

Kinesiology

2019 4(2)

<Index>

1. A SPORTS Nutrition Supplement, Albizia Julibrissin Extract Fermented with Kefir Yogurt Regulates Lipopolysaccharideinduced Inflammatory Signal.
/ Kang Hye-ra, Yang Han-joon
2. The Safety Control and Injury Prevention of Collegiate SPORT Activities in CHINA.
/ Bai Xuefeng, Shin Hong-bum, Zhao Xuemei
3. Comparison of Validity and Accuracy of Circumference, SKF, and BIA Method in Predicting % Body Fat.
/ Cho Chang-mo
4. Verification of Mediating Effects of Training Attitude on the Relationship between Motivation for Participation in Security MARTIAL ARTS and Training Flow of Students Majoring in Security Services.
/ Shin Min-chul, Hong Seong-bong
5. Analysis on Consciousness Structure of HOSPICE Patients and Effectiveness of the Horticultural Therapy.
/ Shin Young-sook, Lim Won-hyeon
6. Comparison of Anaerobic Power According to the Performance Level of Male Middle School HANDBALL Players.
/ Kim Tae-hun

Publication state: Japan
ISSN: 2435-0702

Publisher: J-INSTITUTE
Website: <http://www.j-institute.jp>

Corresponding author
E-mail: hanjoon.yang@hallym.ac.kr

Peer reviewer
E-mail: kinesiology@j-institute.jp

<http://dx.doi.org/10.22471/kinesiology.2019.4.2.01>

© 2019 J-INSTITUTE

A SPORTS Nutrition Supplement, Albizia Julibrissin Extract Fermented with Kefir Yogurt Regulates Lipopolysaccharide-induced Inflammatory Signal

Kang Hye-ra¹

Deawon University College, Jecheon, Republic of Korea

Yang Han-joon^{2*}

Hallym University of Graduate Studies, Seoul, Republic of Korea

Abstract

Although the inflammatory response is vital for biological regulation, chronic inflammation damages the human body. Presently available anti-inflammatory drugs, including steroids, have side effects that prevent their administration to athletes. This study aimed at elucidating a method to control exercise-induced inflammation and oxidative stress, by investigating the anti-inflammatory and antioxidant efficacy of extracts of *Albizia julibrissin* fermented with kefir yogurt (FKA) *in vitro*. We investigated the effect of FKA on RAW 264.7 cells using cell viability assays. The regulatory effect of FKA in lipopolysaccharide (LPS)-induced nitric oxide (NO) production was determined using Griess reagent and the reverse transcription polymerase chain reaction (RT-PCR) assays, with specific primers such as interleukin (IL)-1 β , IL-6, and IL-10, inducible nitric oxide synthase (iNOS), and cyclooxygenase-2 (COX-2) *in vivo*. Furthermore, the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay was performed and the cellular morphology changes were observed using fluorescence microscopy. The results showed that FKA significantly reduced LPS-induced NO production by regulating the expression of IL-1 β , iNOS, and COX-2; thus, FKA exerts cytoprotective effects against ROS-induced cell death. These data suggest the anti-inflammatory therapeutic potential of FKA.

[Keywords] *Albizia Julibrissin, Kefir, Anti-Inflammation, IL-1 β , iNOS*

1. This Regulation is Aimed at the Systemization

1.1. Introduction

Inflammation is a biological defense mechanism used by the body to protect against stimuli such as cytokines and free radicals, which occur during tissue injury or infection. When macrophages are stimulated by lipopolysaccharides (endotoxins), they release inflammatory cytokines such as interleukin (IL)-1 β and IL-6, which induce the expression of nitric oxide synthase (iNOS), cyclooxygenase-2 (COX-2), and inflammatory factors such as nitric oxide (NO) and Prostaglandin E2 [1].

Although NO generation plays a crucial role in cellular immune homeostasis during bacterial in-

fections, its excessive generation adversely affects cellular metabolism. Particularly, the binding of NO to reactive oxygen species (ROS) during exercise can cause muscle ache and damage, which can be fatal to athletes [2][3].

Kefir is mushroom-shaped fermented milk made by Tibetan monks for immunity enhancement, and is well known as Tibetan mushroom yogurt. It is fermented using yeast, and produces vitamins, essential amino acids, and polysaccharides, which augment its bioactive function by improving its antimicrobial effect [4].

Albizia julibrissin has been used in Korean traditional medicine to improve muscle pain and stamina [5]. In the present study, we investigated the effects of *Albizia julibrissin* extract fermented with kefir yogurt (FKA) on lipopolysaccharide (LPS)-stimulated RAW 264.7 macrophages.

2. Methods

2.1. Chemicals

Cell culture reagents were purchased from Gibco-BRL(Gaithersburg, MD, USA). The EZ-cytox cell viability assay was obtained from Daeil Lab Service(Seoul, Korea). The LIVE/DEAD cell viability assay kit was purchased from Thermo Fisher Scientific(Grand Island, NY, USA). All other reagents were purchased from Sigma (St. Louis, MO, USA).

2.2. Experimental design

The EZ-cytox cell viability assay was used to evaluate cell viability, the reverse transcription polymerase chain reaction(RT-PCR) to test the mRNA expression levels of cytokines and inflammatory factors, and the ROS generation assay to determine the cytoprotective effect of FKA.

2.3. Procedures

2.3.1. Fermented plant extraction

Albizia julibrissin was obtained from Dongguk University Oriental Hospital, Korea. One hundred grams of the plant was blended, the crude powder fermented with Kefir yogurt at 25°C for 3 days, and then precipitated with 1000 mL of sterile deionized water at 100°C for 3 h. The aqueous extracts were concentrated and evaporated at 60°C in a vacuum. The extract was then dissolved in 50 mL of sterile deionized water, and lyophilized by freeze-drying at -60°C.

2.3.2. Cell culture and cell viability assay

Cell culture and viability assay were performed as previously reported[6]. RAW 264.7 cells were cultured in DMEM containing 10% FBS and 1% penicillin–streptomycin, in a humidified atmosphere containing 5% CO₂ at 37°C. The cells(5 × 10⁴ cells) were seeded in a 96-well microplate, and incubated with different concentrations of FKA for 24 h. Thereafter, cell viability was measured with ELISA using the EZ-cytox cell viability assay kit. The data were acquired using an ELISA reader according to the manufacturer's instructions.

2.3.3. NO generation assay

This assay was performed as previously reported [6]. RAW 264.7 cells in a 96-well microplate(5 × 10⁴ cells/well) were co-treated with 10–30 µg/mL FKA, in the absence or presence of 100 ng/mL LPS, and cultured for 48 h in DMEM supplemented with 10% FBS. To determine the total concentration of NO in the culture media, Griess reagent was added to 100 µL of the supernatant of each treatment condition, and absorbance was measured at 520 nm using a microplate reader.

2.3.4. RT-PCR

RT-PCR assays were performed as previously reported[7]. The total RNA in the cell lysates were isolated using TRI-reagent and then cDNA was synthesized using 0.5 µg of total RNA; the superscript II reverse transcription system with oligo-deoxythymidine. PCR amplification was performed using the following protocol: pre-denaturation at 95°C for 3 min, and then 30 cycles of denaturation at 94°C for 50 s, annealing at 55°C for 50 s, and extension at 72°C for 50 s, followed by a final extension at 72°C for 10 min. The primers used were as follows: iNOS forward: 5'-ATG TCC GAA GCA AAC ATC AC-3'; iNOS reverse: 5'-TAA TGT CCA GGA AGT AGG TG-3'; COX-2 forward: 5'-GGA GAG ACT ATC AAG ATA GTG ATC-3'; COX-2 reverse: 5'-ATG GTC AGT AGA CTT TTA CAG CTC-3'; IL-1β forward: 5'- TTG ACG GAC CCC AAA AGA TG-3'; IL-1β reverse: 5'- AGA AGG TGC TCA TGT CCT CA-3'; IL-6 forward: 5'- CCA CTT CAC AAG TCG GAG GCT T-3'; IL-6 reverse: 5'- CCA GCT TAT CTG TTA GGA GA-3'; IL-10 forward: 5'- ACC TGGTAG AAG TGA TGC CCC AGG CA-3'; IL-10 reverse: 5'- CTA TGC AGT TGA TGA AGA TGT CAA A-3'; GAPDH forward: 5'- GCC CAT CAC CAT CTT CCA G-3'; GAPDH reverse: 5'- TGA GCC CTT CCA CAA TGC C-3'. The mRNA expression was quantified using an ethidium bromide-stained 1.5% agarose gel. The stained bands were visualized and analyzed using the Image J Software.

2.3.5. ROS radical scavenging analysis

The effect of FKA on DPPH radical scavenging was determined as previously reported [8]. Various concentrations of FKA were prepared using water, and 50 µL of FKA(W/v) mixed with 1 mL of DPPH ethanol solution(0.1 mM) and 450 µL of Tris-HCl buffer(50 mM, pH 7.4) was added. The

mixture was then incubation for 1 h at 25°C, and the absorbance was measured at 517 nm. Cellular morphological changes were observed, and images were captured using an inverted microscope connected to a digital camera (IX71; Olympus, Tokyo, Japan).

2.3.6. Statistical analysis

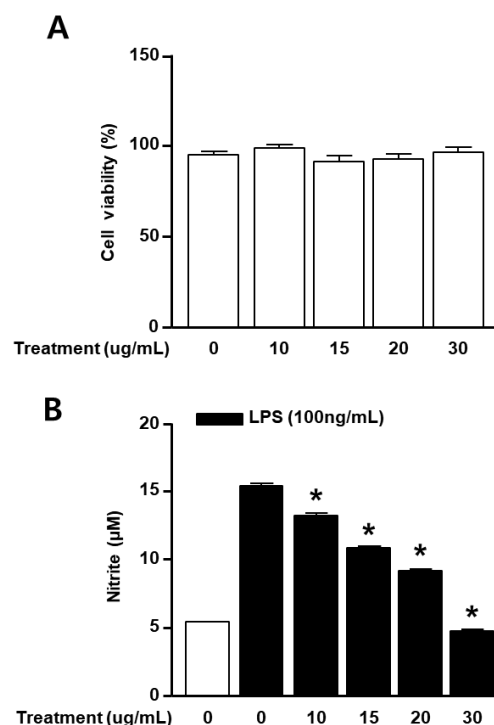
Data are expressed as the mean \pm standard error of the mean (S.E.M.) of the indicated number of experiments. Statistical analysis was performed using the Student's *t*-test for comparisons between 2 groups, using GraphPad prism (GraphPad Software, San Diego, CA, USA). $p < 0.05$ was considered statically significant.

3. Results

3.1. Effect of FKA on cell viability and NO production in LPS-stimulated RAW 264.7 cells

We assessed whether FKA can regulate NO generation in LPS-induced RAW 264.7 cells. As shown in Figure 1A, FKA showed no cytotoxicity at doses up to 30 $\mu\text{g}/\text{mL}$. LPS-stimulated RAW 264.7 cells were treated with 10-30 $\mu\text{g}/\text{mL}$ FKA for 24 h (Figure 1B). LPS (100 ng/mL) significantly induced NO production, whereas FKA significantly reduced NO production. Also, FKA significantly reduced LPS-induced NO levels in a dose-dependent manner.

Figure 1. Effect of FKA on NO production in LPS-stimulated RAW 264.7 cells.

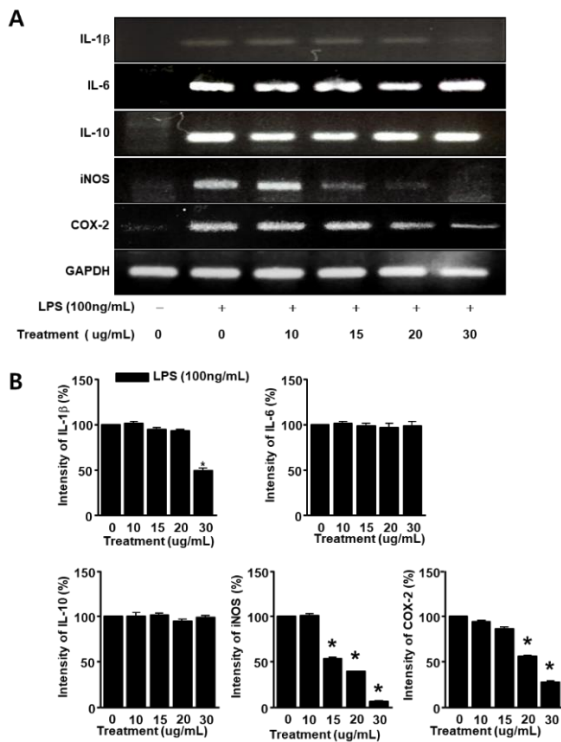


Note: (A) The cells were treated with 10-30 $\mu\text{g}/\text{mL}$ FKA. Cell viability was determined via a cell viability assay. (B) The cells were treated with the presence or absence of 100 ng/mL LPS, and 10-30 $\mu\text{g}/\text{mL}$ FKA. After 24 h, NO production was analyzed using the supernatant. Results are presented as means \pm S.E of 3 independent experiments. * $P < 0.05$ vs. the untreated group.

3.2. Anti-inflammatory effect of FKA on LPS-induced RAW 264.7 cells

To determine the effect of FKA on LPS-induced cytokines and inflammatory factors, we analyzed their mRNA expression, using RT-PCR. LPS-stimulated RAW 264.7 cells were treated with 10-30 $\mu\text{g}/\text{mL}$ FKA for 24 h. As shown in Figure 2, treatment with 100 ng/mL LPS led to increased IL-1 β , IL-6, IL-10, iNOS, and COX-2 expression, which was ameliorated by treatment with 30 $\mu\text{g}/\text{mL}$ FKA. FKA treatment reduced IL-1 β , iNOS, and COX-2 expression by 71, 95, and 80%, respectively.

Figure 2. Effect of FKA in LPS-induced cytokines and inflammatory factors in RAW 264.7 cells.

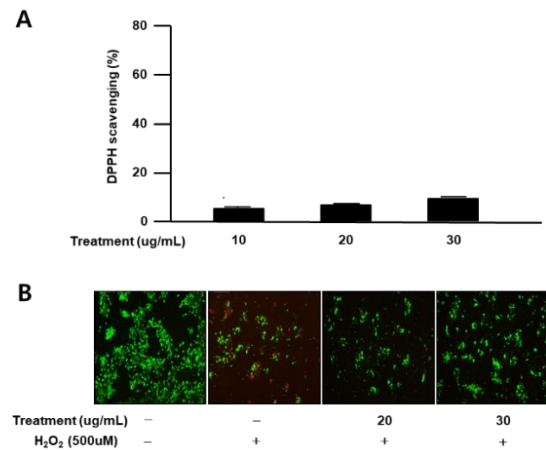


Note: (A) PCR products were loaded into agarose gel and stained with EtBr. The bands indicate expression levels of IL-1 β , IL-6, IL-10, iNOS, and COX-2 mRNAs. (B) The graph shows the intensity of the bands relative to the LPS-treated group. * P < 0.05 vs. the LPS-only treatment. LPS, lipopolysaccharide; IL-1 β , interleukin 1 beta; IL-6, interleukin 6; IL-10, interleukin 10; iNOS, inducible nitric oxide synthase; COX-2, cyclooxygenase 2; GAPDH, glyceraldehyde 3-phosphate dehydrogenase.

3.3. Effect of FKA on ROS generation

We assessed whether FKA can regulate DPPH free radical scavenging and exogenous ROS protection *in vitro*. As shown in Figure 3A, FKA slightly reduced DPPH free radicals. As shown in Figure 3B, H₂O₂-stimulated RAW 264.7 cells were treated with 20 and 30 μ g/mL FKA for 6 h. H₂O₂ (500 μ M) significantly reduced cell viability (red colors, death cells; green colors, live cells), whereas FKA significantly protected against exogenous ROS-induced cell death. Pretreatment with 20 and 30 μ g/mL FKA decreased H₂O₂-induced cell death by 80 and 90%, respectively.

Figure 3. Effect of FKA in ROS generation.



Note: (A) The scavenging activity in DPPH radical. (B) The effects of FKA on cell viability were determined using the LIVE/DEAD cell viability assay kit. Morphological changes in exogenous ROS(H₂O₂)-stimulated RAW 264.7 cells were observed using microscopy.

4. Discussion and Conclusion

The inflammatory response plays an important role in the body's defense mechanism, but an excess of it can be fatal. Anti-inflammatory agents are classified as steroids or non-steroids. Many steroids, including glucocorticoids, bind to glucocorticoid receptors to reduce swelling and inflammation. However, steroid administration to athletes is heavily regulated. Moreover, non-steroidal anti-inflammatory drugs (NSAIDs) that inhibit cyclooxygenase (COX) enzymes to relieve pain, could be an alternative to athletes, but cause gastritis[9]. Therefore, alternative anti-inflammatory drugs for athletes are needed.

Reactive oxygen species (ROS) are cationic catalytic molecules inevitably generated during exercise, which simultaneously exert beneficial and deleterious effects on cells. Excessively elevated cellular ROS levels can lead to oxidative stress, that can lead to extensive cellular damages such as DNA breakdown, lipid peroxidation, and protein denaturation, which can be fatal to muscles[10].

In this study, we found that FKA treatment regulated NO production in LPS-stimulated RAW 264.7 cells, confirmed by decreased IL-1 β , iNOS, and COX-2 expression. Moreover, FKA protected against exogenous ROS-induced cell death. These results indicate that FKA has anti-oxidant and anti-inflammatory effects, thus, can possibly

contribute to the advancement of exercise capacity.

In conclusion, we have clearly demonstrated the anti-oxidant and anti-inflammatory effect of FKA in vitro. Our results suggest that FKA not only reduced iNOS, COX-2, and IL-1 β expression, but protected against exogenous ROS-induced cell death. Therefore, FKA is a promising therapeutic agent for acute and chronic inflammation. However, the mechanism of its effect on exercise-induced inflammation requires further elucidating.

5. References

5.1. Journal articles

- [1] Muniandy K & Gothai S & Badran KMH & Suresh KS & Esa NM & Arulselvan P. Suppression of Proinflammatory Cytokines and Mediators in LPS-induced RAW 264.7 Macrophages by Stem Extract of *Alternanthera Sessilis* Via the Inhibition of the NF- κ B Pathway. *Journal of Immunology Research*, 3430684, 1-12 (2018).
- [2] Nathan C & Cunningham-Bussel A. Beyond Oxidative Stress: An Immunologist's Guide to Reactive Oxygen Species. *Nature Reviews Immunology*, 13(5), 349-361 (2013).
- [3] Serinkan BF & Gambelli F & Potapovich AI & Babu H & Di Giuseppe M & Ortiz LA & Fabisiak JP & Kagan VE. Apoptotic Cells Quench Reactive Oxygen and Nitrogen Species and Modulate TNF-alpha/TGF-beta1 Balance in Activated Macrophages: Involvement of Phosphatidylserine-dependent and Independent Pathways. *Cell Death & Differentiation*, 12(8), 1141-1144 (2005).
- [4] Leite AMO & Miguel MAL & Peixoto RS & Rosado AS & Silva JT & Paschoalin VMF. Microbiological, Technological and Therapeutic Properties of Kefir: A Natural Probiotic Beverage. *Brazilian Journal of Microbiology*, 44(2), 341-349 (2013).
- [5] Cai W & Li Y & Yi Q & Xie F & Du B & Feng L & Qiu L. Total Saponins from *Albizia Julibrissin* Inhibit Vascular Endothelial Growth Factor-mediated Angiogenesis in Vitro and In Vivo. *Molecular Medicine Reports*, 11(5), 3405-3413 (2015).
- [6] Lee KP & Sudjarwo GW & Kim JS & Dirgantara S & Maeng WJ & Hong H. The Anti-inflammatory Effect of Indonesian Areca Catechu Leaf Extract in Vitro and in Vivo. *Nutrition Research and Practice*, 8(3), 267-271 (2014).
- [7] Lee KP & Kim JE & Park WH. Cytoprotective Effect of Rhamnetin on Miconazole-induced H9c2 Cell Damage. *Nutrition Research and Practice*, 9(6), 586-591 (2015).
- [8] Adjimani JP & Asare P. Antioxidant and Free Radical Scavenging Activity of Iron Chelators. *Toxicology Reports*, 2, 721-728 (2015).
- [9] Matsui H & Shimokawa O & Kaneko T & Naganano Y & Rai K & Hyodo I. The Pathophysiology of Non-steroidal Anti-inflammatory Drug (NSAID)-induced Mucosal Injuries in Stomach and Small Intestine. *Journal of Clinical Biochemistry and Nutrition*, 48(2), 107-111 (2011).
- [10] Raicević S & Cubrilo D & Arsenijević S & Vukcević G & Zivković V & Vuletić M & Barudzić N & Andjelković N & Antonović O & Jakovljević V. Oxidative Stress in Fetal Distress: Potential Prospects for Diagnosis. *Oxidative Medicine and Cellular Longevity*, 3(3), 214-218 (2010).

Lead Author

Kang Hye-ra / Deawon University College Resercher
B.A. Deawon University College

Research field

- Sports Nutrition Supplement, Albizia Julibrissin Extract Fermented with Kefir Yogut Regulates Lipopolysaccharide-induced Inflammatory Signal, *Kinesiology*, 4(2) (2019).

Major career

- 2019~present. International Society for Sport Science, Member

Corresponding Author

Yang Han-joon / Hallym University of Graduate Studies
Professor

B.A. Hanbat National University

M.A. Chungnam National University

Ph.D. Myongji University

Research field

- Analyzing Radiation Absorption Difference of Dental Substance by Using Dual CT, *Radiation Effects & Defects in Solids*, 170(7-8) (2015).

- Effect of Clinical Practice on Self-learning Development Ability, *Journal of Radiological Science and Technology*, 40(3) (2017).

Major career

- 2012~present. Hallym University of Graduate Studies, Professor

- 2019~present. International Society for Sport Science, Member

Publication state: Japan
ISSN: 2435-0702

Publisher: J-INSTITUTE
Website: <http://www.j-institute.jp>

Corresponding author
E-mail: shinhb@kmu.ac.kr

Peer reviewer
E-mail: kinesiology@j-institute.jp

<http://dx.doi.org/10.22471/kinesiology.2019.4.2.07>

© 2019 J-INSTITUTE

The Safety Control and Injury Prevention of Collegiate SPORT Activities in CHINA

Bai Xuefeng¹

Keimyung University, Daegu, Republic of Korea

Shin Hong-bum^{2*}

Keimyung University, Daegu, Republic of Korea

Zhao Xuemei³

Shanghai University of Sport, Shanghai, China

Abstract

'Myopia', 'obesity', 'decline in physical fitness' and other sub-health phenomena have always been an urgent problem for Chinese college students to improve the quality of their education and all-round development. To comprehensively improve the physical and mental health of college student's education, the Chinese government has issued many policies urging college students to actively participate in sports activities. After the release of a series of policies, a large number of college students left their dorms to spend more time doing sports activities. As a result, their physical fitness improved, and the sub-health phenomenon was alleviated. However, with the frequent occurrence of sports injury accidents, many college students are afraid to participate in sports activities, and many parents are also afraid of sports activities. As managers of college students and organizers of sports activities, Chinese colleges also face multiple pressures from the society, parents and students. Some colleges have prohibited the holding of dangerous sports activities and heavily restrict students' participation in sports activities. The role of improving students' physical and mental health through sports has also been gradually weakened. A new, important topic in China is ensuring the normal development of college sports activities and the continuous improvement of college students' physical and mental health and the effective and reasonable solution to reduce the harm caused by sports injury accidents. Accordingly, this paper identifies the current safety of college students' physical activity in China. It explores the reasons for the safety of their physical activity and puts forward appropriate protective strategies.

This paper found that sports injury accidents occur in colleges and universities in different regions with different degrees of injury. The reasons are student, school and environmental factors. Based on the main reasons for the occurrence of accidents, the following suggestions are put forward: 1. The protection strategy of student safety: College students should pay attention to individual behavior and enhance their awareness of protection when participating in sports activities. 2. The protection strategy of college security: Colleges should conduct duplicate protection before and after the occurrence of injury accidents and regularly publicize sports safety knowledge, so students understand the causes of injury accidents. It should also improve the maintenance and management system of sports venues and facilities to reduce the number of injuries caused by accidents. Also, it should increase the medical investment and introduce an insurance system. 3. The protection strategy of social and environmental safety: it is hoped that the Chinese government will continue to issue policies that lead to the establishment of a security system for college students' sports activities. It is also hoped that the Chinese government and all sectors of society will increase investment in college sports to ensure the maintenance and renewal of college sports venues and facilities.

[Keywords] Sports Activities, Safety Control, Safety Prevention, Prevention Strategy, Risk Management

1. Introduction

Recently, China has entered a new development stage of creating a generally prosperous society and building a harmonious socialist society. The living standards of people have mainly improved, and sports in daily life and national fitness have become increasingly popular. At a critical moment of modernization in China, its general sports administration has made a 'national fitness program' to arouse enthusiasm of the entire society and improve the nation's awareness of sports. National fitness consists of mass sports fitness activities which aim to mobilize the masses to participate in these activities and promote physical and mental health[1]. For contemporary Chinese college students, their state of physical health constitutes an essential part of the existing national fitness program. Consequently, Chinese colleges and universities are actively engaged in sport activities in response to the national call. However, the issue of safety problems caused by sports activities of colleges and universities in China is increasingly becoming more critical because of the rapid development of sports activities in colleges and universities in China. The occurrence of sports safety accidents in colleges and universities hurts not only the physical and mental health of college students, but also adversely affects the Chinese universities. Dong(2016) selected 20 representative cases of college sports injury in China to study. It revealed that there were 4 cases caused death and other students in 16 cases got injured in different levels. There were 3 cases caused hemiplegia and cognitive impairment for severe brain damage and students have lost the ability to care for the injury. Also there were 5 cases of fractures in different parts of the students' bodies and 5 of eye injuries[2]. These injury accidents have an irreversible impact on the normal life of the injured students, leading to live with the care of professional nursing, or even deprive some student lives. Due to judicial disputes, colleges have been criticized by public and the safety system of colleges has been questioned. In order to avoid the recurrence of injury incidents, some involved colleges have reduced or even banned physical education and sports activities, which has seriously affected the development of college teaching and t physical education.

In order to reduce and control the security issues caused by school sports activities , the Ministry of Education issued "interim measures for risk prevention and control of school sports" by the Chinese government in 2015[3]. It rules that the management responsibility of sports risk prevention and control in college, general requirements and accident treatment method. Taking sports risk prevention and control as the key point of education management and supervision is mainly emphasized by Education administrative department, combining with sound sports risk prevention and control mechanism and implement the responsibility and measures of prevention and control. It manifests that education administrative departments and colleges should purchase sports equipment and facilities in strict accordance with the relevant national standards for products and quality. In the absence of national and industrial standards, the suppliers are required to provide safety testing and evaluation reports of third-party professional institutions and record the service life, regular inspection and maintenance of the equipment; In addition, teachers should carefully check the sports equipment and venues before the teaching and training of physical education classes. In the teaching and training, teachers should break down technically difficult movements in detail and take proper protection and assistance. When organizing large-scale sports activities or sports competitions, the education administrative departments or colleges shall establish safety management agencies, formulate safety emergency plans, and arrange medical personnel and supervise them; To organize students to participate in cross-regional sports activities and sports competitions, students and their parents should be provided with safety notices in accordance with the requirements of the activities or competitions, so as to obtain written feedback from parents; The education administrative departments and colleges need improve the insurance mechanism for students accidental injuries in sports improve the risk management and transfer mechanism through purchasing school liability insurance and encouraging parents or guardians to voluntarily purchase accidental injuries insurance for students. The regulations set out guidelines for education department, colleges and physical education teachers, but some of the rules cannot

be fully implemented because of the actual situation. In addition, as the participants of sports activities, college students' own behaviors have a crucial impact on the safety of sports activities. Therefore, for comprehensively breaking through this problem, this study analyzed the control and prevention issues, combining the existing Chinese situation from the sports activities in colleges and universities, from the perspectives of college students, schools and society, to seek and suggest reasonable strategies for the sports environments and remove the risk related problems.

2. The Current Situation of Safety in College Sport Activities in China

The safety of the college sports activities includes the sports activities of the whole process of physical, mental and property safety. College sports injury accident refers to the incidents which can harm these three aspects[4]. The injury usually happens in the sports venues. College students almost get injury in physical education teaching, extracurricular sports activities, extracurricular sports training, and sports competition, which follow the administrative department of education and school organization or organizations[5].

According to the data of China's colleges sports injury accident in partial cities and provinces, it found that all the colleges and universities happened injury accidents of different levels in investigation. Li(2104) investigated the safety accident types and causes of colleges in Zhejiang province in China for recent three years. The ratio of students who hurt in sports activities was 33.2%. The incidence rate of students in junior colleges was 41.5%[6]. Yu(2017) had carried out statistical analysis of some of the sports injuries in China's Sichuan colleges in past five years, basing on different sports activities. The results showed that the most sporting events that caused accidents were gymnastics, football and basketball. The rate respectively were 21.95%, 19.51% and 17.07%[7]. Wei, Zhang, and Lin(2016) in the survey of sports injuries of college students in China's Guangxi province showed that the rate of incidents of sports injuries was 34.8%[8]. Shang(2015) found that college sports

safety accident frequency is higher, at 41.9% in Cangzhou by investigating the current situation of colleges sports activities accidents in Cangzhou, Hebei province[9]. The author has studied the risk of extracurricular sport activities in colleges and universities in Shenyang, Liaoning province. It found that the rate of sports accidents of the students in investigation is 73%[10].

As a result of the excessive number of cities and provinces in China, this paper only selects some provinces and cities for sports injuries data. According to the data of the collation, the high frequency of sports safety accidents in Chinese colleges should be taken seriously.

3. The Causes of the Safety of Sports Activities in Chinese Colleges

There are various causes of sports injury accidents in college students, which need to be identified with scientific theories and reasonable methods. It is the basis of college students' sports activity safety protection. The primary process includes identifying the risk factors that may cause college students' sports injury accidents and classifying the identified risk factors. At present, many scholars select the possible causes of college students' sports injury accidents based on risk identification methods, including Delphi method, SWOT analysis method and risk checklist. Risk classification methods mainly include the Delphi method and mathematical statistics method[11]. The diversity of identification and classification methods makes the classification of risk factors not reach a harmonious unity, but some classifications have been affirmed and continue to be used. Wang(2011) considers that there are three factors of the risk of school sports injury accident: the risk of material factor, human factor, management factor[12]. Yu(2017) considers that the main factors of sports safety risk in colleges are physical factors, human factors, environmental factors, and other factors[13]. Cao, Zhu, and Zhang(2017) believe that the influence factors of sports safety in schools is management factors, personnel factors, material factors and environmental factors[14].

Different risk categories also contain multiple factors that lead to the occurrence of sports injury accidents. The factors are so many that they are not singled out in this paper. Through consulting a significant amount of research literature, this paper selects and summarizes the risk factors with the highest frequency and the most comprehensive range. On this basis, according to the characteristics of uncertainty, prevention and predictability of risk factors, and combined with the research views of other scholars, the selected risk factors that can cause college students' sports injury accidents are classified into student factors, college factors and environmental factors. Among them, students' factors are mainly inappropriate behaviors of other students, a vague awareness of injuries caused by sports activities, and lack of knowledge of emergency medical treatment when participating in sports activities. School factors are mainly less publicity of sports safety prevention knowledge, damage to some venues and equipment and maintenance not done in time. Medical treatment and the insurance system need to be improved. Environmental factors mainly include the natural environment and the social environment. Natural factors include weather, geography and, sudden, non-human factors. Social environmental factors are mainly political and economic.

4. The Measures of the Prevention and Control of Sports Activities in Colleges

Reasonable safety prevention strategies can reduce or prevent injuries in physical activities. Effective control measures can reduce the degree of damage caused by sports activities[15]. Some suggestions for prevention are put forward according to the reasons for sports accidents.

4.1. The prevention and control measures for college students

Students are the main participants in the sports activities in colleges; their behavior, knowledge of sports safety and the ability to deal with accidents are especially important[16].

First, the student's behavior plays a leading role in the safety of sports activities, and reasonable physical behavior can significantly reduce the occurrence of safety accidents. For example: do warm-ups before the activities and then relax after the activities; do not do dangerous actions beyond your ability. Second, self-protection awareness should be improved. Such as watch more cases of sports injury accidents to understand the causes and types of sports injury accidents, to reduce risk when encountering similar situations and concentrate on physical activity and carry emergency pain or hemostatic medications. Also, students should be able to improve their ability to cope with accidents, so that they can provide simple and effective treatment after the accident, thereby reducing the risk of accidents, for example, participating in sports safety and protection lectures or self-study injury emergency medical treatment knowledge and storing the emergency contact information of the local hospital on a mobile device.

4.2. The prevention and control measures for colleges

'The sports emergency mechanism should be kept in case of priority and taken as a precaution, through strict management, system construction, contingency planning and publicity'[17]. Accordingly, this paper concludes that there should be prevention and control measures before and after an accident.

Prevention and control strategies before the occurrence of sports injury accidents mainly focus on prevention, such as taking reasonable measures to reduce the probability of sports injury accidents[18]. The existing safety prevention at the colleges does not only require the support of the concept and the policy but the action. First of all, it is necessary to share sports safety knowledge regularly for students to understand the cause of injury accidents. Regular lectures on sports activity safety awareness and popularization activities in colleges assist college students in recognizing potential risks in activities, so they can avoid the risks in advance. Students should master correct medical treatment knowledge. Second, colleges should set up health records for students and update them regularly. Although 'interim measures for risk

prevention and control of school sports' issued by Chinese government has asked the colleges establish health files of primary and middle school students, but in terms of the situation, the long-term situation of stay up late, insomnia, obesity, stress and bad habits such as drinking alcohol and smoking have contributed to physical deterioration of college students. The health records should be established and update through the regular physical examination. Through the detailed physical examination, colleges can accurately understand the physical conditions of college students to carry out physical education more reasonable sports activities and avoid excessive intensity causing sports injury accidents. By regularly updating the physical examination data, colleges can know the changes of college students' physical conditions in different periods, and decide whether or not college students can participate in sports activities or which event they can participate according to their physical conditions, so as to reduce the probability of sports injury accidents. In addition, the health records of college students also help to record the medical history of college students and whether it is a special constitution. If there are special circumstances, colleges can also communicate with students or parents in time to reduce or prohibit college students from participating in sports activities and avoid sports injury accidents caused by special circumstances in advance.

The prevention and control strategies after the occurrence of sports injury accidents mainly focus on control: the reduction of the degree of harm and injury caused by accidents through proper treatment and effective medical treatment[19]. Accordingly, the prevention and control strategies after the occurrence of sports injury accidents are mainly divided into two aspects: 1)establishing a sound medical system. Colleges primarily conduct medical treatment after the student's sports accident. They establish a special department for dealing with students' safety accidents. The medical department at the college contacts an external hospital to provide an effective contingency plan. In this way, the college can deal with the injuries of sports safety accidents after sports safety accident. 2)Jointly establishing a compensation sys-

tem for college sports injuries. For college students, the safety of sports activities is not only premised on reasonable protection, but it also needs adequate finance support. Sports injury accidents not only affect the physical and mental health of students but also place economic pressure on their families due to the treatment and recovery costs, as well as the public pressure on the colleges. A sound compensation system for college sports injuries can effectively solve economic problems and reduce social problems caused by the costs related to accidents. A compensation system set up by a single college may not be sufficient. However compensation amount established by plenty colleges jointly is sufficient and can also serve more college students. In view of the fact that China has a large geographical area and a large number of universities, it is suggested that different provinces should jointly establish the compensation system for college sports injury accidents. Compensation can come from state aid, social and corporate donations, university finances, and each student.

4.3. The prevention and control measures for the environment

This paper holds that the environmental factors that may cause college student sports injury accidents mostly include natural environmental factors and social environmental factors. The former refers to weather, geography and sudden and non-human risk factors. In the process of prevention and control of college students' sports injury accidents, the control ability and predictability of natural environment factors are extreme, and the prevention and control of weather, geography and other factors are relatively straightforward[20]. These factors do not easily cause sports injury accidents. However, sudden and non-human risk factors cannot be prevented and controlled because they are unpredictable and almost uncontrollable. Therefore, sports injury accidents caused by natural environmental factors are not considered in this paper.

Social environmental factors refer to the background and current societal situation[21]. Given the research topic of this paper, the following suggestions are made according to the

political and economic environment. The Chinese government has made great efforts to support the development of college students' physical education, but it should continue to issue policies to guide colleges and society to jointly establish a reasonable and comprehensive security system for college students' sports activities. From an economic aspect, it is suggested that all sectors of society should increase investment in college sports to ensure the maintenance and renewal of college sports venues and facilities.

5. Conclusions

The fundamental goal of educational development is to produce more highly talented people. The historical mission of colleges and universities and an essential means of conveying new strength for China's social progress and economic development is to train high-quality students; good physical and mental quality is the premise of realizing this goal[22]. Therefore, any problems that hinder the development of college students' physical and mental health and conscience should be emphasized. A reasonable protection strategy to prevent sports injury accidents does not only effectively avoid the likelihood of sports injury accidents, but can also minimize the harm they cause. It is highly important to study the safety protection and management of college students' sports when responding to the call of the State to make a small contribution to improve the sub-health of college students, or to promote the sustainable development of college physical and quality education to provide guidance, or to ensure the physical and mental health of college students, and to reduce the incidence of physical injury and harm degree. Currently, Chinese scholars have conducted relevant research on this issue and made some progress. However, due to China's vast size and the apparent differences in the natural environment in different regions, some of the results cannot be applied to the whole country. It is hoped that in the future, more extensive research results can be obtained and various factors leading to injury accidents can be considered that consider local conditions. It is also hoped that this paper

can provide the basis for further research in this field.

6. References

6.1. Journal articles

- [5] Li YE. The Cultivation of Injury Concepts of Students in Colleges. *Business*, 22, 1-1, 408 (2013).
- [6] Li SQ. Legal Analysis on Sports Injury Accidents and Countermeasures in Colleges of Zhejiang Province. *Zhejiang Sports Science*, 36(6), 34-37 (2014).
- [7] Yu LF. Duty Belonging and Risk Control of University Sports Injury Accidents in Sichuang. *Sport World(Scholarly)*, 2, 88-89 (2017).
- [8] Wei DY & Zhang Y & Lin J. The Risk Management of Sport Injury of College Students in Guangxi. *Sport Science and Technology*, 37(3), 151-156 (2016).
- [11] Qiu F & Qin ZL & Cui DG. Relationship among Perception of Risk in Physical Activity Sport Injury and Exercise Behavior for Undergraduates. *Journal of Wuhan Institute of Physical Education*, 49(6), 75-81 (2015).
- [13] Yu D & Li M. Research on Risk Prevention and Management Mechanism of College Sports Injury Accidents. *Journal of Liaoning Normal University(Natural Science Edition)*, 40(2), 276-281 (2017).
- [14] Cao KP & Zhu MX & Zhang JL. The Ordinary University Sports Analysis of the Main Types and Influencing Factors of Safety Problems. *Contemporary Sports Technology*, 7(6), 82-83 (2017).
- [16] Shi Y & Fan LL. Theoretical Construction of College Students' Risk Perception in Physical Activity. *Journal of Sports and Science*, 32(1), 102-107 (2011).
- [20] Shen G & Li R. On Risk and Control Measure of College Physical Education in Our Country. *Hebei Normal University of Science & Technology*, 5(4), 96-99 (2006).
- [21] Qiu Y. A Study on the Socio-environmental Factors Affecting Students' Health and the Interventive Measures of Sports. *Journal of Beijing Sport University*, 27(1), 85-87 (2004).

6.2. Thesis degree

- [1] Luo Chang. The Research on Investigation and Measures of Sports Injury Accidents in Regular Universities in Xi'an. Shanxi Normal University, Master's Thesis (2016).
- [2] Luo P. The Cause and Countermeasures of College Sports Emergencies. Fujian Normal University, Master's Thesis (2016).
- [4] Li CB. Research on the Construction of Evaluation System of Sports Security in Colleges and Universities. Fujian Normal University, Doctor's Thesis (2016).
- [9] Shang QL. Investigation and Analysis of the Statue of University Sport Safety in Cangzhou City. Capital University of Physical Education and Sports, Master's Thesis (2015).
- [10] Bai XF. The Research on Response on Risk of Extracurricular Sports Activities in Shenyang Regular Colleges. Shenyang Sport University, Master's Thesis (2015).
- [12] Wang Yan. A Study of Structure of Injury Factors of PE and its Prevention in China. Beijing Sport University, Doctor's Thesis (2011).
- [17] Dong X. Research on Current Situation and Cause of Sports Insurance for University Students in Henan Province. Henan University, Master's Thesis (2010).
- [18] Zhu G. Study on the Identification and Evaluation for Physical Exercise's Risk of Accidental Injury in Kunming Colleges. Yunnan Normal University, Master's Thesis (2017).
- [19] Wu GS. Study on the Mechanism If Sport Risk Control in Guangdong University of Science and Technology. Guangdong Sport University, Master's Thesis (2013).
- [22] Liu XR. Development Strategies for College Sports Insurance in China Based on the Perspective of Consumers' Demand-cased of Universities in Shenyang. Northeastern University, Master's Thesis (2013).

6.3. Books

- [15] Wang X. Risk Management. Shanghai University of Finance and Economics (2003).

6.4. Additional references

- [3] <http://www.moe.gov.cn/> (2015).

Lead Author

Bai Xuefeng / Keimyung University Researcher
B.A. Art and Sciences Collage of Bohai University
M.A. Shenyang Sport University
Ph.D. Keimyung University

Research field

- The Logic on Olympic Stadium Evolvement and Its Enlightenment, Sports Culture Guide, 9(9) (2018).
- How to Protect Collegiate Students from the Risk of Sport Activities in China based on the Risk Investigation, International Journal of Protection, Security & Investigation, 4(1) (2019).

Major career

- 2015~2016. Shenyang Sport University, Lecturer
- 2016~present. Keimyung University, Researcher

Corresponding Author

Shin Hong-bum / Keimyung University Professor
B.A. Myongji University
M.A. Illinois State University
Ph.D. University of New Mexico

Research field

- Examining the Relationship among Acquisition of Sport Rule Knowledge, Enjoyment, and Future Consumption for Preventing Crisis from Challenges in Sport Industry, International Journal of Crisis & Safety, 4(2) (2019).
- How Does Sport-related Mobile Apps Usage Motivation Affect Consumer Perceptions of the Sport Organizations?, Journal of Physical Education and Sport, 19(4), 1391-1397 (2019).

Major career

- 2008~2009. DeSales University, Professor
- 2009~present. Keimyung University, Professor

Co-Author

Zhao Xuemei / Shanghai University of Sport Researcher
B.A. Shenyang Sport University
M.A. Shenyang Sport University
Ph.D. Shanghai University of Sport

Research field

- The Logic on Olympic Stadium Evolvement and Its Enlightenment, Sports Culture Guide, 9(9) (2018).
- The Safety Control and Injury Prevention of Sports Activities: Case of Colleges in China, Kinesiology, 4(2) (2019).

Major career

- 2017~present. Shanghai University of Sport, Researcher
- 2019~present. International Society for Kinesiology, Member

Publication state: Japan
ISSN: 2435-0702

Publisher: J-INSTITUTE
Website: <http://www.j-institute.jp>

Corresponding author
E-mail: cmcho12@kmu.ac.kr

Peer reviewer
E-mail: kinesiology@j-institute.jp

<http://dx.doi.org/10.22471/kinesiology.2019.4.2.14>

© 2019 J-INSTITUTE

Comparison of Validity and Accuracy of Circumference, SKF, and BIA Method in Predicting % Body Fat

Cho Chang-mo

Keimyung University, Daegu, Republic of Korea

Abstract

The purpose of this study was to compare the difference in the percent body fat(% body fat) values estimated by the circumference method, the skinfold method(SKF), the bioelectrical impedance analysis(BIA), and the underwater weighing(UWW) and to examine the accuracy of three different field methods by comparing with reference method. Twenty-nine adults(women = 13 and men =16) volunteered to participate(age = 25 to 49 years) in this study. Body weight and height were measured, and body mass index(BMI) was calculated. Body circumferences, SKF thicknesses, BIA, and UWW were measured from five technicians(beginner level) under the guidance of a trained technician. Several validated equations appropriated to race, gender, and age were used to estimate % body fat from SKF method. The prediction equations for estimating % body fat using circumference method were developed considering only gender and age. The % body fat from BIA was calculated with the value of free fatty acids(FFA) estimated from the preset equation for the device. The data were analyzed by using one-way ANOVA to examine the difference in the % body fat results measured from four different methods, and Pearson correlation coefficients and regression analysis were measured to assess the validity and accuracy for three body composition measurements. Statistical significant was set at $P < 0.05$. The results showed that the % body fat values measured by four different measurements were statistically similar. However, there were differences in the accuracy for estimating % body fat among different measurements, and it was found that the SKF method was the most accurate method, and the circumference method was the lowest method for predicting % body fat. In conclusion, these results suggested that the estimation of body composition from the circumference and SKF method, and BIA can be estimated relatively accurately, even if measured by an untrained technician when following prescribed measurement methods and procedures. Our data also suggested that the population-specific equations appropriate to subject should be used to estimate body composition because they will probably predict more accurate estimates.

[Keywords] Kinesiology, Obesity, Anthropometry, Body Mass Index, Body Composition

1. Introduction

Obesity is a serious health problem that reduces life expectancy by increasing the risk of metabolic disorders such as coronary artery disease, hypertension, and type II diabetes including osteoarthritis and certain types of cancer. It is known that the prevalence of hypertension, hyperlipidemia, and type II diabe-

tes is two to three times greater in obese individuals[1][2]. According to the Korean National Health Statistics of the Ministry of Health and Welfare, the obesity adults(> 19 yrs) in Korea are increased 34.8 % in 2017[3]. The increased health risks associated with obesity are related, not only to the total amount of body fat, but also to the abdominal fat, especially visceral fat[4].

In World Health Organization(WHO), obesity is defined as a body mass index greater than 30 kg/m²[5]. However, this definition is inappropriate because it does not take into account the individual's body composition. In other words, because BMI only calculates height and weight to determine obesity, lean individuals who have little body fat but who weigh more than their ideal weight can be determined as overfat or obese. As a result, BMI can lead to an erroneous conclusion about one's level of body fatness and health risk[6].

The body is made up of various tissues and substances, and determining actual body composition such as fat mass and fat-free mass(ex. water, muscles, bones, and internal organs) can better determine health status and potential risk for disease as well as the prediction of optimal sports performance. There are various methods to measure body composition to estimate the amount of body fat. Among them, underwater weighing(UWW) is well known as one of the gold standard methods for measuring body composition[7]. However, UWW has some disadvantages related with spatial constraints, highly technical and costly, and a subject's difficulty submerging themselves for several seconds.

On the other hand, there are several field methods for measuring body composition. Anthropometry has been used to assess body size and the proportions of body segments by measuring body circumferences and body segments. SKF technique measures the thickness of subcutaneous adipose tissue. These measurements were used to develop numerous anthropometric equations for predicting the total body density and body fat. Nowadays, there are excellent anthropometric equations using SKF or circumference method. Another method of measuring body composition is BIA. Although this technique is more expensive than circumference and SKF method, BIA is fast and noninvasive.

As the body composition measurement, the most representative advantage of circumference and SKF method, and BIA are quick and relatively inexpensive way for measuring

body composition compared to UWW. In addition, these methods are suitable for field and clinical settings because they are easy to administer to large groups. However, it was suggested that these three body composition measurement methods have problems with accuracy due to technician's skill, the type of equipment, subjects' factors, prediction equations, and environmental which can result in significant measurement error[8].

With this purpose, this research examined (1)the difference in % body fat measured by four different methods(circumference method, SKF method, BIA, and UWW), and (2)correlation between % body fat measured by UWW and results of % body fat measured by the other three different measurements.

2. Method

2.1. Subjects

Healthy men(N = 16) and women(N = 13) aged 25 to 49 years were participated in this study. All participants were non-smokers and habitually active in a variety of sports. The description of purpose, procedures, and risk of the study was provided prior to performing the measurements.

2.2. Experimental procedures

Five beginner level of technicians(graduate students) measured body circumference, subcutaneous thickness, BIA, and UWW of all subjects under the guidance of a trained technician. SKF and circumference for given body parts were measured in duplicate and averaged the scores. All measurements were performed in the morning from 7:00 am until 10:00 am. The subjects followed some pretest procedures that included minimum 8 hours of fasting, no high-intensity exercise, and no coffee. The subjects were allowed to drink water ad libitum before measurement. Temperature was maintained between 19°C to 21°C during all circumference, SKF and BIA measurements.

2.3. Subcutaneous fat measurement

Subcutaneous fat thickness (abdomen, chest, calf, midaxillary, subscapular, suprailiac, thigh, and triceps) was measured using Harpenden calipers following the following recommendations defined by Jackson and Pollock (1985) and Jackson, Pollock and Ward (1980) [9][10]. The prediction equations for the calculation of body density (D_b) were used according to gender, and the equations used are as follows. 1) D_b (chest, abdomen, thigh) = $1.10938 - 0.0008267(\text{sum of 3 sites}) + 0.0000016(\text{sum of 3 sites})^2 - 0.0002574(\text{age})$ for men [11]. 2) D_b (chest, triceps, subscapular) = $1.1125025 - 0.0013125(\text{sum of 3 sites}) + 0.0000055(\text{sum of 3 sites})^2 - 0.000244(\text{age})$ for men [9]. 3) D_b (triceps, suprailiac, abdomen, thigh) = $1.096095 - 0.0006952(\text{sum of 4 sites}) + 0.0000011(\text{sum of 4 sites})^2 - 0.0000714(\text{age})$ for women [10]. 4) D_b (chest, midaxillary, triceps, subscapular, abdomen, thigh, suprailiac) = $1.097 - 0.0046971(\text{sum of 7 sites}) + 0.00000056(\text{sum of 7 sites})^2 - 0.00012828(\text{age})$ for women [10]. 5) D_b (suprailiac, triceps, thigh) = $1.099421 - 0.009929(\text{sum of 3 sites}) + 0.0000023(\text{sum of 3 sites})^2 - 0.0001392(\text{age})$ for women [10]. 6) D_b (triceps, suprailiac, abdomen) = $1.089733 - 0.0009245(\text{sum of 3 sites}) + 0.0000025(\text{sum of 3 sites})^2 - 0.0000979(\text{age})$ for women [9]. These body density values were then converted to % body fat using Siri's equation, % body fat = $(4.95/D_b - 4.50) \times 100$ [13].

2.4. Girth measurement

Girths (waist, abdomen, arm, calf, chest, forearm, iliac, thigh, and hip) were measured with anthropometric tape following Callaway et al. (1988) defined method [11]. To convert into % body fat, girth scores of different body sites were used according to gender and age. All procedures and calculations followed 'Body Fat Prediction From Girths' [12]. The scores of upper arm, abdomen, and forearm girth were used for young men (18 - 26 yrs). Abdomen, thigh, and forearm girth were used for young women (18 - 26 yrs). Hip, abdomen, and forearm girth were measured for old men (27 - 50 yrs). The scores of abdomen, thigh, and calf girth were used for old women (27 - 50 yrs). Then the constant A, B, and C corresponding to these girth values

were substituted into the appropriate formula to calculate % body fat. % body fat formulas used in this study were following. 1) % body fat = constant A + constant B - constant C - 10.2 (for young men). 2) % body fat = constant A + constant B - constant C - 15 (for old men). 3) % body fat = constant A + constant B - constant C - 19.6 (for young and old women).

2.5. BIA measurement

BIA was measured in a supine position on non-conducting surface, and electrodes were placed on bared hand, wrist, foot, and ankle. All subjects were maintained their arms and legs slightly abducted to side during measurement. % body fat was calculated by determining the fat mass ($FM = \text{body weight} - \text{lean body mass}$) and dividing FM by the subject's body weight (% body fat = $(FM/\text{body weight}) \times 100$).

2.6. UWW measurement

Subject's body weight was measured first in air. The subject wearing a thin swimsuit sat in a lightweight chair suspended from the scale and submerged beneath the water's surface. The subject was educated to exhale as much as possible while slowly lowering under the water and to hold the breath for 5 to 8 seconds to allow the scale pointer to stabilize. UWW was measured 3 times and the average value was used to calculate D_b . Residual volume (RV) was estimated using following prediction equations; 1) $RV = (0.019 \times \text{height}(\text{cm})) + (0.0115 \times \text{age}) - 2.24$ for men [29], 2) $RV = (0.032 \times \text{height}(\text{cm})) + (0.009 \times \text{age}) - 3.90$ for women [30]. Body density and % body fat were calculated using following prediction equations; 1) $D_b = Wa / \{(Wa - Ww) - Dw - (RV + 0.1)\}$ where Wa means body weight, Ww means under water weight, and Dw means water density. 2) % body fat = $(4.95/D_b - 4.50) \times 100$ [13]. The water temperature was maintained between 34°C and 36°C.

2.7. Statistical analysis

Data were analyzed using SPSS version 25.0 (IBM, U.S.A). Values are expressed as means \pm SD. One-way ANOVA was performed to compare mean differences in the % body fat results measured by 4 different methods.

Pearson correlation coefficients(r) were calculated to assess associations between % body fat by UWW and % body fat measured by circumference, SKF, and BIA. Regression analysis was used to determine the accuracy of each measurement method comparing associations between the absolute difference between % body fat by UWW and % body fat measured by circumference, SKF, and BIA. For all tests, statistical significant was accepted at $P < 0.05$.

3. Results

The physical characteristics of the subjects are listed in <Table 1>. The % body fat determined by four different measurements is shown in <Table 2>. All measurements except girth measurement were measured from all subjects. However, % body fat estimated by circumference measurement was calculated from only 19 subject data.

The results of an ANOVA showed that there were small differences in the results of % body fat estimated by four different measurements. Based on the value measured by UWW as criterion % body fat, % body fat predicted by SKF method showed the smallest difference(about 1.8 % lower). And the results of % body fat predicted by circumference method and BIA were about 5.7 % and 7.2 % higher than that of UWW, respectively. However, there was no significant difference in the mean differences of % body fat measured by four different measurements <Table 2>.

Table 1. Physical characteristics of the subjects.

Variable	Mean \pm S D
Age(yrs)	30.72 \pm 8.70
Height(cm)	171.80 \pm 9.26
weight(kg)	80.88 \pm 17.87
BMI(kg/m ²)	27.02 \pm 3.20

Note: BMI: body mass index.

Table 2. Comparison of % body fat estimated by 4 different measurements.

Method(N)	% body fat	F	Sig.
-----------	------------	---	------

SKF(29)	25.44 \pm 6.09		
Circumference(19)	27.38 \pm 5.01	1.38	.25
BIA(29)	27.91 \pm 5.15		
UWW(29)	25.90 \pm 4.68		

Note: SKF: skinfold, BIA: bioelectrical impedance analysis, UWW: underwater weighing.

The relationships between % body fat determined by UWW and those of circumference, SKF measurement, and BIA are shown in <Figure 1>, <Figure 2>, and <Figure 3>, respectively. The r values between UWW % body fat and % body fat estimated by circumference, SKF, and BIA method were 0.17, 0.59, and 0.40, respectively. The results of % body fat estimated by SKF($P < 0.01$) and BIA($P < 0.05$) were significantly correlated with UWW % body fat. However, better agreement(less variability) was observed between SKF % body fat and UWW % body fat, and r^2 value of SKF also showed highest score compared to those of other measurements.

SEE value for SKF method was smaller than those for the circumference method and BIA. Furthermore, the SEE value(3.84 % body fat) from SKF measurement was within acceptable limits(< 4 % body fat)[8]. The SEE values from anthropometric measurement(4.73 % body fat) and BIA(4.38 % body fat) were higher than 4 %.

Figure 1. Relationship between % body fat determined from UWW and circumference method.

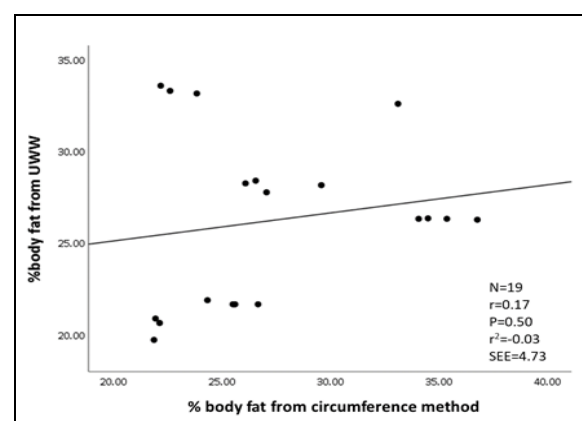


Figure 2. Relationship between % body fat determined from UWW and SKF method.

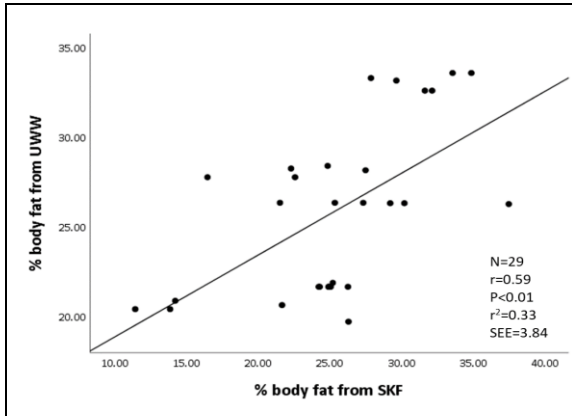
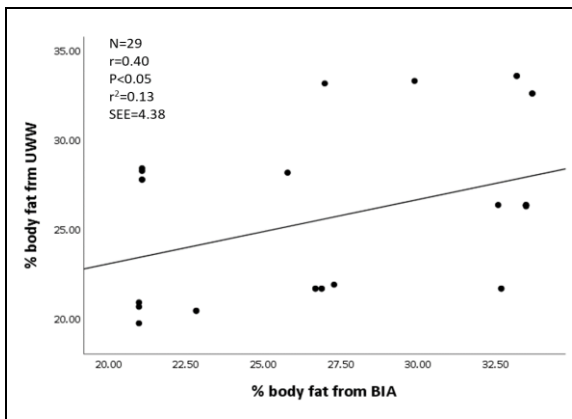


Figure 3. Relationship between % body fat determined from UWW and BIA.



4. Discussion

The principal findings of this study were that there were no significant differences in the mean values of % body fat estimated by four different measurements (SKF, circumference, BIA, and UWW method), but that there are differences in the accuracy of individual estimates of % body fat among those different measurements.

In this study, it was found that as an anthropometric method, circumference measurement to predict % body fat was the least accurate method. It was suggested that the acceptable errors for estimating % body fat by circumferences are ≤ 3.5 % body fat [14]. However, the r value ($r = 0.165$) from circumference method was lowest, and SEE score (SEE = 4.73) was higher than the suggested level. This was highest among other % body fat estimating methods.

The accuracy of circumference methods is affected by equipment, technician skill, and the prediction equation, and subject factors [11]. Above all, anthropometric prediction equations should be selected based on age, gender, and level of body fatness, and there are various available equations developed according to those factors in the research field [15][16][17]. However, the formulas used in this study to estimate % body fat are only based on the age and the constants for the circumference values at the sites of body, but race and body fatness are not considered. Thus, the low validity of circumference method in predicting % body fat is likely due to the lack of accuracy of the % body fat estimating formula used in the present study. Also, small sample size ($N = 19$) in the circumference method may have affected this result.

In addition, circumferences are affected by muscle mass and skeletal size, including fat mass. Therefore, these measures are not only related to fat mass, but also lean body mass. Thus, circumferences can erroneously judge a person with high muscle mass as obese, and this characteristic of the circumference method may have affected this low validity. In this study, % body fat estimated by circumference method was 5.7 % higher compared to those from UWW. On the other hand, there are several advantages of circumference method. It is more reliable than skinfolds, and circumferences can always be measured regardless of body size and fatness.

The validity of the BIA method to predict % body fat is known to be similar to the SKF method [14][19]. In this study, the % body fat estimated by BIA was also highly correlated with the % body fat determined by reference method, and the correlation coefficients were statistically significant (BIA: $r = 0.40$, $P = 0.03$). However, as SEE value (SEE = 3.84) from SKF was smaller than those from BIA (SEE = 4.38) and circumference (SEE = 4.73) method, the accuracy to predict % body fat from BIA was found to be low compared to SKF method. In addition, the % body fat estimated by BIA method tends to overestimate about 5 %.

The BIA method estimates body composition using the principle that electric current

flows at different rates through the body depending on its composition[18]. It is known that the relative predictive accuracy of the BIA method is similar to the SKF method[14][19]. Also, in a study of Aandstad et al.(2014), various equations used for estimating % body fat from BIA method were highly correlated with the % body fat determined from a reference method(DXA scans)[20].

However, in this study, % body fat from BIA method was calculated by FFA which was estimated based on the preset equation for the device. Thus, this relatively low accuracy of BIA method compared to SKF method found in this study is likely to be the result of using a formula that lacks specificity for the subject being measured. Therefore, it is not recommended to use FFM estimates obtained directly from a BIA analyzer for calculating % body fat unless it is known which equations are programmed in the device.

On the other hand, it was reported that In-body as a multifrequency bioelectrical impedance analysis had higher validity than that observed from all single frequency bioelectrical impedance analyses[20]. Therefore, the use of multifrequency bioelectrical impedance analysis may be a reasonable measurement for % body fat in environments where accurate prediction formulas are not available. In addition, BIA may be preferable because it is rapid, noninvasive, relatively inexpensive, and it does not require a high degree of technician skill[8][18].

The correlation coefficient between % body fat from SKF method and UWW was highest among those from other methods in this study(SKF: $r = 0.59$, $P = 0.001$). The accuracy of the SKF method(SEE = 3.84) also higher than the circumference and BIA method. This result means that % body fat can be estimated more accurately from SKF method compared to circumference and BIA. In addition, SKF method showed a small underestimation of % body fat(about 1.8 %) compared to UWW.

The SKF method indirectly measures the thickness of subcutaneous fat tissue, and major advantages of the SKF method are that it

is easy to administer at a relatively low cost, it is rapid, and it is less sensitive to fast changes in hydration status[21][22]. It was demonstrated that the subcutaneous fat measured by SKF is highly correlated with the value obtained from magnetic resonance imaging[23]. However, the validity and reliability of SKF method are depend on the technician's skill, types of caliper, gender, race, age, and the prediction equation for estimating % body fat[24].

In particular, since there are over 100 equations to predict body composition from anthropometric measurement, it is important to select the most population-specific equation for estimating % body fat correctly. It was suggested that effective SKF equations generally estimate body fat within 3.5 % compare to the values from UWW[14][25][26][27]. The equations used in this study were population-specific equations developed taking into account various subject's factors such as race, gender and age. As a result, it was found that % body fat can be estimated more accurately from SKF method. Also, the result found in this study was in accordance with previous studies[20][28].

5. Conclusion

It was examined the difference and the accuracy in % body fat estimated by four different % body fat measurement methods in this study. The values of % body fat predicted from the four different methods were not significantly different each other. However, in predicting % body fat, the SKF method was found to be the most accurate, and the circumference method was the lowest. These results suggested that SKF method is more accurate field method to predict % body fat. However, given the limitations of this study, which did not use population-specific equations in BIA and circumference measures, these results also suggested that it is important to use accurate prediction equations that are appropriate for various factors such as race, age, gender for accurate prediction of body composition.

6. References

6.1. Journal articles

- [1] National Institutes of Health. Health Implication of Obesity: National Institutes of Health Consensus Development Statement. *Annals of Internal Medicine*, 103(1), 147-151 (1985).
- [2] Goodpaster BH & Krishnaswami S & Harris TB & Katsiaras A & Kritchevsky SB & Simonick EM & Nevitt M & Holvoet P & Newman AB. Obesity, Regional Body Fat Distribution, and The Metabolic Syndrome in Older Men and Women. *Archives of Internal Medicine*, 165(7), 777-783 (2005).
- [4] Björntorp P. "Portal" Adipose Tissue as A Generator of Risk Factors for Cardiovascular Disease and Diabetes. *Arteriosclerosis*, 10(4), 493-496 (1990).
- [6] Friedl KE. Size Matters. *The American Journal of Clinical Nutrition*, 93(3), 485-486 (2011).
- [7] Heyward VH. Evaluation of Body Composition. Current issues. *Sports Medicine*, 22(3), 146-156 (1996).
- [9] Jackson AS & Pollock ML. Practical Assessment of Body Composition. *The Physician and Sports Medicine*, 13(5), 76-90 (1985).
- [10] Jackson AS & Pollock ML & Ward A. Generalized Equations for Predicting Body Density of Women. *Medicine and Science in Sports and Exercise*, 12(3), 175-181 (1980).
- [11] Jackson AS & Pollock ML. Generalized Equations for Predicting Body Density of Men. *The British Journal of Nutrition*, 40(3), 497-504 (1978).
- [15] Weltman A & Levine S & Seip RL & Tran ZV. Accurate Assessment of Body Composition in Obese Females. *The American Journal of Clinical Nutrition*, 48(5), 1179-1183 (1988).
- [16] Tran ZV & Weltman A. Generalized Equation for Predicting Body Density of Women from Girth Measurements. *Medicine and Science in Sports and Exercise*, 21(1), 101-104 (1989).
- [17] Wilmore JH & Behnke AR. An Anthropometric Estimation of Body Density and Lean Body Weight in Young Women. *The American Journal of Clinical Nutrition*, 23(3), 267-274 (1970).
- [18] Dehghan M & Merchant AT. Is Bioelectrical Impedance Accurate for Use in Large Epidemiological Studies?. *Nutrition Journal*, 7(1), 26-26 (2008).
- [19] Ackland TR & Lohman TG & Sundgot Borgen J & Maughan RJ & Meyer NL & Stewart AD & Müller W. Current Status of Body Composition Assessment in Sport. *Sports Medicine*, 42(3), 227-249 (2012).
- [20] Aandstad A & Holtberget K & Hageberg R & Holme I & Anderssen SA. Validity and Reliability of Bioelectrical Impedance Analysis and Skinfold Thickness in Predicting Body Fat in Military Personnel. *Military Medicine*, 179(2), 208-217 (2014).
- [21] Hodgdon JA & Friedl KE & Beckett MB & Westphal KA & Shippee RL. Use of Bioelectrical Impedance Analysis Measurements as Predictors of Physical Performance. *The American Journal of Clinical Nutrition*, 64(3 Suppl), 463S-468S (1996).
- [22] Norgan NG. Laboratory and Field Measurements of Body Composition. *Public Health Nutrition*, 8(7A), 1108-1022 (2005).
- [23] Hayes PA & Sowood PJ & Belyavin A & Cohen JB & Smith FW. Sub-cutaneous Fat Thickness Measured by Magnetic Resonance Imaging, Ultrasound, and Calipers. *Medicine and Science in Sports and Exercise*, 20(3), 303-309 (1988).
- [24] Lohman TG & Pollock ML & Slaughter MH & Brandon LJ & Boileau RA. Methodological Factors and The Prediction of Body Fat in Female Athletes. *Medicine and Science in Sports and Exercise*, 16(1), 92-96 (1984).
- [25] Lohman TG. Applicability of Body Composition Techniques and Constants for Children and Youths. *Exercise and Sport Sciences Reviews*, 14, 325-357 (1986).
- [26] Thomas KT & Keller CS & Holbert KE. Ethnic and Age Trends for Body Composition in Women Residing in The U.S. Southwest: II. Total Fat. *Medicine and Science in Sports and Exercise*, 29(1), 90-98 (1997).
- [27] Katch FI & Katch VL. Measurement and Prediction Errors in Body Composition Assessment and The Search for The Perfect Prediction Equation. *Research Quarterly for Exercise and Sport*, 51(1), 249-260 (1980).
- [28] Brandon LJ. Comparison of Existing Skinfold Equations for Estimating Body Fat in African

American and White Women. *The American Journal of Clinical Nutrition*, 67(6), 1155-1161 (1998).

- [29] Boren HG & Kory RC & Syner JC. The Veterans Administration-army Cooperative Study of Pulmonary Function: II. The Lung Volume and Its Subdivisions in Normal Men. *The American Journal of Medicine*, 41(1), 96-114 (1966).
- [30] Goldman HI & Becklake MR. Respiratory Function Tests, Normal Values at Median Altitudes and The Prediction of Normal Results. *American Review of Tuberculosis and Pulmonary Diseases*, 79(4), 457-467 (1959).

6.2. Books

- [8] Heyward VH & Stolarczyk LM. Applied Body Composition Assessment. Human Kinetics (1996).
- [11] Callaway CW & Chumlea WC & Bouchard C & Himes JH & Lohman TG & Martin AD & Mitchell CD & Mueller WH & Roche AF & Seefeldt VD. Circumferences. Anthropometric Standardization Reference Manual. Human Kinetics (1988).
- [12] Katch VL & McArdle WD & Katch FI. Essentials of Exercise Physiology 4th eds. Lippincott Williams & Wilkins (2011).
- [13] Siri WE. Body Composition from Fluid Spaces and Density: Analysis of Methods. Techniques for Measuring Body Composition. National Academy of Sciences (1961).
- [14] Lohman TG. Advances in Body Composition Assessment. Current Issues in Exercise Science Series. Human Kinetics (1992).

6.3. Additional references

- [3] <http://kostat.go.kr/> (2019).
- [5] <https://www.who.int/> (2019).

Author

Cho Chang-mo / Keimyung University Professor
B.A. Keimyung University
M.A. Keimyung University
Ph.D. Keimyung University

Research field

- Effects of Regular Exercise Training and Acute Exhaustive Exercise on Serum SOD Response: The Possibility of Serum SOD as Health-related Indicator, *Journal of Advanced Research in Dynamical & Control System*, 9(12) (2017).
- Effects of a 4-week Vitamin B6·B9·B12 Supplementation on the Muscle Recovery and Muscular Function Induced by Acute Eccentric Exercise, *Kinesiology*, 4(1) (2019).

Major career

- 2010~present. Keimyung University, Professor
- 2019~present. International Society for Kinesiology, Research Chairperson

Publication state: Japan
ISSN: 2435-0702

Publisher: J-INSTITUTE
Website: <http://www.j-institute.jp>

Corresponding author
E-mail: hsb8604@naver.com

Peer reviewer
E-mail: kinesiology@j-institute.jp

<http://dx.doi.org/10.22471/kinesiology.2019.4.2.22>

© 2019 J-INSTITUTE

Verification of Mediating Effects of Training Attitude on the Relationship between Motivation for Participation in Security MARTIAL ARTS and Training Flow of Students Majoring in Security Services

Shin Min-chul¹

Kyungwoon University, Gumi, Republic of Korea

Hong Seong-bong^{2*}

Sungkyungwan University, Suwon, Republic of Korea

Abstract

The objective of this study is to understand the motivation for participation in security martial arts, training flow, and training attitude of students majoring in security services, and also to examine the mediating effects of training attitude on the relationship between motivation for participation and training flow. To achieve the objective of this study, this study conducted a survey targeting total 422 students majoring in security services by selecting the samples through the convenience sampling method, and total 415 questionnaires were used as effective samples. Using the SPSS Program Ver. 23.0 Statistics Program for the collected data, this study conducted the frequency analysis, exploratory factor analysis, reliability analysis, analysis of variance, correlation analysis, multiple regression analysis, and the hierarchical regression analysis through the three-step mediating effect process of Sobel's Z-test. Through the research methods and procedures above, this study drew the results on the motivation for participation in security martial arts, training flow, and training attitude of students majoring in security services. First, the subfactors of motivation for participation in security martial arts, training flow, and training attitude perceived by students majoring in security services showed partially significant differences between groups in accordance with the characteristics such as sex, event, and experience. Second, the motivation for participation in security martial arts(extrinsic motivation, intrinsic motivation), training flow(cognitive flow, behavioral flow), and training attitude(perceptual attitude, attentive attitude, participatory attitude) of students majoring in security services showed significantly positive(+) effects. Third, the training attitude played partial mediating roles in the relationship between motivation for participation in security martial arts and training flow of students majoring in security services. In summary, the motivation for participation in security martial arts perceived by students majoring in security services directly had effects on the training flow, and it also had indirect effects on it through training attitude.

[Keywords] Security Martial Arts, Motivation for Participation, Training Flow, Training Attitude, Security Services

1. Introduction

1.1. Necessities and objective of research

Since the 1980s, the life quality of people has been improved due to the explosive economic growth and development in Korea. With the appearance of diverse crimes and

many social problems in this process, however, the national safety consciousness and demand for public order have been increased. In order to protect their bodies and minds, people are protecting their families and surroundings by training their own physical strength or even paying money to private security companies.

The hazard elements of the actual security situation are the irregularity and uncertainty in which the opponent cannot be cognized. Contrary to the general martial arts, the security martial arts used in site should be able to block the opponent's attack and also to perfectly overpower the opponent at the same time under the special condition in which the type and range of attack and the number of offenders are not predictable, so that the skills to cope with various situations should be learnt and trained[1].

The roles of diverse professional institutions are important to cultivate excellent security guards, and representatively, the role of college is greatly highlighted. Currently, diverse courses are established and taught to cultivate excellent security guards in the department of security martial arts, and lots of time and efforts are invested to develop the most important martial arts performance ability[2]. Moreover, emphasizing the unique educational values just like mental education and moral education, the martial arts education includes both areas of physical activity and psychological activity to develop/cultivate the inner side. Considering this part, the motivation for correct spirit and goal of students majoring in security services must be important factors.

Actually, the motivation could be defined as the direction and intensity of one's efforts to set up goals and also to practice actions to achieve the goals for meeting the desire[3]. To the students majoring in security services, the future goal or mindset before participating in martial arts training is the most important element. This motivation could have positive effects on the consistent attitude towards participation through learning and ex-

perience, and moreover, they could be immersed for the best experience in training body and mind.

However, reviewing the existing researches on the security martial arts, there have been diverse researches such as academic researches on the security martial arts itself like researches by Shin Sang-min & Kim Tae-min(2014), researches on the basis of security martial arts education like researches by Song Yeong-nam & Kim Byeong-chan(2010)[4], and researches on the measures for applying diverse martial arts such as Taekwondo, Judo, Hapkido, Martial Arts for Korean Special Forces, and Kick-Boxing(Kim Do-yeong, Kim Jin-hwan, 2017)[5]. Even though they are necessary for the development and growth of security martial arts, they are not the researches on the concrete training efficiency for achieving the goals of security martial arts. Thus, there should be the researches on the training of security martial arts.

Even though there are not many researches on the training of security martial arts, there are only researches handling each item such as a research on the motivation for participation by Kim Chang-geun & Jeon Ho-moon(2017)[6], a research on the training flow by Choi Woo-chang(2017)[7], and a research on the training attitude by Ham Woo-hyeong, Choi, Dong-jae, & Kim Byeong-tae(2017)[8]. Thus, it would be necessary to have a comprehensive and multilateral research.

Therefore, the objective of this study is to examine the effects of motivation for participation in security martial arts on the training flow of students majoring in security services, and also the mediating effects of training attitude. Through this, the high-level of security martial arts ability could be maintained by examining the relationships of motivation for participation, training flow, and training attitude, and also increasing the training flow.

2. Research Methods

2.1. Research subjects

This study selected total 415 students majoring in security martial arts in Seoul, Gyeonggi, Gyeongbuk, and Daegu regions as research subjects through the purposive sampling method. Excluding seven questionnaires with omitted or biased responses from total 422 collected questionnaires, total 415 questionnaires suitable for this study were used for the final analysis. <Table 1> shows the general characteristics of the subjects participating in this study.

Table 1. General characteristics of research subjects.

Section	Contents	N	%
Sex	Male students	291	70.1
	Female students	124	29.9
Grade	First-year student	146	35.2
	Second-year student	171	41.2
	Third-year student	46	11.1
	Fourth-year student	52	12.5
Training event	Taekwondo	146	35.2
	Judo	171	41.2
	Kendo	46	11.1
	Yongmudo	52	12.5
Training experience	Less than five years	174	41.9
	Less than ten years	134	32.3
	Ten years or more	107	25.8
Number of training	Two times a week or less	146	35.2
	Four times a week or less	101	24.3
	Five times a week or more	168	40.5

2.2. Validity and reliability of measurement tools

The questionnaire used for examining the objective of this study was composed based on preceding researches. All the question-

naire items used the five-point Likert scale including ‘not at all(1point)’ and ‘very much likely(5point)’. To verify the validity of the questionnaire used for this study, the exploratory factor analysis(EFA) was performed, and for the reliability analysis, the Cronbach’s α coefficient as a method to evaluate the reliability by the internal consistency was used.

For verifying the construct validity of the measurement variables(motivation for participation, training flow, training attitude), the exploratory factor analysis using the Maximum likelihood method was conducted. On top of judging the suitability of each research sample by using the Kaiser-Meyer-Olkin(KMO) index, this study conducted the Bartlett’s unit matrix verification. Also, as a factor rotation method, this study performed the oblique rotation using the direct oblimin considering the correlation of each construct. After extracting only factors with eigenvalue as 1.0 or up, the items were selected on the basis of factor loading as .4 or up, and the matter of double loading to other factors was reviewed. The results of conducting the validity and reliability analysis of each questionnaire are shown as <Table 2>, <Table 3>, and <Table 4>.

1)Scale of Motivation for Participation

For the measurement items of motivation for participation, the questionnaire used by Lee Moo-yeon(2010)[9] by referring to the questionnaire used for a research by Jeong Yong-gak(1997)[10] was used after modifying/complementing it suitable for the objective of this study. Besides this study, it was also used for the researches by Kim Beom-joon & Lee Jae-moo(2019)[11], by considering the characteristics of each subject after modifying/complementing it. The items of motivation for participation in this study were composed of total 17 items including nine items about extrinsic motivation and eight items about intrinsic motivation. Just as

shown in <Table 2>, after removing the items(No. 1, 7, 13, 17) showing the multicollinearity or factor loading as .4 or less from the 17 items about motivation for participation of students majoring in security martial arts, this study finally drew total 13 items for extrinsic motivation(eight items) and intrinsic motivation(five items), and two factors. In the results of analyzing the item internal reliability of two subfactors, the Cronbach's α coefficient was .870~.903, which was exceeding the baseline as .7(Nunnally, 1978).

Table 2. Analysis of validity and reliability of motivation for participation.

Factor item	Factor loading	
	Extrinsic motivation	Intrinsic motivation
Motivation for participation 16	.792	.174
Motivation for participation 5	.775	.306
Motivation for participation 2	.726	.199
Motivation for participation 12	.682	.254
Motivation for participation 9	.672	.350
Motivation for participation 4	.640	.430
Motivation for participation 8	.641	.504
Motivation for participation 15	.610	.550
Motivation for participation 3	.195	.805
Motivation for participation 14	.311	.763
Motivation for participation 11	.230	.747
Motivation for participation 6	.303	.738
Motivation for participation 10	.470	.683
Eigenvalue	4.337	3.894
Explanatory power(%)	33.362	29.950
Cronbach' α	.903	.870

Note: KMO sample suitability measurement=.944, Bartlett'sphericity verification =3144.202, $df=78$, $p=.001$, Cumulative explanatory power =63.312.

2)Scale of Training Flow

For the measurement items of training flow, the Korean-version scale developed by Csikszentmihalyi(1975)[12] and then adapted by Lee Jong-gil(1992) was used after modifying/complementing it. Besides this study, it was also used for the researches by Choi Woo-chang, Jeon Yong-tae & Kang hyeon(2019)[13], by considering the characteristics of each subject after modifying/complementing it. The items of training flow in this study were composed of total 12 items including eight items about cognitive flow and four items about behavioral flow. Just as shown in <Table 3>, after removing the items(No 1, 12) showing the multicollinearity or factor loading as .4 or less from the 12 items about training flow of students majoring in security martial arts, this study finally drew total 10 items for cognitive flow(seven items) and behavioral flow(three items) and two factors. In the results of analyzing the item internal reliability of two subfactors, the Cronbach's α coefficient was .811~.911.

Table 3. Analysis of validity and reliability of training flow.

Factor item	Factor loading	
	Cognitive flow	Behavioral flow
Training flow 4	.808	.128
Training flow 7	.789	.293
Training flow 5	.768	.366
Training flow 8	.760	.227
Training flow 6	.754	.268
Training flow 3	.751	.341
Training flow 2	.668	.322
Training flow 10	.129	.904
Training flow 9	.416	.678
Training flow 11	.507	.516
Eigenvalue	4.469	2.210
Explanatory power(%)	44.689	21.204

Cronbach' α	.911	.811
--------------------	------	------

Note: KMO sample suitability measurement=.933, Bartlett sphericity verification =2273.935, $df=45$, $p=.001$, Cumulative explanatory power =65.894.

3) Training Attitude

For the measurement items of training attitude, the questionnaire used for the researches by Shin Seong-hyeon & Lee Hyeong-il(2019)[14] was used after modifying/complementing it by considering the characteristics of each subject. The items of training attitude in this study were composed of total 12 items including four items about perceptual attitude, four items about participatory attitude, and four items about attentive attitude. Just as shown in <Table 4>, among the 12 items about training attitude of students majoring in security martial arts, there were no items showing the multicollinearity or factor loading as .4 or less, so that this study drew total 12 items for perceptual attitude(four items), participatory attitude(four items), and attentive attitude(four items) and three factors. In the results of analyzing the item internal reliability of subfactors, the Cronbach's α coefficient was .766~.846.

Table 4. Analysis of validity and reliability of training attitude.

Factor item	Factor loading		
	Cognitive flow	Behavioral flow	Attentive attitude
Training attitude 1	.837	.258	.057
Training attitude 2	.740	.364	.087
Training attitude 3	.710	.225	.309
Training attitude 4	.708	.177	.311
Training attitude 10	.168	.785	.219
Training attitude 12	.276	.722	.323
Training attitude 9	.411	.697	.146
Training attitude 11	.259	.696	.362

Training attitude 6	.104	.191	.793
Training attitude 7	.204	.343	.722
Training attitude 5	.398	.331	.574
Training attitude 8	.442	.292	.542
Eigenvalue	3.001	2.946	2.084
Explanatory power(%)	25.009	24.554	17.363
Cronbach' α	.837	.846	.766

Note: KMO sample suitability measurement=.935, Bartlett sphericity verification =2466.745, $df=66$, $p=.001$, Cumulative explanatory power =65.894.

2.3. Data processing

Using the SPSS Program Ver. 23.0 Statistics Program, this study conducted the analysis in accordance with the objective of this study. To understand the characteristics of the subjects participating in this study, the frequency analysis was performed. In order to understand the validity and reliability of measurement tool(questionnaire), the exploratory factor analysis and the item internal reliability analysis(Cronbach's α) were conducted. Also, to examine differences between groups in accordance with the individual characteristics of students majoring in security martial arts, the independent t-test and one-way ANOVA were performed. The Scheffe's method was used for the post-test. Also, on top of conducting the correlation analysis to understand the correlation between variables, this study performed the multiple regression analysis and the hierarchical regression analysis through the three-step mediating effect process of Sobel's Z-test, in order to verify the relationships between variables, and mediating effects.

3. Research Results

3.1. Correlation analysis

This study conducted the Pearson's correlation analysis to understand the relationships between each factor, and the results are shown as <Table 6>. Concretely, the subfactors of motivation for participation such as extrinsic motivation and intrinsic motivation, subfactors of training flow such as cognitive flow and behavioral flow, and the subfactors of training attitude such as perceptual attitude, attentive attitude, and participatory attitude showed positive(+) correlations in the statistical level of $p < .01$. As the correlation coefficient between every factor was .80 or less, there was no problem of multicollinearity.

Table 5. Analysis of correlations between factors.

Section	(a)	(b)	(c)	(d)	(e)	(f)	(g)
(a) Extrinsic motivation	1						
(b) Intrinsic motivation	.73	1					
(c) Cognitive flow	.79	.62	1				
(d) Behavioral flow	.62	.67	.68	1			
(e) Perceptual attitude	.67	.57	.65	.53	1		
(f) Attentive attitude	.57	.58	.59	.66	.64	1	
(g) Participatory attitude	.62	.61	.64	.68	.66	.74	1

Note: ** $p < .01$.

3.2. Analysis on the relationships of motivation for participation, training flow, and training attitude

1) Effects of Motivation for Participation and Training Attitude on the Training Flow of Students Majoring in Security Martial Arts

The results of conducting the multiple regression analysis on the effects of motivation for participation and training attitude on the training flow of students majoring in security martial arts, are shown as <Table 6>.

In the results of understanding the effects of motivation for participation on the training flow, the extrinsic motivation ($\beta = .525$) and intrinsic motivation ($\beta = .290$) in order had positive(+) effects on the training flow in the

statistically significant level while the explanatory power of the regression model of motivation for participation and exercise flow was 63.9% ($R^2 = .639$).

The effects of training attitude on the training flow are shown in the second results of <Table 7>. In the results of the analysis, the participatory attitude ($\beta = .369$), attentive attitude ($\beta = .262$), and perceptual attitude ($\beta = .220$) in order had positive(+) effects on the training flow while the explanatory power of the regression model of training flow and exercise flow was 60.1% ($R^2 = .601$).

Table 6. Multiple regression analysis of motivation for participation, training attitude, and training flow.

Dependent variable	Independent variable	B	SE	β	t	p	
Training flow	Constant	.58	.1		4.98	.001	
	Extrinsic motivation	.52	.05	.5	12.7	.001	
	Intrinsic motivation	.29	.09	.2	6.80	.001	
	$R^2 = .639$, Adjusted $R^2 = .637$, F=364.554, $p = .001$						
	Constant	.38	.1		2.92	.004	
	Perceptual attitude	.22	.03	.2	5.26	.001	
	Attentive attitude	.26	.05	.2	5.21	.001	
	Participatory attitude	.36	.08	.3	7.69	.001	
	$R^2 = .601$, Adjusted $R^2 = .598$, F=206.112, $p = .001$						

2) Verification of Mediating Effects of Training Attitude on the Relationship between Motivation for Participation and Training Flow of Students Majoring in Security Martial Arts

In the results of verifying the mediating effects of training attitude perceived by students majoring in security martial arts, just as shown in <Table 7>, in the step 1 analyzing the effects of independent variable on the mediating variable, the motivation for participation ($p < .001$) had significant effects on the training attitude. When the motivation for participation was higher ($\beta = .686$), the training attitude was high. The motivation for participation could explain the training attitude as much as 54.3%.

In the step 2 analyzing the effects of independent variable on the dependent variable, the motivation for participation ($p < .001$) had significant effects on the training flow. When the motivation for participation was higher ($\beta = .819$), the training flow was high. The motivation for participation could explain the training flow as much as 63.1%.

In the last step 3, the effects of independent variable and mediating variable on the dependent variable were analyzed. The training attitude ($p < .001$) as a mediating variable had significant effects on the training flow, so that the mediating effects of it were verified. Also, the motivation for participation ($p < .001$) as an independent variable had significant effects on the training flow, so that the partial mediating effects of it were verified. When the motivation for participation ($\beta = .508$) and training attitude ($\beta = .454$) were higher, the training flow got increased while they could explain the training flow as much as 70.8%.

Table 7. Verification of mediating effects of training attitude through regression analysis.

	Step1	Step2	Step3
	Training attitude	Training flow	Training flow

	Constant	1.190***	.525***	-.015
Independent variable	Motivation for participation	.686***	.819***	.508***
Mediating variable	Training attitude			.454***
		.543		
	R^2		.631	.708
	F	489.755**	706.213**	499.006***

Note: *** $p < .001$.

<Table 8> shows the results of Sobel test on the mediating effects of training attitude. The Z-test was conducted by using the unstandardized coefficient ($\beta = .686$) between motivation for participation as an independent variable and training attitude as a mediating variable, the unstandardized coefficient ($\beta = .454$) between training attitude as a mediating variable and training flow as a dependent variable, the standard error ($SE = .031$) of motivation for participation and training attitude, and the standard error ($SE = .044$) of training attitude and training flow. When the z-value is bigger than 1.96 or smaller than -1.96, the mediating effects are judged to be statistically significant. In the results of the verification ($a = .686$, $b = .454$, $S_a = .031$, $S_b = .044$), there were the mediating effects of training attitude (Sobel $z = 9.9649$, $p < .001$). When the motivation for participation was higher ($\beta = .686$), the training attitude got higher, which was led to the increase of training flow. The indirect effects of motivation for participation on the training flow were $.311$ ($\beta = .686 \times .454 = .311$).

Table 8. Sobel test on the mediating effects of training attitude.

	<i>B</i>	<i>SE</i>	<i>z</i>	<i>p</i>
Motivation for participation → Training attitude	.686	.031	9.352	<.001
Training attitude → Training flow	.454	.044		

4. Discussions

This study understood the motivation for participation in security martial arts, training flow, and training attitude of students majoring in security services, and also examined the mediating effects of training attitude on the relationship between motivation for participation and training flow. Based on the results drawn through the verification of hypotheses, the discussions could be made as follows.

First, in the results of analyzing differences in motivation for participation in security martial arts, training flow, and training attitude of students majoring in security services, except for the participatory attitude as a sub-factor of training attitude, men showed higher results than women in every factor. Also, regarding the differences in accordance with event, the majors in Yongmudo showed higher results than other majors. Regarding the differences in accordance with experience, the group with more experience showed higher results than the group with less experience. This result is supported by the results of a research by Ye Gi-hoon & Kim Se-jin(2014)[15] reporting that the male students' adaptation was higher than the female students in the cognitive/emotional level during the college life, and a research by Kim Deok-jin & Yang Myeong-hwan(2009)[16] re-

porting that men felt bigger interest in competition than women, and the male students also showed the higher performance of participatory, perceptual, and attentive attitude than the female students. Also, the group with higher experience of training showed higher motivation for participation, training flow, and training attitude than the group with lower experience of training, which accords with the results of a research by An Jeong-deok & Song Gang-yeong(2009)[17] reporting that the people with more experience as a player showed the excellent exercise attitude and flow based on their self-management and clear goal-orientation.

The motivation for participation in security martial arts and training attitude of students majoring in security services had significant effects on the training flow. Strengthening the intrinsic/extrinsic motivation for participation in security martial arts for training flow, and also strengthening the perceptual, attentive, and participatory attitude for training attitude had positive effects on the training flow. The research by Hong Hee-jeong & Im Sin-ja(2013)[18] reported that the motivation for participation of Taekwondo Poomsae team members had positive effects on the exercise attitude. The research by Jeong Hoon-in(2014)[19] showed the positive effects of motivation for participation of Judo studio members on the training flow, which supports the results of this study.

On the relationship between motivation for participation in security martial arts and training flow of students majoring in security services, the training attitude showed the partial mediating effects. Indirectly reviewing the researches on martial arts training as there have been no direct researches on the mediating effects of training attitude on the relationship between motivation for participation and training flow, a research by Lee Je-hong, Eom Jin-hong, & Seol Jeong-deok(2011)[20] reported the positive effects

of motivation for participation on the training attitude of participants in golf, and the researches by Choi Woo-chang(2017)[21] reported the positive effects of sports attitude on the exercise flow of sports participants and trainees, which supports the results of this study.

As a result, the motivation for participation had positive effects on the training flow and training attitude of students majoring in security services. And when the training attitude was higher, the higher flow was shown. The motivation for participation in martial arts training, training flow, and training attitude must be essential abilities to students majoring in security services.

5. Conclusions and Suggestions

In order to examine the relationships of motivation for participation in security martial arts, training flow, and training attitude of students majoring in security services, this study aims to analyze differences between groups in accordance with the characteristics such as sex, grade, event, and experience, and also to examine the relationships of each factor and mediating effects by using the correlation analysis and regression analysis. Based on such results, this study reached the conclusions as follows.

First, in the results of analyzing differences in accordance with the demographic characteristics such as sex, grade, event, and experience, except for the participatory attitude of training attitude, men showed higher results than women in every factor while there were no huge differences in accordance with grade. Regarding the differences in accordance with event, the majors in Yongmudo showed the highest while the rest Taekwondo, Judo, and Kendo showed similar results. In the differences in accordance with experience, the group with more experience

showed higher results than the group with less experience.

Second, the motivation for participation in security martial arts, training flow, and training attitude of students majoring in security services showed significantly positive effects.

Third, on the relationship between motivation for participation in security martial arts and training flow of students majoring in security services, the training attitude played partially mediating roles. The motivation for participation in security martial arts perceived by students majoring in security services had direct effects on the training flow, and it also had indirect effects through training attitude.

In summary, when the motivation for participation of students majoring in security services was higher, the training flow got increased, and this motivation for participation also had effects on the training attitude. As the correct training attitude also had positive effects on the training flow, the motivation for participation, training flow, and training attitude must be essential abilities to students majoring in security services.

This study could make suggestions for follow-up researches as follows.

First, to understand the relationships of motivation for participation in security martial arts, training flow, and training attitude of students majoring in security services, this study used the self-report questionnaire. In order to more deeply research the current status or expertise of students majoring in security services, however, it would be great to use the qualitative research method to support the results of this study for better researches.

Second, this study did not consider the experience and major in security martial arts of students majoring in security services. The existing preceding researches showed differ-

ences in accordance with major and experience. Considering the differences in training method or value in accordance with major, and the increased level and completion of training when reaching a certain degree of experience, it would be necessary to have the researches considering each major and experience.

6. References

6.1. Journal articles

- [1] Shin SM & Kim TM. Academic Development and Introspection of Security Martial Arts. *The Journal of Korean Alliance of Martial Arts*, 16(1), 113-127 (2014).
- [2] Yang JY & Lim TH & Kim DH. Effects of Perceived Autonomy Support on Intrinsic Motivation and Passion for Major Students of Security Martial Arts. *The Journal of Korean Security Science Review*, 46, 87-112 (2016).
- [4] Song YN & Kim BC. Development Devices on Security Martial Arts Education of Private Security Personnel. *The Journal of Korean Alliance of Martial Arts*, 12(3), 327-342 (2010).
- [5] Kim DY & Kim JH. Application of Kickboxing Skills to Korean Guard Martial Arts. *The Journal of Korean Alliance of Martial Arts*, 19(4), 179-196(2017).
- [6] Kim CG & Jeon HM. The Effect on both Satisfaction from the Training and Intention to Constant Exercise of the Participation Motive of Kumdo Trainees. *Korean Journal of Kumdo*, 28(1), 27-45 (2017).
- [7] Choi WC. Effects of the Leadership Types of Security Martial Arts Leaders on the Exercise Flow and In-class Attitude of Trainees. *The Journal of Korean Association of Security and Safety*, 12(2), 31-56 (2017).
- [8] Ham WH & Choi DJ & Kim BT. The Effect of Security Martial Arts Instructor's Leadership Type on Protection Major's Practice Attitude and Teaching Outcomes. *The Journal of Korean Journal of Convergence Science*, 6(4), 126-149 (2017).
- [11] Kim BJ & Lee JM. Examining the Mediating Effect of Organization Identification on Participation Motivation and Sport Commitment in Sport Clubs. *Journal of Sport and Leisure Studies*, 77, 275-287(2019).
- [13] Choi WC & Jeon YT & Kang H. Effects of Servant Leadership of Security Martial Arts Instructors on the Exercise Commitment and Training Satisfaction. *The Journal of Korean Security Journal*, 60, 197-226 (2019).
- [14] Shin SH & Lee HI. The Influence of Hapkido Gymnasium's Relationship Marketing on Trainees' Form a Bond of Sympathy and Attitude towards Training. *The Journal of Korean Society of Martial Arts*, 13(2), 109-130 (2019).
- [15] Ye KH & Kim SJ. A Study on the Awareness of Major in Students from Dept. of Optometry at a University. *The Journal of Korean Ophthalmic Optics Society*, 20(1), 25-34 (2015).
- [16] Kim DJ & Yang MH The Effect of the Teacher's Teaching Behaviors on Intrinsic Motivation and Learning Attitude in School Physical Education Class. *The Journal of Exercise and Sport Science*, 15, 15-19(2009).
- [17] Ahn JD & Song KY. A Comparative Analysis of the Korea Olympic Representative Athletes's and Common Athletes's Self-management. *The Journal of Korean Society of Sport Psychology*, 19(3), 197-207 (2008).
- [18] Hong HJ & Lim SW. Intrinsic Motivation and Achievement Goals of Taekwondo Poomsae Players Impact on the Movement Commitment. *The Journal of Korean Society of Martial Arts*, 7(2), 33-48 (2013).
- [20] Lee JH & Eom JJ & Sul JD. Motivation According to Participation of Golf Class, Relationships between Exercising. *The Journal of Sport and Leisure Studies*, 46(1), 27-36 (2011).
- [21] Choi WC. Effects of the Leader-

ship Types of Security Martial Arts Leaders on the Exercise Flow and In-class Attitude of Trainees. *The Journal of Korean Association of Security and Safety*, 12(2), 31-56 (2017).

6.2. Thesis degree

- [9] Lee MY. Effects of participatory Motivation, Flow and addiction on Psychological Happiness in Leisure Sport Participant. Yongin University, Doctoral Thesis (2010).
- [10] Jung YG. (The) Influence of Sport Participation Motivation, Arousal Seeking and Affects on the Behavior of Sport Commitment. Pusan National University, Doctoral Thesis (1997).
- [19] Jung HI. The Effect of Judo Gym Participation Motive on Training Flow and Repurchase Intention. Yongin University, Master's Thesis (2014).

6.3. Books

- [3] Sage GH. Introduction to Motor Behavior. A Neuropsychological Approach. Addison-Wesley (1971).
- [12] Csikszentmihalyi M. Beyond Boredom and Anxiety. Jossey-Bass (1975).

Lead Author

Shin Min-chul / Kyungwoon University Professor
B.A. Youngin University
M.A. Youngin University
Ph.D. Sejong University

Research field

- Relationship with Golf Addiction, Self-management and Leisure Satisfaction among Golf Gambling Participants, *The Korean Journal of Physical Education*, 21(4) (2012).
- Comparison of Structure Modeling with Perceived Service Quality, Reason of Selection, Satisfaction and Loyalty of Consumers by Type of Driving Range, *Journal of Korea Academia-industrial Cooperation Society*, 15(6) (2014).

Major career

- 2007~2019. Seoul University, Lecture
- 2015~2019. Youngin University, Lecture

Corresponding Author

Hong Seong-bong / Sungkyungkwan University Researcher
B.A. Youngin University
M.A. Youngin University
Ph.D. Sungkyungkwan University

Research field

- A Study on the Regional Economic Impacts of Sports Event and Its Usefulness: Survey Data at the National Youth Tournament, *Journal of Measurement and Evaluation in Physical Education and Sports Science*, 21(1) (2019).
- Validation of the Retirement will Measuring Tool for Active College Athletes, *Journal of Measurement and Evaluation in Physical Education and Sports Science*, 21(4) (2019).

Major career

- 2015~present. Pyeongtaek University, Lecturer
- 2016~present. Youngin University, Lecturer

Publication state: Japan
ISSN: 2435-0702

Publisher: J-INSTITUTE
Website: <http://www.j-institute.jp>

Corresponding author
E-mail: lwh7152@hanmail.net

Peer reviewer
E-mail: kinesiology@j-institute.jp

<http://dx.doi.org/10.22471/kinesiology.2019.4.2.33>

© 2019 J-INSTITUTE

Analysis on Consciousness Structure of HOSPICE Patients and Effectiveness of the Horticultural Therapy

Shin Young-sook¹

Daegu Haany University, Gyeongsan, Republic of Korea

Lim Won-hyeon^{2*}

Daegu Haany University, Gyeongsan, Republic of Korea

Abstract

This study was conducted on hospice patients to identify the cognitive structure of hospice patients with a horticultural therapy. 49 patients and carers(22 males and 27 females) from Feb. 17 2016 to Feb. 22, 2017 and 115 patients and carer(61 males and 54 females) at B Hospital from Jan. 7, 2016 to Dec. 28, 2017, and 170 patients and carers(99 females and 334 females) at C Hospital from Jan. 4, 2017 to Dec. 20, 2017 were analyzed. According to this study, love(42.66%), hope(30.54%), gratitude(13.17%), happiness(10.03%) and self-reflection(2.54%) were listed in order. Both gender showed the highest level of love, followed by hope, gratitude, happiness and self-reflection according to effect analysis of horticultural therapy by gender. In consciousness structure of hospice patient, the expression of love to family was most frequently expressed, followed by hope, gratitude, happiness and self-reflection. The hope of hospice patients was examined lower than that of carers, but self-reflection of patients was found to be higher than the average.

[Keywords] Hospice Patients, Horticultural Therapy, Carers, Consciousness Structure, Self-Reflection

1. Introduction

In 1998, spiritual concept was added to the World Health Organization's definition of health, defining "health is not only disease-free or in a frail condition, but also a dynamic and complete state of physical, mental, social and spiritual well-being." [1]. According to data collected through the National Cancer Registration Statistics Project by Ministry of Health and Welfare and the national cancer center, the number of survivors on Jan. 1, 2016 who got cancer since 1999 were about 1.71 million, which is one in thirty-one of Koreans. Breast cancer is said to be on a steady rise since 1999 [2]. Cancer patients suffer from a variety of psychological and social difficulties in addition to physical problems during diagnosis and treatment, and domestic studies show that 43.2 to 61.2 percent of cancer patients under treatment were in depression [3]. Subject of hospice means not only just the pain of physical pain but also social,

spiritual and spiritual pain. Various kinds of pain are closely related, and hospice subjects experience many stages of psychological change [4]. When comparing hospice usage internationally (as of 2011), U.S. (52%), U.K. (46.6%), Canada (40.8%), Taiwan (39%), Japan (11%) and Korea (5.6%) lagged far behind other countries. Comparing internationally based on the World 'Quality of Death' index report, United Kingdom (93.9%) ranked first among 80 countries in the world (as of 2015) while Taiwan (83.1%) ranked sixth, United States (80.8%) ranked ninth, Canada (77.8%) ranked eleventh, Japan (76.3%) ranked fourteenth, and Korea (73.7%) ranked eighteenth [5]. Psychological and social approaches to disease are essential because individual's psychological and social functions become causes of the diseases and at the same time have significant effects on the treatment process and outcome [6]. Hospice patients face mental, physical, social and

spiritual crisis, so to alleviate these pain, there are doctors, nurses, ministers, social worker pharmacists, physical therapists, nutritionists, etc. of the hospice multidisciplinary team, and the development of nursing intervention programs consisting of non-professional volunteers and carers[7].

Horticultural therapy which uses plant is a process promoted by experts trained to improve human physical, cognitive, psychological and social adaptations using plant and horticultural activities[8]. Human brains are taken by 87% of visualization, and with looking at indoor plants, we can see that they have therapeutic effects just by looking because of decreased delta waves in the frontal and left temporal regions of the brain, and increased alpha waves in the occipital regions[9]. Horticulture therapy is characterized more naturally than other treatments, and it minimizes the burden on the patient itself due to a gradual transition[10]. Horticultural therapy, in which the subject is close to nature, has a characteristic of regression to nature, and horticultural therapy using plants helps patients and carers to realize participation of life while still they are alive, and makes hospice patients to approach most fundamental mind by feeling the emotion that they are close to nature. Families can keep close relationships with hospice patients and keep their beautiful memories in photo[11]. Horticultural therapy has been recognized as a new medical technique for cognitive meditation therapy that helps physical and mental health(No. 668 Cognitive Mediation Therapy). According to the research data from horticultural therapy, Son Ki-chul(1999) reports that it has been used as a way to improve disability and to treat, rehabilitate the disabled who adapt to the environment, improving their quality of life, helping them with physical and mental health, and alleviating anxiety and tension[12]. Park Jong-hyun, Shin Young-sook, Kim Mi-sook, Shin Hye-sook, and Choi Byung-jin(2012) say that participation in the horticultural therapy program with people who are in cerebral palsy made them to acquire self-esteem, self-confidence on their own, and also positive way of thinking due to emotional stability[13]. Cho Tae-ok(2014) reports that

horticultural therapy makes schizophrenic patients to recognize self-value, self-respect, and to maintain better relationship by respecting others[14]. Yoo Chun-sook(2014) identified the effectiveness of reducing depression and improving life satisfaction of mild demetia elderly in nursing home in a prior study[15]. Choi Ae-ja (2016) reported positive effects on improving confidence, life satisfaction, interpersonal relationships in her prior study of effects of horticultural leisure program for the improvement of life satisfaction among the elderly in rural area[16]. Meditation therapy for hospice patients was introduced at the Catholic University of Korea's hospice education institute in 2006, and the results of domestic and foreign research related to hospice raw method are as follows. Tak Young-sook(2004) found that the effect of the application of horticulture therapy using flower arrangement reduced patients and family' stress mainly on terminal cancer patients, and improved self-esteem, lowered depression[17]. Kim Kyung-hee(2014) had positive effect on stress reduction by applying flower color harmonization horticulture therapy program for terminal cancer patients[18]. Lee Sang-mi(2015) reports that indoor horticultural therapy program was time for late-stage cancer patients to recognize, encourage themselves, present themselves, and express gratitude to patients or other families through various flower roles depending on carer's mood and energy[19]. Son Ki-chul, Cho Moon-kyung, Song Jong-yeon, Kim Soo-yeon, and Lee Son-sun(2006) reported that in reality, frequency and time in horticultural therapy is more influential in treatment than overall period of time[20], while Song Mi-ok (2010) reported that in the development and effectiveness of the horticultural therapy nursing meditation program for hospice patients, increase in number of times per week and shorter period is more effective than lesser number of times per week and longer period[21].

Jeong Gwan-sook(2011) reported on the journal "effects of self-esteem and quality of life on cancer patients by horticultural therapy" that horticultural activities can be used for alternative method in clinical site by alleviating stress level, anxiety, depression, and

improving self-esteem, and quality of life[22]. Kim Mi-ran(2008) once suggested that horticultural therapy programs can be used to improve self-esteem in hospice patients[23]. Kim Kyung-hee(2006) suggested that horticultural therapy programs have contributed to relief of the symptoms of hospice patients by contributing their effects on serum cortisol concentration, pain, anxiety and depression[24]. Kwon Yoon-hee(2011) reported positive effects on depression and stress in hospice patients[25], while Kim Jong-nam (2010) reported positive effects on the quality of sleep due to the emotional stability of horticultural therapy for hospitalized hospice patients[26]. In a prior study of hope expression of wanted nursing, Park Eun-mi(2009) said that the concept of a word that Korean and American thinks which is related to hope association was bright, light, and wish related to the future[27]. Likewise, similar to most of the preceded studies, the application results of the original method of terminal patients under horticultural therapy were investigated, such as physiological, psychological response, self-esteem, quality of life, sleep, patient's depression and stress, but this study mainly focuses on analyzing hospice patient's consciousness structure caused by effectiveness of the hospital environment, effectiveness of the subject, and the program by using horticultural therapy using plants, therefore increasing the effect, application methods of horticultural therapy of academic theory and social contribution.

2. Methods

2.1. Research subject

The gender of the subjects of this study were 182 males and 152 females, with 84 spouses of patients, 14 parents, 125 children, 11 siblings and 100 patients.

2.2. The horticultural therapy program and operation

The program was conducted in the program room and in the hospital room as a personal method(1 : 1) when the patient, caregiver, and one main horticulture therapist(forestal

therapist, horticulture therapist), one assistant horticulture therapist(nurse, horticulture therapist), and one volunteer (music therapist). The process of collective horticulture in the program room was carried out in the program room with one main horticulture therapist(a forest therapist, a gardener), one assistant gardener(a nurse, a gardener), and one volunteer(a music therapist), and the original method program is as shown in Table 1 of <Table 1>.

Table 1. Horticultural therapy program.

Number	Program	Number	Program
1	Spring flower arrangement	22	Lumora gosari
2	Hyacinth hydroponics	23	Summer, let's be friends
3	Making a fragrance cup	24	Soil hydroponics
4	Soap flowers puppy	25	Hanging in the air
5	Tomorrow Is hope	26	Sunflower
6	Easter basket	27	Cool Scent cup
7	Gypsum aromatic	28	Decora Indian bushbaby
8	Pressed flower hopebox	29	Chrysanthemum basket
9	Success flower bouquet	30	Toffee gift
10	The world of color	31	Small soup decoration
11	Carnation basket	32	Kernels soil hydroponics
12	Spring flower decoration	33	Love plants
13	Hydroponics	34	Happy tree
14	Positive floral decoration	35	Autumn flower arrangement
15	Back off from the heat	36	Carnivorous terrarium

16	Flavoured pouch	37	Chiklaman flowerpots
17	Summer flower decoration	38	Mini Flower decoration
18	Animal toppies-cable animals story sharing	39	A coffee-flavored cup
19	Hydrophobic	40	Christmas leases
20	Multicolored colors	41	Christmas trees
21	Pulsed flower expression	42	New year's card creation

2.3. Data processing

The collected data were calculated on average and standard deviation for each item using Excel and SPSS Windows(version 25.0) statistics programs, and the conscious structure and effect of hospice patients were analyzed using ANOVA and Cross-Tabulations.

3. Results

3.1. General characteristic of horticultural therapy participants

The subjects who participate in a horticultural theory program and express themselves in letters and pickets are shown in <Table 2>.

Table 2. General characteristics of people who participate in horticultural therapy program(Unit: %).

Characteristics	Classification	Number of participants(%)
Hospital A, D city, 2016	Male	22(6.58)
	Female	27(8.08)
Hospital B, D city, 2016	Male	61(18.26)
	Female	54(16.16)
Hospital C, D city, 2016	Male	99(29.64)
	Female	71(21.25)
The sum of the sexes of	Male	182(54.49)

the hospital		
the hospital	Female	152(45.50)
	Parent	14(4.19)
	Children	125(37.42)
	Sibling	11(3.29)
	Patient	100(29.94)
	Total	334(100)

3.2. General characteristic of horticultural therapy participants

What the hospice patients wanted to say consisted of love(42.66%), hope(30.54%), gratitude(13.17%), happiness(10.03%), and self-reflection(2.54%) by analyzing the consciousness structure of the hospice patient based on the probability that it will be reminded as a key factor extracted from the expression of the language.

3.3. Analysis of the effect of the horticultural method on hospice patients

1)Analysis of the effects of hospital environment

The results of the analysis of the effects of hospital environment after participation in the horticultural method program are shown in <Table 3>.

Table 3. Analysis of the effect of hospital environment(Unit: %).

Effect by factor hospital	Love	Happiness	Gratitude	Hope	Reflection	Percentage
2016 A hospital	41.84	13.27	12.24	31.63	1.02	100
2016 B hospital	46.09	9.13	13.04	24.78	4.78	100
2017 C hospital	40.59	9.71	13.53	34.12	1.47	100
Average	42.66	10.03	13.17	30.54	2.54	100

2)Analysis of the effects of the horticultural method program participants

The results of the analysis of the effects of

the participants after participation in the horticultural method program are shown in <Table 4>. After participating in the horticultural method program, the effects of each factor were analyzed and the statistical significance difference ($p < .01$) was found in the hope and self-reflection <Table 5>, <Table 6>. Hope showed that siblings were significantly higher than patients ($F=4.065$, $p=0.003$) and patients were significantly more likely to reflect ($F=4.073$, $p=0.003$) than siblings.

Table 4. Effect analysis of participants of horticultural therapy program (Unit: %).

Effect by factor hospital	Love	Happiness	Gratitude	Hope	Reflection	Percentage
2016 A hospital	41.84	13.27	12.24	31.63	1.02	100
2016 B hospital	46.09	9.13	13.04	24.78	4.78	100
2017 C hospital	40.59	9.71	13.53	34.12	1.47	100
Average	42.66	10.03	13.17	30.54	2.54	100

Table 5. The Effect of hope analysis according to the subject of the horticultural therapy program (Unit: %).

Subjects	Number	Average	Standard deviance	F	p
Spouse	84	36.31	39.842	4.065	0.003
Parents	14	35.71	41.271		
Children	125	33.20	40.133		
Siblings	11	54.55	41.560		
Patients	100	19.00	31.166		
Average	334	30.54	38.885		

Table 6. The effect of self-reflection analysis according to the subject of the horticultural therapy program.

Subjects	Number	Average	Standard deviance	F	p
Spouse	84	0.60	5.455	4.073	0.003
Parents	14	0.00	0.000		
Children	125	0.80	6.299		

Siblings	11	0.00	0.000		
Patients	100	7.00	22.496		
Average	334	2.54	13.461		

3) Analysis of the effects according to the horticultural method program

The results of the analysis of the effects of the horticultural method program are shown in <Table 7>. The results of the effectiveness analysis according to the horticultural program of hope showed that the fragrance was significantly higher than natural flower program as shown in <Table 8> ($F=2.760$, $p=0.028$) ($p < .05$).

Table 7. Effect analysis according to horticultural therapy program (Unit: %).

Effect by factor subjects	Love	Happiness	Gratitude	Hope	Reflection	Percentage
Craft	45.24	13.10	5.95	29.76	5.95	100
House-plant	40.19	11.68	8.88	36.92	1.87	100
Natural flower	45.68	8.64	17.28	24.69	1.85	100
Fragrance	18.18	4.55	22.73	54.55	0.00	100
Average	42.66	10.03	13.17	30.54	2.54	100

Table 8. Effect analysis of hope according to the horticultural therapy program (Unit: %).

Program	Number	Average	Standard deviation	F	p
Craft	42	29.76	35.025	2.760	0.028
Foliage	107	36.92	41.966		
Natural flower	162	24.69	36.648		
Fragrance	11	54.55	35.032		
Average	322	30.54	38.885		

4) Analysis on the effectiveness of each gender in the horticultural method program

The results of the analysis of effects by participation in the horticultural method program are shown in <Table 9>. The results of the effect analysis of the participation in the method of reflection show that men are significantly more likely to be woman($F=7, 712, p=0.006$), as shown in <Table 10>(p<.01).

Table 9. Effect analysis by gender in the horticultural therapy program(Unit: %).

Effect by factor Subjects	Love	Happiness	Gratitude	Hope	Reflection	percentage
Male	43.68	8.79	13.46	28.02	4.40	100
Female	41.45	11.51	12.83	33.55	0.33	100
Average	42.66	10.03	13.17	30.54	2.54	100

Table 10. Self-reflection effect analysis by gender in the horticultural therapy program(Unit: %).

Gender	Number	Average	Standard deviation	F	p
Male	182	4.40	17.665	7.712	0.006
Female	152	.33	4.056		
Average	334	2.54	13.461		

4. Discussion

The results of consciousness structure on hospice patients and effect of horticultural therapy of participants which are 100 hospice patients, 84 spouses, 14 parents, 125 children and 11 siblings at A Hospital in 2016, B Hospital in 2016 and C Hospital in 2017(in total 334 people) are as follows.

Based on the first factor's result, which is love, the patient's wife complained that the patient was unforgivable with a lot of hatred and resentment toward the patient. Kim Chun-kyung, Lee Soo-yeon, Lee Yoon-joo, Jeong Jong-jin, and Choi Woong-yong(2016) said, "The limbic system of the human brain controls emotions and directly affects heart rate, blood pressure, breathing, memory, stress, and hormonal balance and its fine flavoured particles are absorbed into the skin

through pores and affect the treatment of diseases through sweat glands[28]. After the third, fourth, fifth, and sixth sessions, the patients gradually felt sorry for the patients as they got worse, and the volunteers and their guardians shared with them. He said, "I should love the patient's remorse and apology, and now hatred melts," adding, "I love you more than hate." The way of expressing support for patients and carers was positive and happy even though they cried. Those who decorated flowers or received flowers were the healing abilities of plants that made people smile happy with a big smile. A study conducted by Stephanie Brown of the University of Michigan found that helping others not only restores sensitivity of performance but extends one's life span. Nursing is a matter of great stress, as spouse should care every aspect of treatment and ultimately be responsible for the life of the spouse. It may be because of an increased sensitivity of one's ability of performance. Taking care of plants also allows them to live longer.

In a study, senior citizens in nursing homes who were responsible for caring for the plant pot in their room lived longer than those who had the plant pot taken care of by the nursing home staff. Perhaps it might be the similar reasons in case that a coward turns into a warrior when he becomes a parent. A child is a moral handler who transforms his mother and father into powerful moral actors[29]. It was consistent with the results of a study by Tak Young-sook(2004) that she improved the self-esteem of terminally ill cancer patients by touching plants directly, smelling and caring for them, feeling the responsibility and the value of life that she did, and expressing and acting on her own flower decorations[17]. As pain and despair grow, the secretion of endorphins and enkephalin in the brain decreases and the secretion of cholera increases. As the pain grows larger with these changes in neurochemicals[30].

Although the power of hope has reduced hope to pain and despair, patients and carers in the hospice ward have come to believe that hope is just as important a factor in life as the oxygen we breathe. Kim Dal-sook(1996) have studied chronic patients and nurses who

were hospitalized in U.S[31]. to understand the concept of hope among American patients and nurses in the journal of Chungnam University, which is about a cross-cultural study on the notion of hope as a former nursing factor. While American patients' concept of hopes are altruistic and broad such as "world peace" and "great growth of young people," the concept of hope in Korea has been examined to be personal such as "health," "happiness" and "success in social life," and the hope of this study has emerged with similar results(love, affection, gratitude, hope, self-reflection, etc) even though it does not offer hope in the verbal expressions of patients and carers after horticultural therapy program. In a book titled "The Power of Hope" by Jerome Gruffman, a professor of hematology at Harvard University, said, "Hope is the rising emotion that you experience when you see the path to a better future with the eyes of your spirit. Hope gives you a courage to open your eyes and face your own reality, and the ability to overcome that reality. It says that even without body's hope, spirit's hope can last forever [30]. Parents aged 80 or older are said to have a high male authority since it was a difficult time to live, therefore the expression of love for family was poor, and they were not be able to express their love and gratitude to their parents. Love is said to be sometimes awkward expression but cherished expression. The meaning of this study is that although there was a lack of linguistic expression studies in the preceded study and difficulties in generalization of measurements by questionnaire, it examined the effects of the analysis of the cognitive structure of hospice patients and effect of horticultural therapy by organizing the notes that were written on the patient's letters and pickets that were intended to decorate, decorate, and convey to the other person. It is believed that the horticultural therapy program can be used as an important program for emotional and psychological stability of hospice patients and carers, and it should be continue to develop its appropriate measurement system to support carers who participated in horticultural therapy program.

5. Conclusion

Factors affecting the analysis of the effects of the cognitive structure and the horticulture therapy on hospice patients are as follows. Love(42.66%)(F=0.627, p=0.535), Hope (30.54%)(F=0.2012, p=0.135), Audit(13.17%)(F=0.037, p=0.964), Happiness(10.03%)(F=0.473, p0.64) and Reflection factors (2.54%)(F=2.466, p=0.086).

1)The results of the analysis of the effects of hospital environment showed that love (41.84%, 46.09%, and 40.59%) were the highest in A, B hospitals in 2016 And C hospital in 2017. Although the three hospital environments were slightly different, all three hospitals showed the highest level of love, followed by hope, gratitude, happiness and reflection. The analysis of the effects of hospital environment showed no statistical significance difference.

2)The results of the effectiveness analysis by the program subjects showed that love(47.00%, 45.24%, 39.20%, 35.71%) was the highest for the patient's spouse and child parents, and hope(54.55%) was the highest for the brothers.

3)An analysis of the effects of horticulture programs showed that love was the highest in the craft, foliage plant, real flower program, and hope was the highest in the fragrance program. The results of the analysis of the effects of the method program indicated a statistical significant difference(p<.05) in the hope.

4)Analysis of the effects on the gender of participants in the program showed that love(43.68%, 41.45%) is the highest for both male and female. After the program, the men's expression of self-reflection(4.40%) appeared to be higher than women's expression of self-reflection(0.33%). Analysis results based on the gender of the program participants indicated a statistical significant difference(p< 0.01) in the reflection.

Utilizing the five elements of life force and vision, touch, smell, hearing, and taste of plants, horticulture therapy utilizes scent, color, shape, size, cropping, planting, planting,

tearing, stroking, and interacting with trees. Based on the above study, the first key factor was love, which confirmed that the patient's consciousness was filled with expressions of family love. The patient, spouse, children, parents, etc. all expressed love as the most important factor, the second key factor was hope, which confirmed that patients, spouses, children and parents were holding the line of hope until the end. In the case of brothers, hope was the highest. In the case of sibling, hope appeared highest and expressed gratitude, happy heart, remorse, and sorry mind. Therefore, it is believed that the making patients' last precious time a memory by horticultural therapy can be recommended for hospice patients and guardians as an alternative method of mediating between their conscious structure and exhaustion.

6. References

6.1. Journal articles

- [3] Park JS. A Qualitative Case Study on the Coping Experiences of Cancer Survivors in Their Middle Years. *Health and Social Welfare Review*, 37(2), 525-61 (2017).
- [8] Lee SM & Moon JH & Jeong SJ & Kim GM. Effects of Horticultural Therapy Program Focusing on Cultivation Activities for Male Juvenile Prisoners on Mental Health. *Journal of People, Plants, and Environment*, 16(6), 369-376 (2013).
- [12] Son KC. Horticultural Therapist. *Korea Journal of Horticultural Science & Technology*, 17(4), 505-512 (1999).
- [19] Lee SM & Choi YH & Jeong SH & Kim G M. Effects of Horticultural Therapy Program Focused on Indoor Activities for Self-integrity and Post-traumatic Growth of Cancer Patients. *Journal of People, Plants, and Environment*, 18(6), 503-508 (2015).
- [23] Kim MR & Na SS. Effects of Horticulture Program on Self-esteem in the Hospice Patients. *Korean Journal of Hospice Care*, 8(1), 49-54 (2008).
- [24] Kim KH & Lee HR & Song MO & Jeong SH & Jeong HJ. Effects of Horticultural Therapy Program on Serum Cortisol, Pain, Anxiety and Depression of the Hospice Patients. *Korean Journal of Horticultural Science & Technology*, 24(1), 95-103 (2006).
- [25] Kwon YH & Song MO & Kim CN. Effects of Horticulture Therapy on Depression and Stress in Patient of Hospice Unit. *Journal of the Korea Academia-Industrial Cooperation Society*, 12(10), 4394-4402 (2011).
- [26] Kim JN & Song MO & Kwon YH. Development and Effects of Horticulture Therapy on Quality of Sleep and Immune Function in Patients in Hospice Units. *Journal of Korean Clinical Nursing Research*, 16(3), 39-50 (2010).

6.2. Thesis degree

- [7] Choi SE. Development & Effects of Wholistic Hospice Nursing Intervention Program for In-patient of Hospice Palliative Care Unit. Kosin University, Master's Thesis (2005).
- [11] Jeong EK. Approach of Horticultural Therapy for Hospice Clients. Dankook University, Master's Thesis (2004).
- [14] Jo TO. Effect of Horticultural Therapy on the Interpersonal Relationship and Self-esteem of Schizophrenic. Daegu Haany University, Master's Thesis (2014).
- [15] Yoo CS. Determining the Effects of Horticultural Therapy Program for Improving Life Satisfaction and Reducing Depression Symptom of Hospitalized Elderly with Mild Dementia. Konkuk University, Master's Thesis (2014).
- [16] Choi AJ. Effect of Gardening Leisure Activity Programs for Improvement of Life Satisfaction of the Elderly in Rural Area. Gyeongnam National University of Science and Technology, Master's Thesis (2016).
- [17] Tak YS. The Effect of Horticultural Therapy Using the Flower Arrangement in Center: Terminal Cancer Patients. Honam University, Master's Thesis (2004).
- [18] Kim KH. Effects of Horticultural Therapy Program on Physiological and Psychological Responses of the Hospice Patients. Paichai University, Master's thesis (2004).

- [21] Song MO. Development and Effects of Horticultural Therapy Nursing Intervention Program for Hospice Patients. Keimyung University, Doctor's Thesis (2010).
- [22] Jung KS. Effect of Horticultural Activity on Stress, Anxiety, Depress, Self-esteem and Quality of Life in Cancer Patients. Chungnam National University, Doctor's Thesis (2011).
- [27] Park EM. The Hope of the Terminal Cancer Patients Receiving Hospice Care. Chungnam National University, Master's Thesis (2009).

6.3. Books

- [1] Hong HJ & Roh YH. International Organizations. Education and Research Information Service (2009).
- [4] Roh YJ & Han SS & Ahn SH & Kim CG. Hospice & Death. Munmunsa (1997).
- [6] Lee SM & Kim KM & Jeong SJ & Jung SH Choi YH & Kwon SY. Horticultural Therapy Program. Rural Development Administration National Institute of Horticultural and Herbal Science (2015).
- [9] Son KC. Indoor Plants Save People. Central Life History (2004).
- [10] Seo JG & Lee JS & Kwak BH & Kwak HR & Lee AG. Horticultural therapy. Dankook University (2000).
- [20] Son KC & Cho MK & Song JE & Kim SY & Lee SS. Practice of Professional Horticultural Therapy. Coobook (2006).
- [28] Kim CG & Lee SY & Lee YJ & Jeong JJ & Choi UY. Counseling Dictionary. Hagjisa (2016).
- [29] Wegner & Daniel M & Gray & Kurt & Choi HY. God, Dog, and Human Minds: Secrets of a Mind in a Moral Dilemma. Cheonglim (2017).
- [30] Lee MH. The Anatomy of Hope. Nexus (2005).

6.4. Conference proceedings

- [2] National Cancer Information Center. Cancer to See with Statistics (2017).
- [5] The Kyunghyang Shinmun. Korea, Quality of Death 'Good' Palliative Care Awareness is 'Lack' (2016).

- [13] Park JH & Shin YS & Kim MS & Shin HS & Choi BJ. Effects of Horticultural Therapy Self-esteem and Emotional Stability of Cerebral Palsy Disability. Society for People, Plants, and Environment, 141-142 (2012).

Lead Author

Shin Young-sook / Daegu Haany University, Instructor
B.A. Korean National Open University
M.A. Daegu Haany University

Research field

- Analysis of Effects of Conscious Structure and Horticultural Therapy on Hospice Patients, Daegu Haany University, Master's Thesis (2018).

Major career

- 2019~present. Daegu Haany University, Instructor

Corresponding Author

Lim Won-hyeon / Daegu Haany University Professor
B.A. Kyungpook National University
M.A. Kyungpook National University
Ph.D. Kyungpook National University

Research field

- A Study on Gait Characteristics of Visitors Working through Forest Trails, Korean Institute of Forest Recreation and Welfare, 21(2) (2017).
- A Study on Use Behaviors of Hamjisan Forest Walkway, Korean Institute of Forest Recreation and Welfare, 23(1) (2019).

Major career

- 1992~2010. Gyeongju University, Professor
- 2013~present. Daegu Haany University, Professor

Publication state: Japan
ISSN: 2435-0702

Publisher: J-INSTITUTE
Website: <http://www.j-institute.jp>

Corresponding author
E-mail: ronaldo0507@hanmail.net

Peer reviewer
E-mail: kinesiology@j-institute.jp

<http://dx.doi.org/10.22471/kinesiology.2019.4.2.42>

© 2019 J-INSTITUTE

Comparison of Anaerobic Power According to the Performance Level of Male Middle School HANDBALL Players

Kim Tae-hun

Kyungpook National University, Daegu, Republic of Korea

Abstract

Purpose; The purpose of this study is to measure and compare the anaerobic power according to the performance level of male middle school handball players in order to analyze the difference between the well performing group and the non-performing group, while providing the basic data for improving the performance by developing the anaerobic power of the non-performing group in the future. The subjects of this study are consisted of 9 excellent handball players and 8 non-excellent players of Middle School D of Region D. The criteria for the excellent and non-excellent players provide for excellent players being those who played as starting members at the time of winning the 45th National Youth Athletic Conference in 2016 and the replacement players being the non-excellent players. As for the method of measuring anaerobic power, the Wingate test, which is the anaerobic power test for short term, and blood lactate concentration analysis were performed. The data processing of this study were analyzed using the SPSS 18.0 statistical program, and the mean and standard deviation were calculated for each item. The independent t-test was performed to examine the difference in anaerobic power between the groups, while all statistical significance levels were set to $P < .05$, respectively. The research results indicated that the excellent players were higher statistically than the non-excellent players in terms of anaerobic mean power ($p < .05$) and total work ($p < .05$) considering 1kg of weight for anaerobic power. However, even while the significant difference was demonstrated between the groups in terms of the mean power per kg of weight and total work per kg of weight, it determined that the resistance to the lactic acid generated from a high intensity workout over short term was enhanced via training by the excellent group, which did not yield a significant difference in the maximum lactic acid between the two groups. In conclusion, as for the anaerobic power variable, which has a significant influence on the handball performance, the anaerobic mean power which may be exercised by glycolysis continuously over a long term with strong resistance against lactic acid is considered to be important. It is also determined that the anaerobic energy storage method and training method need to be developed accordingly.

[Keywords] Anaerobic Power, Wingate Anaerobic Test, Blood Lactate Density, Anaerobic Mean Power, Glycolysis

1. Introduction

Handball is a game that which combines fast movements such as those of running, throwing, dribbling and shooting, as well repeated jumps, and a variety of skill unfolding movements in a stadium of 20m of goal line x 40m of sideline. In a handball game, offense is the process of dribbling and passing the ball

towards the opponent's goal area, taking shots in front of defenders, or beating the last defender with a quick pass and with fainting, then scoring with assist and making direct goal. Defenders block the offensive activity to the extent allowed by the rules, while having the purpose of interrupting and blocking the offender's pass connection thereby preventing giving the opponent a chance to score,

and connecting with the defender's goalkeeper to secure the ball and make the fast transition to offense. Therefore, a handball game may be seen as a fast paced activity at the turnover as a result of the action of attacking and defending teams near the goal area line(6m) and the free throw line(9m).

During the international handball games, the average traveling distance for 60 minutes for the first half and second half is 14 to 23m, with 70% of the total moving at a speed of 6.5 to 9m/sec, and is also said to be a sport which consumes more physical strength than any other sport. In addition, since momentary full sprint occurs frequently during the turnover, it is a competitive sport which requires both aerobic and anaerobic energy production capabilities[1][2][3].

During the exercise, the human body's energy system is divided into aerobic and anaerobic energies, depending on the oxygen dependence, while the muscular power has many variables such as motor coordination and the characteristics of muscular contraction. These variables are necessary to predict the athletes' ability to exert muscular power, which means the energy exercised per unit time, and the capacity may be said to represent the total available capacity of energy[4].

Almost all ball games in sports are reported to perform intermittent exercise, through which the intermittent rest was irregular in the development of the exercise, but the energy was supplied by the aerobic energy system which is frequently retained during the game. Therefore, handball game is a form of intermittent exercise by which aerobic exercise with a short recovery period is repeated. However, the energy supply required for playing with fast speed and agility when unfolding offense or scoring a goal in handball games may be achieved by supplying anaerobic energy, whereby anaerobic power ability is very important for handball players. Therefore, coaches and athletes in the field are much interested in the ways to increase their anaerobic power[5][6][7].

Such a power is one of the essential physical strength factors for the athletes to be successful, and is also essential for improving

their gaming performance. Such a power is commonly used to assess strength, endurance, muscular fatigue and agility. In particular, for the athletes who require short-term anaerobic power, the anaerobic power, which requires a continuous high strength and short-term power, may be deemed to be an important physical strength factor for excellent athletic performance and achievement[8][9][10]. However, while there exist many studies examining the correlation between physical strength and athletic variables, almost no studies have been conducted on the male middle school handball players.

Therefore, the purpose of this study is to analyze the differences between the groups by comparing the anaerobic power variables of the middle school male handball players and the non-excellent players, and also provide the basic data for improving their anaerobic power variables and performance.

2. Method

2.1. Subjects

The subjects of this study are 9 excellent players and 8 non-excellent players among 17 handball players of Middle School D of Region D. registered with the Korean Sport & Olympic Committee. The criteria for excellent and non-excellent athletes classified starting members as excellent athletes and replacements as non-excellent athletes for winning the National Youth Athletic Conference in 2016. The research participants voluntarily participated after listening to the explanation of the purpose and procedures of this study prior to participating in the study, and as for the participation time, it was held 2 weeks after the consummation of the National Youth Athletic Conference. The physical characteristics of the subjects participating in this experiment are as illustrated in <Table 1>.

Table 1. Physical characteristics of research subjects.

Measured item	Excellent athletes	Non-excellent athletes
---------------	--------------------	------------------------

Age(year)	14.01±0.70	14.01±0.69
Height(cm)	168.88±8.24	169.03±4.36
Body weight(kg)	58.19±12.24	59.45±5.17
Muscular mass(kg)	47.11±5.52	46.85±3.64
Body fat percent- age(%)	7.41±5.07	8.48±4.16
Fat free mass(kg)	50.66±6.15	50.93±2.77
Body mass index(kg/m ²)	20.41±3.92	20.68±3.09
Personnel(people)	9	8

2.2. Measurement items and methods

1) Measurement of physical body composition

After 12 hours of meal on the day of the experiment, they relaxed for 15 to 20 minutes at the lab with empty stomach, then used the product of Inbody 3.7 biospace(Korea) to lightly wear it to avoid the maximum effect on the subject's body weight, after which the muscular mass, body fat, lean body mass, and body mass index were measured while the electrode was held in contact with the foot electrode.

2) Measurement of anaerobic power capacity

Anaerobic power capacity was measured by the Win-Gate method reported by Bar-or. The measuring time for the anaerobic power was performed for 30 seconds with the maximum pedaling exercise, and the relative load given to the individual subject was set to the body weight \times 0.075 kp to apply different relative loads for each individual. As for the measuring process, before the measurement, the athletes were seated on the bicycle's ergometer saddle, the feet were firmly fixed in pedals, then adjusted to the individual limbs, after which it was fixed while being seated, with the warm-up exercise was performed for approximately 2 to 4 minutes at approximately 80rpm, and after approximately 3 to 5 minutes of break, the exercise was performed. This exercise encouraged pedaling at the maximum possible speed, and also encouraged the atmosphere to reach a predetermined load within 2 to 4 seconds, after which it coaches and lab staffs were encouraged, then was exploded until 30 seconds after the end of the exercise[8].

3) Blood lactate density

As for the blood lactate density, it was measured at the end of the exercise phase at the end of each exercise phase 20 seconds before the end of each exercise phase by the fingertip method at rest, immediately after exercise, and at the recovery period at 1, 3, 5, 7, 10 and 15 minutes. This method used auto-lancet and capillary tube to sample a minimum of 25 μ l of whole blood, while being careful not to exceed the measurement time for the whole blood sampling. The collected blood was analyzed by using a lactic acid analyzer(YSI-1500, USA)[9].

2.3. Data analysis

The data processing method intended for this study analyzed using the SPSS 18.0 statistical program, and the mean and standard deviation were calculated for each item. Independent t-test was performed to determine the differences between anaerobic power between excellent and non-excellent athletes, while all statistically significant levels were set to $P < .05$.

3. Results

3.1. Anaerobic power

<Table 2> illustrates the results of the anaerobic power of excellent and non-excellent athletes. The peak power did not yield a significant difference ($p > .05$) given excellent athletes (620.43 \pm 141.45 watts) and non-excellent athletes (577.01 \pm 89.34 watts). The anaerobic mean power did not yield a significant difference ($p > .05$) given excellent athletes (507.66 \pm 102.98 watt) and non-excellent athlete (453.22 \pm 63.88 watt). Total work yielded no significant difference ($p > .05$) given excellent athletes (1582.12 \pm 331.32 kpm) and non-excellent athletes (1415.90 \pm 201.98 kpm).

Table 2. Comparison of anaerobic power.

Measured item	Non-excellent athletes	Excellent athletes	p
Peak power (watt)	577.01 \pm 89.34	620.43 \pm 141.45	.520
Anaerobic mean power (watt)	453.22 \pm 63.88	507.66 \pm 102.98	.292

Total power (Kpm)	1415.90 ±201.98	1582.12 ±331.32	.294
-------------------	--------------------	--------------------	------

3.2. Anaerobic power per kg of weight

<Table 3> illustrates the results of anaerobic power per kilogram of body weight of excellent and non-excellent athletes. The peak power per kg of body weight yielded no significant difference ($p > .05$) given excellent athletes (11.01 ± 1.21 watt) and non-excellent athletes (9.56 ± 0.88 watt). The anaerobic mean power per 1 kg of body weight yielded a significant difference ($p < .05$) given excellent athletes (8.82 ± 0.69 watt) and non-excellent athletes (7.60 ± 0.38 watt). The total work per kg of body weight yielded a significant difference ($p < .05$) given excellent athletes (28.35 ± 1.85 kpm) and non-excellent athlete (23.61 ± 24.11 watt).

Table 3. Comparison of anaerobic power per kg of weight.

Measured item	Non-excellent athletes	Excellent athletes	p
Peak power (watt/1kg)	9.56±0.88	11.01±1.21	.119
Anaerobic mean power (watt/1kg)	7.60±0.38	8.82±0.69*	.004
Total power (kpm/1kg)	23.61±24.11	28.35±1.85*	.003

Note: Value are mean±SD, * $p < 0.05$.

3.3. Anaerobic power for each time zone

<Table 4> illustrates the results of anaerobic power according to each time zone of the excellent athletes and non-excellent athletes. There was no significant difference in the anaerobic power of excellent and non-excellent athletes for each time zone, and across all sections ($p > .05$).

Table 4. Comparison of anaerobic power for each time zone.

Group Time	Excellent athletes	Non-excellent athletes	p
5 seconds	589.35±169.11	559.81±100.99	.706
10 seconds	584.32±110.21	526.17±85.12	.419

15 seconds	519.28±98.74	469.96±48.35	.294
20 seconds	499.40±81.34	428.47±48.41	.088
25 seconds	423.15±79.58	359.49±78.99	.216
30 seconds	424.38±139.41	359.25±75.48	.331

3.4. Comparison of blood lactate density for each time zone

<Table 5> illustrates the results of blood lactate density for each time zone of the excellent athletes and non-excellent athletes. The blood lactate density at the point of 7 minutes for each time zone yielded a significant difference ($p < .05$) given excellent athletes (6.79 ± 0.88 mMol/ml) and non-excellent athletes (5.61 ± 0.48 mMol/ml), while there was no significant difference for the rest of other sections ($p > .05$).

Table 5. Comparison of blood lactate density for each time zone.

Group Time	Excellent athletes	Non-excellent athletes	p
When rested	1.42±0.58	1.57±0.87	.317
Immediately after exercise	3.99±1.15	3.59±1.18	.564
3 minutes	6.39±0.81	6.33±0.69	.785
5 minutes	6.48±0.95	6.05±0.29	.356
7 minutes	6.79±0.88*	5.61±0.48	.048
10 minutes	6.44±0.75	5.78±1.19	.259
15 minutes	5.66±1.09	5.09±0.84	.368

Note: Unit: mMol/ml.

3.5. Comparison of maximum blood lactate density

<Table 6> illustrates the results of the maximum blood lactate density of the excellent athletes and the non-excellent

athletes. There was no significant difference ($p > .05$) given the excellent athletes ($7.18 \pm 0.88 \text{ mMol/m}\ell$) and the non-excellent athletes ($6.37 \pm 0.49 \text{ mMol/m}\ell$).

Table 6. Comparison of maximum blood lactate density.

Measured item	Non-excellent athletes	Excellent athletes	p
Maximum lactate	6.37±0.49	7.18±0.88	.179

Note: Unit: mMol/mℓ.

4. Discussion

This study compared the anaerobic power of 9 excellent athletes and 8 non-excellent athletes of handball of Middle School D of Region D in order to compare and analyze the anaerobic power of male middle school handball players according to their performance level.

Anaerobic power is the maximum capacity of the anaerobic process (ATP-PC and Glycolysis) to produce energy without depending on the aerobic energy supply [10], and is also highly related to the ability to exercise requiring strong movements executed under time constraint, which refers to repeating or maintaining a strong muscular contraction activity [11][12][13][14].

In this study, anaerobic power of the male middle school handball players was measured via the Wingate test. The items which the Wingate anaerobic power test measures include peak power, anaerobic mean power, total work, peak power considering the body weight of 1kg, anaerobic mean power, total work and anaerobic power for each time zone, maximum blood lactate density, and the blood lactate density for each time zone.

The anaerobic power of male middle school handball players who are excellent and non-excellent yielded significantly better in anaerobic mean power and total work considering 1kg of body weight for the excellent athletes versus non-excellent athletes. Other anaerobic power factors were not statistically significant either, yet the excellent players yielded

excellent overall results, indicating that the overall anaerobic power had an important effect on the handball performance.

In the anaerobic power, the ATP-PC system is directly influenced by lean body mass or muscular mass within the skeletal muscle, and the anaerobic power and lean body fat have a very high correlation with the behavior of the athletes requiring an explosive strength, such as power sports athletes, and so the anaerobic power has been reported to have relevance to the lean fat [15].

The peak power is the power generated by the explosive muscular contraction within 5 seconds, with energy supplied to by the ATP-PC system stored within the skeletal muscle, and as examined in the physical characteristics of the two groups of athletes, the lean body mass including the muscular mass of the two groups is almost identical, and gathering the studies of Kwon Tae-Won and Cho Mun-Shik mentioned earlier together with that of Yang Jong-Bok, there was no significant difference in the peak power caused by short-term explosive muscular contraction [4][16][17].

In the study of anaerobic power according to the gaming performance level of Taekwondo players, there was no difference between the peak power and anaerobic mean power for the elementary and middle school period, but it was reported that there was a statistically significant difference in the peak power and anaerobic mean power for the youth period of age 17 or older. That is, it is determined that the ratio of peak power and continuous anaerobic mean power may be predicted according to the period of development of muscular mass and muscular strength [18].

Since the blood lactate density is influenced by the exercise intensity, duration of exercise, meal, and glycogen concentration, etc., the interpretation of blood lactate density needs to be careful. Increases in the blood lactate density may indirectly measure the improvement of anaerobic metabolic capacity, and in terms of the relationship between exercise and lactic acid, it may also im-

prove the blood lactate density and its resistance in terms for improving the utilization of the lactate system[19]. While there was no significant difference between the groups in the mean power per kg of body weight and total work per kg of body weight, there was no significant difference in the maximum lactic acid between the two groups because it is determined that the resistance to lactic acid is improved, which is generated over a short term of high intensity via training by the excellent group. In addition, the non-excellent group enters the recovery phase in approximately 3 minutes after the exercise, whereas the excellent group may be seen to continued to increase little by little up to 7 minutes. It is determined that the ability to mobilize energy generated by the anaerobic mean power, that is, lactate system, representing muscular endurance by the excellent group, is excellent.

The scoring activity which determines the outcome of handball games is ultimately the strong jump shot and diving shot. In addition, in order to create such a scoring situation, it is only possible by continuing passing, dribbling, and tactical movements in the areas where there is no ball. The anaerobic mean power per 30 kg of body weight has been reported to be correlated with 30 meters of running, which is thought such that in the handball games, it is necessary to move quickly and repeatedly for a distance which is less than 30 meters when moving and defending each time. It is also thought that such a movement is performed by anaerobic mean power by anaerobic glycolysis. Such movements are not caused by the ATP-PC system due to the explosive muscular contractions over a short term, yet are almost dependent on the lactate system since they produce energy in the situations where oxygen is insufficient [20][21].

Therefore, as for the gaming performance capability of the youth's handball, the anaerobic mean power, which should be continuously exercised as much as the importance of peak power due to the short term explosive muscular contraction such as shooting movement or full sprint, is also important, and it is also determined that the anaerobic energy storage method and training method need to

be developed accordingly.

5. References

5.1. Journal articles

- [1] Sin CH. Comparison of Isokinetic Upper Limb Muscular Strength of Professional Women Basketball Players and Industrial Handball Players. *Journal of Coaching Development*, 7(2), 15-17 (2005).
- [4] Kwon TW & Jo MS. Correlation Analysis of Agility and Muscular Mass of Anaerobic Power. *The Korean Journal of Physical Education*, 23(3), 1409-1417 (2014).
- [6] Kim KJ. Interpretation Concerning the Highest Values of Physiological Variables in Measuring Cardiopulmonary Function and Anaerobic Power. *The Korean Journal of Physical Education*, 31, 105-110 (1993).
- [7] So JS. Comparison of Evaluation Methods for Anaerobic Athletic Capability. *The Korean Journal of Sports Science*, 15(2), 573-583 (2006).
- [8] Bar-or O. The Wingate Anaerobic Test: An Update on Methodology, Reliability and Validity. *Sports Medicine*, 4, 381-394 (1987).
- [9] Blimkie CJ & Roache P & Hay JT & Bar-Or O. Anaerobic Power of Arms in Teenage Boys and Girls: Relationship to Lean Tissue. *European Journal of Applied physiology*, 57, 677-683 (1988).
- [10] Park IR & Jun TW & Park KS & Ryoo BK & Choi JH. A Study on the Change of Heart Rate, Blood Lactate, Blood Pressure and MVO₂ in Taekwondo Athletes during Taekwondo Competition. *The Korean Journal of Physical Education*, 41(5), 613-621 (2002).
- [11] Gladden LB. Lactate Metabolism: A New Paradigm for the Third Millennium. *The Journal of Physiology*, 558, 5-30 (2004).
- [15] Blimkie CJ & Roache P & Hay JT & Bar-Or O. Anaerobic Power of Arms in Teenage Boys and Girls: Relationship to Lean Tissue. *European Journal of Applied physiology*, 57, 677-683 (1988).
- [19] Kim WK & Cha BJ & Kim KJ. Anaerobic Metabolism of Wrestling Athletes. *Sports Science Research Report*, 35(2), 249-256

(1988).

- [20] Kim JH & Ahn NY & Kim JH & Kim KJ. A Study on the Importance of Power Evaluation for the Youth Track & Field Athletes. *Journal of Coaching Development*, 12(3), 163-168 (2010).

5.2. Thesis degree

- [2] Lim SS. A Study on the Correlation between Physical Strength Factors and Accuracy of Long Range Shooting of Handball Players. Catholic Kwandong University, Master's Thesis (2004).
- [3] Kim R. Comparison of Isokinetic Muscular Strength and Anaerobic Athletic Capability of Middle and High School Women Handball Players and National Team Players. Inha University, Master's Thesis (2007).
- [5] Kim KJ. Relation between Changes in Metabolic Variables and Muscular Fiber Composition Ratio for Anaerobic Exercise. Sungkyunkwan University, Doctoral Thesis (1992).
- [14] Ko SJ. Impact of Musical Rhythmic Patterns on the Anaerobic Exercise Capability. Korea National Sport University, Master's Thesis (2009).
- [16] Yang JB. A Study on the Development of Physical Strength according to Kidney's Developmental Patterns. Kongju National University, Master's Thesis (2003).
- [17] Lee SW. A Study on the Maximum Oxygen Intake Capability and Anaerobic Power of Middle School Male Athletes of Jeju Region. Jeju National University, Master's Thesis (2015).
- [18] Sin DY. Anaerobic Power according to the Performance Level of Youth Taekwondo Players. Dankook University, Master's Thesis (2005).

5.3. Books

- [12] Inbar O & Bar-or O & Skinner JS. The Wingate Anaerobic Test. Philadelphia Human Kinetics (1996).
- [13] Kim SS. Exercise Physiology. Daekyung Books (2004).
- [21] Sports Science Research Institute. Field Application of Sports Science. Sports Science Research Institute (2000).

Author

Kim Tae-hun / Kyungpook National University, Lecturer
B.A. Pusan National University
M.A. Keimyung University
Ph.D. Keimyung University

Research field

- Effects of Barefoot Rhythm Training on the Body Composition and Physical Activity Promotion System(PAPS) in Adolescents, *Journal of Learner-centered Curriculum and Instruction*, 19(22), 141-164 (2019).

Major career

- 2018~present. Kyungpook National University, Lecturer
- 2019~present. Korean Association for Learner Centered Curriculum and Instruction, Director
- 2019~present. The Korean Journal of Elementary Physical Education, Director