduction of obesity in elderly women. HDL-C, referred to as an anti-atherosclerosis factor, delivers cholesterol from the peripheral tissue to the liver, and reduces cholesterol levels in the endothelial cells. HDL-C also has an antioxidant and anti-inflammatory function. Increased levels of HDL-C are known to prevent cardiovascular diseases ⁴⁰. Our study demonstrated that exercise resulted in an increase in HDL-C, which may be important in reducing the risk of cardiovascular diseases.

Our results failed to demonstrate any significant change in HOMA-IR, the insulin resistance index. Insulin resistance causes the metabolic syndrome and accelerates the development of cardiovascular diseases ⁴¹. In addition, insulin resistance activates renin-angiotensin II and also causes vascular inflammation ⁴². Exercise reduces insulin resistance by increasing the expression of cell membrane glucose transporter 4 (GLUT-4) ⁴³. The ACSM recommends moderate intensity exercise thrice a week to improve insulin resistance. An increase in insulin sensitivity results in effective energy metabolism as it enables increased synthesis of glycogen in the muscle. Therefore, regular exercise has a positive role in facilitating insulin activity ⁴⁴. There is conflicting evidence regarding the effect of exercise training on insulin resistance. In⁴⁵ reported a 31.7% decrease in HOMA-IR following a 12-week combined exercise and yoga program. The authors suggested that exercise improved insulin resistance regardless of age. Similarly, In⁴⁶ reported a significant reduction in HOMA-IR following a 12-week combined exercise training program. On the other hand, In⁴⁷ reported no significant change in the HOMA-IR values of elderly Japanese subjects following a 12-week combined exercise program (resistance elastic band exercise and walking more than 8,000 steps a day). In⁴⁸ analyzed fasting blood glucose and insulin levels, and identified two groups of people, one with high insulin resistance, and the other without. The group with high insulin resistance demonstrated a reduction in fasting blood glucose and insulin levels following weight loss. This was not observed in the group with low insulin resistance. This evidence suggests that weight-loss related improvement in insulin resistance is seen only in subjects with high insulin resistance. Since the subjects in our study did not have high baseline levels of insulin resistance, our results are consistent with the evidence presented by In⁴⁸. Further studies are necessary to investigate factors related to exercise that can predict improvement in insulin resistance.

CRP, released in response to Interleukin-6 and TNF- α , is secreted by fat cells and synthesized in the liver ⁴⁹ as well as in the blood vessels, heart, kidney, fat cells, and neurons. Its increase indicates arteriosclerosis or coronary artery tissue damage ⁵⁰. Some of the factors that increase CRP levels are obesity, low levels of HDL-C, hypertriglyceridemia, and hypertension. There is a strong correlation between increased CRP and physical inactivity ⁵¹. Exercise or physical activity is associated with suppression of insulin resistance and inflammatory response, which in turn suppress CRP levels ⁵². Our data demonstrated a significant reduction in CRP levels following 16 weeks of exercise. This is consistent with literature where CRP levels in patients with heart disease are demonstrated to improve following exercise ⁵³. In⁵⁴ reported a reduction in CRP levels in elderly women who participated in a combined exercise program of resistance and aerobic exercises, confirming an inverse correlation between exercise and serum CRP levels ^{55,56}. The reduction in CRP following exercise supports the argument that exercise improves vascular function by reducing inflammation and preventing loss of elasticity or damage of the vessel wall ⁵⁷. The fall in CRP levels also indicates reduction of body fat and an increase in the levels of HDL-C ⁵⁸. The Centers for Disease Control and Prevention (CDC) and the AHA report a two-fold increase in the incidence of cardiovascular diseases with CRP levels above 3.0 mg/L compared to levels less than 1.0 mg/L ⁵⁹. Therefore, our results demonstrating a reduction in CRP levels following a combined exercise program are indicative of a reduction in the risk of cardiovascular diseases in hypertensive patients.

Our study demonstrated that a combined aerobic and resistance exercise program was associated with significant benefits in terms of improvement in body composition, blood pressure, serum lipid, and C-reactive protein levels in elderly women with hypertension. Our findings suggest an important role for a combined exercise program in the reduction of cardiovascular risk factors.

ACKNOWLEDGMENT

We would like to thank the physicians and specialists that coordinated this study, and all of the subjects who volunteered for this experiment.

REFERENCES

- [1] Azeem K, Varghese A. Impact of aerobic and aerobic cross training on coronary heart disease (CHD) and bio-motor variables among obese males, *Indian Journal of Science and Technology*, 2015, 8 (8), pp. 720-8.
- [2] Stanley J M L, Elantamilan D, Kumaravel T S. Prevalence of prehypertension and its correlation with Indian diabetic risk score in rural population, *Indian Journal of Science and Technology*, 2013, 6 (8), pp. 5163-6.
- [3] Lewington S, Clarke R, Qizilbash N, Peto R, Collins R. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies, *Lancet*, 2002, 14, pp. 1903-13.
- [4] Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL. The Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report *JAMA*, 2003, 289(19), pp. 2560-72.
- [5] Poehlman ET, Dvorak RV, DeNino WF, Brochu M, Ades PA. Effects of resistance training and endurance training on insulin sensitive in nonobese, young women: a controlled randomized trial, *Journal of Clinical Endocrinology Metabolism*, 2000, 85(7), pp. 2463-8.
- [6] Cornelissen VA, Fagard RH. Effects of endurance training on blood pressure, blood pressure-regulating mechanisms, and cardiovascular risk factors, *Hypertension*, 2005, 46(4), pp. 667-75.
- [7] Braith RW, Stewart KJ. Resistance exercise training: its role in the prevention of cardiovascular disease, *Circulation*, 2006, 113(22), pp. 2642-50.
- [8] Pollock ML, Franklin BA, Balady GJ, Chaitman BL, Fleg JL, Fletcher B. AHA Science Advisory. Resistance exercise in individuals with and without cardiovascular diseases: benefits, rationale, safety, and prescription: An advisory from the Committee on Exercise, Rehabilitation, and Prevention, Council on Clinical Cardiology, American Heart Association, Position paper endorsed by the American College of Sports Medicine, *Circulation*, 2000, 101(7), pp. 828-33.
- [9] Pescatello LS, Franklin BA, Fagard R, Farquhar WB, Kelley GA, Ray C A. American College of Sports Medicine, American College of Sports Medicine position stand, Exercise and hypertension, *Medicine and Science in Sports and Exercise*, 2004, 36(3), pp. 533-53.
- [10] Harris KA, Holly RG. Physiological response to circuit weight training in borderline hypertensive subjects, *Medicine and Science in Sports and Exercise*, 1987, 19(3), pp. 246-52.
- [11] Cornelissen VA, Fagard RH. Effects of resistance training on resting blood pressure: a meta-analysis of randomized controlled trials, *Journal of Hypertension*, 2005, 23(2), pp. 251-9.
- [12] Kwon HJ. The effect of 12 weeks combined exercise program on blood lipids and cardiovascular disease risk factor in the elderly women, *Journal of Korean Physical Education Association for Girls and Women*, 2009, 23(4), pp. 1-12.
- [13] Baster T, Baster-Brooks C. Exercise and hypertension, *Australian Family Physician*, 2005, 34(6), pp. 419-24.
- [14] Borg GAV. Psychophysical bases of perceived exertion, *Medicine and Science in Sports and Exercise*, 1982, 14, pp. 377-381.
- [15] Davidson MH, Tonstad S, Oparil S, Schwieters M, Day WW, Bowden CH. Changes in cardiovascular risk associated with phentermine and topiramate extended-release in participants with comorbidities and a body mass index ≥ 27 kg/m², *American Journal of Cardiology*, 2013, 111(8), pp. 1131-8.
- [16] Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher D F, Turner RC. Homeostasis model assessment: Insulin resistance and beta-cell function from fasting plasma glucose and insulin concentration in man, *Diabetologia*, 1985, 28(7), pp. 412-29.
- [17] Mostarda C, Moraes-Silva IC, Salemi VM, Machi JF, Rodrigues B, De Angelis K et al. Exercise training prevents diastolic dysfunction induced by metabolic syndrome in rats, *Clinics*, 2012, 67(7), pp. 815-20.
- [18] Klein S, Burke LE, Bray GA, Blair S, Allison DB, Pi-Sunyer X. Clinical implications of obesity with specific focus on cardiovascular disease: a statement for professionals from the American Heart

- Association Council on Nutrition, Physical Activity, and Metabolism: endorsed by the American College of Cardiology Foundation, *Circulation*, 2004, 110(18), pp. 2952-67.
- [19] He J, Goodpaster BH, Kelley DE. Effects of weight loss and physical activity on muscle lipid content and droplet size, *Obesity Research*, 2004, 12(5), pp. 761-9.
- [20] Treuth MS, Ryan AS, Pratley RE, Rubin MA, Miller JP, Nicklas BJ. Effects of strength training on total and regional body composition in older men, *Journal of Applied Physiology*, 1994, 77(2), pp. 614-20.
- [21] You BK. The change of severely obese middle aged women's body fat, cardiovascular strength and blood hormone on the combined exercise, *The Korean Journal of Exercise Nutrition*, 2005, 9(3), pp. 253-9.
- [22] Donnelly JE, Smith B, Jacobsen DJ, Kirk E, Dubose K, Hyder M. The role of exercise for weight loss and maintenance, *Best Practice Research, Clinical Gastroenterology*, 2004, 18(6), pp. 1009-29.
- [23] American College of Sports Medicine, ACSM's Guidelines for Exercise Testing and Prescription, Philadelphia, Pa: Lippincott Williams & Wilkins, 2010.
- [24] Manson JE, Hu FB, Rich-Edwards JW, Colditz GA, Stampfer MJ, Willett WC. A prospective study of walking as compared with vigorous exercise in the prevention of coronary heart disease in women, *New England Journal of Medicine*, 1999, 341(9), pp. 650-8.
- [25] Ko SS. Effects of combined exercise training type on body composition, health related fitness, and metabolic syndrome markers in middle aged women, *The Korean Journal of Growth and Development*, 2009, 17(2), pp. 89-97.
- [26] Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association, *Circulation*, 2007, 116(9), pp. 1081-93.
- [27] Chase NL, Sui X, Lee DC, Blair SN. The association of cardiorespiratory fitness and physical activity with incidence of hypertension in men, *American Journal of Hypertension*, 2009, 22(4), pp. 417-24.
- [28] Guimarães GV, Ciolac EG, Carvalho VO, D'Avila VM, Bortolotto LA, Bocchi EA. Effects of continuous vs, interval exercise training on blood pressure and arterial stiffness in treated hypertension, *Hypertension Research*, 2010, 33(6), pp. 627-32.
- [29] Ciolac EG, Bocchi EA, Bortolotto LA, Carvalho VO, Greve JM, Guimarães GV. Effects of high-intensity aerobic interval training vs. moderate exercise on hemodynamic, metabolic and neuro-humoral abnormalities of young normotensive women at high familial risk for hypertension. *Hypertension Research*, 2010, 33(8), pp. 836-43.
- [30] Yoon ES, Jung SJ, Roh DI, Jae SY. Effects of resistance exercise on 24 hour ambulatory blood pressure in pre and hypertensive subjects, *Exercise Science*, 2010, 19(2), pp. 143-54.
- [31] Wallace JP. Exercise in hypertension, A clinical review, *Sports Medicine*. 2003, 33(8), pp. 585-98.
- [32] Kelley GA, Kelley KS. Progressive resistance exercise and resting blood pressure: A meta-analysis of randomized controlled trials, *Hypertension*, 2000, 35(3), pp. 838-43.
- [33] Whelton SP, Chin A, Xin X, He J. Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. *Annals of Internal Medicine*, 2002, 136(7), pp. 493-503.
- [34] Moyna NM, Thompson PD. The effect of physical activity on endothelial function in man, *Acta Physiologica Scandinavica*, 2004, 180(2), pp. 113-23.
- [35] Katzmarzyk PT, Leon AS, Rankinen T, Gagnon J, Skinner JS, Wilmore JH et al. Changes in blood lipids consequent to aerobic exercise training related to changes in body fatness and aerobic fitness, *Metabolism*, 2001, 50(7), pp. 841-8.
- [36] Thompson PD, Cullinane E, Henderson LO, Herbert PN. Acute effects of prolonged exercise on serum lipids, *Metabolism*, 1980, 29(7), pp. 662-5.
- [37] Choi PB. Long-term combined exercise has effect on regional bone mineral density and cardiovascular disease risk factors of the elderly with osteoporosis. *Journal of the Korean Gerontological Society*. 2011, 31(2), pp. 355-369.
- [38] Kang HS. Study on the Effect of Resistive Training Program on the Iron Content and Serum Lipid, Immunity of Middle-aged Women. *Journal of Sport and Leisure Studies*. 2003, 19(2), pp. 1047-1056.
- [39] Clapp JF 3rd, Kiess W. Effects of pregnancy and exercise on concentrations of the metabolic markers tumor necrosis factor alpha and leptin, *American Journal of Obstetrics and Gynecology*. 2000 Feb, 182(2), pp. 300-306.
- [40] Walberg JL, Greenwood MR, Stern JS. Lipoprotein lipase activity and lipolysis after swim training in obese Zucker rats. *American Journal of Physiology*. 1983 Nov, 245(5 Pt 1), pp. R706-712.

- [41] Reaven GM. Banting lecture 1988, Role of insulin resistance in human disease. *Diabetes*, 1988 Dec, 37(12), pp. 1595-1607.
- [42] Prasad A, Quyyumi AA. Renin-angiotensin system and angiotensin receptor blockers in the metabolic syndrome. *Circulation*. 2004 Sep, 110(11), pp. 1507-1512.
- [43] Holloszy JO. Exercise-induced increase in muscle insulin sensitivity. *Journal of Applied Physiology*. 2005 Jul, 99(1), pp. 338-343.
- [44] Lee MG. Effects of 12 weeks of aerobic exercise training on insulin sensitivity at rest, after ingestion of a meal, and during recovery after submaximal exercise. *Korean Journal of Sport Science*. 2002, 13(4), pp. 23-41.
- [45] Park SK, Kwon YC, Kim EH. The Effects of Combined Exercise on self-reliance Fitness, Insulin Resistance and Blood Pressure in Frail Elderly Women. *The Korean Journal of Physical Education*. 2006, 45(5), pp. 369-370.
- [46] Kodama S, Shu M, Saito K, Murakami H, Tanaka K, Kuno S. Even low-intensity and low-volume exercise training may improve insulin resistance in the elderly, *Internal Medicine*. 2007 Jul, 46(14), pp. 1071-1077.
- [47] Tokudome M, Nagasaki M, Shimaoka K, Sato Y. Effects of home-based combined resistance training and walking on metabolic profiles in elderly Japanese. *Geriatrics and Gerontology International*. 2004 Sep, 4(3), pp. 157-162.
- [48] McLaughlin T, Abbasi F, Lamendola C, Kim HS, Reaven GM. Metabolic changes following sibutramine-assisted weight loss in obese individuals: role of plasma free fatty acids in the insulin resistance of obesity. *Metabolism*. 2001 Jul, 50(7), pp. 819-824.
- [49] Jialal I, Devaraj S. Inflammation and atherosclerosis: the value of the high-sensitivity C-reactive protein assay as a risk marker. *American Journal of Clinical Pathology*. 2001 Dec, 116, pp. S108-115.
- [50] Yudkin JS, Stehouwer CD, Emeis JJ, Coppack SW. C-reactive protein in healthy subjects: associations with obesity, insulin resistance, and endothelial dysfunction: a potential role for cytokines originating from adipose tissue?. *Arteriosclerosis, Thrombosis, and Vascular Biology*. 1999 Apr, 19(4), pp. 972-978.
- [51] Libby P. Inflammation in atherosclerosis. *Nature*. 2002 Dec, 420(6917), pp. 868-874.
- [52] Albert MA, Glynn RJ, Ridker PM. Effect of physical activity on serum C-reactive protein. *American Journal of Cardiology*. 2004 Jan, 93(2), pp. 221-225.
- [53] Goldhammer E, Tanchilevitch A, Maor I, Beniamini Y, Rosenschein U, Sagiv M. Exercise training modulates cytokines activity in coronary heart disease patients. *International Journal of Cardiology*. 2005 Apr, 100(1), pp. 93-99.
- [54] Wannamethee SG, Lowe GD, Whincup PH, Rumley A, Walker M, Lennon L. Physical activity and hemostatic and inflammatory variables in elderly men. *Circulation*. 2002 Apr, 105(15), pp. 1785-1790.
- [55] Abramson JL, Vaccarino V. Relationship between physical activity and inflammation among apparently healthy middle-aged and older US adults. *Archives of Internal Medicine*. 2002 Jun, 162(11), pp. 1286-92.
- [56] Geffken DF, Cushman M, Burke GL, Polak JF, Sakkinen PA, Tracy RP. Association between physical activity and markers of inflammation in a healthy elderly population. *American Journal of Epidemiology*. 2001 Feb, 153(3), pp. 242-250.
- [57] Santa-Clara H, Fernhall B, Baptista F, Mendes M, Bettencourt Sardinha L. Effect of a one-year combined exercise training program on body composition in men with coronary artery disease. *Metabolism*. 2003 Nov, 52(11), pp. 1413-1417.
- [58] Tsukui S, Kanda T, Nara M, Nishino M, Kondo T, Kobayashi I. Moderate-intensity regular exercise decreases serum tumor necrosis factor-alpha and HbA1c levels in healthy women. *International Journal of Obesity and Related Metabolic Disorders*. 2000 Sep, 24(9), pp. 1207-1211.
- [59] Pearson TA, Bazzarre TL, Daniels SR, Fair JM, Fortmann SP, Franklin BA. American Heart Association guide for improving cardiovascular health at the community level: a statement for public health practitioners, healthcare providers, and health policy makers from the American Heart Association Expert Panel on Population and Prevention Science. *Circulation*. 2003 Feb, 107(4), pp. 645-651.



ISSN
0975-6299

Usefulness of Prophylactic Extraction 3rd Molar: A Case Report

Lim Kun Ok*, Department of Dental Hygiene, SunMoon University, Asansi, Korea. E-mail:kolim139@sunmoon.ac.kr

Kam Ji Young, Department of Dental Hygiene, SunMoon University, Asansi, Korea. E-mail:gamjigamji@naver.com

Abstract---

Background/Objectives: This case report evaluated usefulness of a prophylactic extraction of third molar and impact on caries and periodontal diseases of adjacent teeth. In relation to this, we presented results of case and observations in order to explore oral health education scheme by dental hygienist for the importance of prophylactic extraction of third molar and manage of adjacent teeth.

Methods/Statistical analysis: Based on dental records, We used Silness and Loe plaque index to quantitative plaque recording on four surfaces (mesial, buccal, distal, lingual) of second molar. Periodontal pocket depth were also measured on four surfaces (mesial, buccal, distal, lingual) by using Williams probe within 1mm interval. Bodecker's modified index were used to measure the caries on 5 surfaces (mesial, buccal, distal, lingual, occlusal)

Findings In experimental case (I, II), There were crown and root caries and pocket depth over 7mm on distal of secondary molar. On the other hand, In control case, There were no caries on distal of secondary molar but on occlusal of secondary molar and 3mm pocket depth. Judging from results, Treatment of caries and periodontal disease on secondary molar was considered by individuals.

Improvements/Applications: The prophylactic extraction of 3rd molar is very important in time and for improving the oral health environment.

Furthermore, It is considered to need further study for assessing improvement of oral health status by measuring periodically through oral health education before and after 3rd molar extraction. And also they would be able to contribute to establish a foothold reinforcing the oral health education by dental hygienist.

Keywords--- Third Molar, Dental Hygienist, Extraction, Prophylactic, Caries, Periodontal Diseases.

* Corresponding Author

I. INTRODUCTION

A wisdom teeth or third molar is one of the three molars per quadrant of the human dentition.

The third molars generally appear much later than other teeth, usually between the ages of 17 and 25 when a person reaches adulthood. It is generally thought among linguists that they are called wisdom teeth because they appear so late, at an age when a person matures into adulthood and is wiser than other teeth have erupted. The third molars also have different eruption angle, direction, period according to individual. It can be difficult to reach the wisdom teeth with a regular toothbrush which makes cleaning more difficult and taking charge of chewing function.

As human evolution, There are many abnormal eruption cases, especially on the mandible caused of reducing the jaw which makes into the lack of eruption intervals, eruptive direction disorder, morphological abnormality.¹ By the partial eruption of the third molars, The periodontal pocket are formed and It is a good medium to oral bacteria as retaining residue on food and dental plaque.^{2,3,4,5,6,7}

Because it is located in the mouth innermost, it is difficult to reach the wisdom teeth and it is one of reason to decrease ability to manage.

It is the second molars that receives most occlusion pressure, and second molars located in front of third molars plays an important role serving to chew tough food in the digestive tract.

However, after the third molars eruption, In case of poor hygiene control or partial eruption, the third molars negatively influence the second molars.

Therefore, If a prophylactic extraction of third molars is not occurred in a timely, it can cause pericoronitis in third molar and root absorption, gingivitis, dental caries in second molars.^{8,9}

Last 20 years, Extraction of asymptomatic the third molars remain a controversial issue. In America, Korea and Japan, prophylactic extraction has been recommended.

However, In Europe, in terms of cost effective side, it has been claimed that extraction of asymptomatic the third molars should be limited.¹⁰

Gassi et al ¹¹ reported a healthy periodontal status does not affect harmful to adjacent teeth. Especially It is important maintain the healthy status on the second molars as existence of the third molar. Therefore, Even if the third molars is normally erupted, It is difficult to manage on account of the innermost location.

In expanding health service by the ageing population, urbanization and industrialization, It generalized down to be not a privilege but human rights that maintaining and protecting the health of people. To expand the area of interest as recognizing changes in national interest, The importance of oral health have emerged in social situation.¹²

Therefore, To make a habit of preventive oral hygiene behavior, People must first make a desirable behavior and this should start with develop their knowledge to take right information.¹³

The dental hygienist curriculum has been developed a fragmentary knowledge and skill training to dental hygienists' roll and dental hygiene performance based on problem-solving capability.^{14,15,16}

To have problem-solving capability, Dental hygienist have ability not only assist to treatment but also to manage patients and conduct oral health instruction.

Consequently, Dental hygienists should have to develop their ability for conveying right knowledge and information through clinical cases and untiring self-development.

This case report evaluated usefulness of a prophylactic extraction of third molar and impact on caries and periodontal diseases of adjacent teeth. In relation to this, we presented results of case and observations in order to explore oral health education scheme by dental hygienist for the importance of prophylactic extraction of third molar and manage of adjacent teeth.

II. CASE REPORT

A. Subjects

This report deals with three cases (2 males, 1 female) who consented to research after describing of the study purpose among patients who visited in order to receive dental care from January 2016 to April 2016.

For accuracy of the study, Patients who had third molar were assigned to experimental case (I, II) and the others were assigned to control case. All cases were limited only to impact mandibular second molars.

B. Material and Methods

Based on dental records, We used Silness and Loe plaque index to quantitative plaque recording on four surfaces (mesial, buccal, distal, lingual) of second molar. Periodontal pocket depth were also measured on four surfaces (mesial, buccal, distal, lingual) by using Williams probe within 1mm interval. Bodecker's modified index were used to measure the caries on 5 surfaces (mesial, buccal, distal, lingual, occlusal) and Digital radiograph image by panoramic X-ray was taken for measuring radiographic bone loss on distal of secondary molar.

III. CONCLUSIONS AND DISCUSSIONS

A. Conclusions

In experimental case (I, II), There were crown and root caries and pocket depth over 7mm on distal of secondary molar. On the other hand, In control case, There were no caries on distal of secondary molar but on occlusal of secondary molar and 3mm pocket depth. Judging from results, Treatment of caries and periodontal disease on secondary molar was considered by individuals. However, 3 cases presented that prophylactic extraction 3rd molar was assessed as being very deep relationship to the dental caries and periodontal disease on distal of second molar. In conclusion, the present report demonstrated the prophylactic extraction 3rd molar was needed to prevent interproximal caries and periodontal disease on the second molar in that the maintenance of second molar is difficult.

The comparison results of oral status between the second molar in case of a prophylactic extraction of third molar and experimental group causing dental caries and periodontitis as non-extraction of third molar showed that it is difficult to manage the second molar's hygiene and lead to chronic disease.

Therefore, Due to the result of this case report, it is considered the prophylactic extraction of the third molar for preventing approximal caries and periodontitis of the second molars.

B. Discussions

The second molars is innermost teeth except that the third molars and they are more likely to be affected from oral health status influenced wrong toothbrush method or existence of the third molars.

In case of careless manage of the second molar, it come about dental caries in distal side of the second molar and increases dental plaque. In accordance having bone loss, It will be developed to acute periodontitis.^{2,3,4,5,6,7}

Laskin reported extraction of the third molar is need prophylactic extraction in case of abnormal eruption. It can decide from X-ray on 16-17 years old.⁶

Kaplan reported the presence of third molars does not appear to produce a greater degree of lower anterior crowding and rotational release after the cessation of retention than that which occurs in patients with third molar agenesis. It is reported that in case of presence of the third molars cause more 1mm mandible crowding than agenesis case.¹⁷

Non eruptive or eruptive the mandible third molars sometimes can cause crowding to force to anterior teeth. Therefore, it is needed extraction during orthodontic treatment or after orthodontic treatment.^{18,19,20}

Knulsson et al reported expiry extant of the third molar can make into periocoronitis, dental caries, periodontitis, complication on the second molars and absorption of root of the second molars.⁹

As we can see through a number of studies, It is recommended to pull out the third molars at asymptomatic stage. Because that makes minimize the adjacent periodontal tissue injury.²¹

Dental caries is one of the most common diseases in human, and cause a decrease of mineral substances in the tooth.²²

The significance of the study is in that visiting oral health care subject elderly people's oral health levels were actually measured and correlation of the related indicators were analyzed to provide basic data in developing elderly oral healthcare business program.²³

This study reported that it can be seen that the plaque index is high in case of existence of the third molar. Consequently, it gives to know that prophylactic extraction of the third molar is very important for improving the oral status.

Also, It is expected to widen to systemic oral hygiene instruction help into remind for importance of posterior teeth manage.

Furthermore, It should be needed the prospective study for periodical comparison with the improvements of oral hygiene index through oral health instruction before and after extraction of the third molars.

It is considered to establish reinforcement of dental hygienists' oral hygiene instruction improving recognition for oral care through manage of the posterior teeth tooth brush instruction and proper preventive maintenance.

REFERENCES

- [1] Almendros-Marques N, Alaejos-Algarra E, Quinteros-Borgarello, Berini-Aytes L, Gay-Escoda C, "Factors influencing the prophylactic luencing the prophylactic removal of asymptomatic impacted lower third molars." *Int J Oral Maxillofac Surg* 2008, vol. 37. PP.29-35.
- [2] Arch, W.H, "Oral and Maxillofacial Surgery", 55thes. W.B. Saunders Co.1975, Vol. PP.1, 1627.
- [3] Geoffrey, L.H, "Minor Oral Surgery", 2nded. Johnwright and Sons Ltd.1977, PP.185
- [4] Kay, L.W, "The management of Pericoroni-tis", *Dental Practitioner Dent. Rec.*1960, PP.11-80.
- [5] Laskin, D.M, "Indication and Contraindica-tion for removal of impacted third molars", *Dent. N. Am*,1969, PP 13,919.
- [6] Laskin, D.M, "Oral and Maxillofacial Surgery", Mosby,1985, Vol. 2 PP.50.
- [7] Kay, L.W, "Investigations into the nature of pericoronitis", *I. Brit. J. Oral Surg.*1966, PP.3,188.
- [8] Chapasco M. Cicco L. D, Marrone G, "Side effects and complications associated with third molar surgery", *Oral Surg. Oral med. Oral Pathol*, 1993, Vol. 77, PP.412-420.
- [9] Knulsson K, Brchmer B. Lysell. Rohlin M, "Pathoses associatrd with mandibular third molars subjected to removal", 1996, Vol. 82 PP.7-10.
- [10] Wonse P. "Reconsideration of decision making for third molar extraction", *J Korean Assoc Oral Maxillofac Surg*.2011, Vol. 37 pp.343-348.
- [11] Grassi M. Tellenbach R. Lang N. P. "Periodontal conditions of teeth adjacent to extraction sites", *J. clin. Periodontal*. 1987, vol. 14, pp.334-339.
- [12] Kim JB, Moon HS, Paik DI, Ro IK, " A study on the percentage of extraction required by causes in Korea."1998, Vol.22(3). Pp.183-194.
- [13] Harris NO, Christen AG, "Primary preventive dentistry. 4th ed. Stamford, Appleton & Lange, 1995 pp.393.
- [14] Cho YS, Lee SY: Developing a integrated curriculum for a clinical dental hygiene. *J Dent HygSci* 2005, Vol 5. pp.33-38.
- [15] Choi GY, "Analysis of curriculum decision-making systems of dental hygiene department". Unpublished doctoral dissertation, Kyungnam University, Changwon, 2010.
- [16] Chung WG, Kim EG, Choi EM, et al. "A study on developmental direction of the dental hygiene discipline in Korea". Korea Dental Hygienists Association, Korean Association of Dental Hygiene Professors, Seoul, 2009.
- [17] Kaplan, R.G. "Mandibular third molars & postretention crowding. *American Journal of Orthodontics*", 1974 vol. 66, pp.4.
- [18] Dewey, M. "The third molars in relation to malocclusion." *Int. J. Orthodont*.1917, Vol. 3, pp.529.
- [19] Rounda, C.E. "Principles and technique of exodontia." St. Louis, C.V. Mosby Co, 1962 ,pp.279
- [20] Waldron, R. "Question of the influence of erupting impacted third molars on the occlusion of treated and untreated cases." *Amer. J. Orthodont*. 1937, Vol. 23, pp.221.
- [21] Kim HS, Kim TK, Heo SR, Cho IH. "The effect of third molar extraction on the periodontal status of the adjacent second molar."2003, Vol. 33.Pp.407-414.
- [22] Lee SY, Lim SR, Cho YS. "Remineralisation Effect of Fluoride on Early Caries Lesions using a Quantitative Light-Induced Fluorescence-Digital (QLF-D)." *Indian Journal of Science and Technology*, January 2015, Vol 8(S1), 457-461.
- [23] Jang JH, Park YD, Kim JH, Kim EJ. "Clinical Predictors Related to Oral Health-Related Quality of Life (OHRQoL) in Korean Elderly for Visiting Oral Healthcare." *Indian Journal of Science and Technology*, 2015, Vol 8(25), DOI: 10.17485.

Table 1: Value of Plaque Indices*

Group	Mesial	Buccal	Distal	Lingual	Total
Experimental case I	2	1	3	2	8
Experimental case II	3	3	3	3	12
Control case I	0	0	1	1	2

*Silness and Loe plaque index

Table 2: Pocket Depth on Second Molar

Group	Mesial	Buccal	Distal	Lingual	Total
Experimental case I	2	3	12	3	20
Experimental case II	9	10	11	10	40
Control case I	4	2	3	2	11

Table 3: DMFS Index* on Second Molar

Group	Mesial	Buccal	Distal	Lingual	Occlusal	Total
Experimental case I	0	0	2	0	2	4
Experimental case II	0	0	2	0	2	4
Control case I	0	0	0	0	2	2

*Bodecker's modified index

Table 4: Pocket Depth on Second Molar

Group	Plaque index	Pocket depth	DMFS	Total
Experimental case I	8	20	4	32
Experimental case II	12	40	4	56
Control case I	2	11	2	15



ISSN
0975-6299

The Development of Prevention System for Repeat Radio Graphs and Fall Accident by Patient Movement

Sinyoung Yu, Department of Radiology, Seoul Sung-sim Hospital, Wangsan-ro, Dondaemun-gu, Seoul, Korea.
E-mail:ryusinyoung@gmail.com

Joonkoo Choi*, Department of Radiological Science, Graduate School of Health Science, Far East University, Daehak-gil, Gangok-myeon, Eumsung-gun, Chungcheongbuk-do, Korea. E-mail:rlaser@hanmail.net

Ghajung Kim, Department of Radiological Science, Graduate School of Health Science, Far East University, Daehak-gil, Gangok-myeon, Eumsung-gun, Chungcheongbuk-do, Korea. E-mail:ghajung@naver.com

Joongseok Go, Department of Radiology, Seoul National University Bundang Hospital, 82, Gumi-ro 173neon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea. E-mail:snuhgo@hanmail.net

Seunggi Kim, Department of Radiology, Senam University Myongji Hospital 55, Hwasu-ro 14beon-gil, Deogyang-gu, Goyang-si, Gyeonggi-do, Korea. E-mail:cocuncap@naver.com

Kwanghyun Chang, Department of Diagnostic Image, Samsung Seoul Hospital, 81, Irwon-ro, Gangnam-gu, Seoul, Korea.
E-mail:002abbackh@gmail.com

Abstract---

Background/Objectives: The present study aimed to help improve patient safety related to radiation and fall accidents by reducing movement-induced repeat radiographs and risk for falling by rapidly detecting unexpected movements and acting accordingly.

Methods/Statistical Analysis: The developed system operates with an infrared-sensor-based module connected to X-ray equipment. The sensor mounted to the system is activated during the preparation stage of radiography. If the system detects movements, it interrupts the X-ray exposure by automatically cutting power to the circuit and alerting the operator with a light signal and sound alarm. To evaluate the system, reaction speed was measured by varying the table height and electrical resistivity at 11 locations at different distances.

Findings: The results of the system evaluation revealed that the reaction speed was highest at the centrally situated locations K, C, and H and lowest at locations A, E, F, and J, which were situated near the edges. The highest reaction speed occurred when the table was placed at a height of 140cm. When the measurements were made by varying the resistivity values from 100 to 500 K Ω in steps of 100 K Ω , reaction speed decreased as resistivity increased.

Improvements/Applications: Expected to help improve patient safety related to radiation and fall accidents by reducing movement-induced repeat radiographs and risk for falling by rapidly detecting unexpected movements and acting accordingly.

Keywords--- Infrared-Sensor, Fall Accident, Radiation, Repeat Radiograph.

* Corresponding Author

Special Issue on "Medical Science"

I. INTRODUCTION

The use of medical radiation benefits not only individual patients, but also society as a whole. However, large radiation doses carry risk for patients; therefore, proper protection from and management of medical radiation is being suggested¹.

The principles of protection against medical radiation are careful justification and optimization of shielding. Justification is the result of careful judgment and decision making for applying radiation for each patient, while optimization is attempting to minimize the radiation dose for the patient².

Optimization of shielding is important for medical radiation that does not have a radiation dose limit in order to minimize radiation exposure for the patients³.

During radiological examination, not only should the radiation exposure be considered, but also other factors related to the patient's safety. Recently, there have been an increasing number of injuries from falls during radiological examination.

Unexpected movement in unstable patients can lead to injuries from falls. Falling should be prevented during the examination in order to avoid additional damage to the patients. Not all falls result in physical injuries to the patients, but psychological trauma after the fall can lead to contraction in activities, fracture, brain injury, and possibly death.

Overall, injuries from falls will negatively impact the patient's quality of life⁴.

Injuries from falls are in fact one of the most frequent reasons for additional medical cost from prolonged admission periods and additional examinations, treatment, or rehabilitation, as well as lawsuits for malpractice⁵.

The general population recognizes radiation exposure during procedures that utilize radioactive material as extremely dangerous.

Although patients generally understand that exposure to medical radiation brings more benefits than risks, there is growing interest in minimizing the risks during procedures using medical radiation. Furthermore, the recent nuclear disaster in Fukushima and other earthquakes around the world caused an increased level of concern over radiation exposure for the general population. In fact, most artificial radiation exposure comes from medical radiation⁶.

Radiation technologists should try to minimize radiation exposure for patients during examination or treatment procedures, and perform examinations accurately in order to avoid unnecessary, repeated examinations and additional exposure to radiation⁷.

Most centers in Korea are reluctant to release information on the rate of injuries from falls, and therefore, the accurate rate is not known. However, according to the event reported in general hospitals, about 30% of the reports state injuries from falls.

In the U.S., about 38% of the events in hospitals are injuries from falls.

In 2000, the direct medical cost associated with injuries from falls was \$20 billion, and the rate of injuries from falls in elderly patients was 1.5 falls per bed annually⁸. These results indicate the seriousness of injuries from falls in hospitals around the world.

Therefore, there is a need for the system that detects the patient's movement, terminates the X-ray examination, and helps the operator to react quickly to potential falls, in order to prevent repeated X-ray examination and injuries from falls caused by the patient's movement.

II. PROPOSED WORK

The SH-906 infrared sensor works by detecting the human body's infrared radiation. By connecting this sensor to the exposure switch of the X-ray imaging equipment, we hope to develop a module that alerts the operator with an alarm and LED lamp if the patient's movement is detected by the sensor, then automatically shuts down the X-ray examination by breaking the circuit.(Figure 1)

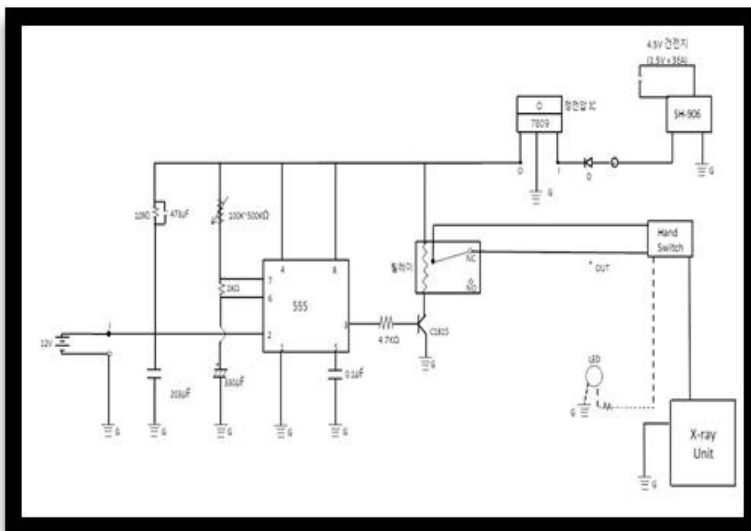


Figure 1: System-Wide Circuit

The centers of the X-ray tube and infrared sensor are aligned, and the sensor is installed on the ceiling of the examination room such that its horizontal and vertical sensing ranges match with the horizontal and vertical ranges of the table. (Figure 2)

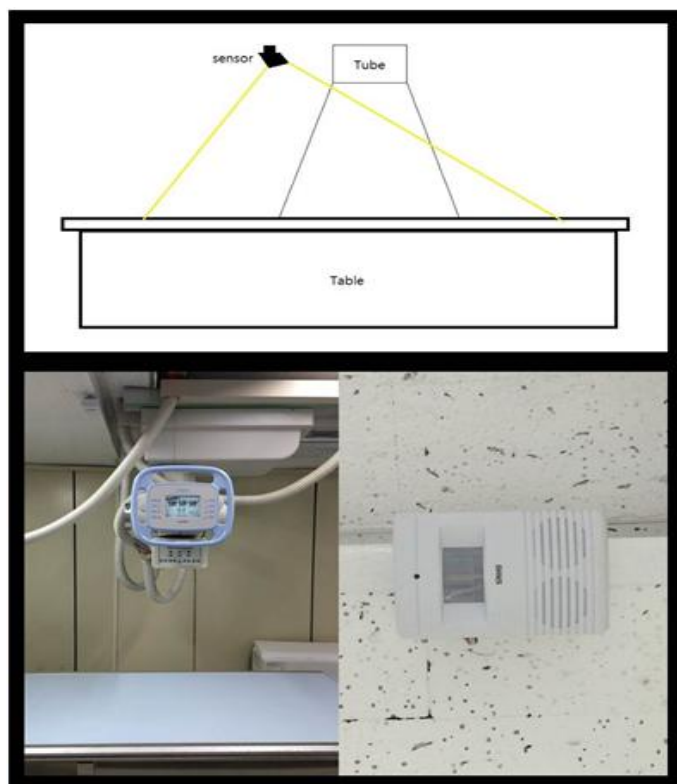


Figure 2: Sensor Installation

In order to allow temperature detection of the infrared sensor, water was used as a tissue equivalent material. Five hundred milliliters of water was incubated for 24 h until it reached body temperature. The bottle containing the water was put onto a roll mixer with manual movement and experiments were performed at each measuring point.

Measurements were repeated five times at 11 different points (A, B, C, D, E, F, G, H, I, J, K) within the 200 × 80 cm area (horizontal × vertical). At each point, the activity was measured by turning off the LED lamp and measuring the time between the LED lamp being turned off and detection by the sensor. Five independent measurements at each point were averaged to produce the final result. Measuring points are outlined in Figure 3. (Figure 3)

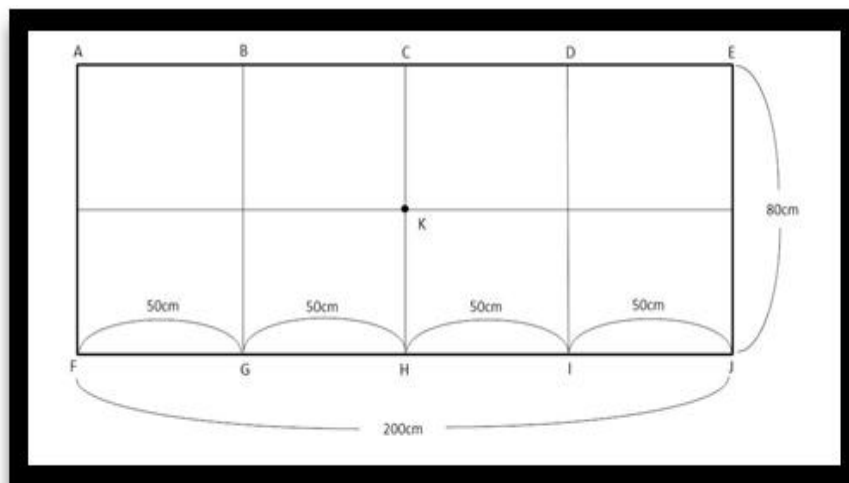


Figure 3: Measurement Location

The height of the table was altered between high, intermediate, and low. Measurements were made five times at each point, A, B, C, D, E, F, G, H, I, J, and K, and the average value of the five measurements was used as the final measurement. "High" position is the highest position for the table, where the distance between the sensor and the table is 140 cm. "Intermediate" position has 160 cm between the sensor and the table, while "low" position has 180 cm.

Resistance values were varied between 100 K Ω , 200 K Ω , 300 K Ω , 400 K Ω , and 500 K Ω , which gave five different response times. Five measurements were made at each of the 11 measuring points (A, B, C, D, E, F, G, H, I, J, K) and the average value was used for further analysis.

SPSS statistics 21 was used for statistical analysis of the system. Nonparametric tests and chi-squared tests (χ^2 -test) were used for analysis.

III. CONCLUSION

In order to assess the system, response times were measured at 11 different measuring points within the range of 200 × 80 cm, with varying table heights and resistance values as shown in table 1 to table 11.

Table 1: System Operating Time from the Sensor Detects at Point A

unit : sec

	100 K Ω	200 K Ω	300 K Ω	400 K Ω	500 K Ω
High(140cm)	1.33	1.54	2.31	2.97	3.69
Middle(160cm)	2.24	2.61	3.17	4.02	4.89
Low(180cm)	4.25	4.43	5.41	6.01	6.71
mean	2.57	2.86	3.63	4.33	5.09

Table 2: System operating Time from the Sensor Detects at Point B

unit : sec

	100 K Ω	200 K Ω	300 K Ω	400 K Ω	500 K Ω
High(140cm)	1.27	1.54	2.02	2.57	3.39
Middle(160cm)	2.19	2.41	2.99	3.76	4.67
Low(180cm)	4.18	4.43	4.93	5.43	6.17
mean	2.54	2.79	3.31	3.92	4.74

Table 3: System Operating Time from the Sensor Detects at Point C

unit : sec

	100 K Ω	200 K Ω	300 K Ω	400 K Ω	500 K Ω
High(140cm)	1.17	1.44	1.86	2.34	3.05
Middle(160cm)	2.03	2.21	2.71	3.42	4.35
Low(180cm)	4.09	4.33	4.93	5.47	6.21
mean	2.43	2.66	3.16	3.74	4.53

Table 4: System Operating Time from the Sensor Detects at Point D

unit : sec

	100 K Ω	200 K Ω	300 K Ω	400 K Ω	500 K Ω
High(140cm)	1.22	1.44	2.01	2.57	3.49
Middle(160cm)	2.14	2.31	2.95	3.71	4.81
Low(180cm)	4.15	4.43	5.01	5.56	6.31
mean	2.50	2.72	3.32	3.94	4.87

Table 5: System Operating Time from the Sensor Detects at Point E

unit : sec

	100 K Ω	200 K Ω	300 K Ω	400 K Ω	500 K Ω
High(140cm)	1.31	1.54	2.01	2.77	3.69
Middle(160cm)	2.19	2.51	3.01	3.91	4.89
Low(180cm)	4.18	4.43	5.11	5.89	6.71
mean	2.56	2.82	3.37	4.19	5.09

Table 6 System operating time from the sensor detects at point F

unit : sec

	100 K Ω	200 K Ω	300 K Ω	400 K Ω	500 K Ω
High(140cm)	1.29	1.51	2.02	2.77	3.69
Middle(160cm)	2.14	2.41	3.07	3.91	4.89
Low(180cm)	4.25	4.43	5.21	5.88	6.71
mean	2.56	2.78	3.43	4.18	5.09

Table 7: System Operating Time from the Sensor Detects at Point G

unit : sec

	100 K Ω	200 K Ω	300 K Ω	400 K Ω	500 K Ω
High(140cm)	1.24	1.44	2.01	2.67	3.41
Middle(160cm)	2.13	2.41	3.07	3.78	4.72
Low(180cm)	4.12	4.43	4.91	5.41	6.20
mean	2.49	2.76	3.33	3.95	4.77

Table 8: System Operating Time from the Sensor Detects at Point H

unit : sec

	100 K Ω	200 K Ω	300 K Ω	400 K Ω	500 K Ω
High(140cm)	1.18	1.39	1.99	2.45	3.03
Middle(160cm)	2.05	2.39	2.95	3.88	4.31
Low(180cm)	4.11	4.43	5.02	5.51	6.18
mean	2.44	2.73	3.32	3.94	4.50

Table 9: System Operating Time from the Sensor Detects at Point I

unit : sec

	100 K Ω	200 K Ω	300 K Ω	400 K Ω	500 K Ω
High(140cm)	1.25	1.54	1.99	2.57	3.42
Middle(160cm)	2.12	2.37	3.07	3.81	4.75
Low(180cm)	4.15	4.43	5.01	5.44	6.23
mean	2.50	2.78	3.35	3.94	4.80

Table 10: System Operating Time from the Sensor Detects at Point J

unit : sec

	100 K Ω	200 K Ω	300 K Ω	400 K Ω	500 K Ω
High(140cm)	1.33	1.54	2.21	2.97	3.69
Middle(160cm)	2.22	2.61	3.07	3.91	4.89
Low(180cm)	4.21	4.43	5.01	5.79	6.71
mean	2.58	2.86	3.43	4.23	5.09

Table 11: System Operating Time from the Sensor Detects at Point K

unit : sec

	100 K Ω	200 K Ω	300 K Ω	400 K Ω	500 K Ω
High(140cm)	1.17	1.34	1.87	2.34	3.01
Middle(160cm)	2.02	2.29	2.78	3.41	4.26
Low(180cm)	4.01	4.22	4.65	5.21	6.11
mean	2.40	2.61	3.10	3.65	4.46

The results of the system evaluation revealed that the reaction speed was highest at the centrally situated locations K, C, and H and lowest at locations A, E, F, and J, which were situated near the edges.

The highest reaction speed occurred when the table was placed at a height of 140 cm. When the measurements were made by varying the resistivity values from 100 to 500 K Ω in steps of 100 K Ω , reaction speed decreased as resistivity increased.

1) significance test between each measurement point

Test statistics at each measuring point were the following: N = 15, chi-square value of 115.135, d.f. = 10, and P-value = 0 as shown in table 12.

Table 12: Significance Test between Each Measurement Point

test statistic	
N	15
chi-square	115.135
Degree of freedom	10
P-value	.000

2) significance test between each resistance

Test statistics at each resistance were the following: N = 33, chi-square value of 132.000, d.f. = 4, and P-value = 0 as shown in table 13.

Table 13: Significance Test between Each Resistance

test statistic	
N	33
chi-square	132.000
Degree of freedom	4
P-value	.000

3) Significance test according to change in table height on each resistance

Test statistics according to the table height at each resistance were the following: N = 11, chi-square value of 22, d.f. = 2, and P-value = 0 as shown in table 14.

Table 14: Significance Test according to Change in Table Height on Each Resistance

	100 K Ω	200 K Ω	300 K Ω	400 K Ω	500 K Ω
N	11	11	11	11	11
chi-square	22.000	22.000	22.000	22.000	22.000
Degree of freedom	2	2	2	2	2
P-value	.000	.000	.000	.000	.000

Analysis of the system using SPSS statistics 21 showed a P-value of 0, which is smaller than 0.05, indicating the significance of the assessment of this system.

IV. DISCUSSION

On considering these results together, the system can be more effectively applied by minimizing the distance between the sensor and table and aligning the radiation region of the body with the vertical line from the sensor. Low resistivity is favorable for rapid detection of movements. The proposed system is expected to help improve patient safety related to radiation and fall accidents by reducing movement-induced repeat radiographs and risk for falling by rapidly detecting unexpected movements and acting accordingly.

By appropriate operation of a function that sets off an alarm by detecting movement within the system and a function that shuts off the LED lamp, this system is useful for preventing secondary damage from falls and allows fast reaction against potential falls.

However, not always can the sensors be aligned with the X-ray tube or the angle cannot be adjusted properly due to the limitations in the of sensor installation location during system development. These issues should be addressed and improved in future for more efficient operation of the system.

This study was mainly concerned with the development of the system and validation of its applicability. Using a high-sensitivity sensor to reduce the response time can further improve the effectiveness of the system. Furthermore, the system does not require new equipment, and therefore, can be conveniently installed at low cost.

We hope that this study will serve as a foundational study for the development of the system to prevent repeated examinations and ensure patient safety.

REFERENCES

- [1] Kyung-Hyun Do, The health effects of low-dose radiation exposure, J Korean Med Assoc, December 2011 54(12), pp 1253-1261.
- [2] Valentin J, Low-dose extrapolation of radiation -related cancer risk, Ann ICRP, 2005 Vol 35, pp 1-140.
- [3] Berrington de Gonzalez A, Darby S, Risk of cancer from diagnostic X-rays, estimates for the UK and 14 other countries, Lancet 2004 (363), pp345-351.
- [4] Myoung-Hee Kim, Hye-Won Jeon, Mi-Young Chon, Study on the Knowledge and Attitudes of Falls and Awareness of Fall Risk Factors among Nursing Students, Indian Journal of Science and Technology, January 2015 Vol 8(S1), pp 74-80.
- [5] Kwon I. G, Kim K. H, A study on the variables forecasting elderly inpatients fall experience. Journal of Korean Academy of Psychiatric and Mental Health Nursing, 2007 (16), pp 59-68.
- [6] Mohammad Javad Keikhaei Farzaneh, Mahdi Shirin Shandiz, Mojtaba Vardian, Mohammad Reza Deevband, Mohammad Reza Karden, The Quality Control of Diagnostic Radiology Devices in Hospitals of Sistan and Baluchestan, Indian Journal of Science and Technology, Nov 2011 Vol 4 (No.11), pp 1458-1459.
- [7] Mi-Hwa Lee, Hong-Ryang Jung, Change in Exposure Index according to the Subject and Foreign Body Movement of Position, Indian Journal of Science and Technology, October 2015 Vol 8(26), pp 1-5.
- [8] Eun-Kyung Kim, Jae-Chang Lee, Mi-Ran Eom, Falls Risk Factors of Inpatients, J Korean Acad Nurs, 2008 October Vol 38(No.5), pp 676-684.



ISSN
0975-6299

Serf Architecture for the Transpose-Minify Framework Using Cloud Computing

Dr.M. Sunil Kumar, Associate Professor & HOD, Dept of CSE, Sree Vidyanikethan Engineering College, Tirupati, India.

E-mail:sunilmalchi1@gmail.com

V. Abirami*, PG Student, Dept of CSE, Sree Vidyanikethan Engineering College, Tirupati, India.

E-mail:honeyabi17@gmail.com

Abstract---

With the advent of the cloud computing technology the user can operate the data and perform the computations anywhere, anytime in the world. Cloud computing provides highly scalable services to be easily consumed over the Internet on an as-needed basis. The interest thing in cloud computing has been motivated by many factors such as the low cost of system hardware, the increase in computing power and storage capacity and the massive growth in data size generated by digital media, Web authoring, scientific instruments, physical simulations, etc. To this end, still the main challenge in the cloud is how to effectively store, query, analyze, and utilize these immense datasets. To provide the solution to this problem in this paper a novel highly decentralized software framework called Transpose-Minify Framework is used for effectively managing the data.

Keywords--- Map, Reduce, Data Processing, Transpose, Minify.

* Corresponding Author

I. INTRODUCTION

Cloud computing has been coined as an umbrella term to describe a category of sophisticated on-demand computing services initially offered by commercial providers, such as Amazon, Google, and Microsoft. It denotes a model on which a computing infrastructure is viewed as a cloud from which businesses and individuals access applications from anywhere in the world on demand. The main principle behind this model is offering computing, storage, and software "as a service. In addition to raw computing and storage, cloud computing providers usually offer a broad range of software services. They also include APIs and development tools that allow developers to build seamlessly scalable applications upon their services. Indeed, the long-held dream of delivering computing as a utility has been realized with the advent of cloud computing. Cloud computing provides software as a service (saas), Platform as a service(paas), Infrastructure as a service(Iaas). Cloud provides feature such as pay for usage (metering and billing), elasticity, self service, and customization. Further cloud provides deployment models such as Private cloud, Public cloud, Hybrid cloud. The important feature offered by the cloud is the users data resides anywhere in the world and which can be operated remotely in unknown machine by the user. In the day-to-day life the organizations produce large amount of data.

The interest thing in cloud computing has been motivated by many factors such as the low cost of system hardware, the increase in computing power and storage capacity and the massive growth in data size generated by digital media(images, video, audio), Web authoring, scientific instruments, physical simulations, etc. To this end, still the main challenge in the cloud is how to effectively store, query, analyze, and utilize these immense datasets. To effectively manage the data produced by the organizations in this paper a novel highly decentralized software framework implemented which is called Map Reducing Technology. The main aim of this paper is to combine cloud computing Technologies to efficiently store, query, analyze, and utilize the organizations data.

This paper is structured as follows: Section II presents the Transpose-Minify is a software framework for data processing in the cloud. In section III contains the existing and proposed system analysis. Further in section IV discussed about main features of transpose-minify framework. In section V implements the sculptor- Serf architecture for the Transpose-Minify Framework. Further in section VI the Transpose-Minify Framework is implemented using the Transpose and minify functions. Section VII discussed about the some of the related implementations for the Transpose-Minify Framework done in the cloud. Finally section VII presents our conclusions and future work.

II. TRANSPOSE-MINIFY MODEL

Transpose-Minify is a software framework for solving many large-scale computing problems.. By using this programming model large set of data sets can be processed.

Transpose-Minify has the two main functions Transpose and Minify.

Transpose Function

This function performs the searching and sorting of the similar data items.

Minify Function

This procedure performs the summary operation. The Transpose-Minify provides many useful features such as simplicity, fault tolerance, and scalability. It is the most powerful realization of data-intensive cloud computing programming. It is often advocated as an easier-to-use, efficient and reliable replacement for the traditional data intensive programming model for cloud computing. It is proposed to form the basis of the data-centre software stack. The Transpose-Minify can be applied in many fields such as data and compute-intensive applications, machine learning, graphic programming, multi-core programming.

III. SYSTEM ANALYSIS

Existing System

In the past for managing the large amount data produced by the organization the traditional data intensive system was used which is not suitable for the cloud computing due to the bottleneck of the Internet when transferring large amounts of data to a distant CPU. The drawbacks of the traditional method are it is

lack in scalability and it has no enough space to store large amount of data. And also it does not support the query processing.

Proposed System

In proposed system a novel approach, namely Transpose-Minify software framework is use to effectively manage the large data sets. The main feature of this model is simplicity, fault tolerance, and scalability. In this model the computing and data resources are co-located, thus minimizing the communication cost and benefiting the service providers.

IV. MAIN FEATURES OF TRANSPOSE-MINIFY FRAMEWORK

The Transpose-Minify runtime is responsible for parallelization and concurrency control, this allows programmers to easily design parallel and distributed applications. It provides the two level of management

1. To manage the input data- prepare the data to execute.
2. To manage the output data- to get the reduced data.

Simplicity

The Transpose-Minify runtime is responsible for parallelization and concurrency control, this allows programmers to easily design parallel and distributed applications.

Manageability

The Transpose-Minify runtime is responsible for parallelization and concurrency control, this allows programmers to easily design parallel and distributed applications. It provides the two level of management

1. To manage the input data- prepare the data to execute.
2. To manage the output data- to get the reduced data

Scalability

When the node increases then the performance of the Transpose-Minify potentially increases.

Fault Tolerance and Reliability

When the node increases then the performance of the Transpose-Minify potentially increases.

The data in the GFS are distributed on clusters with thousands of nodes. Thus any nodes with hardware failures can be handled by simply removing them and installing a new node in their place. Moreover, Transpose-Minify, taking advantage of the replication in GFS, can achieve high reliability by (1) rerunning all the tasks (completed or in progress) when a host node is going off-line, (2) rerunning failed tasks on another node, and (3) launching backup tasks when these tasks are slowing down and causing a bottleneck to the entire job.

V. TRANSPOSE-MINIFY IMPLEMENTATION

The Transpose-Minify framework uses the sculptor- Serf architecture (Fig.1).

Transpose Step

The sculptor node takes the input, divides it into smaller sub-problems, and distributes them to Serf nodes. A Serf node may do this again in turn, leading to a multi-level tree structure. The Serf node processes the smaller problem, and passes the answer back to its sculptor node.

Minify Step

The sculptor node then collects the answers to all the sub-problems and combines them in some way to form the output – the answer to the problem it was originally trying to solve.

The slave which is hosting the task's blocks, and Monitoring the successes and failures of the tasks.

The function of Serf

The Serf also called slave, execute the tasks as directed by the master.

VI. IMPLEMENTATION OF TRANSPOSE-MINIFY

- Prepare the input from the user.
- Then the input is send to the sculptor of the architecture.
- The sculptor segments the input and assigns it to all the Serf nodes.
- The Serf nodes process the inputs and produce the relevant output.
- Then the Serf node sends the out file to the sculptor

For doing the above mentioned steps the pivotal - appraisal pair is generated for Transpose and Minify functions

- For Transpose (P1, A1)→ list (P2, A2)
- For reducing (P2, list (A2))→ list (A3)

The Transpose Minify library in the user program first splits the input files into M pieces of typically 16 to 64 megabytes (MB) per piece. It then starts many copies of the program on a cluster. One is the “sculptor” and the rest are “Serf.” The sculptor is responsible for scheduling (assigns the Transpose and Minify tasks to the worker) and monitoring (monitors the task progress and the Serf health).

When Transpose tasks arise, the sculptor assigns the task to an idle Serf, taking into account the data locality. A Serf reads the content of the corresponding input split and emits a pivotal /appraisal pairs to the user-defined Transpose function. The intermediate key/value pairs produced by the Transpose function are first buffered in memory and then periodically written to a local disk, partitioned into R sets by the partitioning function. The sculptor passes the location of these stored pairs to the Serf which reads the buffered data from the Transpose using remote procedure calls (RPC). It then sorts the intermediate keys so that all occurrences of the same key are grouped together. For each key, the worker passes the corresponding intermediate value for its entire occurrence to the Minify function. Finally, the output is available in R output files (one per Minify task).

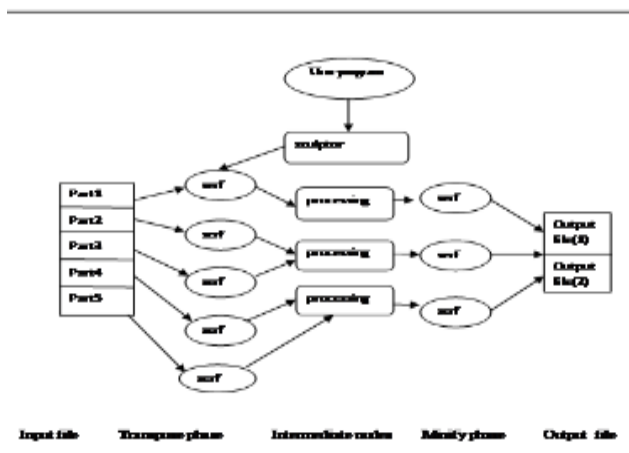


Figure 1: Sculptor- Serf Architecture

VII. TRANSPOSE-MINIFY IMPLEMENTATIONS FOR THE CLOUD

The Transpose-Minify framework can be implemented in various fields using the cloud computing technology.

Hadoop

The Hadoop common [7], formerly Hadoop core, includes file System, RPC, and serialization libraries and provides the basic services for building a cloud computing environment with commodity hardware. The two fundamental subprojects are the Transpose-Minify framework and the Hadoop Distributed File System (HDFS).The

Hadoop Distributed File System is a distributed file system designed to run on clusters of commodity machines. It is highly fault-tolerant and is appropriate for data-intensive applications as it provides high speed access the application data. The Hadoop The sculptor also called master, is responsible for Querying

the Name Node for the block locations, Scheduling the tasks on Transpose-Minify framework is highly reliant on its shared file system (i.e., it comes with plug-ins for HDFS, Cloud Store [15], and Amazon Simple Storage Service S3 [16]).

Disco

Disco is an open-source Transpose-Minify implementation developed by Nokia [21]. The Disco core is written in Erlang, while users of Disco typically write jobs in Python. Disco was started at Nokia Research Centre as a lightweight framework for rapid scripting of distributed data processing tasks. Furthermore, Disco has been successfully used, for instance, in parsing and reformatting data, data clustering, probabilistic modeling, data mining, full-text indexing, and log analysis with hundreds of gigabytes of real-world data. Disco is based on the master-slave architecture. When the Disco master receives jobs from clients, it adds them to the job queue, and runs them in the cluster when CPUs become available. On each node there is a Worker supervisor that is responsible for spawning and monitoring all the running Python worker processes within that node. The Python worker runs the assigned tasks and then sends the addresses of the resulting files to the master through their supervisor.

Mapreduce.NET

Mapreduce.NET [22] is a realization of Transpose-Minify for the .NET platform. It aims to provide support for a wider variety of data-intensive and compute intensive applications (e.g., MRPGA is an extension of Transpose-Minify for GA applications based on Transpose-Minify.NET [23]). Transpose-Minify.NET is designed for the Windows platform, with emphasis on reusing as many existing Windows components as possible. The Transpose-Minify.Net runtime library is assisted by several components services from Aneka [24, 25] and runs on WinDFS. Aneka is a .NET-based platform for enterprise and public cloud computing. It supports the development and deployment of .NET-based cloud applications in public cloud environments, such as Amazon EC2. Besides Aneka, Reduce.NET is using WinDFS, a distributed storage service over the .NET platform. WinDFS manages the stored data by providing an object-based interface with a flat name space. Moreover, MapReduce.NET can also work with the Common Internet File System (CIFS) or NTFS.

Skynet

Skynet [17, 26] is a Ruby implementation of Transpose-Minify, created by Geni. Skynet is "an adaptive, self-upgrading, fault-tolerant, and fully distributed system with no single point of failure" [17]. At the heart of Skynet is plug-in based message queue architecture, with the message queuing allowing workers to watch out for each other. If a worker fails, another worker will notice and pickup that task. Currently, there are two message queue implementations available: one built on Rinda that uses Tuplespace and one built on MySQL. Skynet works by putting "tasks" on a message queue that are picked up by skynet workers. Skynet workers execute the tasks after loading the code at startup; Skynet tells the worker where all the needed code is. The workers put their results back on the message queue.

Grid Gain

Grid Gain is an open cloud platform, developed in Java, for Java. Grid Gain enables users to develop and run applications on private or public clouds. The Transpose-Minify paradigm is at core of what Grid Gain does. It defines the process of splitting an initial task into multiple subtasks, executing these subtasks in parallel and aggregating (reducing) results back to one final result. New features have been added in the Grid Gain Transpose-Minify implementation such as: distributed task session, checkpoints for long running tasks, early and late load balancing, and affinity co-location with data grids.

VIII. CONCLUSION AND FUTURE WORK

In this paper introduces the Transpose-Minify Framework Which is important programming model for next-generation distributed systems, namely cloud computing.

In this paper presented the different impacts of the Transpose-Minify model in the computer science discipline, along with different efforts around the world. It can be observed that while there has been a lot of effort in the development of different implementations of Transpose-Minify, there is still more to be achieved in terms of Transpose-Minify optimizations and implementing this simple model indifferent areas. The future work of this paper is performing the optimizations using the Transpose-Minify Framework.

REFERENCES

- [1] A. Szalay, A. Bunn, J. Gray, I. Foster, I. Raicu. The Importance of Data Locality in Distributed Computing Applications, Proceedings of NSF Workflow, 2006.
- [2] A. S. Szalay, P. Z. Kunszt, A. Thakar, J. Gray, D. Slutz, and R. J. Brunner, Designing and mining multi-terabyte astronomy archives: The Sloan Digital Sky Survey, Proceedings of the SIGMOD International Conference on Management of Data, 2000, pp. 451-462.
- [3] J. Dean and S. Ghemawat, MapReduce: Simplified data processing on large clusters, Communications of the ACM, 51(1):107-113, 2008.
- [4] S. Ghemawat, H. Gobioff, and S. T. Leung, The Google File System, in Proceedings of the 19th ACM Symposium on Operating Systems Principles, LakeGeorge, NY, October, 2003.
- [5] D. A. Patterson, Technical perspective: The data center is the computer, Communications of the ACM, 51(1):105, 2008, pp. 105-105.
- [6] Hadoop: <http://lucene.apache.org/>
- [7] Yahoo!, Yahoo! Developer Network, [http:// developer.yahoo.com/ blogs/hadoop/2008/02/yahoo-worlds-largest-production-hadoop.html](http://developer.yahoo.com/blogs/hadoop/2008/02/yahoo-worlds-largest-production-hadoop.html) (accessed September 2009).
- [8] Hadoop, Applications powered by Hadoop: [http://wiki.apache.org/hadoop/ PoweredB](http://wiki.apache.org/hadoop/PoweredB)
- [9] Presentation by Randal E. Bryant, Presented in conjunction with the 2007 Federated Computing Research Conference, [http://www.cs.cmu.edu/~bryant/ presentations/DISC-FCRC07.ppt](http://www.cs.cmu.edu/~bryant/presentations/DISC-FCRC07.ppt).
- [10] L. Barroso, J. Dean, and U. Holzle, Web search for a planet: The Google cluster architecture, IEEE Micro, 23(2), 2003, pp. 22-28.
- [11] MapReduce in Wikipedia, <http://en.wikipedia.org/wiki/MapReduce> (accessed September 2009).
- [12] Hadoop in Wikipedia, <http://en.wikipedia.org/wiki/Hadoop> (accessed September 2009).
- [13] CNET news, http://news.cnet.com/8301-13505_3-10196871-16.html (accessed September 2009).
- [14] CloudStore (Formerly Kosmos File System), <http://kosmosfs.sourceforge.net/>
- [15] Cloudera Homepage, <http://www.cloudera.com/>
- [16] OpensolarisHadoop Live CD, [http://opensolaris.org /os/project /livehadoop/](http://opensolaris.org/os/project/livehadoop/)
- [17] Amazon Elastic MapReduce, [http://aws.amazon. Com /elasticmapreduce/](http://aws.amazon.Com /elasticmapreduce/)
- [18] Disco Project Homepage, <http://discoproject.org/>
- [19] C. Jin and R. Buyya, MapReduce programming model for.NET-based cloud computing, in Proceedings of the 15th International European Parallel Computing Conference (EuroPar 2009), Delft, The Netherlands, August 25_28,2009, pp. 417-428.
- [20] C. Jin, C. Vecchiola, and R. Buyya, MRPGA: An Extension
- [21] X. Chu, K. Nadiminti, J. Chao, S. Venugopal, and R. Buyya, Aneka: Next- Generation Enterprise Grid Platform for e-Science and e-Business Applications, Proceedings of the 3rd IEEE International Conference and Grid Computing,Bangalore, India, December 10_13, 2007, pp. 151-159.
- [22] Manjrasoft Products, <http://www.manjrasoft.com/products.html> (accessed September)
- [23] Skynet, <http://skynet.rubyforge.org/>
- [24] Rinda Doc page, <http://www.ruby-doc.org/stdlib/lib doc/rinda/rdoc /index.html>
- [25] Tuplespace in Wikipedia, http://en.wikipedia.org/wiki/Tuple_space (accessed September 2009).
- [26] GridGain, <http://www.gridgain.com/>



ISSN
0975-6299

Improve Package Cohesion through Automization of Service Interface by Using Refactoring Approach

Dr.M. Sunil Kumar, Associate Professor & HOD, Dept of CSE, Sree Vidyanikethan Engineering College, Tirupati, India.

E-mail:sunilmalchi1@gmail.com

T.N. Gayathri*, PG Student, Dept of CSE, Sree Vidyanikethan Engineering College, Tirupati, India.

E-mail:gayathri.gayu1211@gmail.com

Abstract---

In the software development technology due to High cohesion software design has an incredible impact on software reuse and maintenance. In the context of service-oriented development, cohesion refers to how well the package of service interface are related together. Software cohesion is improved based on refactoring method that rely on information, extracted from the software implementation. The approach cohesion driven decomposition of service interface progressively decomposes a given service interface into more cohesive interfaces and group the similar data and make simple interaction with client. In the existing work the decompositions performed by the method are not perfectly adjusted and further smaller and more cohesive decompositions can be made. Hence in the work implementing a technique cohesion Automuzation for information retrieval and is widely used to measure the degree of similarity between a set of text based documents and make further decompositions. However it is challenging factor to improve the cohesion for the service interface. Hence the quality and maintenance of software can be improved.

Keywords--- Software Design, Class Cohesion, Service Interface, Automization, Refactoring.

* Corresponding Author

I. INTRODUCTION

Software Engineering is defined as the systematic approach to the development, maintenance, retirement and operation of software. In other words the discipline of software engineering is to find the best quality of software using tools and techniques. A software engineer aims to change existing software using methods to make it better quality and reuse of software. High quality software is easier to use, understand and maintain.

Software Engineering can be subdivided into eight disciplines. They were

1. Requirements Engineering
2. Software Design
3. Software Testing
4. Software Maintenance
5. Software Configuration Management
6. Embedded Software
7. Software Evolution
8. Software Quality Management

Among them Software Design plays a major role in the development of software.

A. *Software Design- An Overview*

Software Design in software engineering is a process to transform customer requirements into some suitable form, which helps the programmer in software development, coding and maintenance. For a Period of time, the developed software may need some modification according to customer requirements. The design process comprises a set of principles, concepts and practices, which allow a software engineer to model the software or product that is to be built. Firstly to begin the design phase the requirements document of a software should be developed. The requirement specification deals with the problem of software. Once the requirements document for the software to be developed is available, then the software design phase begins. While the requirement specification work entirely deals with the problem domain, design is the first phase of transforming the problem of software into a solution. In the design phase, the business requirement, technical considerations and customer all come together to formulate a product or a software system.

Software design is the process of finding and implementing the software solutions to one or more sets of problems. The main component of software design for development is software requirements analysis (SRA). SRA is a part of the software development process that lists specifications used in software engineering. If the software is user centered or semi-automated, software design may require user experience design to determine those specifications of the system. If the software is completely no user to user interface, then software design may be as simple as a flow chart a planned sequence of events. There are also semi-standard methods like Unified Modeling Language and modeling concepts to develop the design and outline of the product. In either case, some documentation of the plan is usually the product of the design. Furthermore, a software design may be platform-independent or platform-specific, depending upon the availability of the technology used for the design. The main difference between design and software analysis is that the output of a software analysis consists of smaller sub problems to solve. In Addition to that, analysis should not be designed differently among different team members or another groups. However the design focuses on capabilities, and thus multiple designs for the same problem will exist. Depending on the software environment, the design changes often, whether design is created from scalable work and implemented with perfect design patterns. Some of such designs include web pages, operation systems, mobile devices and also the cloud computing technology.

Requirements analysis is a long process during which, many delicate functioning skills are involved. Large systems involve analysts with thousands of system requirements. New systems change the relationships and environment between people, hence it is important to identify the customers, take into account their needs and ensure that they understand the specifications of the new systems. Analysts manages several techniques for the requirements to the customer. This may include the development of scenarios or agile methods, the identification of use cases, the use of workplace observation or ethnography, holding interviews, or and creating requirements lists. Where necessary, the analyst will employ a combination of these methods to establish the exact requirements of the stakeholders, so that a system that meets the business needs is produced. Requirements quality can be improved through these and other methods.

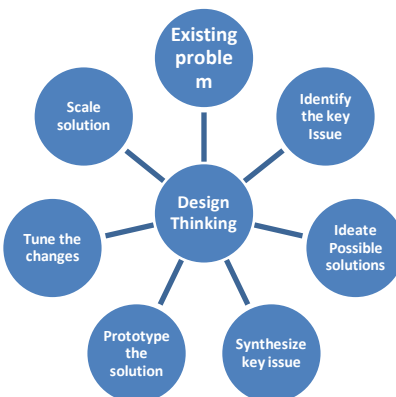


Fig. 1: Software Design Process

B. Software Design Principles

Some of the commonly followed design principles are as following for obtaining a good design software:

- **Software design should be related to the analysis model:** Often a design modules relate to many requirements, so there must be known that how the design model satisfies all the requirements represented by the analysis model.
- **Software design should be integrated and uniform :** Software design should be considered as uniform and integrated, if the interfaces are properly defined among the design components. For this, rules, format, and styles are established before the design team starts designing the software.
- **Flexible software design:** Software design must be flexible to get adapted easily. For a flexible design modularity, abstraction, and refinement should be effectively applied.
- **Minimization of semantic errors in software design:** Major conceptual errors in design should be address such as inconsistency and ambiguousness before dealing with syntactical errors present in design model.
- **Software reuse:** Software engineers believe on the 'do not re-invent the wheel'. Therefore, software components should be designed in such a way that they can be effectively reused to increase the productivity.

C. Software Design Evolution

Software is more than a programming code. A program is an executable code, which serves for some computing purpose. Software is considered to be collection of executable programming code, libraries and documentations. Software, when made for a specific requirement is called software product Engineering on the other hand, it is all about developing products, using scientific principles and methods.

A design characteristic that is special, besides this gradual emergence of goals, is that the largest task is to generate alternate designs. There are lot of theories of decision making, a field that has been heavily cultivated by economists and statisticians. Most theories of decision making for design start with a given set of design alternatives and then ask to choose among from them. In design, usually most of the time and effort is spent in generating the new designs. Of course generating alternative designs and choosing among them aren't difficult from each other. The idea that is choosed to start out with all the alternatives and then choosen among them is fully unrealistic. If you are designing an important bridge, you might consider two or three basic kinds of bridges and choose one, then go to the next level of detail, and so on. Throughout the design process you are always generating two or three alternatives and choosing among them, and then setting the values of specific parameters to fit the application at hand. Many traditional software development assumptions and practices haven't recognized this changing nature and increasingly find themselves in deep trouble as a result. The assumption that your project can be developed to a fixed-price, build to-pre specification contract that treats "requirements creep" as something to be discouraged will increasingly result in an obsolete, brittle system that you can't evolve into something better. Assuming that a single form of evolutionary development covers all situations often leads to unrealistic commitments and dead-end systems as situations change.

II. LITERATURE REVIEW

In this section we discuss our approach with respect to state of art. More specifically in section 2.1 we discuss relation of our approach with Software Refactoring and its previous work i.e to make modifications in existing software without changing its external behavior of software. Then in section 2.2 we focus on Software Cohesion Metrics that has been worked on Service oriented and object-Oriented Platforms.

A. Metrics based Software Refactoring (MSR)

Refactoring is changing process that improve quality of software. It is mandatory to refactor the structure of software to improve its quality and maintenance. To improve the quality of software in software engineering some metric based software engineering approaches are proposed that converts the software engineering problem into a mathematical problem that can be calculated with a metrics-driven approach. Metric Based software engineering can be defined as the application of problem in solving optimization problems in software engineering. This involves defining a search space, or the set of possible solutions for problem. This space is typically too large, to suggest a metrics-driven approach. A metric (also called a fitness function, objective measure, cost function, or quality measure) is then used to measure the quality of potential solutions of software.

A refactoring improves design of a software if the resultant code results to meaningful abstractions that make it easier to extend the program. Software sometimes needs to be restructured before it is reused. A main goal of software refactoring is to increase the value of a software. Refactoring a system will make possible to add additional features to the existing system, or make the software reusable in many other systems. Software refactoring approaches have become increasingly attractive as the cost of programmer time relative to computer time has increased. Software refactoring is often used at maintenance of software, where the lack of software structure often is most expensive and evident. However, it can be applied in the development phases and earlier design also.

Many software engineering problem can be reformulated as a computational search problem by using Metrics based software refactoring(MSR) applies metaheuristic search techniques such as genetic algorithms, simulated annealing for software engineering problems. Many activities in software engineering can be stated as optimization problems. Optimization techniques of operations research such as linear programming or dynamic programming are mostly impractical for large scale software engineering problems because of their computational complexity. Researchers and practitioners use metaheuristic search techniques to good solutions.

From the last two decades, a large number of research works have been proposed in the literature to support automatic approaches to help software engineers maintain and extend existing systems. In fact, several studies addressed the problem of clustering to find the best decomposition of a system in terms of packages and not improving existing modularizations. In this section, we focus on existing refactoring studies based on refactoring techniques.

There are two types of search based Metrics. They are:

1. Structural Search Based Metrics
2. Automatic Search Based Metrics

a. Structural Search based Metrics

The various types of structural based metrics for software based on refactoring of software to find distance between module of class and class members. More specifically, clustering methods can identify conceptually meaningful groups of similar entities.

Clustering Algorithm

Clustering is a process which partition of a given data set into homogeneous groups based on given features such that similar objects are kept in a group whereas dissimilar objects are in different groups. It is the most important unsupervised learning problem. It deals with finding structure in a collection of unlabeled data. Clustering analysis has been an emerging research issue in data mining due its variety of applications. With the advent of many data clustering algorithms in the recent few years and its extensive use in wide variety of applications, including image processing, computational biology, mobile

communication, medicine and economics, has lead to the popularity of this algorithms. Main problem with the data clustering algorithms is that it cannot be standardized.

When large software systems are reverse engineered, one of the views that is produced is the system decomposition hierarchy. This hierarchy shows the system's subsystems, the contents of the subsystems (i.e., modules or other subsystems), and so on. Software clustering tools create the system decomposition automatically or semi-automatically with the aid of the software engineer. The Bunch software clustering tool shows how meta-heuristic search algorithms can be applied to the software clustering problem, successfully. Unfortunately, do not know how close the solutions produced by Bunch are to the optimal solution. Hence can obtain the optimal solution for trivial systems using an exhaustive search.

T.A.Wiggerts et al[10]provides the theoretical background for the application of cluster analysis in system restructuring. He discusses on how to establish similarity criteria between the entities to cluster and provide the summary of possible clustering algorithms to use in system restructuring. Later, Anquetil and Lethbridge use cohesion and coupling of modules within a decomposition to evaluate its quality. They tested some of the algorithms proposed by Wiggerts and compared their strengths and weaknesses when applied to system remodularization. Solving of optimization problems which include module clustering, where a software system is reorganised into loosely coupled clusters of highly cohesive modules to aid reengineering, automated testing and project management problems such as requirements scheduling and project cost estimation.

The clustering algorithms are follows. They are:

1. Hierarchical Agglomerative Clustering
2. Spectral Clustering Algorithm

1. Hierarchical Agglomerative Clustering Algorithm

M.Bowman,et al[6] proposed on the application of hierarchical agglomerative clustering in the context of software architecture recovery and modularization. They investigate the measures to use in this domain, categorizing various similarity and distance measures into families according to their characteristics. Hierarchical agglomerative clustering algorithm there are two aspects that one should pay attention to. A novel method for the selection of a software clustering algorithm for specific needs, as well as a method for software clustering algorithm improvement.

The underlying idea of these approaches is to:

1. Group in module highly cohesive source code components, where the cohesiveness is measured in terms of intra-module links.
2. Reduce the coupling between modules, where the coupling is measured in terms of inter-module dependencies.

Hierarchical algorithm is inherently inefficient, as it uses in the entire data set S for every length scale, completely ignoring the fact that different length scales result in different types of partitioning. In general, larger the each cluster is expected to be. This Algorithm is essentially a hierarchical implementation, beginning by separation in a large scale, and then recursively partitioning each of the resulting clusters. Specifically, it first searches for a good initial partitioning of S , beginning with and going backwards. Hence notice that this algorithm is different from simulated algorithm, hill climbing algorithm by only producing one partitioning of the data. In addition to the many conceptual advantages of hierarchical data clustering such as simplicity of representation or the efficiency of the 'divide and conquer' principle, the computational burden is also eased significantly. In each recursion the data is clustered, so that the size of S that is used to call the algorithm recursively decreases exponentially. This is translated to easier computational task.

2. Spectral Clustering Algorithm

A. D.Doval, S. Mancoridis et al.[2] Spectral clustering algorithm in order to remodularize a system. They also view this process as an optimization problem using the Modularization Quality measure as an objective function. The main difference between the philosophy behind these works and our approach, lies in the fact that they result in a single solution that is close to the optimal one, which the designer should accept or reject in its entirety. On the contrary, the proposed method is essentially a stepwise approach, that extracts a set of refactoring suggestions ranked by an appropriate metric. This offers the advantage of gradual change of a system, allowing the designer to assess the conceptual integrity of the refactoring suggestions at each step.

Spectral clustering is a general framework for partitioning the rows and columns of matrices derived from the data in terms of few of their eigenvectors.

The Software system, search for a “good” partition of the set. Here accomplish this by treating clustering as an optimization problem where the goal is to maximize the value of an objective function. This objective function characterizes the trade-off between coupling (i.e., connections between the components of two distinct clusters) and cohesion (i.e., connections between the components of the same cluster). Specifically, the objective function is designed to identify the set of complex components that constitute individual software capabilities as well as to identify how these components interact with other complex in rest of the system.

Spectral clustering algorithm in order to remodularize a system also view this process as an optimization problem using the modularization quality measure as an objective function. This method suffers from the fact that the thresholds for the metrics are empirically or statistically determined and thus may differ from system to system.

b. Automatic Search based Approaches

There have been several developments in search-based approaches to support the automation of software modularization. There are some meta-heuristic optimization algorithms to numerous approaches that can be applied to solving that problem, from local searches such as exhaustive search.

Some of the search based approaches to refactor software are:

1. Hill Climbing Algorithm
2. Simulated Annealing Algorithm
3. Genetic Algorithm

1. Hill Climbing Algorithm

M. O’Keeffe et al.[4] were the first search based approach to address the problem of software modularization using a single objective approach. Their idea of identifying the modularization of a software system is based on the use of the hill-climbing search heuristic to maximize cohesion and minimize coupling. A tool supporting automatic system decomposition. Subsystem decomposition is performed by Bunch by partitioning a graph of entities and relations in a given source code. To evaluate the quality of the graph partition, a fitness function is used to find the trade-off between interconnectivity (i.e., dependencies between the modules of two distinct subsystems) and intra-connectivity(i.e., dependencies between the modules of the same subsystem), to found out a satisfactory solution.

M. Harman et al. [5] for software engineering task that is framed as a search problem, there where numerous approaches that can be applied to solving that problem, from local searches such as exhaustive search and hill-climbing gives best quality optimization results. Hill climbing is a mathematical optimization technique which belongs to the family of local search. It is an iterative algorithm that starts with an arbitrary solution to a problem, then attempts to find a better solution by incrementally changing a single element of the solution. If the change produces a better solution, an incremental change is made to the new solution, repeating until no further improvements can be found. Hill-climbing search algorithms suffer from the wellknown problem of “getting stuck” at local optimum points, and therefore possibly missing the global optimum (best solution). To address this concern we have investigated other search algorithms such as Genetic Algorithms Goldberg, and applied these algorithms to the software clustering problem.

Bunch proposed hill-climbing algorithm are typically better than the Bunch Genetic Algorithm. Upon studying this outcome, we concluded that further work on our encoding and crossover techniques are necessary. The hill-climbing algorithm starts with a generated random partition of the set. It then iterates using our neighboring partition strategy to find an “improved” partition using the set objective function.

During each iteration several options are available for controlling the behavior of the hill-climbing algorithm: 1.The neighboring process uses the first partition that it discovers with a larger set as the basis for the next iteration. 2.The neighboring process examines all neighboring partitions and selects the partition with the largest set as the basis for the next iteration.

2. *Simulated Annealing Algorithm*

M. O'Keefe et al.[4] proposed a heuristic search-based approach for automatically optimizing (i.e., reducing) the dependencies between packages of a software system using simulated annealing. Their optimization technique, is based on moving classes between the original packages for set of coupling and cohesion metrics that assess packages organization in large legacy object-oriented software. Many large object-oriented software systems consisting of several thousands of classes that are organized into several hundreds of packages. In such software systems, classes cannot be considered as units for software modularization. In such context, packages are not simply classes containers, but they also play the role of modules: a package should focus to provide well identified services to the rest of the software system. Therefore, understanding and assessing package organization is primordial for software maintenance tasks. Although there exist a lot of works proposing metrics for the quality of a single class and/or the quality of inter-class relationships, there exist few works dealing with some aspects for the quality of package organization and relationship. We believe that additional investigations are required for assessing package modularity aspects. In this topic, tackled the problem of assessing modularizations for not API-based object-oriented software systems. We defined a complementary set of coupling and cohesion metrics that assess packages organization in large legacy object-oriented software. While designing our metrics, addressed some modularity principles related to packages encapsulation, changeability and reusability. In addition, it defined metrics characterizing packages role within a given modularization. It defined the metrics with regard to two different types of object-oriented inter-class dependencies: method call and inheritance relationships. It also provided metrics with exhaustive interpretations for both types of dependencies.

Hill-climbing algorithm is that certain initial starting points may converge to poor solutions (i.e., local optima). To address this problem, our hillclimbing algorithm does not rely on a single random starting point, but instead uses a collection of random starting points. Another way to overcome the above described problem is to use Simulated Annealing (SA) algorithms are based on modeling the cooling processes of metals, and the way liquids freeze and crystalize. When applied to optimization problems, SA enables the search algorithm to accept, with some probability, a worse variation as the new solution of the current iteration. As the computation proceeds, the probability diminishes. The slower the cooling schedule, or rate of decrease, the more likely the algorithm is to find an optimal or near-optimal solution. Simulated Annealing techniques typically represent the cooling schedule with a cooling function that reduces the probability of accepting a worse variation as the optimization algorithm runs. We defined a cooling function that establishes the probability of accepting a worse, instead of a better partition during each iteration of the hill-climbing algorithm. The idea is that by accepting a worse neighbor, occasionally the algorithm will "jump" to explore a new area in the search space. Our cooling function is designed to respect the properties of the Simulated Annealing algorithm cooling schedule, namely: (a) decrease the probability of accepting a worse move over time, and (b) increase the probability of accepting a worse move if the rate of improvement is small.

3. *Genetic Algorithm*

D. Doval, S. Mancoridis[2] use a genetic algorithm to improve the subsystem decomposition of a software system. The fitness function to maximize is defined using a combination of quality metrics, for instance, coupling, cohesion, and complexity. Similarly, M. O'Keefe et al. [6] treated the remodularization task as a single-objective optimization problem using genetic algorithm. The goal is to develop a methodology for object-oriented systems that, starting from an existing subsystem decomposition, determines a decomposition with better metric values and fewer violations of design principles. Taking inspiration from previous work by Ouni and Abdeen have extended their initial work to consider the remodularization task as a multi-objective optimization problem to improve existing packages structure while minimizing the modification amount on the original design. Using NSGA, this optimization approach aims at increasing the cohesion and reducing the coupling and cyclic connectivity of packages, by modifying as less as possible the existing packages organization.

M. Bowman et al.[6] proposed recently formulated the software clustering problem as a multi-objective optimization problem. Their work aim at maximizing the modularization quality measurement, minimizing the inter-package dependencies, increasing intra-package dependencies, maximizing the number of clusters having similar sizes and minimizing the number of isolated clusters. Most of the refactoring approaches in the literature are based on information derived only from structural metrics to modularize/restructure the original package organization. However, this is not enough to produce a semantically coherent design. The

first attempt that addresses this problem was by Bavota proposed an automated, single-objective, approach to split an existing package into smaller but more cohesive ones. The proposed approach analyzes the structural and semantic relationships between classes in a package identifying chains of strongly related classes. The identified chains are used to define new packages with higher cohesion than the original package. The proposed approach has been empirically evaluated through a case study. The context of the study is represented by an open source system, and two software systems developed by teams of students at the University of Salerno. The analysis of the results reveals that the proposed approach generates meaningful re-modularization of the studied systems, which can lead to higher quality. This work has been extended to propose an interactive multi-objective modularization approach.

The specific contributions can be summarized as follows:

1. An analysis of the impact of the algorithm's configuration parameters on the performances of the proposed approach. The analysis allowed us to derive an heuristic based on Principal Component Analysis (PCA) to identify of default values for the configuration parameters. The proposed heuristic improves the usability of the proposed approach by facilitating its application in real usage scenarios.
2. An analysis of the orthogonality of the measures used to capture relationships between classes. We also empirically analyze the role of the semantic measures in the context of software re-modularization.
3. The replication of the preliminary evaluation. In addition to the three systems used in Bavota the evaluation has been extended to include two other software systems. In the context of the study we merged several packages of the object systems and used the proposed approach to split the merged package aiming at reconstructing the original packages. Our assumption is that the higher the reconstruction accuracy of our approach, the higher the meaningfulness of the proposed re-modularization. This assumption is supported in part by our choice of systems, which have high quality. The evaluation revealed that the technique produces meaningful decompositions from structural and functional point of view. Due to the heterogeneous nature of software systems, it is always hard to propose analysis techniques that perform equally on any system. Thus, replicating the study on other systems is the only way to corroborate the results achieved and mitigate the external threat to validity related to the generalization of the findings.

B. Cohesion Metrics

Cohesion is a measure that defines the degree of intra-dependability within elements of a module. The greater the cohesion, the better is the program design. Coupling is a measure that defines the level of inter-dependability among modules of a program. It tells at what level the modules interfere and interact with each other. The lower the coupling, the better the program. Refactoring are widely recognized as ways to improve the internal structure of object-oriented software while maintaining its external behavior. Refactoring concentrate on the treatment of symptoms (the so called code-smells), thus improvements depend a lot on the skills of the maintainer. Coupling and cohesion on the other hand are quality attributes which are generally recognized as being among the most likely quantifiable indicators for software maintainability.

L.Briand et.al[7] The concept of cohesion has been used with reference to modules or modular systems. It assesses the tightness with which "related" program features are "grouped together" in systems or modules. It is assumed that the better the programmer is able to encapsulate related program features together, the more reliable and maintainable the system. This assumption seems to be supported by experimental results. Intuitively, we expect cohesion to be nonnegative and, more importantly, to be normalized so that the measure is independent of the size of the modular system or module. Moreover, if there are no internal relationships in a module or in all the modules in a system, we expect cohesion to be null for that module or for the system, since, as far as we know, there is no relationship between the elements and there is no evidence they should be encapsulated together. Additional internal relationships in modules cannot decrease cohesion since they are supposed to be additional evidence to encapsulate system elements together. When two modules showing no relationships between them are merged, cohesion cannot increase because seemingly unrelated elements are encapsulated together.

Lack of Cohesion Metrics (LOCM)

Chidamber and Kemerer [9] proposed the well-known LCOM metric (Lack of Cohesion of Methods) for measuring the cohesion of object-oriented software. Cohesion was recognized as an important principle of

service design in several approaches that concern the overall service-oriented development methodology. Pereplechikov investigated the issue of cohesion in the case of real-world services. Cohesion is the degree to which the elements of a class or object belong together. Many different object-oriented cohesion metrics have been developed; many of them are based on the notion of degree of similarity of methods.

Classes are the basic units in object-oriented programs, and therefore, their quality has impact on the overall quality of the software. Class cohesion is a key quality factor, and it refers to the degree of relatedness of class attributes and methods. Software developers use class cohesion measure to assess the quality of their products and to guide the restructuring of poorly designed classes. Several class cohesion metrics are proposed in the literature, and the impact of considering the special methods (i.e., constructors, destructors, and access methods) in cohesion calculation is not empirically studied, this issue for one of the most popular class cohesion metrics, referenced as Lack of Cohesion (LCOM).

Jehad Al Dallal[3] et al. defined cohesion, in the procedural programming paradigm, as a measure of the extent of the functional relationships between the elements of a module. Many metrics have been proposed in the last several years in order to measure class cohesion in OOS. The argument over the most meaningful of those metrics continues to be debated. Major of proposed cohesion metrics are based on the notion of similarity of methods, and usually capture cohesion in terms of connections between members of a class. They present, however, some differences in the definition of the relationships between members of a class. A class is more cohesive, as stated in , when a larger number of its instance variables are referenced by a method LCOM* a larger number of methods pairs share instance variables (LCOM1, LCOM2, LCOM3 , LCOM4 , Co , TCC and LCC, DCD and DCI).

Cohesion for Object-Oriented Paradigm

M.Bowman et al.[6] explained object-oriented paradigm, the majority of cohesion metrics measure at degree to which the methods of package are related based on implementation level. While there are many object oriented design (OOD) methodologies, one that reflects the essential features of OOD is presented by Booch. He outlines four major steps involved in the object-oriented design process.

- **Identification of Classes (and Objects):** In this step, key abstractions in the problem space are identified and labeled as potential classes and objects.
- **Identification of the Semantics of Classes (and Objects):** In this step, the meaning of the classes and objects identified in the previous step is established, this includes definition of the life-cycles of each object from creation to destruction.
- **Implementation of Classes (and Objects):** In this step, detailed internal views are constructed, including definitions of methods and their various behaviors.

III. METHODOLOGY

In this section we focus on the cohesion Metrics that we work for the decomposition of service Interfaces. In section 3.1 we introduce a generic Cohesion metric Lack of Cohesion(LOC), that measures the level of cohesion of service interfaces, by checking similarity function among the classes. In section 3.2 we define three different methods to measure the cohesion metric that depend on corresponding similarity functions based on its operations.

A. Background & Problem Statement

Cohesion refers to the degree to which the elements of a module belong together. Thus, cohesion measures the strength of relationship between pieces of functionality within a given module. In highly cohesive systems functionality is strongly related. Cohesion is often contrasted with coupling, a different concept. High cohesion often correlates with loose coupling.

In web service world often handling all the operations in single package has become very complex situation and because if any of the operation has changed in the service interface the whole applications has to get updated. So to get rid of this we divide the message queue interface into set of decompositions i.e corresponding set of surrogate classes and group the similar type of data into corresponding packages. One such data is Amazon SQS as shown in the following figure. The overall approach to measure cohesion is based on generic view of service interface which is shown below.

- a. Service Interface
- b. Service Interface Level graph

- c. Ideal Service Interface graph
- d. Lack of service Interface Cohesion

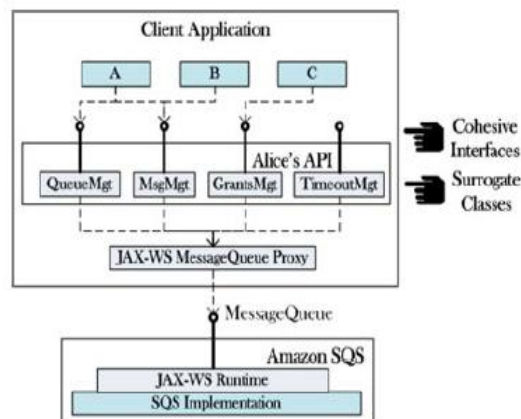


Fig. 2: Application Rely on Cohesive Decompositions for MessageQueue Interface

Definition 1: Service Interface

A service Interface is considered as input and consists of interface name(si) and its operations(O). The Operation consists of Input value and an output value. A Value is a set of parameters with name and its type which may XML complex type operators.

To measure cohesion, Service Interface Graph concept is introduced which represents the relationship between the service interface and its Operations. Two operations are similar if and only if its properties (name, Parameter) are similar up to some extent. The similarity of operations is represented as OP_s^* .

Table 1: Specifications of Interface

Si	$= (name : String, O)$
O	$= (op : operation)$
Operation	$= (name : string, in : value, out : value)$
Message	$= (p : Parameter)$
Parameter	$= (name : string, type :type)$

Definition 2: Service Interface Level Graph

An Service Interface level graph, with vertices and edges as input to the operation for a given service interface. (a) The vertices V_{si} of graph represents operations of si . (b) edges E_{si} of graph represents relation between pair of operations. (c) an edge, $(OP_i, OP_j) \in E_{si}$, iff $OP_s^*(OP_i, OP_j) > 0$ as shown in table 1.

Table 2: Specifications Interface Level Graph

$$G_{si}^* = (V_{si}, E_{si}, OP_s^*)$$

$$OP_s^* = si.O * si.O \rightarrow [0, 1]$$

Ideally, A Interface si graph would be fully cohesive because if every operation of si is related with every other operations and similarity between every pair of operations is maximum. So to this we need an ideal service interface level graph.

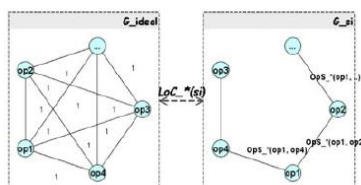


Fig. 3: Lack of Cohesion (LOC) Graph

Definition 3 : Ideal Service Interface Graph E

The ideal service interface level graph $G^{*ideal} = (V_{si}, E_{ideal}, OPs^*)$ for a service interface has two properties. (a) G^{*ideal} is complete. (b) for all, $(OP_i, OP_j) \in E_{ideal}$, $OPs^*(OP_i, OP_j) = 1$.

Here the Lack of cohesion of a service interface si , measures the amount of transformation of actual service interface graph G^{*si} of si must withstand to become identical for ideal service interface graph G^{*ideal} as shown table 3.

Definition 4: Lack of Service Interface Cohesion

The lack of service interface si , $LOC^*(si, OPs^*)$, is defined as the relative difference between the ideal service interface graph G^{*ideal} , and service interface level graph G^{*si} as follows.

B. Similarity Check Cohesion Metrics

The Proposed cohesion metrics refine the general definition on lack of cohesion metrics (LOC^*) that discussed in section 3.1. In general we provide the similarity checking metrics for the service interface graph, for the different similarity function operations.

1. Message level similarity
2. Sequential level similarity
3. Domain level similarity

a. Message Level Similarity

The Message-level cohesion for two operations assumes that two operations are related if their input messages (simultaneously, output) messages are similar. To measure similarity between two messages we employ the notion of message-level graph defined below.

Table 3: Lack of Cohesion of Similarity

$$LOC^*(si, OPs^*) = \frac{|E_{ideal}| - \sum_{(op_i, op_j) \in E_{si}} E_{si}^{(OPs^*(OP_i, OP_j))}}{|E_{ideal}|}$$

Where, $|E_{ideal}| = \frac{|V_{si}| * (|V_{si}| - 1)}{2}$

Message-Level Graph

A Message level graph, $G_m = (V_m, E_m)$, for a message, m , is a graph representation of structure m . The nodes of V_m are participates in there ways such as single node, one parameter per message and elements of a structure. E_m denotes all the edges of the graph with relationship.

Message similarity:

The similarity between the two messages (m_i, m_j) is measured with respect to the message graph (G_{m_i}, G_{m_j}) . Then the similarity between the $Msg^s(m_i, m_j)$ between m_i and m_j is the number of nodes of graph G .

$$Msg^s(m_i, m_j) = \frac{|V_{m_i} \cap V_{m_j}|}{|V_{m_i} \cup V_{m_j}|}$$

Solving the problem of two message level graphs is simple, we match each sub graph of the nodes of G_{m_i} with respect to the G_{m_j} as the nodes are uniquely isomorphism is directly reduced by nodes.

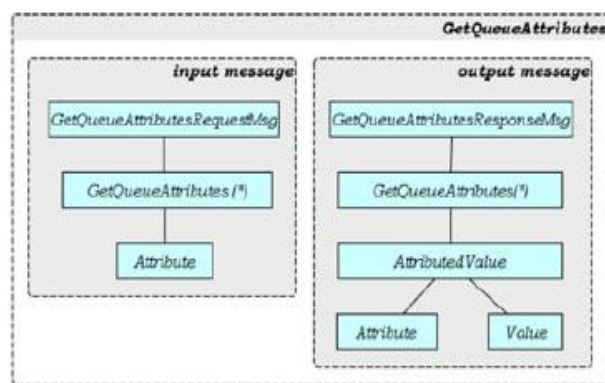
Message Level Operation Similarity

The Message level similarity OPs_{msg} , between two operations $(op_i, op_j) \in si.O$ of a service interface si .

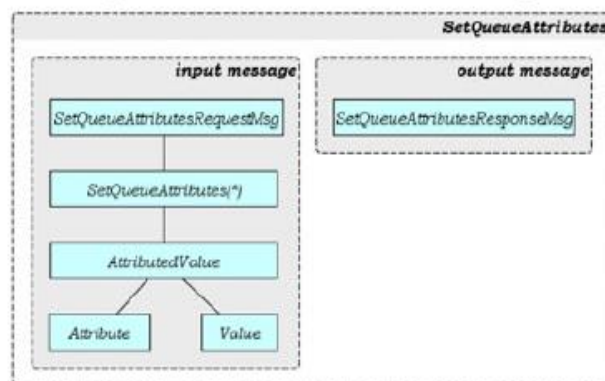
1. The similarity between the input message of OP_i and OP_j

2. The similarity between the output messages of OP_i and OP_j .

Considering an example of Amazon SQS, figure 4 shows the message level graph for the input message of getqueue attributes operation. The GetQueueAttributesRequestMsg node represents the message. The GetQueueAttributes node is a parameter that comprises a sequence of attributes. The Attribute node represents a primitive XML string element. Fig. 3a, further gives the message-level graph for the output message of the GetQueueAttributes operation. The GetQueueAttributesResponseMsg node represents the message.



(a) Messages of the GetQueueAttributes operation.



(b) Messages of the SetQueueAttributes operation.

Fig. 4: Example of Message Level Graph with Message Queue

The GetQueueAttributes node represents a parameter that comprises a sequence of attribute value pairs. The AttributedValue node represents a complex XML element, which consists of two primitive XML string elements, represented by the Attribute and the Value nodes. Similarly, Fig. 3b gives the message-level graphs for the input and the output messages of the SetQueueAttributes operation. The maximum common subgraph for the message-level graphs of the two input messages comprises only the Attribute node. The union of the two graphs consists of seven nodes. Hence, the similarity between the two input messages is $1/7$. On the other hand, the message-level graphs of the two output messages have nothing in common.

Thus, the similarity between the two output messages is 0. Overall, the message-level similarity between the two operations is $(1/7 + 0)/2$. Based on the message-level similarity between operations, we refine the LoC_{msg} metric.

Lack of Message Level Cohesion

For a service interface, si , the lack of message-level cohesion, $LoC_{msg\ si}$, is an alias for LoC_{si} ; $OpSmsg_{si}$. Specifically, $LoC_{msg\ si}$ measures the relative difference between the interface-level graph, $G_{msg\ si} \setminus \frac{1}{4} (V_{si}; E_{si})$; $OpSmsg_{si}$, defined based on the message-level similarity function, OP_{msg} , and the ideal interface-level graph, G_{msg}^{ideal} .

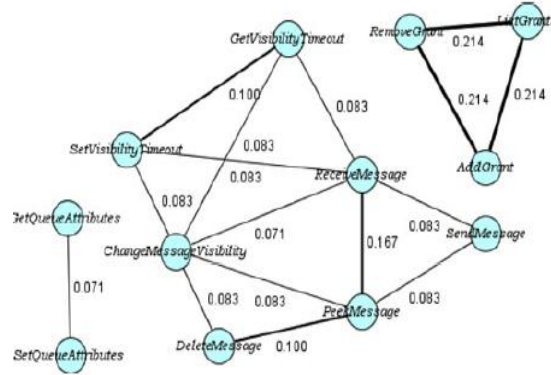


Fig. 5: Gmsg for Message Queue

Fig. 5 gives the interface-level graph for the MessageQueue interface that is derived with respect to OpSmsg. For presentation purposes the edges width is proportional to the similarity between the operations. We see that the graph is not complete. Moreover, the message-level relations between the operations are weak; the similarities between the operations range from 0.07 to 0.21. Overall, the lack of message-level cohesion is LoC msg MessageQueue=0.98.

b. Sequential Level Similarity

The notion of sequential-level cohesion assumes that an operation is related with another if the former's input (respectively output) message is similar with the latter's output (respectively input) message. More formally, we define the conversation-level similarity between two operations as follows.

Sequential-Level Operation Similarity

The sequential-level similarity between two operations, opi ; opj 2 $si:0$, of a service interface, si , is the average of

- The similarity between the input message of opi and the output message of opj and
- The similarity between the output message of opi and the input message of opj .

Returning to our example, the input message of GetQueueAttributes (Fig. 3a) and the output message of SetQueueAttributes (Fig. 3b), have nothing in common.

Similarity Functions

$$MsgS(m_i, m_j) = \frac{|V_{m_i \cap m_j}|}{|V_{m_i \cup m_j}|} \quad (1)$$

$$OpS_{msg}(op_i, op_j) = \frac{MsgS(op_i.in, op_j.in)}{2} + \frac{MsgS(op_i.out, op_j.out)}{2} \quad (2)$$

$$OpS_{conv}(op_i, op_j) = \frac{MsgS(op_i.in, op_j.out)}{2} + \frac{MsgS(op_i.out, op_j.in)}{2} \quad (3)$$

$$OpS_{dom}(op_i, op_j) = \frac{|T_{op_i} \cap T_{op_j}|}{|T_{op_i} \cup T_{op_j}|} \quad (4)$$

Lack of Sequential-Level Cohesion

For a service interface, si , the lack of sequential-level cohesion, Loc_{seq} , is an alias for LoC_{si} ; OpS_{seq} . In particular, Loc_{seq} measures the relative difference between the interface-level graph, $G_{conv\ si} \frac{1}{4} V_{si}; E_{si}$; OpS_{seq} , defined with respect to the conversation-level similarity function, OpS_{seq} , and the ideal interface-level graph, $G_{seq\ ideal}$. Regarding our example, the interface-level graph that shows the sequential-level relations for the Message- Queue interface is given in Fig. As in the case of message level cohesion, the graph is not ideal. The overall lack of conversation- level cohesion is $LoC_{seq\ MessageQueue}=0.98$.

c. Domain Level Similarity

The basic behind the notion of domain-level cohesion is that the names of the operations that are provided by a service reflect what these operations do. More specifically, the names of the operations comprise terms that correspond to certain actions (e.g., set, get) and terms that correspond to concepts of the domain that is targeted by the service (e.g., queue, attribute, message). Based on this intuition, two operations are considered as being related if their names share domain-level terms. In our approach, we assume that the names of the operations follow standard naming conventions of widely adopted coding styles; we extract the domain-level terms from the names of the operations based on this assumption. Following standard naming conventions is quite typical in On the other hand, the Yahoo services follow the Java coding style.⁸ Then, we measure the domain-level similarity between two operations with the following similarity function.

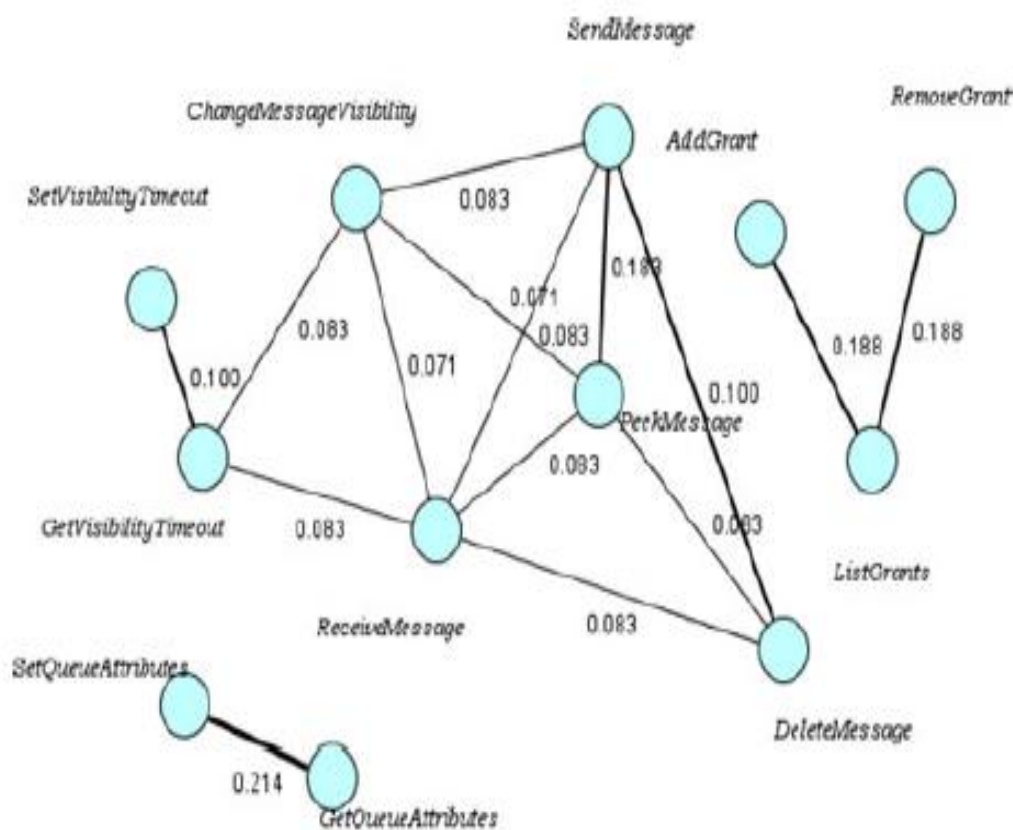


Fig. 6: G_{seq} for Message Queue

Getting back to our example, the name of `GetQueueAttributes` consists of the action term `Get`, which is related with two domain-level terms, `Queue` and `Attributes`. The name of `SetQueueAttributes` comprises the action term `Set`, which is also related with `Queue` and `Attributes`. Therefore, the domain-level similarity between the two operations is 2. The refinement of the LoC_{seq} metric, with respect to the domain-level similarity between two operations, is given below. introduce the following refinement of the LoC metric.

Practice in the case of major service providers. For instance, the Amazon services follow the PascalCase coding style⁷ (the names of operations are sequences of terms with the first letter of each term being capitalized).

(AttributedValue, Attribute and Value). Hence, the conversation-level similarity between the two operations is $(3/7+0)/2$.

Domain-level Operation Similarity

Given the sequential-level similarity between operations, we

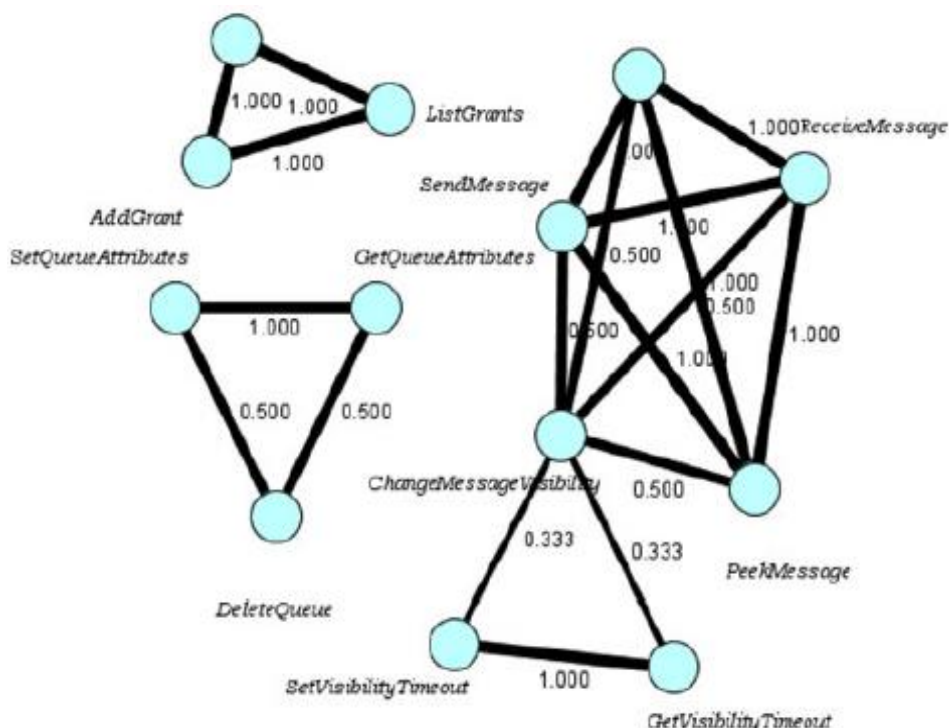


Fig. 7: G^{dom} for Message Queue

Lack of Domain-Level Cohesion

The lack of domain-level cohesion, $LoC_{\text{dom}} si$, for a service interface, si , is an alias for LoC_{si} ; $OpS_{\text{dom}P}$. $LoC_{\text{dom}} si$ measures the relative difference between the interface-level graph, $G_{\text{dom}} si \frac{1}{4} V_{si}; E_{si}; OpS_{\text{dom}}$, defined with respect to the domain-level similarity function, OpS_{dom} , and the ideal interface-level graph, $G_{\text{dom}} \text{ideal}$.

Concerning our example, in Fig. , we have the interface level graph that shows the domain-level relations for the MessageQueue interface. However, the domain-level relations are generally strong; the similarities between operations range from 0.3 to 1. Overall, the lack of domain-level cohesion is $LoC_{\text{dom}} \text{MessageQueue} = 0.81$.

IV. EXPERIMENTAL STUDY

In this section, we discuss the method that describe about methods defined in the section3 for the Cohesion-Driven Automization of service interfaces.

From the perspective, the automization of a service interface si , into more cohesive interfaces. The Complexity of finding the optimal solution to this problem is exponential, powerset, $2^{si.0}$. So to deal with this approach we employ a greedy approach, which progressively splits si into more cohesive interfaces(Algorithm 1). We assume as input as single service interface, the method is applied to service that provides multiple interfaces. In such case, the service interface can be merged into a single interface. Then this interface can be given as input to the cohesion-driven Automization method. As the Automization

proceeds for s_i , it splits into more cohesive interfaces. To this end we maintain a queue Q which contains participants for the automatization. Initially Q contains only service interface s_i (Algorithm 1, line 1). During each step the method dequeues from Q an intermediate interface r_a , and checks whether it is possible to improve cohesion of r_a . By removing a set of operations, split interface to refer as r_b , while r_b denotes the interface the rest of operations of r_a . The split interface takes place into two phases. The first phase is *Createsplit*, checks if it is possible to improve the cohesion of r_a . If the phase fails to find such an operation r_a is inserted into resultant set R_{s_i+n} (Algorithm 1, lines 9-23). Otherwise the resultant set splinter interface r_b , that contain operation is returned as *Createsplit* along with interface r_c . If the service interface is automatized the values are stored in R_{s_i+n} , if the values are still to be decomposed then again it is to be stored in R_c . Then if the further decompositions are to be performed *ExtendSplit* is performed further improves the cohesion of r_c (Algorithm 1, line 25-34).

Algorithm 1: AutomizeInterface()

Input: R_{s_i} /* An interface as input to Automize into more cohesive interfaces */

Output: R_{s_i+n} /* An produced interfaces,

n = number of additional interface produced*/

1. Var Q : Queue
2. $R_{s_i+n} = 0$; $Q.enqueue(R_{s_i})$
3. Repeat
4. Var r_a : Intermediate interface picked form queue Q ;
5. Var r_b : Split interface removed from operations removed from r_a ;
6. Var r_c : Interface having remaining operations of r_i ;
7. If $r_a \leftarrow Q.dequeue()$;
8. $r_b = \text{null}$, $r_c = \text{null}$;

Create split

9. $(r_b, r_c) \leftarrow \text{create split}(r_a)$ //phase 1//
10. Var OP_s = operation whose removal maximizes cohesion;
11. Var $\Delta_{\max}$ = max cohesion improvement that can be achieved by removing an operation r_a .
12. Var V_{temp} = Temporary interface used to simulate removal of operation from r_a ;
13. $R_s = \text{null}$; $r_r = \text{null}$;
14. $\Delta_{\max} = 0$; $OP_s = \text{null}$;
15. $R_{\text{temp}} = \text{null}$;
16. For all $OP_i \in r_a.O$ do
17. $R_{\text{temp}} \leftarrow \text{new.Si}$;
18. $R_{\text{temp}}.O \leftarrow r_a.O - \{OP_i\}$
19. If $LOC^*(r_a) - LOC^*(r_{\text{temp}}) > \Delta_{\max}$ then
20. $OP_s \leftarrow OP_i$
21. End if
22. Return (r_b, r_c)
23. If $R_{s_i+n} \leftarrow R_{s_i+n} \cup \{r_a\}$ // $LOC^*(r_a)$ cannot be further improved//
24. Else

Extend split

25. $(r_b, r_c) \leftarrow \text{extend split}(r_a, r_b, r_c)$ //Phase 2//
26. $r_{c \text{ temp}} \leftarrow \text{new.Si}$;
27. $r_{c \text{ temp}}.O \leftarrow r_c.O - \{OP_i\}$
28. $\Delta_r \leftarrow LOC^*(r_c) - LOC^*(r_{c \text{ temp}})$
29. $\Delta_r \leftarrow LOC^*(r_b) - LOC^*(r_{b \text{ temp}})$
30. End
31. $Q.enqueue(r_b)$, $Q.enqueue(r_c)$;
32. End if
33. Until $Q.size() = 0$;
34. Return R_{s_i+n} //output of service interface//

Decompositions of MessageQueue that result based on LoCmsg, LoCconv and LoCdom, respectively. In particular, the message-level decomposition of MessageQueue consists of six interfaces. The average lack of message-level cohesion of the interfaces is 0.92. Hence, an improvement has been made compared to the initial interface, but the improvement is small. This result is anticipated because the message-level relations between the operations of MessageQueue are not strong. The sequential-level decomposition consists of seven interfaces. The average lack of conversation-level cohesion in this case is 0.88. Again, the improvement compared to the initial interface is small, because the sequential-level relations between the operations of MessageQueue are not strong. The improvement in this case is high, since the domain-level relations between the operations of MessageQueue are quite strong.

V. VALIDATION

Effectiveness

To assess the effectiveness of the approach from the quantitative perspective we focus on the following :

- Improvement of cohesion
- Size of automization

Threats to Validity

A possible threat to the internal validity of the results that we obtained from the developers' involved in the validation is the developers' fatigue or boredom. To reduce this threat we arranged our study according to the developers' availability, instead of imposing a strict schedule. To avoid effects caused by interactions between the developers, we made clear that the required tasks should not be performed in a collaborative manner. Finally, to avoid learning effects, the different decompositions of each interface were provided to the developers in a random order. Regarding external validity, our validation is among the very few ones that involve real services. Specifically, we used a representative set of services, provided by two major service providers; the services offer diverse functionalities and their interfaces vary in size and complexity. Moreover, we employed a representative set of developers that have knowledge of the service-oriented computing paradigm, related technologies and standards. On the other hand, a possible limitation is that the validation was not based on a large number of developers.

VI. CONCLUSION AND FUTURE WORK

This study aims at finding the refactoring solution that improve the structure of packages by optimizing some metrics such as number of service interface per package, decrease coupling and increase cohesion, improve the cohesion of the restructured program, maximize the consistency with development change history to automatically refactor the software by using similarity based approaches and Modified Cohesion-Driven Automization with Lack of cohesion metrics(LOCM).

As part of the future work again further automization can be made for service interfaces. Furthermore, we will investigate the impact of different parameter settings on the quality of results.

REFERENCES

- [1] Dionysis Athanasopoulos, Apostolos V. Zarra "Cohesindriven decomposition of service interface Without acceses to source code," IEEE Transactions Computing, pp.550-562 , Aug 2015.
- [2] D. Doval, S. Mancoridis, and B.S. Mitchell, "Automatic Clustering of Software Systems Using a Genetic Algorithm," Proc. Ninth IEEE Software Technology and Eng. Practice (STEP), pp. 73-81, 1999.
- [3] J.A. Dallal and L. Briand, "A Precise Method-Method Interaction- Based Cohesion Metric for Object-Oriented Classes," ACM Trans. Software Eng. and Methodology, vol. 21, no. 2, article 8, 2012.
- [4] M. O'Keeffe and M.Cinneide, "Search-Based Refactoring for Software Maintenance," J. Systems and Software, vol. 81, no. 4, pp. 502- 516, 2008.
- [5] M. Harman and L. Tratt, "Pareto Optimal Search Based Refactoring at the Design Level," Proc. Genetic and Evolutionary Computation Conf. (GECCO) pp. 1106-1113, 2007
- [6] M. Bowman, L.C. Briand, and Y. Labiche, "Solving the Class Responsibility Assignment Problem in Object-Oriented Analysis with Multi-Objective Genetic Algorithms," IEEE Trans. Software Eng., vol. 36, no. 6, pp. 817-837, Nov./Dec. 2010.

- [7] M. Pereplechikov, C. Ryan, and Z. Tari, "The Impact of Service Cohesion on the Analyzability of Service-Oriented Software," IEEE Trans. Services Computing, vol. 3, no. 2, pp. 89-103, Apr./June 2010.
- [8] L.C. Briand, J.W. Daly, and J. Weust, "A Unified Framework for Cohesion Measurement in Object-Oriented Systems," Empirical Software Eng., vol. 3, no. 1, pp. 65-117, 1998.
- [9] S.R. Chidamber and C.F. Kemerer, "A Metrics Suite for Object Oriented Design," IEEE Trans. Software Eng., vol. 20, no. 6, pp. 476-493, June 1994.
- [10] T. A. Wiggerts. "Using clustering algorithms in legacy systems remodularization". Proceedings of the 4th Working Conference on Reverse Engineering. IEEE, 33-43.1997



ISSN
0975-6299

Evaluating the Unification and Refactoring Activities of Software Clones

Dr.M. Sunil Kumar, Associate Professor & HOD, Dept of CSE, Sree Vidyanikethan Engineering College, Tirupati, India.
E-mail:sunilmalchi1@gmail.com

K. Kavya*, PG Student, Dept of CSE, Sree Vidyanikethan Engineering College, Tirupati, India.
E-mail:kavyakarnati12@gmail.com

Abstract---

Code duplication has been recognized as a serious problem having a negative impact on the software systems. In the past, several techniques have been developed for the detection and management of software clones. Existing code duplication can be eliminated by extracting the common functionality into a single module. However, the unification and refactoring of software clones is a challenging problem. Here an approach is proposed for automatically detect the clones and assessing whether a pair of clones can be safely refactored without changing the behaviour of the program. This approach examines if the differences present between the clones can be safely parameterized without causing any side-effects and eliminated the code duplication within the module.

Keywords--- Software Clones, Refactoring, Clone Detection.

* Corresponding Author

I. INTRODUCTION

Software engineering is the application of engineering to software. The life cycle paradigm for software includes: requirements, design, construction, testing, and maintenance. The integral part of a software life cycle is software maintenance. However, in most organizations development has had a much higher degree than maintenance. Further, many issues are identified of maintaining code developed in software systems by others. Maintenance is also expensive. For these reasons, there is an opportunity to increase the productivity of maintenance activities. Here presents an overview on the area of software maintenance.

A. *Software Maintenance in Software Engineering*

Over a period of time, according to the changing user requirements the modifications are needed to the development of software systems. In such cases, maintenance becomes essential part. The software maintenance process comprises a set of software engineering activities that occur after the software has been delivered to the users.

Sometimes, maintenance also involves in using the latest technology and adding the new features and functionalities to the existing software system. The primary objective of software maintenance is to fix the bugs in the software and makes software system meets the current requirements of the users. Software patches are used in the small segment of the software code in software maintenance. These patches are used to fix errors only in the software code that contains errors. Software maintenance is affected by several constraints such as increase in cost etc.

Key Issues in Software Maintenance

Number of key issues are effects the maintenance of software. Software maintenance provides unique technical and management challenges for software engineers—for example, trying to find the identical lines of code in the source code. The following are some of the issues related to software maintenance.

- Technical issues,
- Management issues,
- Cost estimation, and
- Measurement

There are four types of software maintenance are shown in the figure 1.

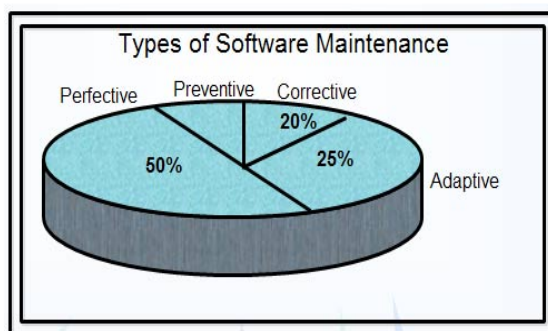


Fig. 1: Types of Software Maintenance

B. *Techniques of Software Maintenance*

Various techniques are used to perform the software maintenance effectively. These techniques are used to maintaining the system and improve the quality of the existing system. These include re-documentation, restructuring, re-engineering, reverse engineering.

1) *Re-documentation*

Re-documentation uses to provide the additional information of the source code. This helps to software maintenance team to understand the source code. The output of static code analysis is either graphical or textual, which can be used to measure whether the re-documentation is required.

2) **Restructuring**

Restructuring involves the transformation of unstructured code into structured code thereby making it easier to understand and change.

II. **REVERSE ENGINEERING**

Reverse engineering like re-documentation which provides the information about the design that used in the software code. This information stored in the format which can easily modified. This helps to the software maintenance team to understand the software code easily.

Re-engineering

Re-engineering is an extension of reverse engineering. This technique refers to the systematic transformation of the present software system into a new form to make quality improvements in operation, system capability, functionality, and achieving high performance at low costs.

The advantages associated with re-engineering are listed below.

- Reduced cost
- Reduced risk
- Better use of existing.
- Incremental development

A. Refactoring

Refactoring is used to avoid duplications in code. It the process of changing a software system in such a way that it does not change the external behavior of the code yet improves its internal structure. It is a way to clean up code that minimizes the chances of introducing bugs. Refactoring is used to improving the design of the code after it has been written.

Refactoring is used to improve code quality, reliability, and maintainability throughout the software lifecycle. Code design and code quality are enhanced with refactoring. Refactoring also increases developer productivity and increases code reuse Continuous design allows one to add more flexibility into the design, by adding to an initially simple design as the need arises, instead of having a big upfront design. Thus the design will evolve as the code grows. There is a shift from building software towards growing it. The process of refactoring can be used to contribute to these evolving states of the code. Refactoring improves the design of software. Without refactoring the design of the program will decay. Poorly designed code usually takes more to do the same things, often because the does the same thing in different places Refactoring makes the code easier to understand In most software development environments, somebody else will eventually have to read the code so it becomes easy for others to comprehend. Refactoring helps to find bugs .It helps in finding the Bugs present in the program. Refactoring helps to program fast.

B. Refactoring activities

Numbers of different activities are contained in the refactoring process:

- Identify where the software should be refactored.
- Determine which refactorings should be applied.
- The applied refactoring preserves behavior.
- Apply the refactoring.
- Assess the effect of refactoring on software quality characteristics;
- Maintain consistency between refactored program code and other software.

C. Refactoring Techniques

1) Composing methods

- *Extract Method:* having a code fragment that can be grouped together. Turn this fragment into a method whose name explains the purpose of this method
- *Replace Temp with Query:* You are using a temporary variable to hold the result of an expression. Extract the expression into a method. Replace all references to the temp with the expression. The new method can then be used in other methods.

- *Split Temporary Variable*: You have a temporary variable assigned to more than once, but it is not a loop variable or a collecting temporary variable. Make a separate temporary variable for each assignment.
- 2) *Moving features between objects*
- *Move Method*: A method is, or will be, using or used by more features of another class than the class on which it is defined. Create a new method with a similar body in the class it uses most. Either turn the old method into a simple delegation, or remove it altogether.
 - *Inline Class*: A class isn't doing very much. Move all its features into another class and delete it.
- 3) *Organizing data*
- *Replace Type Code with Class*: A class has a numeric type code that does not affect its behaviour. Replace the number with a new class.
 - *Change Value to Reference*: You have a class with many equal instances that you want to replace with a single object. Turn the object into a reference object.
 - *Replace Array With Object*: You have an array in which certain elements mean different things. Replace the array with an object that has a field for each element.

D. Code Clones

Common activity done by the software development is reusing code fragments by copying and pasting with or without minor changes in the software code. As a result software systems contain sections of code that are very similar, called code clones. Such types of clones are harmful in software maintenance and evolution. For example, if a bug is detected in the code fragment all fragments similar to it should be checked for the same bug. By using clone detection tools these bugs are detected and then refactored. An example for software clones are shown in the figure 2 .

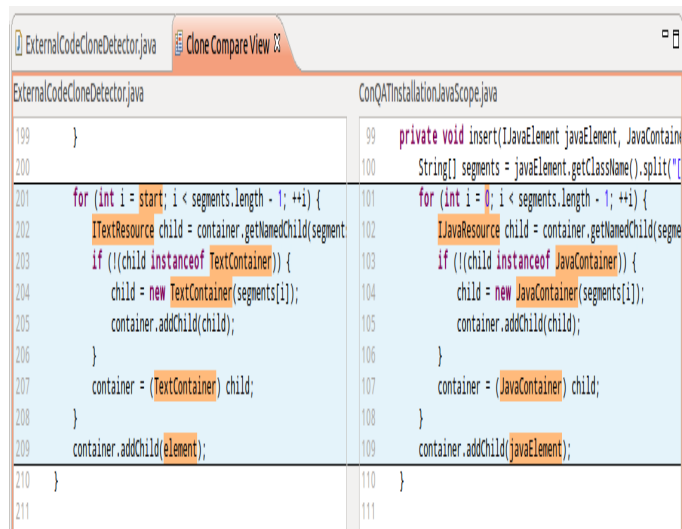


Fig. 2: Example for Code Clones

E. Types of Clones

There are two main kinds of similarity between code fragments. Fragments can be similar based on the similarity of their program text, or they can be similar based on their functionality (independent of their text). The first kind of clone is often the result of copying a code fragment from one location and pasting into another location. In the following we provide the types of clones:

Type-1: Identical code fragments except for variations in whitespace, layout and comments.

Type-2: Syntactically identical fragments except for variations in identifiers, literals, types, whitespace, layout and comments.

Type-3: Copied fragments with further modifications such as changed, added or removed statements, in addition to variations in identifiers, literals, types, whitespace, layout and comments.

Type-4: Two or more code fragments that perform the same computation but are implemented by different syntactic variants.

III. LITERATURE SURVEY

Recently, Hotta et al. [1] studied the impact of clones in software maintenance activities with a different approach which measures the frequencies of duplicate and non duplicate code segments. They conducted a large study using different tools and suggest that the presence of clones does not introduce extra difficulties to the maintenance phase.

Krinke et al. [2] measured how code clones are changed in Java, C and C++ code by using the clone detector tools and file comparison utility during maintenance process. He found that clone groups changed consistently through half their lifetime. In his most recent investigation on calculating the average ages of the cloned and non-cloned code, he has proved cloned code to be more stable than non-cloned code.

Lozano and Wermelinger et al. [3] conduct an experiment to measure the effects of clones on the changeability of software using CCFinder as the clone detector. They have calculated three changeability measures: (i) likelihood; (ii) impact of a method change; and, (iii) work required for maintaining a method. In another experiment, they experienced that cloned code leads to more changes. Their study suggests that cloned methods remain cloned most of their lifetime and that cloning introduces a higher density of modification during maintenance.

Clone Detection Techniques

In this section includes the literature survey of past years in the clone detection techniques.

Text-Based Approach: The code fragments are considered as sequence of text and this sequence of a text is compared with each other as the basis of various transformations like removing comments, whitespace, newlines etc. There are various researchers who found various techniques to detect clones on the basis of text. Baker et al. [4] used line-based string matching algorithm. In this algorithm each sequence or line of the text are given token values by using a tool named as Dup. Ducasse et al. [5] presented an approach using dynamic pattern matching which is language independent to identifying the clones in source code.

Token-based approach: This technique overcoming the problems faced in text-based approach like change in space, identifier name by parse the whole source code into sequence of tokens.

Kamiya et al. [6] developed a tool name CCFinder as a clone detection tool to identifying the clones in source code by using token based approach.

Tree-based approach: This technique constructs the sub trees for each code fragment and by matching the sub trees the code clones are identified. This is done by creating the AST of the code. CloneDR is a well known tool which uses this technique in this by using the hash function the clones are detected.

Graph-based technique: Graph based technique is a Program Dependency Graph (PDG) overcome the problems faced in AST and also maintain the data and control flow and therefore it become easier to clones semantically as well as syntactically by using Program Dependency Graph matching techniques the clones are detected. Komondoor and Horwitz et al. [7] gave an approach known as PDG-DUP which used program slicing method to identify the clone groups without changing its semantics.

Metric-based technique: This technique does not work directly on the source code fragment instead it calculated different metric values for code like number of source lines, number of functions etc. and by comparing the metric values the code clones are identified. Mayrand et al. [8] used this technique and calculated the metrics from names, layouts, expression and control flow but it was not able to identify segment based copy-paste operation.

Kaur et al. [9] proposed an algorithm to identify the duplicate codes based on the metrics of source code. The main objective of this algorithm to find the code clones by using metric based and text based approach. In textual comparison, a line by line code comparison is used in post-processing rather than by taking token or word.

Some of the clone detection tools and their comparisons are listed below in table 1.

Table 1: Clone Detection Tools

TOOLS	COMPARISON
Dup	Token
CloneDR	AST
CCFinder	Token
DupliX	PDG
CLAN	Function Metrics
Duploc	Text

Program Dependence Graphs

The Program Dependence Graphs (PDGs) is built for corresponding to duplicated code fragments. A PDG is a directed graph with multiple types of edges and nodes. A node in a PDG represents a statement of a function or a control predicate, and an edge represents control or data flow dependences between the nodes. A control dependence edge denotes that the execution of the statement at the end point of the edge depends on the control conditions of the control predicate statement (e.g., if, for) at the start point of the edge. A data dependence edge is always labeled with a variable v and it denotes that the statement at the end point of the edge is using the value of v , which has been modified by the statement at the start point of the edge.

Program Dependency Graph Mapping Techniques

Komondoor et al. [10] use program dependency graph and slicing to identify the isomorphic subtrees with in the code clones. The main advantage of this approach is it detects the clones with gap, reorder matching statements in the clones, and clones that are intervened with each other. In this approach two program dependency graph are matched if their nodes are having the syntactically identical statements or predicates. And for each pair of matching nodes they performed forward and backward slicing to construct the pair of isomorphic subgraph.

Krinke et al. [11] developed a method to identify code clones by computing the maximal similar subgraphs in fine-grained PDGs induced by k -limited paths starting from a pair of vertices. In this method fine-grained PDG are having the special nodes for expressions, variable definitions, function calls etc. and special edges between the expression components. He considered starting point as a subset of vertices i.e. predicate vertices in order to reduce the complexity of the algorithm. One important limitation of this proposal is that the running time of the algorithm increases tremendously as k -limit increases. And another limitation is that the use of k -limit may lead to an incomplete solution (i.e., the selected k -limit is insufficient for detecting all possible matching vertices). Using only predicate nodes as starting vertices is also a drawback since it can result in not finding some clones.

Shepherd et al. [12] implemented an automated aspect mining technique exploiting the Program Dependence Graph and Abstract Syntax Tree representations of a program. In this proposed method by using the control based comparisons it detects the initial refactoring candidates and then based on the dependence information it filters the undesirable refactoring candidates. They use a source level PDG in which nodes that correspond to the same source line number are collapsed into a single node and the duplicate edges are avoided from or to the subsuming nodes. By matching the control dependency subgraph of each PDG the mapping of the two code fragments are performed. The limitation of this approach it will fail to match the control dependence subgraphs nested in different levels.

Abstract Syntax Tree-based Mapping Techniques

Fluri et al. [13] describe an approach to extract the fine-grained changes that occur across different versions of a program. Their method is based on the tree alignment algorithm proposed by Chawathe et al. [14], which takes as input two trees and produces a minimum edit script that can transform one tree into the other. They extended the original algorithm by applying the bigram string similarity it the matching of leaf nodes, and an enhanced subtree similarity criterion that takes into account the similarity of the nested nodes for the matching of control predicate structures. A limitation of the proposed approach is that string-based similarity matching is not resilient to extensive renaming of identifiers. In addition, the best match approach applied for leaf level nodes may match reoccurring statements that are not at the same position in the method body. Cottrell et al. [15] present an approach to help developers integrate reusable source code. They proposed an algorithm takes as input two ASTs and applies bottom up comparisons for two ASTs starting from leaf nodes (e.g., identifiers, types) and moving up to non-leaf nodes. The leaf nodes are compared by

means of the longest common substring measure. Non-leaf nodes are compared recursively taking into account the similarity of their children. A limitation is that the approach is only semi-automated, since user intervention is required to resolve the conflicts when multiple matches are found. Additionally, it tries to find a best fit in a greedy manner, which may lead to a non-optimal solution for the entire problem.

E.Kodhai et al. [16] proposed an approach for detection of functional clones. This technique is combination of text and metric based approach.

IV. PROBLEM STATEMENT

Many clone detection tools are proposed for detecting the duplicate code in source code. All clones are identified by the clone detection tools are not refactoring oriented clones. Identifying the refactoring oriented clones is a major challenge. So, the first challenge is to find code clones that can be unified for the purpose of refactoring.

Non-trivial Differences

There are other challenges involved in unifying the code fragments. If Type-1 clones are easy and straightforward to merge, Type-2 clones often contain non-trivial differences. Type-2 clones are syntactically identical code fragments that differ in variable identifiers, method call identifiers, literals, and types. Type-2 clones can be refactored by mapping the differences among the clones of a clone group and introducing a parameter of appropriate type in the extracted method for each parameterized difference.

Limitations in Clone Detection approaches

Textual approach: Textual approach is a text-based approach in this approach the detection processes directly from the source code in their detection method. it uses little or no transformation on the source code before its actual comparison. Limitations of text-based Approaches

- A line-by-line method cannot handle identifier renaming.
- If code segments having line breaks are not recognized as clones.
- It creates a problem when comparing two code portions when one of the two portions has brackets and the second portion does not have brackets.

Lexical Approaches: Lexical approach is a token based approach in this by using lexical analyzer it transforms source code into a sequence of "tokens". By comparing the token values of two code fragment the clones are detected.

Limitations of Lexical Approaches

- When the order of statements is modified in copied code, copied code cannot be detected.
- This technique cannot detect the code clones with added or removed tokens along with the swapped lines.
- Token-based approaches cost more in terms of space and time complexity than textual approaches.

Syntactic Approaches: To convert the source programs into a parse tree or abstract syntax trees (AST) parser is used. Then, the tree match approach is used to find clones.

Tree matching approach: In tree-based approaches the clones are detected by identifying similar subtrees. Literal values, variable names and other tokens in the source code are converted in a tree representation, for detection of clones.

Limitations of Syntactic Approaches:

- Tree-based techniques can't handle literal and identifiers values for clone detection in ASTs.
- Tree-based techniques cannot detect reordered statement clones.

Metrics-based Approaches: A Metrics-based approach calculates a number of metrics from code fragments and then compares metrics vectors directly. Metrics are calculated for syntactic units such as classes, loops, functions and statements.

Limitations of Syntactic Approaches:

- Tree-based techniques can't handle literal and identifiers values for clone detection in ASTs.
- Tree-based techniques cannot detect reordered statement clones.
- A metric-based technique requires a parser or a PDG generator for metrics values computation.

- Based on matrices alone two code fragments may not found to be similar code fragments even if they have similar metric values.

Semantic Approaches: Static program analysis is used to provide more precise information in semantics-based clone detection approaches. In some approaches, a PDG (program dependency graph) represents a program. The nodes are representing statements and expressions, and the edges are representing control and data dependencies.

Limitations of Semantic Approaches:

- PDG-based approaches are not scalable for large systems.
- Graph matching that is used in PDG-based techniques is expensive.

V. PROPOSED METHODOLOGY

In this proposed approach focus on finding the solution for finding the code clones in java file by using the metric based approach. This method is to find the similarity between the two java files. Rather than working on the source code directly the metric based approach calculate the metric values from source code and use these metrics to measure the clones. Numbers of tools are available for calculating the metrics for source code. But all the tools are not suitable for calculating the metrics of the java file. Tools that are available for calculating the java code metrics like Datrix and it is easy to use.

Clone Detection Process

In clone detection process as shown in the figure 3 the clone detection first parses the source code and then performs the program analysis on the parsed code. All similar code segments are identified and then inconsistency detection is performed. The entire procedure is executed and the results are stored in database. As first part of the analysis through parsing of source code, they find the similarity and in the second phase the metrics are calculated and finally they are detected.

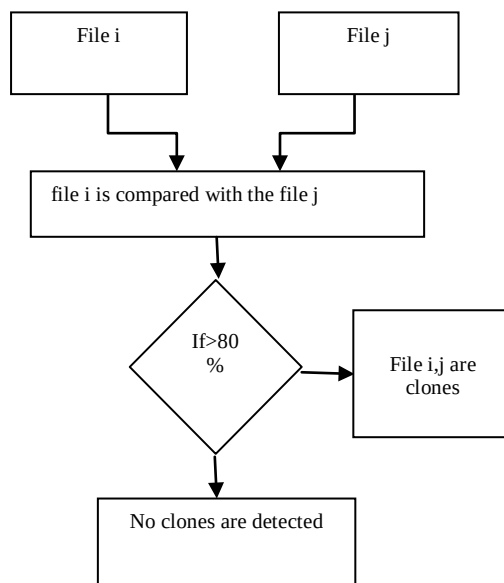


Fig. 3: Clone Detection Process

Algorithm

The proposed algorithm is mainly based on the distance and similarity measures of the code clones. The distance and similarity metrics are calculated by the Datrix tool. This algorithm is used to comparing the similarity between two file and calculate the metric values that were required to identify the potential clones in the java file. The metric values are calculated for each file given as input. The proposed algorithm detects the clones by comparing the metrics of each file based on the metric based approach. The clones detected by the metric based approach are further compared line by line by using text based approach to find that the clones detected by the proposed algorithm are actual clones are not. Metric and textual comparison is done over different java source code fragment to find the identical clones.

The metric values calculated for number classes are exist in the file, number of methods in the file, number of arguments are passed for each method, number of local variables in method, number of loop statements in each method, number of function calling in method, number of return statement for each method etc. these metric values are calculated and compared metric values of one java source code file with another code file.

The set of 12 metrics is used in this proposed method for detecting the type-1, type-2, type-3, type-4 clones. They are as follows:

- No. of effective lines of code in each method.
- No. of arguments passed to the method.
- No. of function calls in each method.
- No. of local variables declared in each method.
- No. of conditional statements in each method.
- No. of looping statements in each method.
- No. of return statements in each method.
- No. of function calling in each method.
- No. of inheritance in each method.
- No. of virtual functions in each method.
- No. of overloading constructor in each method.
- No. of overriding functions in each method.

Algorithm

Input: Java File i, File j

Output: Clones

1: BEGIN

2: Read File i

3: Read File j

4: Compute Metric values at File

for i←0,File i do

File i Metric.calculateMetric();

for j←0,File j do

File j Metric.calculateMetric();

5: if File i.Metric=File j.Metric

for i←0,File i do

for j←0,File j do

Compare File.Sim(File i,File j)

Compare File.Dist(File i,File j)

if(File i==File j) then

Clones←File;

6: else

7: Extract File i.Class(), File i.Method()

8: Extract File j.Class(), File j.Method()

9: Compute Metic values File i.Class(),Compute Metric values File i.Method()

10: Compute Metic values File j.Class(), Compute metric values File j.Method()

11: for i←0 File i.Method do

for j←0 Filej.Method do

if Method.Metric(File i)==Method.Metric(File j)

Compare Method.Sim(Method i,Method j)

Compare Method.Dist(Method i,Method j)

```

        if(Method i==Method j) then
            Clones←Method
12: for i←0 File i.Class do
    for j←0 Filej.Class do
        if Class.Metric(File i)==Class.Metric(File j)
            Compare Class.Sim(Class i,Class j)
            Compare Cass.Dist(Class i,Class j)
            if(Class i==Class j) then
                Clones←Class
13: END

```

Explanation of Algorithm

In this algorithm, the line of code in first java file is compared with line of code in second java file. Here file i and file j are used to indicate first and second java files. In this algorithm we are comparing every line of code of first file with each line of second file. But before actual comparison, the metrics of two files are computed and based upon the analyzed metrics the comparison is carried out. Initially we start with reading the two java files file i, file j and calculate the metric values for file i and file j. and we have to find and matches the file similarity and file distance. If the both files having any matching lines of code then that code referred as a clones. In second step we have to extract the class and methods of the file and the compute the metric values for class and methods in the file. And in next compare the metric values of class i with class j and method i with method j of the file. If any matches are detected then those are referred as clones. Later on the clones detected by this proposed algorithm are compared line by line by using text based approach to identify the actual clones.

After detecting the clones by using proposed algorithm a set precondition are applied on the detected clones and observe the program behaviour. If any changes or identified in the program behaviour by applying the preconditions on the clones, such type of clones are not refactoring oriented clones.

VI. RESULTS

Metrics and the textual comparison were performed over different java source code fragments and it provided less complexity in finding the clones and gave accurate results. A set of twelve metrics were used in this proposed technique to improve the precision and recall values. The results of the proposed techniques are better than the existing techniques in terms of accuracy, precision, recall and error rate values.

VII. CONCLUSION

In this paper the proposed technique is used both combination of metric based and text based techniques. This technique is applied on the java source code file. In the proposed technique the metric values are calculated for each method and classes in the file. And by comparing the similarity and distance metric values of the java code files the code clones are detected. Later on by comparing the line by line using text based approach to check whether the potential clones detected using metric based comparison are actually clones or not. After detecting the actual clones a set of preconditions are applied to the detected clones to observe the program behaviour and to assess whether the detected clones can be safely refactorable or not. We have observed that our proposed method is better than existing technique in terms of parameters such as precision, recall, accuracy, error rate.

REFERENCES

- [1] K. Hotta, Y. Sano, Y. Higo, S. Kusumoto, "Is Duplicate Code More Frequently Modified than Non-duplicate Code in Software Evolution?: An Empirical Study on Open Source Software," Proc. EVOL/IWPSE, 2010, pp. 73–82.
- [2] J. Krinke, "A study of consistent and inconsistent changes to code clones," Proc. WCRE, 2007, pp. 170–178.
- [3] A. Lozano, and M. Wermelinger, "Assessing the effect of clones on changeability," Proc. em ICSM, 2008, pp. 227–236.

- [4] B. Baker, A Program for Identifying Duplicated Code, in: Proceedings of Computing Science and Statistics: 24th Symposium on the Interface, Vol. 24:4957, 24:49-57 (1992).
- [5] S. Ducasse, M. Rieger and S. Demeyer, A Language Independent Approach for Detecting Duplicated Code, in: Proceedings of the 15th International Conference on Software Maintenance, ICSM 1999, pp. 109-118 (1999).
- [6] T.Kamiya, S.Kusumoto and K.Inoue, CCFinder: A Multi linguistic Token-Based Code Clone Detection System for Large Scale Source Code, IEEE Transactions on Software Engineering, 28(7):654-670 (2002).
- [7] R.KomondoorandS. Horwitz, Using Slicing to Identify Duplication in Source Code, in: Proceedings of the 8th International Symposium on Static Analysis, SAS 2001, pp. 40-56 (2001).
- [8] J.Mayrand, C.Lebanc and E.Merlo. Experiment on the Automatic Detection of Function Clones in a Software System Using Metrics, in: Proceedings of the 12th International Conference on Software Maintenance, ICSM 1996, pp. 244-253 (1996).
- [9] E. Merlo, G. Antoniol, M. Penta and V. Rollo, Linear Complexity Object-Oriented Similarity for Clone Detection and Software Evolution Analyses, in: Proceedings of the 20th International Conference on Software Maintenance, ICSM 2004, pp. 412-416 (2004).
- [10] Raghavan Komondoor and Susan Horwitz. Using slicing to identify duplication in source code. In Proceedings of the 8th International Symposium on Static Analysis, pages 40-56, 2001.
- [11] Jens Krinke. Identifying similar code with program dependence graphs. In Proceedings of the Eighth Working Conference on Reverse Engineering, pages 301-307, 2001.
- [12] David Shepherd, Emily Gibson, and Lori L. Pollock. Design and evaluation of an automated aspect mining tool. In Software Engineering Research and Practice, pages 601-607, 2004.
- [13] Beat Fluri, Michael Wuersch, Martin Pinzger, and Harald Gall. Change distilling: Tree differencing for fine-grained source code change extraction. IEEE Trans. Softw. Eng., 33(11):725-743, November 2007.
- [14] Sudarshan S. Chawathe, Anand Rajaraman, Hector Garcia-Molina, and Jennifer Widom. Change detection in hierarchically structured information. In Proceedings of the 1996 ACM SIGMOD International Conference on Management of Data, pages 493-504, 1996.
- [15] Rylan Cottrell, Robert J. Walker, and Jörg Denzinger. Semi-automating small-scale source code reuse via structural correspondence. In Proceedings of the 16th ACM SIGSOFT International Symposium on Foundations of Software Engineering, pages 214-225, 2008.
- [16] E. Kodhai, S. Kanmani, A. Kamatchi, R. Radhika, and B. VijayaSaranya, "Detection of Type-1 and Type-2 Code Clones Using Textual Analysis and Metrics", International Conference on Recent Trends in Information, Telecommunication and Computing (ITC), 2010, pp. 241-243.



ISSN
0975-6299

A Survey on Feast of Diverse Scheduling Techniques in Resource Management in Cloud Computing

P. Neelima*, Research Scholar, Dept of CSE JNTUA College of Engineering Anantapur, India

E-mail: neelima.pannem@gmail.com

Dr. A. Rama Mohan Reddy, Professor, Dept of CSE SVU College of Engineering, SV University

Tirupati, India E-mail: ramamohansvu@yahoo.com

Abstract---

The CLOUD computing represents the innovative and upcoming trend in disseminating computing which enable the software applications, platform, and hardware infrastructures as a mode of service. It contributes its mite to the significant growth of the grid computing, virtualization and web techniques. The cloud service providers furnish the related services in accordance with the customized Service Level Agreements (SLAs) which represent the user's required Quality of Service (QoS) constraints. The Cloud service scheduling is habitually classified into two distinct levels such as the user level and the system level. At the user level the scheduling elegantly performs the task of effectively tackling the challenges originated by means of the service stipulation between the providers and the clients. On the other hand, the system level scheduling is concerned with the effective handling the resource management within the data center. Moreover, the task scheduling has emerged as one of vital challenges in the domain of the cloud computing mechanism. In this paper we discuss various scheduling techniques in Cloud Computing.

Keywords--- Component, Formatting, Style, Styling.

* Corresponding Author

I. INTRODUCTION

The Cloud computing represents the innovative and upcoming trend in disseminating computing which enable the software applications, platform, and hardware infrastructures as a mode of service. It contributes its mite to the significant growth of the grid computing, virtualization and web techniques. The cloud service providers furnish the related services in accordance with the customized Service Level Agreements (SLAs) which represent the user's required Quality of Service (QoS) constraints. The cloud computing leads to the incredible reduction in investment on several resources such as the hardware, software and permit the resources to be rented and set free. Further, it effectively cuts down the preliminary investment, maintenance expenses and operating overheads. The cloud services are hosted on service provider's own infrastructure or on third party cloud infrastructure providers [3]. In addition, the cloud computing constitutes an internet based computing which offers the infrastructure as a service (IaaS), platform as a service (PaaS), and software as services (SaaS). In the SaaS, software application is offered by the cloud provider. In the PaaS an application development platform is furnished as a service to the developer to generate a web based application. In the IaaS computing infrastructure is offered as a service to the applicant in the shape of the Virtual Machine (VM). Further, the clouds can be broadly categorized into three kinds such as the public, private and hybrid [6]. When the cloud is offered to the common customer on a pay-per-use basis, then it is known as a public cloud. When institutions build up their own unique applications and operate their own internal infrastructure then it is called the private cloud as the access is restricted to users within the organization. The hybrid cloud is achieved by the combination and consolidation of the public and private clouds.

The Cloud service scheduling is habitually classified into two distinct levels such as the user level and the system level. At the user level the scheduling elegantly performs the task of effectively tackling the challenges originated by means of the service stipulation between the providers and the clients. On the other hand, the system level scheduling is concerned with the effective handling the resource management within the data center. Generally, the service providers furnish various services to the clients on the basis of contract. In accordance with services offered to the clients they make a levy of charge on the clients, who are competent to reimburse for the service offered by means of the payment mechanism labeled as the "pay as you go" method. Consequently, the cost cutback has emerged as the one of the major advantages of exploiting the cloud computing. In addition, the service providers make an assurance regarding the quality of the services offered like the data processing, data storage and the data access. As far as a cloud provider is concerned, a perplexed issue crops up in the form of excessive purchase of resources in advance, which is habitually cost-prohibitive. Another ray of hope arrives from the Cloud Federation which surfaces as an ideal candidate which entails the service providers the facility of dealing their sources by means of the federation agreement.

II. RELATED WORK

A. Workflow Scheduling Strategy

The below Fig 1 shows the overview of our workflow scheduling system. Users first submit workflow with their QoS requirements. The system then allocates appropriate services for processing the workflow tasks and schedules the tasks on the services according to the QoS requirements and the cloud environment.

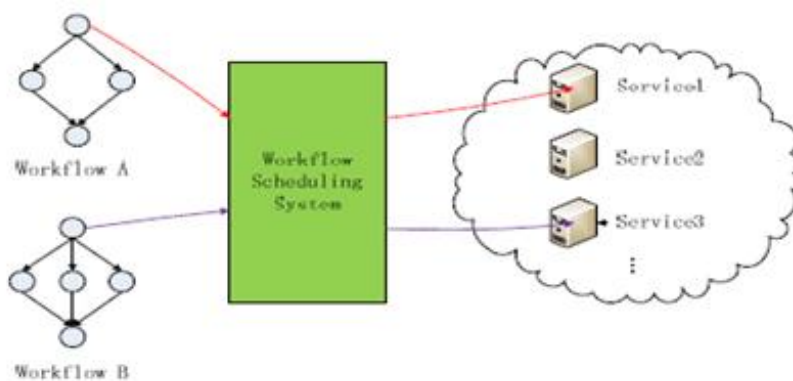


Figure 1: Overview of Scheduling workflow

In order to schedule the workflow dynamically and optimize the resource allocation decision, the system we proposed consists of three core components: Preprocessor, Scheduler and Executor. The Preprocessor computes four attributes of the ready tasks. The available service number, the covariance for time and cost, the time quota, the cost quota. In addition, the Preprocessor computes the time and cost surplus of the workflow. Then it submits the ready tasks the Scheduler queue, which is a sorted set containing all tasks from different users waiting to be scheduled. Then the Scheduler re-computes the above attributes of the tasks in the queue and then re-sorts all tasks in the queue according to the strategy which will be discussed below. The Executor selects the best service to sequential execute the tasks in the queue. When a task finishes, the Executor notifies the Preprocessor which the task belongs to of the completion status. The collaboration is implemented by the continuous and dynamic event triggered communication among core components, as defined in Fig. 2.

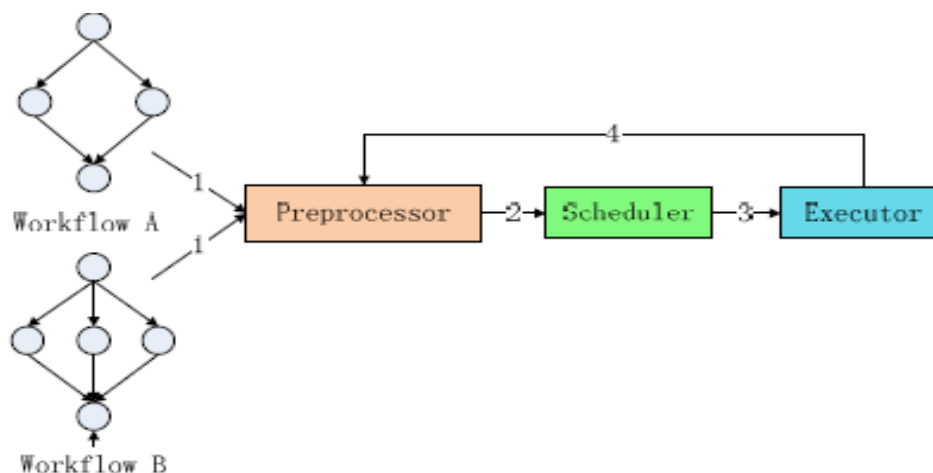


Figure 2: An Overview of the Scheduling Strategy

1) Workflow submission: When a new workflow arrives, it is submitted to the Preprocessor. Then the Preprocessor computes the attributes of all ready tasks.

2) Preprocessing: After computing the attributes of all ready tasks within the workflow, the Preprocessor inserts the ready tasks into the queue. In the very first time, only entry tasks will be submitted. Afterwards, upon notification by the Executor of completion of a task, the Preprocessor will determine if any successor tasks become ready and submit them. The task attributes information is submitted along with the task.

3) Task scheduling: Whenever there are services available and a task is waiting in the queue, the Scheduler will re-compute all tasks currently present in the queue and sort all tasks and then repeatedly do:

- a) Remove the first task in the queue;
- b) Allocate the task to the service which is best fitted;
- c) Insert the task into the next round queue if there are not services which can finish the task.

4) Task completion notification: When a task finishes successfully, the Executor will notify the Preprocessor of the task completion status.

B. Task Scheduling In Parallel Systems

Multiprocessor scheduling problems can be classified into many different classes based on characteristics of the program and tasks to be scheduled, the multiprocessor system, and the availability of information. El Rewini et al. give a general taxonomy of scheduling problems and discusses differences between classes. We focus on a deterministic scheduling problem in which there exist precedence relations among the tasks to be scheduled and in which task duplication is allowed. A deterministic scheduling problem is one in which all information about the tasks and their relations to each other, such as execution time and precedence relations, are known to the scheduling algorithm in advance. Such problems, also known as static scheduling problems, contrast to nondeterministic scheduling problems in which some information about tasks and their

relations may be undeterminable until runtime, i.e., task execution time and precedence relations may be determined by data input.

Within the class of deterministic scheduling problems, this work focuses on problems with the following characteristics:

1. Precedence relations among the tasks exist. Precedence relations among tasks determine the order in which tasks must be performed.
2. Communication costs exist. Communication cost is the cost to transmit messages from a task on one processor to a succeeding task on a different processor. Communication cost between two tasks on the same processor is assumed to be zero.
3. Task duplication is allowed. The same task may be assigned to more than one processor to reduce communication costs and schedule length.
4. The multiprocessor system consists of a limited number of fully connected processors.

We represent a parallel program as a directed acyclic graph (DAG), $G = (V, E)$, where V is a set of nodes each of which represents a component subtask of the program and E is a set of directed edges that specify both precedence constraints and communication paths among nodes. Hereafter, we will use the terms node and task interchangeably. In the DAG model, each node label gives the execution time for the corresponding task and each edge label gives communication time required to pass data from one node to the next if the two nodes are assigned to different processors during program execution. A task cannot start until all of its predecessor tasks are complete

An integer programming model was excellently brought to limelight by Xingquan Zuo *et al.* [12] for the resources allocation challenge of an IaaS cloud in a hybrid cloud scenario. A self-adaptive learning PSO (SLPSO)-based scheduling technique was envisioned for the purpose of effectively addressing the corresponding challenge. In this regard, each and every dimension of a particle represented a task and a particle taken together represented the precedence of the entire tasks in the SLPSO. The novel technique was able to achieve a superior quality scheduling solution by adaptively selecting the velocity revising techniques to modify each and every particle.

Amazing applause saluted Amit Agarwal and Saloni Jain [14] for their contribution in the cloud scenario, in which a unique scheduling technique was investigated by them which was competent with the requisite skills of effectively programming the evaluation endeavors. They had the brains to kick-start the FCFS, Round robin scheduling Algorithm and the novel technique which represented a (GPA) generalized priority algorithm. In the arena of the cloud, priority emerged as a vital subject of job scheduling. In respect of a fluctuating number of Virtual Machines the investigation was carried out and the workload traced. Further, they also carried out an assessment and contrast of the investigation conducted vis-à-vis the FCFS and the Round Robin.

Yuming Xu *et al.* [14] excellently elucidated the genetic algorithm for the purpose of task scheduling on diverse computing mechanism with the assistance of the manifold priority queues. The underlying concept behind their novel technique idea of their approach was to gain the maximum merit from the evolutionary-based and heuristic-based approaches simultaneously keeping at bay the depressing deficiencies. They intelligently integrated an innovative genetic algorithm (GA) technique in the novel technique with the attention of allocating a preference to each subtask simultaneously employing a heuristic-based earliest finish time (EFT) method to continue the hunt in search of a solution for the task-to-processor mapping. The MPQGA approach was also able to formulate the crossover, mutation, and fitness functions ideal for the backdrop of directed acyclic graph (DAG) scheduling. The test outcomes for the titanic hassles from a bulky set of arbitrarily created graphs in addition to the graphs of concurrent issues endowed with several attributes illustrated the amazing acumen of the MPQGA approach in achieving superlative efficiency in performance outsmarting two non-evolutionary heuristics and an arbitrary investigation technique with regard to the schedule quality.

Ting Shi *et al.* [15] significantly brought to limelight an energy-efficient scheduling technique for the time-constrained function in the local mobile clouds. The Mobile Cloud Computing (MCC) facilitated the mobile devices to employ the resource providers with the exception of the mobile devices to host the implementation of the mobile applications. During the last few years, various mobile cloud designs and scheduling techniques were subjected to thorough investigation. In the document, at the outset, they

pioneered the local mobile clouds generated by the nearby mobile devices and furnish the mathematical models of the mobile devices and their applications. Further, they devised the scheduling issue in the local mobile clouds. They took pains to discuss in depth the resource discovery approach and the adaptive, probabilistic scheduling technique; At last they were able to authenticate the efficiency in execution of the epoch-making technique by carrying out a host of replication tests.

Nhan Nguyen and Mohammad [16] were instrumental in bringing to limelight the -Loop Context Aware Data Acquisition and Resource Allocation Framework for Dynamic Data Driven Applications Systems (DDDAS) on the Cloud. In the document, at the outset, they brilliantly brought in a centralized approach which was intended to maximize the general quality of data for the entire network for the specified utility functions and the significance grades of the sensor nodes. They followed it up with a threshold based heuristic which was endowed with the astounding skills for averting the error of incredibly significant nodes at decisive durations. At last, they conducted an investigation on the proactive resource optimization structure which was competent to adaptively distribute the resources like the servers in reaction to the modified sampling rates. A wide-ranging appraisal of the cloud platform for several backgrounds threw light on the fact that their innovative technique was well-geared to swiftly acclimatize the sampling rates and redistribute the resources as a consequence of the enhanced significance of the sensor nodes, thereby leading to the drastic cutback in the data loss.

III. CONCLUSION

Scheduling is a standout amongst the most critical task in cloud computing environment. Scheduling system is all that much important to enhance the server and resource performance of the computer. It helps in the good understanding of resource allocation and task scheduling options. With the help of task scheduling, the resources of the cloud systems are efficiently allocated and managed and optimized.

REFERENCES

- [1] Paul, M., Sanyal, G., "Survey and analysis of optimal scheduling strategies in cloud environment", IEEE, 2012
- [2] Jeyarani, R., Ram, R. Vasanth, Nagaveni, N., "Design and Implementation of an Efficient Two-Level Scheduler for Cloud Computing Environment", IEEE, 2010
- [3] Huang Qi-yi, Huang Ting-lei, "An optimistic job scheduling strategy based on QoS for Cloud Computing", IEEE, 2010
- [4] Meng Xu, Lizhen Cui, Haiyang Wang, Yanbing Bi, "A Multiple QoS Constrained Scheduling Strategy of Multiple Workflows for Cloud Computing", IEEE, 2009
- [5] Hao Li, Huixi Li, "A Research of Resource Scheduling Strategy for Cloud Computing Based on Pareto Optimality $M \times N$ Production Model", IEEE, 2011
- [6] Kuan-Rong Lee, Meng-Hsuan Fu, Yau-Hwang Kuo, "A hierarchical scheduling strategy for the composition services architecture based on cloud computing", IEEE, 2011
- [7] Gunho Leey, Byung-Gon Chunz, Randy H. Katzy, "Heterogeneity-Aware Resource Allocation and Scheduling in the Cloud", University of California
- [8] Shu-Ching Wang, Kuo-Qin Yan, Shun-Sheng Wang, Ching-Wei Chen, "A Three-Phases Scheduling in a Hierarchical Cloud Computing Network", IEEE, 2011
- [9] Peixoto, M.L.M., Santana, M.J., Estrella, J.C., Tavares, T.C., Kuehne, B.T., Santana, R.H.C., "A Metascheduler architecture to provide QoS on the cloudcomputing", IEEE, 2010
- [10] P. Kumar and Sheila Anand, "An Approach To Optimize Workflow Scheduling For Cloud Computing Environment, " Journal of Theoretical and Applied Information Technology, Vol. 57 No.3, 30th November 2013.
- [11] Xingquan Zuo, Guoxiang Zhang, and Wei Tan, "Self-Adaptive Learning PSO-Based Deadline Constrained Task Scheduling for Hybrid IaaS Cloud", IEEE transactions on automation science and engineering, Vol. 11, No. 2, pp. 564-573, 2014.
- [12] Xingquan Zuo, Guoxiang Zhang, and Wei Tan, "Self-Adaptive Learning PSO-Based Deadline Constrained Task Scheduling for Hybrid IaaS Cloud", IEEE transactions on automation science and engineering, Vol. 11, No. 2, pp. 564-573, 2014.

- [13] Dr. Amit Agarwal, Saloni Jain, "Efficient Optimal Algorithm of Task Scheduling in Cloud Computing Environment," International Journal of Computer Trends and Technology (IJCTT) – volume 9 number 7– Mar 2014.
- [14] Yuming Xu , Kenli Li , Jingtong Hu and Keqin Li, "A genetic algorithm for task scheduling on heterogeneous computing systems using multiple priority queues", Information Sciences, vol. 270, pp.255–287, 2014.
- [15] Ting Shi, Mei Yang, Xiang Li, Qing Lei and Yingtao Jiang, "An energy-efficient scheduling scheme for time-constrained tasks in local mobile clouds", Pervasive and Mobile Computing, vol.17, 2015
- [16] Nhan Nguyen and Mohammad Maifi Hasan Khan, "A Closed-Loop Context Aware Data Acquisition and Resource Allocation Framework for Dynamic Data Driven Applications Systems (DDDAS) on the Cloud", Journal of Systems and Software, 2015



ISSN
0975-6299

N-Keyword Search over Efficient Encrypted ad hoc Mobile Cloud Data

K. Ravichandran*, Research Scholar, Vels University, Chennai, India. E-mail:Ravi72@gmail.com

Dr. S. Saravana Kumar, Professor, Department of CSE, Karpagam College of Engineering, Coimbatore, India.
E-mail:Saravanakumars81@gmail.com

Abstract---

Ad hoc mobile cloud computing is one of the recent interesting technology. Mobile cloud is nothing but everything is available on internet just we have to pay and utilize the resources. But there is no security for the contents which are available over the internet. A variety of security and routing algorithms have been developed to provide Mobile cloud users with data security. But still there is issues using mobile cloud computing. Cryptography is a heart of security. It plays vital role in information and security area. Information security is very much important in all sectors. Best way to protect the information is the way of cryptography. There is mainly two cryptographic algorithms are used to solve this issue Symmetric key algorithms and Asymmetric key algorithms. Symmetric key algorithms are said to be as the most commonly used. Symmetric key, the speed to encrypt data is fast. This paper presents the comparison between the symmetric key algorithms.

** Corresponding Author*

Special Issue on "Medical Science"

I. INTRODUCTION

A variety of encryption algorithms have been developed to provide Mobile cloud users with data security. These algorithms are said to support compliance, protect the user against data breach incidents, and secure information against advanced persistent threats. A few Mobile cloud services claim to have obtained 3rd party certification on the security of the particular algorithm that they use in data encryption. Others claim that their algorithm is military-grade or bank-grade. But, what are these algorithms? How do they work? Symmetric key algorithms use the same key for encryption and decryption. Therefore, these encryptions are also called private key encryptions. It is one of the oldest methods of encryption in use in the world today and is secure because the user must have the key to decrypt and read the data. The encryption may use a stream cipher or block cipher based on the amount of data that needs to be encrypted. Stream ciphers encrypt one character at a time, while block ciphers will encrypt block of data. Popular encryption algorithms in this category are Data Encryption standard (DES), Advanced Encryption Standard (AES), International Data encryption Algorithm (DEA) and Blowfish algorithm[1].

II. AES ALGORITHM

AES is an abbreviation for Advanced Encryption Standard. This algorithm was established by the National Institute of Standards and Technology (NIST) in 2001; and is based on a cipher known as the Rijndael cipher. It was developed by two Belgian cryptographers called Joan Daemen and Vincent Rijmen. This algorithm is used by many governments round the world. AES is often described as a symmetric key algorithm as the same key is used for both encryption and decryption of the data. It works on the principle of substitution-permutation at both the software and hardware level. The block sizes used can be 128, 192 or 256; and uses a 4×4 column major order matrix of bytes (called State). The key size specifies the number of cycles or rounds that have to be performed on the data so that it is encrypted. Commonly, 10, 12 or 14 cycles are used for transforming plain text into encrypted text. A set of reverse rounds are applied to decrypt the text AES is a block cipher with a block length of 128 bits. AES allows for three different key lengths: 128, 192, or 256 bits. Most of our discussion will assume that the key length is 128bits. Encryption consists of 10 rounds of processing for 128-bit keys, 12 rounds for 192-bit keys, and 14 rounds for 256-bit keys. Except for the last round in each case, all other rounds are identical. Each round of processing includes one single-byte based substitution step, a row-wise permutation step, a column-wise mixing step, and the addition of the round key. The order in which these four steps are executed is different for encryption and decryption. To appreciate the processing steps used in a single round, it is best to think of a 128-bit block as consisting of a 4×4 matrix of bytes, arranged as follows:

byte0	byte4	byte8	byte12
byte1	byte5	byte9	byte13
byte2	byte6	byte10	byte14
byte3	byte7	byte11	byte15

Therefore, the first four bytes of a 128-bit input block occupy the first column in the 4×4 matrix of bytes. The next four bytes occupy the second column, and so on. The 4×4 matrix of bytes is referred to as the state array.

AES also has the notion of a word. A word consists of four bytes that is 32 bits. Therefore, each column of the state array is a word, as is each row.

Each round of processing works on the input state array and produces an output state array. The output state array produced by the last round is rearranged into a 128-bit output block. Unlike DES, the decryption algorithm differs substantially from the encryption algorithm. Although, overall, the same steps are used in encryption and decryption, the order in which the steps are carried out is different, as mentioned previously. Whereas AES requires the block size to be 128 bits, the original Rijndael cipher works with any block size (and any key size) that is a multiple of 32 as long as it exceeds 128. The state array for the different block sizes still has only four rows in the Rijndael cipher. However, the number of columns depends on size of the block. For example, when the block size is 192, the Rijndael cipher requires a state array to consist of 4 rows and 6 columns. DES was based on the Feistel network. On the other hand, what AES uses is a substitution permutation network in a more general sense. Each round of processing in AES involves byte-level substitutions followed by word-level permutations. Speaking generally, DES also involves substitutions and permutations, except that the permutations are based on the Feistel notion of dividing the input block into two halves, processing each half separately, and then swapping the two halves.

The Encryption Key and its Expansion

Assuming a 128-bit key, the key is also arranged in the form of a matrix of 4×4 bytes. As with the input block, the first word from the key fills the first column of the matrix, and so on[2]. The four column words of the key matrix are expanded into a schedule of 44 words. Each round consumes four words from the key schedule. Figure 1 depicts the arrangement of the encryption key in the form of 4-byte words and the expansion of the key into a key schedule consisting of 44 4-byte words.

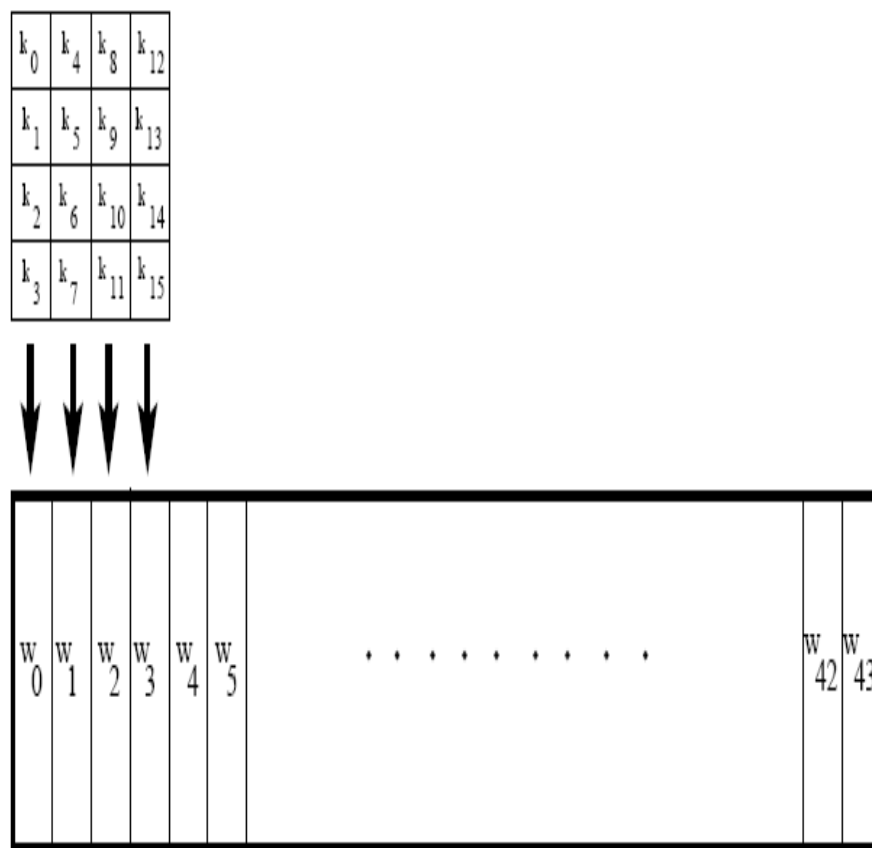


Figure 1: This Figure Shows the Four Words of the Original 128-Bit Key being Expanded into a Key Schedule Consisting of 44 Words

The Overall Structure of AES

The overall structure of AES encryption/decryption is shown in Figure 2. The number of rounds shown in Figure 2, 10, is for the case when the encryption key is 128 bit long. (As mentioned earlier, the number of rounds is 12 when the key is 192 bits, and 14 when the key is 256.) Before any round-based processing for encryption can begin, the input state array is XORed with the first four words of the key schedule. The same thing happens during decryption — except that now we XOR the cipher text state array with the last four words of the key schedule. For encryption, each round consists of the following four steps:

1) Substitute bytes, 2) Shift rows, 3) Mix columns, and 4) Add round key. The last step consists of XORing the output of the Previous three steps with four words from the key schedule. For decryption, each round consists of the following four steps:

1) Inverse shift rows, 2) Inverse substitute bytes, 3) Add round key, and 4) Inverse mix columns. The third step consists of XORing the output of the previous two steps with four words from the key schedule. Note the differences between the order in which substitution and shifting operations are carried out in a decryption round vis-a-vis the order in which similar operations are carried out in an encryption round. The last round for encryption does not involve the "Mix columns" step. The last round for decryption does not involve the "Inverse mix columns" step.

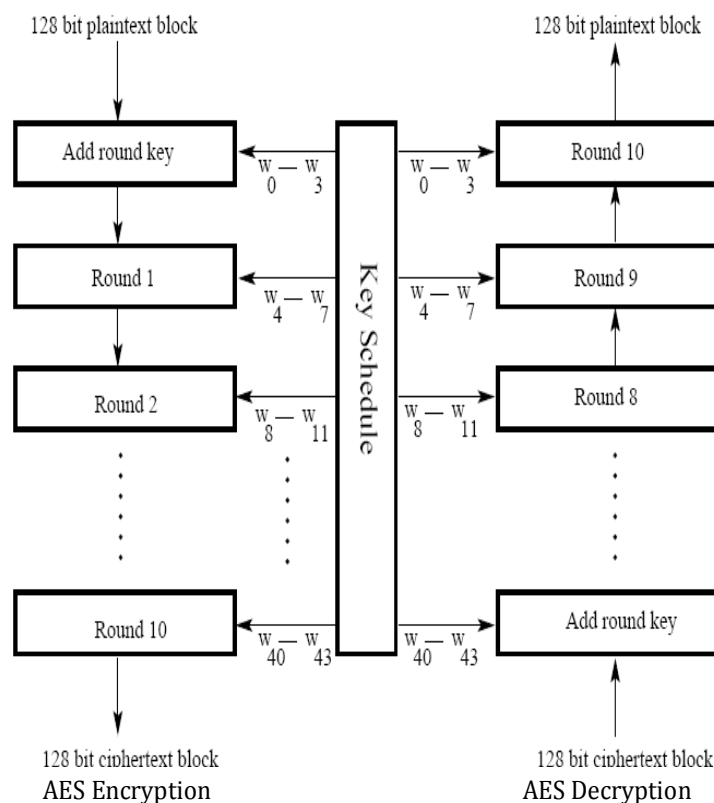


Figure 2: The Overall Structure of AES for the case of 128- Bit Encryption Key

III. BLOWFISH ALGORITHM

This is another popular algorithm that is used for Mobile cloud computing. This is also a symmetric block cipher that was designed by Bruce Schneier in 1993. It was originally designed as a general purpose algorithm. It uses key dependent S-Boxes and highly complex key-schedules [5]. It uses a 64 bit block size and variable key length that can range from 32 bits to 448 bits. 16 rounds are performed and its structure resembles CAST-128. Decryption is performed by initiating reverse rounds. Blowfish is a keyed, symmetric block cipher, designed in 1993 by Bruce Schneier and included in a large number of cipher suites and encryption products. Blowfish is a symmetric block cipher that can be used as a drop-in replacement for DES or IDEA.

There are two parts to this algorithm;

- 1) A part that handles the expansion of the key.
- 2) A part that handles the encryption of the data.

The expansion of the key: break the original key into a set of sub keys. Specifically, a key of no more than 448 bits is separated into 4168 bytes. There is a P-array and four 32-bit S-boxes. The P-array contains 18 32-bit sub keys, while each S-box contains 256 entries. The encryption of the data: 64-bit input is denoted with an x , while the P-array is denoted with a P_i (where i is the iteration).

The Blowfish Algorithm: Key Expansions

Blowfish has a 64-bit block size and a key length of anywhere from 32 bits to 448 bits (32-448 bits in steps of 8 bits; default 128 bits) [4]. It is a 16-round Feistel cipher and uses large key-dependent S-boxes. Figure 3 shows the action of Blowfish. Each line represents 32 bits. The algorithm keeps two sub key arrays: the 18-entry P-array and four 256-entry S-boxes. The S-boxes accept 8-bit input and produce 32-bit output. One entry of the P-array is used every round, and after the final round, each half of the data block is XORed with one of the two remaining unused P-entries. Initialize the P-array and S-boxes XOR P-array with the key bits. For example, P_1 XOR (first 32 bits of key), P_2 XOR (second 32 bits of key),

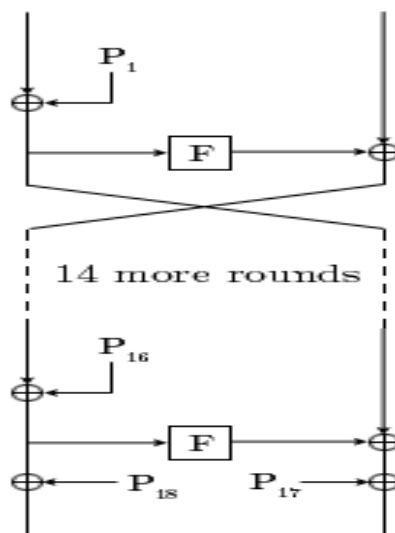


Figure 3: Action of Blowfish

Use the above method to encrypt the all-zero string. This new output is now P1 and P2. Encrypt the new P1 and P2 with the modified sub keys. This new output is now P3 and P4. Repeat 521 times in order to calculate new sub keys for the P-array and the four S-boxes [6].

The Figure 4 shows Blowfish's F-function. The function splits the 32-bit input into four eight-bit quarters, and uses the quarters as input to the S-boxes. The outputs are added modulo 2^{32} and XORed to produce the final 32-bit output. Since Blowfish is a Feistel network, it can be inverted simply by XORing P17 and P18 to the cipher text block, then using the P-entries in reverse order.

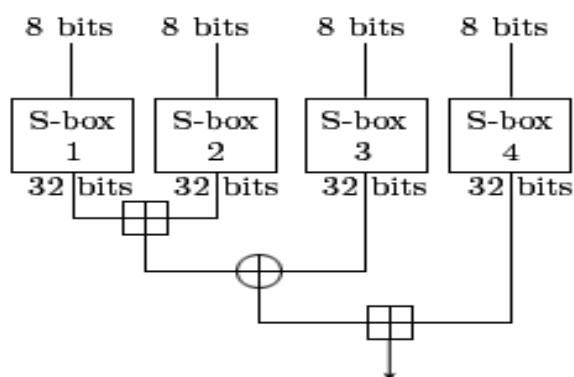


Figure 4: Diagram of Blowfish's F Function

Blowfish's key schedule starts by initializing the P-array and S-boxes with values derived from the hexadecimal digits of pi, which contain no obvious pattern. The secret key is then XORed with the P-entries in order (cycling the key if necessary). A 64-bit all-zero block is then encrypted with the algorithm as it stands. The resultant cipher text replaces P1 and P2. The cipher text is then encrypted again with the new sub keys, and P3 and P4 are replaced by the new cipher text. This continues, replacing the entire P-array and all the S-box entries. In all, the Blowfish encryption algorithm will run 521 times to generate all the sub keys - about 4KB of data is processed [7].

Cryptanalysis of Blowfish

Blowfish is one of the fastest block ciphers in widespread use, except when changing keys. Each new key requires pre-processing equivalent to encrypting about 4 kilobytes of text, which is very slow compared to other block ciphers. This prevents its use in certain applications, but is not a problem in others. In one application, it is actually a benefit: the password-hashing method used in Open BSD uses an algorithm derived from Blowfish that makes use of the slow key schedule; the idea is that the extra computational effort

required gives protection against dictionary attacks. In some implementations, Blowfish has a relatively large memory footprint of just over 4 kilobytes of RAM. This is not a problem even for older smaller desktop and laptop computers, but it does prevent use in the smallest embedded systems such as early smartcards. Blowfish is not subject to any patents and is therefore freely available for anyone to use. This has contributed to its popularity in cryptographic software.

IV. CONCLUSION

Cryptography is used to achieve Confidentiality, Authentication .In order to achieve these goals various cryptographic algorithms are developed by various people. From the above results, when you are interested in performance of algorithm, go for BLOWFISH and AES for the security of data, go for the AES. Finally for less time and more secure algorithm, AES algorithm is best [8].

REFERENCES

- [1] Sherif El-etriby, Eman M. Mohamed, Hatem S. Abdul-kader" Modern Encryption Techniques for Mobile cloud Computing Randomness and Performance Testing" in ICICT ,800-805 ,2012.Definition ", ACM SIGCOMM Computer Communication Review, Vol. 39, No. 1, 2009
- [2] Priyanka Arora, Arun Singh, Himanshu Tyagi "Analysis of performance by using security algorithm on mobile cloud network" in international conference on Emerging trends in engineering and management (ICETM2012), 23-24 June , 2012
- [3] Priyanka Arora, Arun Singh, Himanshu Tyagi " Evaluation and Comparison of Security Issues on Mobile cloud Computing Environment" in World of Computer Science and Information Technology Journal (WCSIT) ISSN: 2221-0741 Vol. 2, No. 5, 179-183, 2012.
- [4] http://en.wikipedia.org/wiki/Triple_DES, cited on Aug 21,2013
- [5] Ayushi, "A Symmetric Key Cryptographic aalgorithm", International Journal of Computer Applications, 2010.
- [6] B. Forouzan, "Cryptography and Network ecurity" 4th edition, Mc Graw Hill, Inc 2007.
- [7] Kamini H. Solanki[1], Chandni R. Patel[2]" New Symmetric Key Cryptographic algorithm for Enhancing Security of Data "International Journal Of Research In Computer Engineering And Electronics. PAGE # 1 ISSN 2319-376X VOL :1 ISSUE :3 (DEC 2012) .
- [8] Gurpreet Kaur, Manish Mahajan Evaluation and Comparison of Symmetric key algorithms, International Journal of Science, Engineering and Technology Research (IJSETR) Volume 2, Issue 10, October 2013

S. Saravanakumar has more than 11 years of teaching and research experience. He did his Postgraduate in ME in Computer Science and Engineering at Bharath engineering college, Chennai, and Ph.D. in Computer Science and Engineering at Bharath University, Chennai. He occupied various positions as Lecturer, Senior Lecturer, Assistant Professor, Associate Professor and Professor & HOD. He has published more than 20 research papers in High Impact factor International Journal, National and International conferences and visited many countries like Taiwan, Bangkok and Singapore. He has guiding a number of research scholars in the area Adhoc Network, ANN, Security in Sensor Networks, Mobile Database and Data Mining under Bharath University Chennai, Sathyabama University, St. Peters University, Veltech University.



ISSN
0975-6299

Bandwidth Recycling in Metropolitan Area Networks

B. Sangamithra*, Assistant Professor, Dept of CSE, SVEC, Tirupati, India. E-mail:mithra197@gmail.com

Dr. M. Sunil Kumar, Associate Professor & HOD, Dept of CSE, SVEC, Tirupati, India. E-mail:sunilmalchi1@gmail.com

Abstract---

In case of variable bite rate application, the subscriber station requires bandwidth for downlink and uplink of data transmission. As subscriber station cant estimate how much data it wants and to ensure the QOS guaranteed services, It may reserve more bandwidth than its demand. As a result, the reserved bandwidth may not be fully utilized all the time. Hence there is a wastage of bandwidth. This paper consists of a scheme named as 'Bandwidth Recycling', to recycle the unused bandwidth without changing the existing bandwidth reservation. In this scheme the subscriber station will used the available unused bandwidth. By this system throughput can also increase while maintain the same quality of services. In this scheme we use mathematical analysis and simulation. And this results in the scheme can recycle 35% of unused bandwidth on average. The extension for this project can also be showed by the three scheduling algorithms. Thus the simulation results to improve overall throughput by 40% in a steady network.

Index Terms--- IEEE 802.16 Standards, QOS, Recycling, Bandwidth, FDMA.

* Corresponding Author

I. INTRODUCTION

The worldwide interoperability for microwave Access (Wimax) which is based on IEEE 802.16 standard, is designed to facilitate services with high transmission rate for data and multimedia application in metropolitan areas. The physical (PHY) and Medium Access Control (MAC) layers of WIMAX have been specified in the IEEE 802.16 standards. Many advanced communication technologies such as Orthogonal Frequency Division Multiple Access (OFDMA) and Multiple-input & Multiple-output (MIMO) are also present in the standard. Supported by these modern technologies, WIMAX is able to provide a large services coverage, high data rates & QOS guaranteed services. Because of these features WIMAX is considered as a promising alternative for last mile broadband wireless access (BWA).

In order to provide QOS guaranteed services, the subscriber station (SS) has to reserve necessary bandwidth from the base station (BS) before any data transmission. In order to serve variable bit rate (VBR) applications, the SS tends to keep the reserved bandwidth to maintain the QOS guaranteed services. As a result, the reserved bandwidth transmission data may be more than the amount of transmission data and the reserved bandwidth may not be fully utilized all the times. Although the amount of reserved bandwidth is adjustable via. Making bandwidth request (BR), the adjusted bandwidth is applicable to the next coming frame because of this the unused bandwidth in the current frame has no change to be utilized. It is very difficult to adjust the amount of reserved bandwidth. Thus the SS may be exposed to the risk of degrading the QOS. To improve the bandwidth utilization while maintaining the same QOS guaranteed services, our research objective is two fold:

- The existing bandwidth reservation is not changed to maintain the same QOS guaranteed services.
- Our research work focuses on increasing the bandwidth utilization by utilizing the unused bandwidth.

We proposed a scheme, named bandwidth recycling, which recycles the unused bandwidth while keeping QOS with our introducing extra delay. The concept in our scheme is to allow other SSs to utilize the unused bandwidth left by the current transmission SS. The unused bandwidth is not supposed to occur regularly, our schema allow SSs with non-real time applications, which have more flexibility of delay requirements to recycle the unused bandwidth. Thus, our scheme improves the overall throughput while providing the same QOS guaranteed services. According to the IEEE 802.16 standard, SSs scheduled on the uplink (UL) MAP should have transmission opportunities in the current frame. We called SSs as the TSS (Transmission SSs) in this paper. The main idea of the proposed scheme is to allow the BS to schedule a backup SS to each TS. The backup SS is assigned to stand by for any opportunities to recycle the unused bandwidth of its corresponding TS. So, we call the backup SS as the complementary station (ss).

In the IEEE 802.16 standard, BR's are made in pre-connection basis. The BS allocates bandwidth in per SS basic. It gives the SS flexibility to allocate the granted bandwidth to each connection locally. Therefore, the unused bandwidth is defined as the granted bandwidth which is still available after serving all connections running on the SS. In our scheme, when a TS has unused bandwidth, it should transmit a message, called releasing message (RM), to inform its corresponding CS to recycle the unused bandwidth. However, because of the variety of the geographical distance between TS and CS and the transmission power of the TS, the CS may not receive the RM. Our theoretical analysis shows that this probability is least 42% which is confirmed by our simulation. By further investigating the factors that affect the effectiveness of our scheme, two factors are conclude.

- The CS cannot receive the RM
- The CS does not have non-real time data to transmit while receiving a RM.

To mitigate those factors, additional scheduling algorithms are proposed algorithm further improve the average throughput by 4% in a steady N/W.

II. BACKGROUND INFORMATION

IEEE 802.16 is written by a working group established by IEEE Standards Board in 1999 to develop standards for the global deployment of broadband 'Wireless Metropolitan Area Networks'. Then although the 802.16 family of standards is officially called wireless MAN in IEEE, it has been commercialized under the name "WIMAX".

In the IEEE 802.16 standard the physical (PHY) and Medium Access Control (MAC) layers of wimax have been specified. AND in this three types of transmission mediums supported as the physical layer (PHY). They

are single channel (SC) i.e., Using single signal at a given frequency and bandwidth, Orthogonal Frequency-Division Multiplexing (OFDM) i.e., it is essentially identical to coded OFDM (COFDM) and it is a frequency division multiplexing (FDM) scheme utilized as a digital multi-carrier modulation method orthogonal frequency-division multiple access (OFDMA) is a multi user version of the popular orthogonal frequency-division multiplexing (OFDM) digital modulation scheme. Multiple access is achieved in OFDMA by assigning subsets of subcarriers to individual users. Hence OFDMA assume as the PHY in our analytical model since it is employed to support mobility in IEEE 802.16e standard (the true mobile wimax standard of 802.16e is divergent from fixed wimax) and the scheme working in this should also work in others. Various types of modulations supported by OFDMA is BSPK (binary phase shift keying modulation) QPSK (quadrature phase shift keying modulation), 16-QAM (quadrature amplitude modulation) 64-QAM.

Here focused on point to multi point(PMP) made in which the ss will not allow to communicate with another ss but the bs directly. Depending on the transmission direction, bs and ss communication classified into downlink(DL) and uplink(UL) transmissions. Hence the former transmission is BS TO SS. Conversely SS to BS.As IEEE 802.16 supports two types of transmission modes. Both UL and DL transmissions can not be operated simultaneously in time division duplex(TDD) but it can in frequency division duplex (FDD) mode. In this paper we focused on the TDD mode. BS is responsible for scheduling both UL and DL transmissions in wimax. All these behavior is expressed in a MAC frame.

In IEEE 802.16 standard the structure of a MAC frame contains two parts, UL and DL subframe for UL transmissions and DL transmissions respectively. In this IEEE 802.16 networks is coordinated by the BS. All the required details including burst profiles and offsets is in the DL and UL maps, which are broadcasted at the beginning of a MAC frame. This is a connection-oriented. It gives the advantage of having better control over network resource to provide QOS guaranteed services. It support wide variety of applications, the IEEE 802.16 standard classifies traffic into five scheduling classes : Unsolicited Grant Service(UGS) i.e., is a service flow in which the transmission system automatically and periodically provides a defines number of timeslots and fixed packet size that is used by a particular receiver., Real Time Polling Service(rtps) i.e., It is designed to support real-time service flows that generate variable size data packets on a periodic basis, such as MPEG video,, Non-Real Time Polling service(nrtPS) i.e., It is designed to support non-real time service flows that require variable size Data Grant Burst Types on a regular basis, such as high bandwidth FTP(File Transfer Protocol), Best Effort(BE), Extended Real Time Polling Service(ertPS) i.e., it is a scheduling mechanism that builds on the efficiency of both UGS and rtps. It is designed for realtime traffic with variable data rate over the WIMAX. Each application is classified into one of the scheduling classes and establish a connection with the BS based on its scheduling class. The BS assigns a connection ID(CID) to each connection. The bandwidth reservation is made based on the CID via sending a BR when receiving a BR, the BS can either grant or reject the BR depending on its available resource and scheduling policies.

Types of BRs defined in the IEEE 802.16 standard are incremental and aggregate BRs. The former allow the SS to indicate the extra bandwidth required for a connection. Thus, the amount of reserved bandwidth can be only increased via incremental BRs. On the other hand, the SS specifies the current state of queue for the particular connection via a aggregate request. The BS resets its perception of that service's needs upon receiving the request. Consequently, the reserved bandwidth may be decreased.

III. MOTIVATION AND RELATED WORK

To provide QOS guaranteed services Bandwidth reservation allows IEEE 802.16 networks to provide QOS guaranteed services. The SS reserves the required bandwidth before any data transmissions. Due to the nature of VBR applications, it is very difficult for the SS to make the optimal bandwidth reservation. It is possible that the amount of reserved bandwidth is more than the demand. Therefore, the reserved bandwidth cannot be fully utilized. Although the reserved bandwidth can be adjusted via BRs, however, the updated reserved bandwidth is applied as early as to the next coming frame and there is no way to utilize the unused bandwidth in the current frame. In our scheme, the SS releases its unused bandwidth in the current frame and another SS pre-assigned by the BS has opportunities to utilize this unused bandwidth. This improves the bandwidth utilization. Moreover, since the existing bandwidth reservation is not changed, the same QoS guaranteed services are provided without introducing any extra delay.

IV. PROPOSED SCHEME

The objectives of our research are twofold:

- The same QoS guaranteed services are provided by maintaining the existing bandwidth reservation.
- The bandwidth utilization is improved by recycling the unused bandwidth.

To reach these objectives, our scheme named *Bandwidth Recycling* is proposed. The main idea is to allow the BS to pre-assign a CS for each TS at the beginning of a frame. The CS waits for its time (the possible opportunities) to recycle the unused bandwidth of its corresponding TS in this frame. The CS information scheduled by the BS is resided in a list, called complementary list (CL). The CL includes the mapping relation between each pair of pre-assigned CS and TS. Each CS is mapped to at least one TS. The CL is broadcasted followed by the UL map. To reach the backward compatibility, a broadcast CID (B-CID) is attached in front of the CL. Moreover, a stuff byte value (SBV) is transmitted followed by the B-CID to distinguish the CL from other broadcast DL transmission intervals.

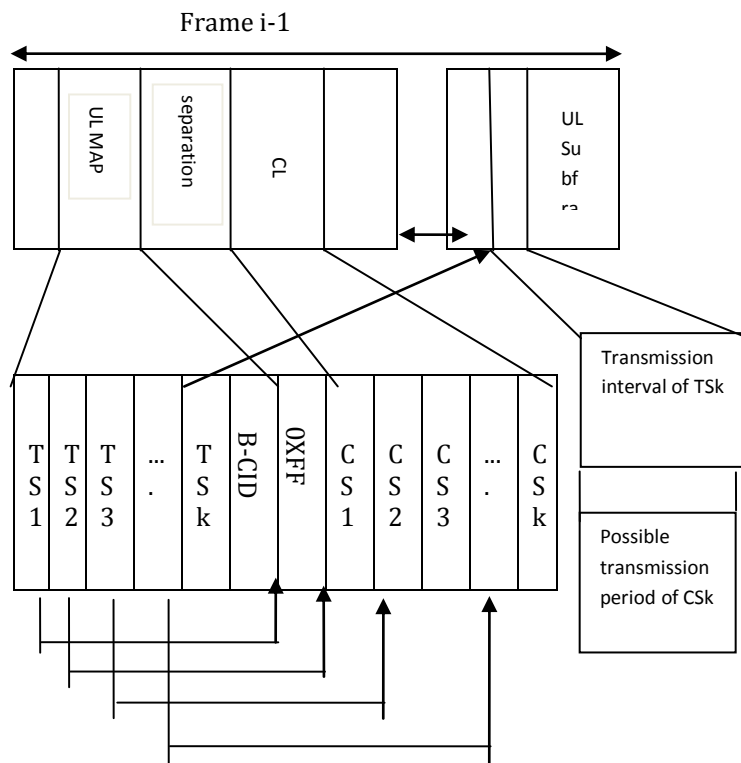


Fig.1. The Mapping relation between CSs and TSs in aMAC Frame

The UL map including burst profiles and offsets of each TS is received by all SSs within the network. Thus, if a SS is on both UL map and CL, the necessary UL MAP and CL, the necessary information (e.g., burst profile) residing in the CL may be reduced to the mapping information between the CS and its corresponding TS. The BS only specifies the burst profiles for the SSs which are only scheduled on the CL. For example, CS_j is scheduled as the corresponding CS of TS_j , where $1 \leq j \leq k$. When TS_j has unused bandwidth, it performs our protocol introduced in Section protocol. If CS_j receives the message sent from TS_j , it starts to transmit data by using the agreed burst profile. The burst profile of a CS is resided on either the UL map if the CS is also scheduled on the UL map or the CL if the CS is only scheduled on CL. Our proposed scheme is presented into two parts: the protocol and the scheduling algorithm. The protocol describes how the TS identifies the unused bandwidth and informs recycling opportunities to its corresponding CS.

Protocol

As in IEEE 802.16 standard, the allocated space within a data burst that is unused should be initialized to a known state. Each unused byte should be set as a padding value (i.e., 0xFF), called stuffed byte value (SBV). If the size of the unused region is at least the size of a MAC header, the entire unused region is initialized as a MAC PDU. The padding CID is used in the CID field of the MAC PDU header. In this research, we intend to

recycle the unused space for data transmissions. Instead of padding all portion of the unused bandwidth in our scheme, a TS with unused bandwidth transmits only a SBV and a RM. The SBV is used to inform the BS that no more data are coming from the TS. On the other hand, the RM comprises a generic MAC PDU with no payload. The mapping information between CL and UL map is based on the basic CID of each SS. The CID field in RM should be filled by the basic CID of the TS. Moreover, the transmission coverage of the RM should be as large as possible in order to maximize the probability that the RM is able to be received successfully by the CS. To maximize the transmission coverage of the RM, one possible solution is to increase the transmission power of the TS while transmitting the RM. However,

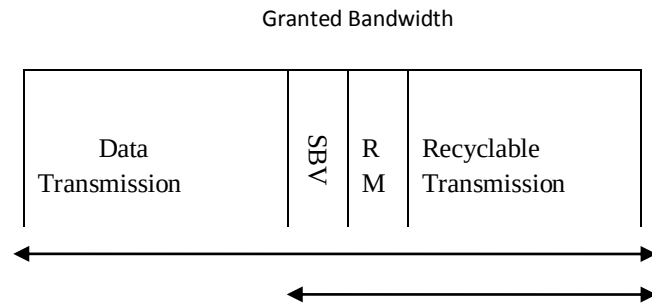


Fig.2. Messages to release the unused bandwidth within a UL transmission interval.

HT=0	EC	TYPE	Rev	CI	EKS	Rsv	LEN MSB
LEN LSB			CID MSB				
CID LSB			HCS				

Fig.3. The format of RM.

The power may be a critical resource for the TS and should not be increased dramatically. Therefore, under the circumstance of without increasing the transmission power of the TS, the RM should be transmitted via BPSK which has the largest coverage among all modulations supported in the IEEE 802.16 standard. For example, illustrates the physical location of the BS, TS and CS, respectively. The solid circle represents the coverage of QPSK which is the modulation for data transmissions between BS and TS. When the TS has unused bandwidth, it transmits a SBV via this modulation (i.e., QPSK) to inform the BS that there are no more data coming from the TS. It is easy to observe that the corresponding CS is out of QPSK coverage. In order to maximize the coverage of the RM under the circumstance of without increasing the transmission power of the TS, the TS transmits the RM via BPSK which coverage is represented by the dished circle. The radius of the dished circle is KL , where L is the distance between TS and BS and K is the ratio of transmission range of BPSK to the transmission range of QPSK depending on the transmission power. Assume all channels are in good condition. As long as the CS is within the coverage of BPSK, it can receive the RM successfully and start to recycle the unused bandwidth. Since both UL map and CL can be received by the CS, the CS knows the UL transmission period of its corresponding TS. This period is called the UL transmission interval. The CS monitors this interval to see if a RM. An example of corresponding locations of

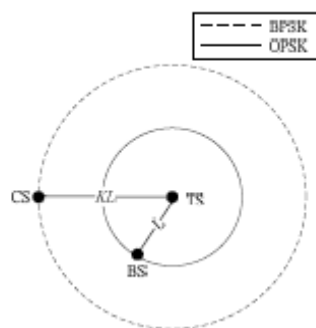


Fig.4. An example of TS,BS and CS.

TS, BS and CS is received from its corresponding TS. Once received, the CS starts to recycle the unused bandwidth by using the burst profile residing in either UL map or CL, until using up the rest of the TS's transmission interval. If the CS does not have any data to transmit, it simply pads the rest of the transmission interval.

Scheduling Algorithm

Let us consider Q represents the set of SSs serving non-real time connections like nrtPS or BE connections and T is the set of TSs. As this scheme follows TDD, the UL and DL operations cannot be performed simultaneously, we cannot schedule the SS which UL transmission interval is overlapped with the target TS. For any TS, St , let O_t be the set of SSs which UL transmission interval overlaps with that of St in Q . Thus, the possible corresponding CS of St must be in $Q - O_t$. All SSs in $Q - O_t$ are considered as candidates of the CS for St . This scheduling algorithm, called *Priority-based Scheduling Algorithm (PSA)*, is used to schedule a SS with the highest priority as the CS. The priority of each candidate is decided based on the scheduling factor (SF) defined as the ratio of the current requested bandwidth (CR) to the current granted bandwidth (CG). The SS with higher SF has more demand on the bandwidth. Hence, we give the higher priority to those SSs. The highest priority is given to the SSs with zero CG. Non-real time connections include nrtPS and BE connections. The nrtPS connections should have higher priority than the BE connections because of the QoS requirements. The priority of candidates of CSs is concluded from high to low as: nrtPS with zero CG, BE with zero CG, nrtPS with non-zero CG and BE with non-zero CG. If there are more than one SS with the highest priority, we select one with the largest CR as the CS in order to decrease the probability of overflow.

Algorithm 1 Priority-based Scheduling Algorithm

Input: T is the set of TSs scheduling on the UL map

Q is the set of SSs running non-real time Applications.

Output: Schedule CSs for all TSs in T .

For $i=1$ to $||T||$ **do**

- a. $S_t \leftarrow TS_i$.
- b. $Q_t \leftarrow Q - O_t$.
- c. Calculate the SF for each SS in Q_t .
- d. **If** Any SS $\in Q_t$ has zero granted bandwidth,
If Any SSs have nrtPS traffics and zero granted bandwidth,
Choose one running nrtPS traffics with the largest CR.
Else
Choose one with the largest CR.
Else
Choose one with largest SF and CR.
- e. Schedule the SS as the corresponding CS of S_t .

End For

V. ANALYSIS

The presence of percentage of potentially unused bandwidth occupied in the reserved bandwidth is critical for the potential performance gain of our scheme. we investigate this percentage on VBR traffics which is popularly used today. In order to that, in our scheme, each TS should transmit a RM to inform its corresponding CS when it has unused bandwidth. However, the transmission range of the TS may not be able to cover the corresponding CS. It depends on the location and the transmission power of the TS. There is chance that CS does not receive the RM, thus results in failure of utilizing unused bandwidth. So, the benefit of our scheme is reduced. In this section, we analyze mathematically the probability of a CS to receive a RM successfully. As a result probability affects the bandwidth recycling rate (BBR).BBR stands for the percentage of the unused bandwidth which is recycled. Moreover, the performance analysis is presented in terms of throughput gain (TG). At the end, we evaluate the performance of our scheme under different traffic load. All analytical results are validated by the simulation.

The Probability of RMs received by the corresponding CSs Successfully

Let us assume a BS resides at the center of a geographical area. There are n SSs uniformly distributed in the coverage area of the BS. Since PMP mode is considered, the transmissions only exits between BS and SSs. Moreover, each SS may be in different locations. The transmission rate of each SS may be variant depending on the PHY transmission technology and transmission power. For a given SS, S_t , let $R_t^{(B)}$, $R_t^{(Q)}$, $R_t^{(16)}$ and $R_t^{(64)}$ denote as the transmission range of BPSK, QPSK, 16-QAM and 64-QAM, respectively. In our scheme, the RM should be transmitted via the most robust modulation. Since it has the largest coverage of RMs among all modulations supported by the IEEE 802.16 standard without adjusting the transmission power. Based on the fixed transmission power, the relation of transmission range between modulations is expressed as:

$$R_t^{(B)} = K_t^{(Q)} R_t^{(Q)} = K_t^{(16)} R_t^{(16)} = K_t^{(64)} R_t^{(64)}$$

Where $K_t^{(Q)}$, $K_t^{(16)}$ and $K_t^{(64)}$ are constants depending on the transmission power of S_t and $K_t^{(64)} \geq K_t^{(16)} \geq K_t^{(Q)} \geq 1$. Then again the RM should be transmitted via BPSK. In the rest of the paper, we use R_t to represent the BPSK transmission range of S_t . Moreover, S_B and R are denoted the BS and its transmission range of BPSK, respectively.

Depending on the distance between them and the modulation used for communications. In our scheme, we do not intend to change the transmission power. Therefore, the RM should be transmitted via BPSK to maximize the transmission coverage of the RM may not be able to cover the whole servies area of S_B . Consequently, the CS may not able to receive the RM. And the location therefore, we must analyze the probability that a CS receives a RM from its corresponding TS successfully. We can analyze the probability that a CS receives a RM from its corresponding TS successfully. We can analyze the average value of this probability. Transmission Station S_t , suppose S_j is denoted as the CS of S_t . The relation between S_t and S_B can be classified into two categories based on the location of S_t . The Coverage of S_t is within the coverage of S_B

In this category, the coverage of S_t , denoted as A_{in} , can be derived as:

$$A_{in} = \pi R_t^2$$

The probability of S_j receiving a RM denoted as $P_c^{(t)}$ is the same as the ratio of coverage of S_t to S_B .

$$P_c(t) = R_t^2 / R^2$$

Moreover, the coverage of the two stations must intersect on no more than one point.

Suppose L represents the distance b/w S_t & S_B .

The condition here is

$$L \leq R - R_t$$

Because R_t represents the basic transmission range of S_t , we can have:

$$R_t = K L$$

Where K is a constant depending on the transmission power and modulation that S_t uses to communicate with S_B . Thus

$$L \leq R / (K+1)$$

The probability of S_t within this category is

$$P_{oe}(t) = K^2 / (1+K^2)$$

The probability is S_j to receive a RM from S_t is concluded as:

$$\text{Mean } P_t(t) = P_c(t) \cdot P_{oc}(t)$$

Consequently, in average, the probability of a CS to receive the RM from its corresponding TS is derived as

$$p_t = \frac{\sum_{t=1}^{|T|} p_t(t)}{|T|}$$

Where T is the set of all TSs.

VI. SIMULATION RESULTS

In this section, we first present our simulation model followed by introducing the definition of performance metrics used for measuring the network performance. The simulation results are shown as the third part of this section. At the end, we provide the validation of theoretical analysis and simulation results.

Simulation Model

In our model we comprises one BS residing at the center of geographical area and 50 SSs uniformly distributed in the service coverage of BS. The parameters of PHY and MAC layers used in the simulation are summarized in Table 1. PMP mode is employed in our model. Since our proposed scheme is used to recycle the unused bandwidth in UL subframe, the simulation only focuses on the performance of UL transmissions.

The System Parameters used in our Simulation

Parameters	Value
Node number	51(including BS)
Frame duration	20MS
UL/DL subframe duration	10MS
Modulation scheme	BPSK,QPSK,16QAM,64QAM
DCD/UCD broadcast interval	5s
TTG/RTG	10US
SS transition gap(SSTG)	4US

CBR is a typical traffic type used to measure the performance of networks in WiMAX research. However, it may not be able to represent the network traffic existing in real life. Moreover, the IEEE 802.16 network aims to serve both data and multi-media applications. Most of the modern streaming videos are encoded by industrial standards (e.g., H.264 or MPEG 4) which generate data in variant rates. In this research, we include VBR traffics to illustrate H.264 and MPEG 4-encoded videos. In our simulation, the traffic models for these streaming videos are based on related research [12] [13] [14]. Additionally, other commonly used VBR traffics such as HTTP and FTP applications are also included in our simulation. The characteristics of traffic types are summarized in Table2.

In our simulation, each SS serves at least one and up to 5 connections. Each connection serves one type of traffic which is mapped to the scheduling classes supported in the IEEE 802.16 standards (i.e., UGS, rtPS, ertPS, nrtPS and BE). Table 2 enumerates all types of traffic and their corresponding scheduling classes used in our simulation. In particular, all VBR traffic in our simulation is considered as ON/OFF traffic. We fix the mean data rate of each application but make the mean packet size randomly selected from 512 to 1024 bytes. Thus, the mean packet arrive rate can be determined based on the corresponding mean packet size. As mentioned earlier, the size of each packet is modeled as Poisson distribution and the packet arrival rate is modeled as exponential distribution. For example, in order to simulate the network traffics more realistically, the start time of each connection is randomly selected from 0 to 15th second. Moreover, the real time connection stops to generate data from 75th to 100th second. It is for investigating the performance of our scheme when the large amount of unused bandwidth is available. Therefore, the number of active connections (the connections which are transmitting data) may be different during the simulation.

The traffic model used in the simulation

Application	VoIP	Multimedia	HTTP	FTP
Traffic type	CBR	VBR	VBR	VBR
Scheduling class	UGS	RtPS	BE	nrtPS
Start Time(sec.)	m*	m*	m*	m*
End Time(sec.)	n*	n*	100	100
Mean Packet Size	512	Z*	Z*	Z*
Mean Bit Rate	122kbps	2Mbps	2Mbps	50Mbps
Max burst Size(Bytes)	31	7.5k	10	1500k
Packet Size	Fixed	P*	P*	P*
Packet Arrival Rate	Fixed	E*	E*	E*
Note: m * is a random number between 0 and 15. n * is a random number between 75 and 100. Z* is a random number between 512 and 1024 bytes. P* stands for Poisson distribution E* stands for Exponential distribution.				

The Performance Metrics

The simulation for evaluating the performance of the proposed scheme is based on the three metrics:

1) Throughput gain (TG):

It represents the percentage of throughput which is improved by implementing our scheme. The formal definition can be expressed as

$$TG = \frac{T_{\text{recycle}} - T_{\text{no\_recycle}}}{T_{\text{no\_recycle}}}$$

where T_{recycle} and $T_{\text{no-recycle}}$ represent the throughput with and without implementing our scheme, respectively. The higher TG achieved shows the higher performance that our scheme can make.

2) Unused bandwidth rate (UBR):

It is defined as the percentage of the unused bandwidth occupied in the total granted bandwidth in the system without using bandwidth recycling. It can be defined formally as:

$$UBR = \frac{B_{\text{unused\_BW}}}{B_{\text{total\_BW}}}$$

where $B_{\text{unused\_bw}}$ and $B_{\text{total\_bw}}$ are the unused bandwidth and total allocated bandwidth, respectively. The UBR shows the room which can be improved by our scheme. The higher UBR means the more recycling opportunities.

3) Bandwidth recycling rate (BRR):

It illustrates the percentage of bandwidth which is recycled from the unused bandwidth. The percentage can be demonstrated formally as:

$$BRR = \frac{B_{\text{recycled}}}{B_{\text{unused\_BW}}}$$

where B_{recycled} is the bandwidth recycled from $B_{\text{unused\_bw}}$. BRR is considered as the most critical metric since it directly reveals the effectiveness of our scheme.

Simulation Results

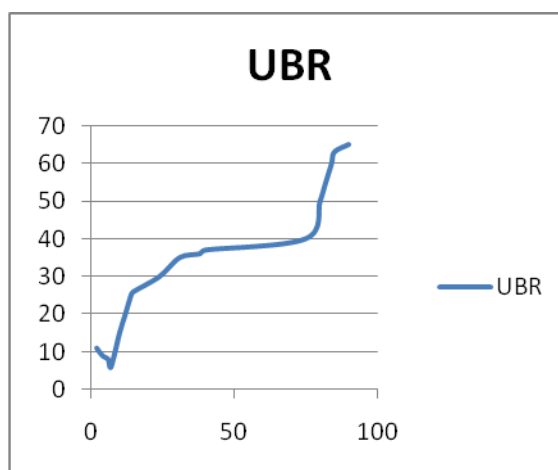


Fig.5. Simulation results of UBR

Fig. 5 presents the percentage of the unused bandwidth in our simulation traffic model (i.e., *UBR*). It shows the room of improvement by implementing our scheme. From the simulation results, we conclude that the average *UBR* is around 38%. In the beginning, the *UBR* goes down. It is because each connection still requests bandwidth from the BS. As time goes on, the *UBR* starts to increase when the connection has received the requested bandwidth. After 75th second of simulation time, *UBR* increases dramatically due to the inactivity of real time connections. The purpose to have inactive real time connections is to simulate a network with large amount of unused bandwidth and evaluate the improvement of the proposed scheme in such network status. The evaluation is presented in the later of this section.

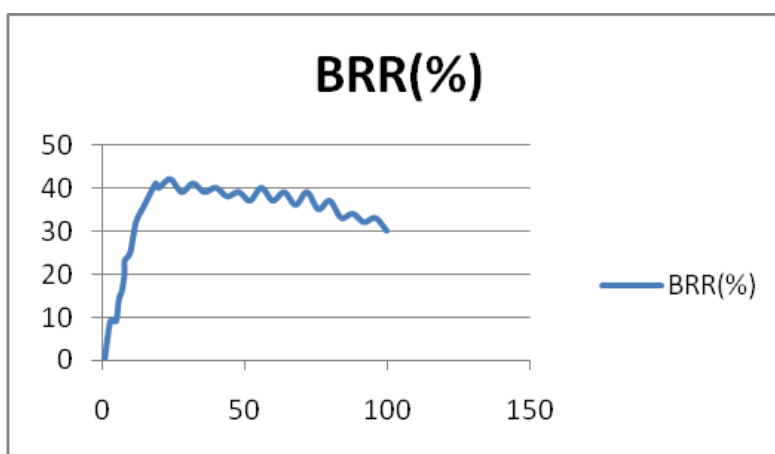


Fig.6. Simulation results of BRR

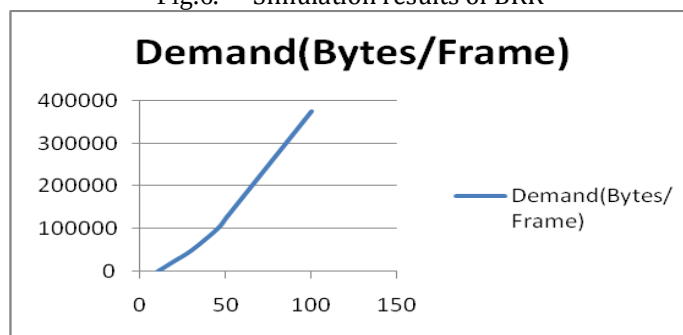


Fig.7. Total Bandwidth Demand

The simulation results of recycling rate are presented in Fig. 6. From the figure, we observe that the recycling rate is very close to zero at the beginning of the simulation. It is because that only a few connections transmit data during that time and the network has a light load. Therefore, only few connections need to recycle the unused bandwidth from others. As time goes on, many active connections join in the network. The available bandwidth may not be able to satisfy the needs of connections. Therefore, there is a high probability that the CS recycles the unused bandwidth. It leads a higher *BRR*. Fig. 7 shows the total bandwidth demand requested by SSs during the simulation. In the figure, the dashed line indicates the system bandwidth capacity. During the simulation, the BS always allocates the bandwidth to satisfy the demand of real time connections due to the QoS requirement. Therefore, the amount of bandwidth allocated to non-real time connections may be shrunk. At the same time, the new non-real time data are generated. Therefore, the non-real time data are accumulated in the queue. It is the reason that the demand of bandwidth keeps increasing.

VII. CONCLUSION

Variable bit rate applications generate data in variant rates. It is very challenging for SSs to predict the amount of arriving data precisely. Although the existing method allows the SS to adjust the reserved bandwidth via bandwidth requests in each frame, it cannot avoid the risk of failing to satisfy the QoS requirements. Moreover, the unused bandwidth occurs in the current frame cannot be utilized by the existing bandwidth adjustment since the adjusted amount of bandwidth can be applied as early as in the next coming frame. Our research does not change the existing bandwidth reservation to ensure that the same QoS guaranteed services are provided. We proposed *bandwidth recycling* to recycle the unused bandwidth once it occurs. It allows the BS to schedule a complementary station for each transmission stations. Each complementary station monitors the entire UL transmission interval of its corresponding TS and standby for any opportunities to recycle the unused bandwidth. Besides the naive priority-based scheduling algorithm, three additional algorithms have been proposed to improve the recycling effectiveness. Our mathematical and simulation results confirm that our scheme can not only improve the throughput but also reduce the delay with negligible overhead and satisfy the QoS requirements.

REFERENCES

- [1] IEEE 802.16 WG, "IEEE Standard for Local and Metropolitan Area Network Part 16: Air Interface for Fixed Broadband Wireless Access Systems" IEEE Std 802.16-2004 p.1 - p.857
- [2] IEEE 802.16WG, "IEEE standard for local and metropolitan area networks part 16: Air interface for fixed and mobile broadband wireless access systems, Amendment 2," IEEE 802.16 Standard, December 2005.
- [3] ianhua He, Kun Yang and Ken Guild "A Dynamic Bandwidth Reservation Scheme for Hybrid IEEE 802.16 Wireless Networks" ICC'08 p.2571-2575.
- [4] Kamal Gakhar, Mounir Achir and Annie Gravey, "Dynamic resource reservation in IEEE 802.16 broadband wireless networks", IWQoS, 2006. p.140-148
- [5] J. Tao, F. Liu, Z. Zeng, and Z. Lin, Throughput enhancement in WiMax mesh networks using concurrent transmission, In Proc. IEEE Int. Conf. Wireless Commun., Netw. Mobile Comput., 2005, p.871V874.
- [6] Xiaofeng Bai, Abdallah Shami and Yinghua Ye "Robust QoS Control for Single Carrier PMP Mode IEEE 802.16 Systems", IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 7, NO. 4, APRIL 2008, p.416-429
- [7] Eun-Chan Park, Hwangnam Kim, Jae-Young Kim, Han-Seok Kim "Dynamic Bandwidth Request-Allocation Algorithm for Real-time Services in IEEE 802.16 Broadband Wireless Access Networks", INFOCOM 2008, p.852 - 860
- [8] Thomas G. Robertazzi "Computer Networks and Systems: Theory and Performance Evaluation." Springer-Verlag 1990
- [9] Kamal Gakhar, Mounir Achir and Annie Gravey, "How Many Traffic Classes Do We Need In WiMAX?," WCNC 2007, p.3703-3708
- [10] Giuseppe Iazeolla, Pieter Kritzinger and Paolo Pileggi, "Modelling quality of service in IEEE 802.16 networks," SoftCOM 2008. p.130-134
- [11] Qualnet, http://www.scalable-networks.com/products/developer/new_in_45.php
- [12] Frank H.P. Fitzek, Martin Reisslein, "MPEG-4 and H.263 Video Traces for Network Performance Evaluation", IEEE Network, Vol. 15, No. 6, p.40-54, November/December 2001

- [13] Patrick Seeling, Martin Reisslein, and Beshan Kulapala, "Network Performance Evaluation Using Frame Size and Quality Traces of Single-Layer and Two-Layer Video: A Tutorial", IEEE Communications Surveys and Tutorials, Vol. 6, No. 2 p.58-78, Third Quarter 2004
- [14] Geert Van der Auwera, Prasanth T. David, and Martin Reisslein, "Traffic and Quality Characterization of Single-Layer Video Streams Encoded with H.264/AVC Advanced Video Coding Standard and Scalable Video Coding Extension", IEEE Transactions on Broadcasting Vol. 54, No. 3 p.698-718 September 2008