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<Index>

1. Strategic Cognitive Model for Preoccupying the Market of SPORT in KOREA
/ **Jang Jin-hyuk, Lee Soon-hwan**
2. The Impact of the SPORTS Participation Motivation of KOREA College Students on Social Support and Social Adaptation
/ **Park Su-ul, Kim Dong-je**
3. Effect of SMO16, a KOREAN Poly-Herbal Medicine, on Bone Mass in Ovariectomized Rat
/ **Seo Il-bok, Ahn Sang-hyun**
4. The Comparative Analysis on Balance Ability of Throwers between Excellent ATHLETES and Non Excellent ATHLETES
/ **Park Jung-min, Kim Tae-bok, Kang Min-cheol**

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Strategic Cognitive Model for Preoccupying the Market of SPORT in KOREA

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Abstract

This study suggests strategic approaches to the sport market by analyzing the effects of sport participants' personality on motivations participated in sport activities and the interrelation of personality, participation motivation and decision factors in purchasing sport products.

A total of 737 effective responses over 15 years old, living in the capital city in Korea were chosen by using convenience sampling technique. The data were analyzed using SPSS 20 and Amos 20.

The personality of sport and leisure participants seems to have a positive effect on introverted motives for participation in sport activities. In addition, their personalities have a positive effect on extroverted motives for participation in sport activities. Sport and leisure participants' personalities also have a positive effect on product factor and have a positive effect on the image factor in purchasing sport products.

On the other hand, sport leisure participants' personalities do not seem to have a positive effect on external factors in purchasing sport products directly. It was also found that sport leisure participants' introverted motives do not affect the product factor in purchasing sport products positively. Similarly, sport leisure participants' introverted motives do not affect image factor in purchasing sport products. In addition, their introverted motives do not affect external factors in purchasing sport products. Sport and leisure participants' extroverted motives also do not seem to affect the product factor or the image factor in purchasing sport products. However, extroverted motives affect the product factor in purchasing sport products positively.

Through the study, it is possible to see the potential value of sport activities in the sport market. Further study on the interrelationship between various personalities of sports and leisure consumers and the decision factors in their purchases is expected to be helpful for leading consumer market in sport industry.

[Keywords] Sport Market, Cognitive Model, Motivational Factor, Sporting Behavior, Personality

1. Introduction

Usually, sporting behavior is considered as a direct or indirect participation in sport-related activities and as the consumption of sport-related products. As sport facilities, events, services, or manufacturers have been increased in Korea[1], the expansion of sporting behavior has led us to see the economic and potential values of the sport-related consumption. In accordance with the expansion of sporting behaviors, sport market and sport consumption became more important than

ever and sport enterprises and their owners started to focus on the consuming trend of consumers. Sport consumers have attempted to fulfill their needs and wants through sport behaviors and they also became more eager for better services[2][3]. Thus, sport marketers today are required to focus on making consumer-centered strategies that can meet their needs and wants. Providing consumer-centered products is the most important factor in the intensely competitive market in these days[4]. It demonstrates the study on understanding consumer behavior focusing

more on personal emotional experiences and personality.

Individual personality can generate differences in brand preference and consumption pattern among consumers. In order to understand their needs and wants, the study to analyze their private activities, interests and opinions that represent their life styles as well as their behaviors and the style of expression was needed[5][6]. As all consumers have different their own consuming patterns, the relevant business can use these patterns to make effective marketing strategies for better profits.

The previous studies on the relationship between personality and consumer behavior have some weak points. The subjects were limited to young people in their 20's or 30's although the studies aim to demonstrate general consumer trends. The limited age group may represent certain trends of the group. Also, most of studies on certain industry sectors aim to determine general consumer trends or find out how personality affects on purchase of certain items and researchers are inclined to refine or generalize the purpose of their studies. In other words, it is not that easy to demonstrate that personality may act as a significant parameter as it varies depending on the category of the goods and there are only a few referable comparative studies[7].

Meanwhile, recognition of various motivating factors is recommended as a strategic approach to understand the consumers. Consumer motivating is a basic target to execute a successful marketing. If one can define motivating factors of sport participants to purchase a product or service that would be the decisive factor of a success[8].

This study is to determine the cause-and-effect relationship between the participation motive and sporting good purchase by analyzing how the personalities of sport participants affect on participation and purchase of the relevant products in the sport market.

For the purpose, this study suggest a conceptual model for interrelation of the variables and clarify it in a positive way. In partic-

ular, this study aims to suggest a strategic approach to sport market through the analysis of a structural model for interrelationship of variables. By understanding personality of sport participants, marketers can properly deal with their needs and wants. A study on personality and customer satisfaction can be used to categorize a market by marketers and also for promotion events to attract sport participants. If the cognitive side is fully studied and adjusted to marketing, the sport market is expected to achieve a significant growth by promoting sport participants' understanding and raising connectedness and royalty.

Therefore, the purpose of this study is to provide a new paradigm to preoccupy a dominant position in sport market by analyzing the participation motives and consumption patterns of sport participants.

In this study, three hypotheses were established in order to clarify the cause-and-effect relationship among major factors such as the participant's personality, sport participation motivation, and purchase decisive attribute.

Hypothesis 1. Cause-and-effect relationship between personality and participation motive

1-1. The personality factor of a sport-leisure participant will have a positive effect(+) on the inner participation motivation.

1-2. The personality factor of a sport-leisure participant will have a positive effect(+) on the external participation motivation.

Hypothesis 2. Cause-and-effect relationship between personality and purchase decisive factor

2-1. The personality factor of a sport-leisure participant will have a positive effect(+) on the purchase decisive factor.

2-2. The personality factor of a sport-leisure participant will have a positive effect(+) on the image factor of the purchase decisive attribute.

2-3. The personality factor of a sport-leisure participant will have a positive effect(+) on the external factors of the purchase decisive attribute.

Hypothesis 3. Cause-and-effect relationship between participation motivation and purchase decisive attribute

3-1. The inner sport participation motive will have a positive effect(+) on the product factor of the purchase decisive attribute.

3-2. The inner sport participation motive will have a positive effect(+) on the image factor of the purchase decisive attribute.

3-3. The inner sport participation motive will have a positive effect(+) on the external factors of the purchase decisive attribute.

3-4. The external sport participation motive will have a positive effect(+) on the product factor of the purchase decisive attribute.

3-5. The external sport participation motive will have a positive effect(+) on the image factor of the purchase decisive attribute.

3-6. The external sport participation motive will have a positive effect(+) on the external factors of the purchase decisive attribute.

2. Methodology

2.1. Subjects

Total 737 subjects over 15-year-old, living in the capital city of Korea and regularly participating in sport activities were used to analyze the result for this study. <Table 1> shows the general information of the subjects for this study.

Table 1. General information of the samples.

Feature	Classification	N	%
Sex	Male	1431	63.9
	Female	807	36.1
Age	Under 20	261	11.7
	20~29	795	35.5
	30~39	699	31.2
	40~49	291	13.0
	50~59	141	6.3
	Over 60	51	2.3
Marriage status	Not married	1416	63.3
	Married (no child)	183	8.2
	Married (have a child)	639	28.6

Occupation	Agriculture, Fishery	30	1.3
	Self-employed	114	5.1
	Sales, Service	258	11.5
	Technician	117	5.2
	Office worker	384	17.2
	Administrator	66	2.9
	Professional	243	10.9
	Housewife	117	5.2
	Student	747	33.4
	Unemployed	33	1.5
	Others	129	5.8
Average monthly income	Less than 1million won	261	11.7
	1~1.99 million won	360	16.1
	2~2.99 million won	582	26.0
	3~3.99 million won	408	18.2
	4~4.99 million won	297	13.3
	Over 5 million won	330	14.7
Education degree	High school graduate	411	18.4
	College student	705	31.5
	University graduate	822	36.7
	Master / Ph.D.	243	10.9
	Others	57	2.5
Housing	Own	1275	57.0
	Rent	498	22.3
	Monthly	312	13.9
	Others	153	6.8

2.2. Measurement tool

For the research of personality of sport participants, HEXACO-60 personality test was used[9]. Total 60 questions about personality of sport participants are divided into two groups of 6 personality factors and 24 sub-factors.

A refined version of questionnaire that was formed based on SMS-28(sport motivation scale)[10] and LIM(liesure intrinsic motivation)[11] was used for the research on the participation motives of sport participants[12]. There are 12 questions in relation to introverted motives of sport participants and 13 questions in relation to extroverted motives of sport participants.

For the research on purchase determination attribute of sport goods, a refined and reorganized version of the questionnaire was

used[13]. The questionnaire is mainly divided into three parts related to the product factor(design, color, function), image factor(trend, advertisement, brand), and external factor(price, service, location).

2.3. Data analysis

For this study, frequency analysis was conducted to examine characteristics of sport participants and sample data. Exploratory factor analysis was also conducted to verify construct validity of their personalities and sport participation motives and the purchases of sport goods and then Cronbach's α was used to verify reliability and consistency among questions. To secure independence of measurement variables, confirmatory factor analysis based on analysis of covariance was conducted for each factor and reliability, discriminant validity and convergent validity were secured through analysis on model fit statistics, concept reliability, average variance extracted, correlation between latent variables and stationarity confirmation. Verification of study hypothesis was decided based on t-value($t > 1.96$) of path-coefficient between theoretical variables that were suggested in covariance structure analysis of study model. Finally, Structural Equation Modeling(SEM) was used to clarify the effects of a sport participant's personality on introverted or extroverted motives for participation, sport products purchase, image, and other external factors.

3. Result

3.1. Confirmatory factor analysis

For this study, confirmatory factor analysis(CFA) was conducted on measurement variables to examine conformity of variable structure with empirical data and stability of endogenous structure for each variable as well as verify convergent validity[14].

The results of model suitability test through maximum likelihood method showed

306.838 in χ^2 value, 137 in df value, .972 in CFI value, .966 in TLI value and .041 in RMSEA value, which means the model is suitable and confirmatory factor analysis is valid.

After the evaluation of model suitability, reliability and validity of latent variables was evaluated. Theoretically construct reliability over .7 and average variance extracted over .5 somewhat guarantee reliability of latent variables. For this study, construct reliability and average variance extracted of all latent variables meet the standard, which means reliability and convergent validity were secured. Also, values of construct reliability and average variance extracted for all factors were bigger than critical ratio. It is considered that reliability of latent variables is secured theoretically. As shown in <Table 2>, construct reliability and average variance extracted values are over critical ratio, which suggests reliability and convergent validity were secured.

Along with suitability by confirmatory factor analysis to verify connection between these measurement variables and latent variables, standardized factor coefficient estimation about properties of sport activities, sport participation motivation and purchase determination of sport goods is presented in <Figure 1>.

3.2. Testing study hypothesis

Hypothesis testing about connection among personalities of sport participants, sport participation motives and the purchases of sport goods produced results shown in <Table 3> presenting Path-coefficients among variables. The analysis results of this study model are schematized in <Figure 2> showing the path diagram and non-standardized estimate of path coefficient from analysis of the structural equation model. The rectangle shows measurement variables, the oval expresses latent variables and error terms are from e01 to e19.

Table 2. The result of factor analysis and reliability analysis for study model.

Potential parameter	Identified parameter	Estimate	Estimated standardization error	CR	AVE
Personality	Honesty-humility	.442	.805	.789	.508
	Emotionality	Eliminated	-		
	Extraversion	.902	.186		
	Agreeableness	Eliminated	-		
	Conscientiousness	.891	.206		
	Openness to experience	.480	.770		
Intrinsic motivation	Enjoyment	.816	.334	.895	.740
	Skill development	.905	.181		
	Achievement	.857	.266		
Extrinsic motivation	Condition	.661	.563	.806	.584
	Affiliation	.865	.252		
	Health & fitness	.752	.434		
Product	Design	.806	.350	.858	.669
	Color	.795	.368		
	Function	.851	.276		
Image	Trend	.995	.010	.762	.548
	Advertisement	.718	.484		
	Brand	.372	.862		
External	Price	.967	.065	.809	.596
	Service	.697	.514		
	Location	.605	.634		

Note: CR: Construct Reliability, AVE: Average Variance Extracted.

Figure 1. Standardized coefficient estimation of cognitive properties recognized by a sport participant.

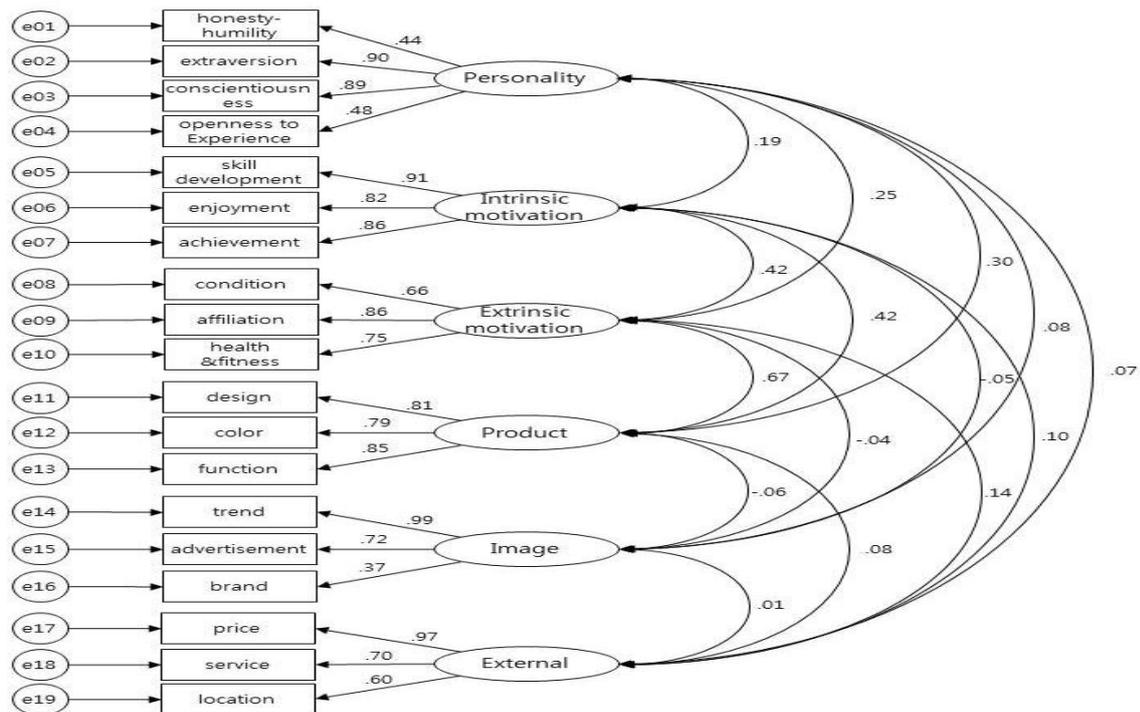
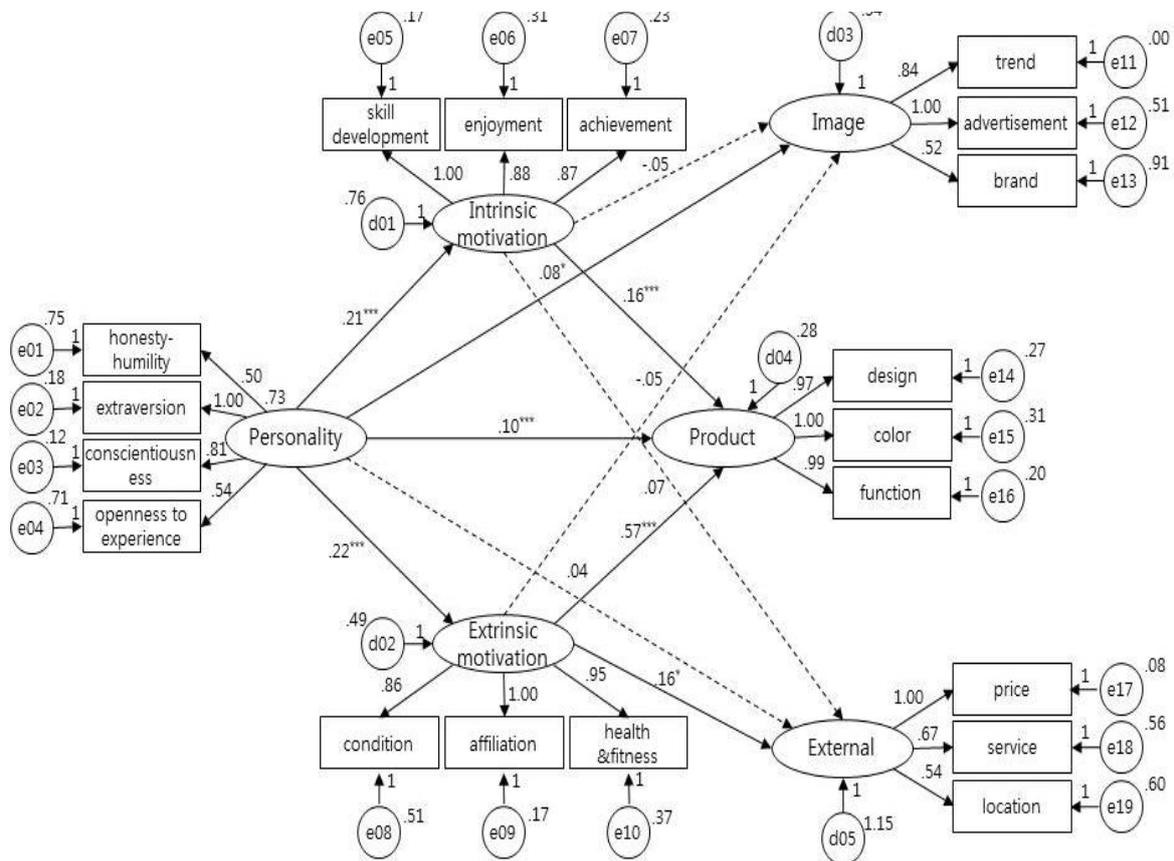


Table 3. The result of parameter estimation using maximum likelihood method of study model.

Theory/Route			Standardization	Non-standardization	S.E.	C.R.	P	Hypothesis tested
H1-1	Intrinsic	← Personality	.200	.209	.042	4.920	***	Adopted
H1-2	Extrinsic	← Personality	.256	.219	.036	6.083	***	Adopted
H2-1	Product	← Personality	.125	.104	.031	3.351	***	Adopted
H2-2	Image	← Personality	.098	.084	.037	2.290	.022	Adopted
H2-3	External	← Personality	.029	.037	.054	0.685	.493	Rejected
H3-1	Product	← Intrinsic	.203	.162	.028	5.673	***	Adopted
H3-2	Image	← Intrinsic	-.059	-.049	.033	-1.475	.140	Rejected
H3-3	External	← Intrinsic	.056	.068	.049	1.373	.170	Rejected
H3-4	Product	← Extrinsic	.581	.567	.043	13.122	***	Adopted
H3-3	Image	← Extrinsic	-.044	-.045	.043	-1.058	.290	Rejected
H3-4	External	← Extrinsic	.105	.157	.064	2.459	.014	Adopted

Note: ***p<.001

Figure 2. The result of non-standardization of structural formula model test.



Note: *p<.05, **p<.01, ***p<.001, → adopted, → rejected

4. Discussion

4.1. Relationship between personality factor and participation motivation

As shown in the results, personality of sport participants has positive(+) influence

on internal and external participation motivation. Therefore results of this study model support the hypothesis.

According to the research on relationship between sport activities and sport attitude of youth, frequency of youth sport activities influences their sense of justice. The more youth participate in leisure activities, the bigger their sense of justice becomes[15]. The previous study showed correlation between factors to form sport activities preference including individual sport preference, team sport preference, interest in health, direct, game watch, indirect game watch, challenging sport and exercise time and five personality factors[16].

There are 2 researches[17][18] explained that strong recognition about leisure motivation reduces restriction on leisure participation and becomes an important factor to decide direction intensity and persistence of certain leisure behaviors. These researches partially support the results of this study.

Therefore, sport instructors need to meet various kinds of needs of sport participants, provide them adequate goals continuously so that participants do not have difficulties or boredom in sport activities and help them have pleasant and healthy life. Furthermore, it is considered that the participation motives can work as a strategic variable in marketing to draw new participants

4.2. Relationship between personality and purchase determination

The result of this study showed that personality of sport participant and the product factor of sport goods have positive(+) influence on each other. Moreover, personality and the image factor have positive(+) influence on each other. Therefore the testing results of this study model support the set hypothesis.

According to the previous study on sport shoes purchase of teenagers, what makes customers feel satisfied about products greatly is color and design, which means that outlook of products is important[19]. A research[20] reported that people with high

conscientiousness tend to make more careful and cautious decisions than others.

It suggests that when sport participants with various personalities purchase sport goods design, color and function of sport goods become purchase determination factors. It also suggests that when sport participants with different personalities purchase sport goods, the image factor such as trend, advertisement and brand works as purchase determination factors.

From the result of this study, it was found that personality of sport participant has no positive(+) influence on external factors of sport good purchase. The result of this study model failed to support the set hypothesis.

The study about influence of sport marketing mix factors on brand asset and consumption behaviors explains that location, a sub-factor of sport marketing, influences on perceived quality[21]. However, purchase location among purchase determination factors doesn't have significant influence on all sub-factors among brand assets[22]. These results fail to support the results of this study.

Although some previous study shows no connection between product purchase by sport participants with various personalities and the product factor in relation to purchase of sport goods such as price, service and location, other advanced researches suggest that there might be connection between them.

These results were produced possibly because increase of owner-driven cars or transformational development made it much easier for people to buy sport goods. Due to active marketing campaign customers take good service for granted and personalities of purchasers do not greatly influence on product price because of their brand loyalty. However, price is still very important when customers buy products. Therefore it is necessary to understand connection among personalities of sport-leisure participants, image factor in relation to purchase determination of sport goods and price, service and location of products for better marketing strategy.

4.3. Relationship between participation motives and purchase determination

This study showed that introverted participation motives have a positive(+) effect on the product factor and it supports the hypothesis. In the study about influence of sport participation factors on product purchase and consumption behaviors[23], sport participation motives influence on product purchase and consumption behaviors, which means that the participation motives are an influential variable. Frequent social exchange and high self-realization increased interest in product purchase and unhealthy condition of a body lowered pleasure and self-expression. High stress factors of sport participants greatly influenced on pleasure. It is considered social exchange and sense of belonging provide people more pleasure of sport good purchase. Self-expression was high in self-realization and stress groups. Healthiness of body showed negative(-) influence on self-expression and it could mean that low healthy index brings low self-expression in product purchase. These research results partially support the result of this study.

In relationship between various introverted motives of sport participants and sport good purchase, product factor such as design, color, function, trend and advertisement become purchase determination factors.

Participants with the introverted motives engage themselves in sport activities due to technology development, pleasure and sense of accomplishment. Since they intend to satisfy their desire for pleasure and sense of accomplishment through product purchase, it is required to invest on functional development of products for steady sales.

Introverted motive factors have no positive(+) influence on the image factors and external factors. Therefore, the results of this study model fail to support the hypothesis.

The previous study on amateur golfers' participation motives, club selection and repurchase possibility through PLS path model analysis shows that only function of golf club has significant influence on repurchase and other factors including A/S and brand name do not have influence on repurchase[24]. It supports the results of this study.

The study suggests that in purchase of sport goods, various participation motives of sport participants fails to show relation to the image factor of sport goods including advertisement, trend and brand. Various participation motives of the participants also fails to show relation to external factors of sport goods including price, service and location in purchase of sport goods.

One possible reason for this is that exiting sport participants purchase products in wide and various ways both on-line and off-line, which means there is no locational restriction about purchasing products. Unlike existing consumption patterns, a lot of purchase is conducted through on-off line. Therefore, purchase location is not a problem when customers purchase sport goods. However, mood of purchase location and assessment on the place influence on brand image[25]. Sport shops and agencies that sell sport goods are different from other stores because they also provide service. Sport shop is a place that stimulates customers' brains and neuron data, so that atmosphere, interior and kindness of staff in a shop become very important factors to form image of the brand in the shop. So it is recommended for sport companies and managers to understand sport shops, stores and agencies as a space to communicate with customers and pay attention to atmosphere and interior of their shops to give customers confidence in their brands[22].

5. Conclusion & Recommendation

In this study, the cognitive side of sport participants through scientific and objective methods is considered. The personalities of sport participants were categorized by the motives, participants' personalities with decisive purchase factors, and participants' motives with decisive purchase factors.

The sport participants' personalities seem to affect the introverted motives in participating in sport activities positively. In order to utilize different personality of the sport participants, sport leaders and sport marketers need to use the motives such as technical development, pleasure, and accomplishment strategically.

This study aimed to find connection along personality of sport participants, motivation for sport participation and purchase of sport goods, which had not been a major issue in existing studies. However it showed several theoretical and empirical limits and here comes some suggestion for next studies.

This study only presented demographic and general characteristics of subjects with no comparative analysis of various factors. More various data based on comparative analysis of demographic and general characteristics of study subjects should be presented for sport trainers and marketers.

Motivation for sport only showed partial direct and indirect effect on personality of sport participants and purchase determination in this study leaving room for questions and necessity of further studies. Also it is required to examine multiple mediator effect model that included other variables in relation to cognition of sport participants and find out various important factors between human cognition and sport by inputting more factors based on this study for in-depth and continuous study.

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The Impact of the SPORTS Participation Motivation of KOREA College Students on Social Support and Social Adaptation

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Abstract

The purpose of this research is to provide the basic data for college students towards their healthy participation in sports activities by articulating the relationship between the sports participation motivation, social support and social adaptation of the college students participating in the sports activities. In order to achieve this research objective, college students participating in sports activities at five universities during 2017 were selected as the research subjects by using the systematic stratified cluster random sampling method.

The self-administration method was used to prepare the survey questionnaire, and the questionnaire survey was conducted by the researcher visiting the research subjects and explaining the purpose of the research to the participants of the collegiate sports activities. The research subjects responded to the survey on the spot, and the researcher retrieved their responses accordingly. As such, a total of 650 copies were distributed, of which the responses whose details were incomplete or absent were excluded from the analysis. In addition, the statistical method was used to undergo the process to remove the extreme values, and 42 samples were excluded, followed by the selection of 608 people as the final valid samples for the final analysis.

The collected data then have undergone frequency analysis, reliability analysis and multiple regression analysis using the SPSS version 21.0 program, and the significance level was examined at the $p < .05$ level to derive the following conclusions.

First, as a result of performing the regression analysis of the impact of the participation motivation of the college students' participation in sports on social support, the motivation subfactors such as health, socialization and recreation seem to have a positive impact on the emotional support.

Second, the regression analysis of the participation motivation of the college students' participation in sports showed that health and social factors, which are subfactors of the participation motivation, have a positive impact on adaptation, which is a subfactor of the life adaptation.

Third, as a result of analyzing the impact of social support of the college students on the life adaptation, emotional support and information support factors, which are social support facts, have a positive impact on the adaptation factor, which is a subfactor of the life adaptation.

The college students' participation in sport is based on physical activity, and they feel emotional bond and form friendly relationship, so that through a good relationship with college students, they could have a sense of community and adapt to their school life. Therefore, the sports participation activities help the college students to grow their health, socialization, and pleasure, among others, thereby raising their ability to adapt to social life as a factor, and the efforts to expand their chances to participate in sports, develop sports programs, and secure facilities will be needed.

This study suggests strategic approaches to the sport market by analyzing the effects of sport participants' personality on motivations participated in sport activities and the interrelation of personality, participation motivation and decision factors in purchasing sport products.

A total of 737 effective responses over 15 years old, living in the capital city in Korea were chosen by using convenience sampling technique. The data were analyzed using SPSS 20 and Amos 20.

The personality of sport and leisure participants seems to have a positive effect on introverted motives for participation in sport activities. In addition, their personalities have a positive effect on extroverted motives for participation in sport activities. Sport and leisure participants' personalities also have a positive effect on product factor and have a positive effect on the image factor in purchasing sport products.

On the other hand, sport leisure participants' personalities do not seem to have a positive effect on external factors in purchasing sport products directly. It was also found that sport leisure participants' introverted motives do not affect the product factor in purchasing sport products positively. Similarly, sport leisure participants' introverted motives do not affect image factor in purchasing sport products. In addition, their introverted motives do not affect external factors in purchasing sport products. Sport and leisure participants' extroverted motives also do not seem to affect the product factor or the image factor in purchasing sport products. However, extroverted motives affect the product factor in purchasing sport products positively.

Through the study, it is possible to see the potential value of sport activities in the sport market. Further study on the interrelationship between various personalities of sports and leisure consumers and the decision factors in their purchases is expected to be helpful for leading consumer market in sport industry.

[Keywords] Sports, College Student, Social Support, Social Adaptation, Participation Motivation

1. Introduction

Participation in sports activities by the college students is among the most active recreational activities for the college students[1], and while improving health and physical fitness, the participation also elevates the quality of college life and plays such an important role as an effective venue for making the recreational time as sound as possible[2].

Participation in sports activities in college has become an academic interest to many scholars as it has been proven that the physical, social and psychological effects are positive on the college students. However, there is still a lack of interest and research on the psychological variables of the individuals, which are important factors in adapting to college life, further to the positive variables that help out with the adaptation.

Therefore, in this research, the purpose is to articulate the relationship among the social support and social adaptation by the sports participation motivation for the college students currently participating in sports activities based on the results of the previous researches, thereby activating the sound and desirable sports participation activities of the colleges students and providing basic data for the facilitation towards that end.

2. Methodology

2.1. Subjects

The subjects of this research were the college students participating in sports activities at 5 universities in 2017, and the final research samples were derived from using the systematic stratified cluster random sampling method. The self-administration method was used to prepare the survey questionnaire, and the questionnaire survey was conducted by the researcher visiting the research subjects and explaining the purpose of the research to the participants of the collegiate sports activities. The research subjects responded to the survey on the spot, and the researcher retrieved their responses accordingly. As such, a total of 650 copies were distributed, of which the responses whose details were incomplete or absent were excluded from the analysis. In addition, the statistical method was used to undergo the process to remove the extreme values, and 42 samples were excluded, followed by the selection of 608 people as the final valid samples for the final analysis. The general characteristics of the survey subjects are shown in <Table 1>.

Table 1. General information of the samples.

Feature	Classification	N	%
Sex	Male	341	56.1
	Female	267	43.9
Grade	1st grade	153	25.2
	2nd grade	150	24.7
	3rd grade	148	24.3
	4th grade	157	25.8
Type of exercise	Competitive	186	30.6
	Combat	232	38.2
	Rhythm	190	31.2

2.2. Measurement tool

The survey tool used in this research is the questionnaire, and among the tools used to perform the examination of the reliability and validity in the previous researches conducted domestic and abroad, the variables used for the purpose and contents of this research were used. The questionnaire scale consisted of Likert scale of 5 points were used, and the details of the variables are as follows.

In order to measure the participation motivation of the college students, Jung, Cheol Woon, and Lee, Cheol Hwa(2011)[3] revised the participation motivation scale questionnaire according to the purpose of this research and asked 5 items on health, 5 items on socialization, 5 items on self development and 5 items on recreation, for the total of 20 items.

The social support scale was composed of the total of 8 items including 4 items on emotional support and 4 items on information support, which were modified and supplemented according to the purpose of this research based on the items used in the research of Cho, Myung Shil(2007)[4].

As for the social adaptation scale, the items developed by Jeon, Mi Hyang(1997)[5]

were revised and supplemented with the 20 items used in the research of Kwak, Ho Keun(2007)[6].

2.3. Data analysis

Among the collected data, the analyzable data were subjected to the SPSS WIN 22.0 using the exploratory factor analysis, reliability analysis, frequency analysis, correlation analysis and the multiple regression analysis.

3. Result

3.1. Correlation between participation motivation, social support, and social adaptation

In this research, before examining the impact of the set variables, I examined correlations between the subscales of the participation motivation, social support, and social adaptation, and further analyzed correlations as shown in <Table 2> to confirm the multicollinearity. As a result, the relation among all the configuration concepts was positively correlated, suggesting that the directions of the relationships among the variables presented in the research hypothesis are in congruence.

Table 2. Correlation between participation motivation, social support, and social adaptation.

Feature	1	2	3	4	5	6	7	8
Health	1							
Socialization	.467**	1						
Self-development	.235**	.168**	1					
Recreation	.611**	.263**	.563**	1				
Emotional support	.447**	.234**	.164**	.678**	1			
Information support	.455**	.426**	.162**	.367**	.143*	1		
Adaptation	.643**	.917**	.358**	.219**	.420**	.558**	1	
Impulsiveness	.280**	.191**	.099*	.300**	.284**	.539**	.344**	1

Note: *p< .05, **p< .01

Table 3. Impact of participation motivation on social support.

Variable	Participation motivation			
	Health	Socialization	Self-development	Recreation
Emotional support	.285***	2.319*	.134	6.046***
information support	.809	2.644	.117	1.602
R2	.216 F=3.203	.329 F=24.805	.303 F=21.99	.459 F=13.63

Note: * : p<.05, *** : p<.001

Table 4. Impact of participation motivation on social adaptation.

Variable	Participation motivation			
	Health	Socialization	Self-development	Recreation
Adaptation	.173***	5.458***	1.521	.108
Impulsiveness	.055	1.698	12.269	.594
R2	.083 F=26.443	.237 F=26.443	.464 F=13.086	.286 F=20.885

Note: *** : p<.001

Table 5. Impact of social support on social adaptation.

Variable	Social support	
	Emotional support	Information support
Adaptation	2.607***	2.416***
Impulsiveness	1.520	.036
R2	.203 F=12.901	.174 F=8.205

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

3.2. Impact of participation motivation on social support

<Table 3> provides the results of verifying the impact of the sports participation motivation on social support. Health($F=3.203$), socialization($F=24.805$), and recreation($F=13.63$), which were subfactors of the participation motivation, had a significant impact on the emotional support factor, which is a subfactor of the social support, and each had the power of explanation of 21.6%, 32.9% and 45%, respectively.

3.3. Impact of participation motivation on social adaptation

<Table 4> provides the results of verifying the impact of the sports participation motivation on social adaptation. The factors of health($F=26.443$) and socialization($F=26.443$), which are subfactors of the participation motivation, had a significant impact on the adaptation factor, which is the subfactor of social adaptation, and each had the power of explanation of 8.3% and 23.7%, respectively.

3.4. Impact of social support on social adaptation

<Table 5> provides the results of examining the impact of social support of the college students' sports club participants on adaptation, the subfactor of social adaptation. Emotional support and informational support factors, which are the subfactors of social support, had a significant impact on adapta-

tion($F=12.901$, $F=8.205$), which is the subfactor of social adaptation, and each had the power of explanation of showed 20.3% and 17.4%, respectively.

4. Discussion

Based on the results of this research, the following hypotheses may be discussed.

First, in the relationship between the sports participation motivation and the social support of the college students, the participation motivation had a positive impact on the social support factors. Choi, Chung Shik (2006)[7], Park, Bo-Hyeon, and Lee, Yeon-Ju (2009)[8] also reported on the causal relationship between the sports participation motivation and the informational support, and such a result is thought to act as a strengthening factor for the social support factor via a high impact from the emotional and informational support, among others, through the sports participation activities. Therefore, it would be necessary for the colleges and universities to make effort to secure the leaders as well as develop the sports programs and facilities to ensure that the sports activities are activated.

Second, looking at the impact of the sports participation motivation and the social adaptation, the impact is seen to have a significant impact on health, social and recreational activities, which are the subfactors of the participation motivation. The results are consistent with those of the previous researchers

conducted. In the research of Kim, Soon Young and Kwak, Jae Won(2014)[9], the physical activity participation is reported to have a significant impact on the adaptation to school life, and in the research of Kim, Jung Wan and Moon, Han Shik(2013)[10], the sports activity participation by the female students is reported to have a significant impact on the adaptation to school. As such, the sports activity participation is quite an important factor in helping the college students make their adaptation to their college life.

Third, looking at the impact of the social support of the college students' sports activity participants on the social adaptation, the emotional support and informational support factors, which are among the subfactors of the social support, had a significant impact

The adaptation factor, which is a subfactor of the social adaptation. These results are consistent with those of the researches of Lim, Beon Jang et al.(2006)[11] and Sunwoo, Yoo Young(2008)[12], and the social support is seen to induce the participation of the sports activities, and through the sports activity participation, can offer help for the social adaptation.

College students have the understanding that they would be able to gain new vitality through the environment of tension and various experiences which continue in the midst of the sports activities, further to improving the health and fitness, and form various human relationships for a better value. High perception of the social support may be said to play such an important role for the healthy development and social adaptation of the humans by satisfying the basic human needs and providing a sense of control over the environment.

5. Conclusion & Recommendation

As a result of analyzing the relationship between the sports activity participation, social support, and the social adaptation of the Korean college students, the following conclusions have been derived.

First, it was discovered that health, socialization and recreation, which are subfactor of

the college students' sports participation motivation, had a positive impact on emotional support, which is a social support factor.

Second, it was discovered that health and socialization factors, which are subfactors of the sports participation motivation of the college students, had a positive impact on adaptation, which is a subfactor of the life adaptation.

Third, as a result of analyzing the impact of social support of the college students on life adaptation, emotional support, which is a social support factor, had a positive impact on adaptation, which are the subfactors of life adaptation.

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Effect of SMO16, a KOREAN Poly-Herbal Medicine, on Bone Mass in Ovariectomized Rat

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Abstract

The objective of this study was to explore the effect of SMO16, a Korean poly-herbal medicine, on bone mass in ovariectomized (OVX) rats. The loss of bone mass is known to be associated with hormone deficiency in OVX rats. In the present study, we successfully produced the osteoporosis animal-model by dissecting the ovary. To determine the protective effect of SMO16 in OVX rat, SMO16 was administered at a dose of 2.25 g/kg in saline solution for 8 weeks after OVX. Furthermore, we evaluated the direct effect of SMO16 by using a soft X-ray system and Masson's trichrome staining, phloxine-tartrazine staining, and immunohistochemistry in vivo. SMO16 significantly regulated the expression of proteoglycan and osteopontin. These data suggest that SMO16 exerts a protective effect against osteoporosis via the activation of proteoglycan and osteopontin that are closely associated with bone balance. Moreover, these findings suggest that SMO16 can act as a potential therapeutic agent for the treatment of osteoporosis.

[Keywords] Ovariectomized Rat, Osteoporosis, Osteopontin, Osteoblast, Korean Medicine

1. Introduction

The skeletal system is a complex structure composed of bones and plays an important role in maintaining weight and stability in the body. Although bones have the ability to remodel during an organism's lifetime, bone homeostasis is weakened by various risk factors such as genetic disorders, nutritional imbalance, and aging[1]. Osteoporosis is one of the most common problems affecting bones and is characterized by a decrease in osteoblast. The loss of bone mass is also influenced by a deficiency of osteopontin(OPN) from osteoblasts. Consequently, clinical manifestations of osteoporosis include reduced proteoglycan and extracellular matrix in bone[2].

Osteoporosis is associated with the female hormone estrogen, and women are more likely to be affected than men. Furthermore, according to a WHO survey, the incidence of

osteoporosis and the increase in the elderly population are closely related[3]. Currently, FDA-approved drugs such as alendronate, ibandronate, risedronate, zoledronic acid, calcitonin, raloxifene, denosumab, and estrogen are prescribed for the treatment and prevention of osteoporosis, and all have been reported to cause side effects, including gastric problems[4]. Therefore, alternative treatment strategies are required to improve gastric problems in patients with osteoporosis. Recently, an interest in natural products to treat osteoporosis has been growing.

In the present study, we examined the anti-osteoporosis effects of a natural product decoction containing *Carthamus tinctorius*, *Caragana sinica*, *Achyranthes aspera*, *Phlomis umbrosa*, *Eucommia ulmoides*, and *Drynaria fortunei*. We demonstrated that the decoction extract inhibits osteoporosis by upregulating the expression of OPN. These findings may

provide an alternative strategy for the treatment of osteoporosis without causing gastric problems.

2. Methods

2.1. Chemicals

The decalcification solution, trichrome stain, tartrazine, bouins, and phloxine B were purchased from Sigma(St. Louis, MO, USA). The Vectastain ABC kits were obtained from Vector Laboratories(Burlingame, CA, USA). The following antibody used in this study anti-OPN purchased from Santa Cruz(Santa Cruz, MA, USA).

2.2. Design of experiments

To explore the effect of SMO16, we performed X-ray analysis, Masson's trichrome staining, phloxine-tartrazine staining, and immunohistochemistry on the femur of an ovariectomized rat.

2.3. Procedure

2.3.1. Plant materials and water extraction of SMO16

The *C. tinctorius*(30 g), *C. sinica*(30 g), *A. aspera*(30 g), *P. umbrosa*(30 g), *E. ulmoides* (30 g), and *D. fortune* (30 g) used in the experiment were placed in 2,000 ml of distilled water, preheated for 3 h, and then filtered. The filtrate was reduced to 50 ml using a rotary evaporator, then concentrated and lyophilized to obtain 27 g of an extract (yield: 15%). The dose was determined to be 2.25 g/kg.

2.3.2. Preparation of osteoporosis model

The rat ovariectomy procedure was similar to that in previous studies by Liu M et al[5]. Briefly, 94 virgin Wistar female rats (weight 250 ± 20.0 g) were obtained from Orient Bio, Inc.(Seoul, Korea). The rats were maintained at 22°C with a 12 h light/dark cycle. All experiments and animal care were in conformity with institutional guidelines(SEMCARE 16-06-01). The rats were divided into three groups: a normal control group, ovariectomized(OVX)

group, and the group treated with SMO16 after OVX(ST). The SMO16, in 50% ethanol, was orally administered, every day for 8 weeks at a dose of 2.25 g/kg.

2.3.3. X-ray analysis

The radiographic analysis of the femora was performed as previously described[6], using a soft X-ray system(model SRO-M50; SOFRON, Tokyo, Japan).

2.3.4. Histochemistry and immunohistochemistry

The femurs were treated with decalcification solution for 12 h, and then embedded in paraffin. Then, 5- μ M-thick sections were cut and stained with Masson's trichrome and phloxine-tartrazine. To detect OPN, the tissue sections were treated with blocking serum, 10% normal goat serum, for 4 h at room temperature(RT). Then, the sections were reacted in a humidified chamber at 72 ° C for 72 h with mouse anti-OPN.

The sections were incubated with a secondary antibody: biotinylated goat anti-mouse IgG1 for 24 h at RT. Next, they were incubated with an avidin biotin complex kit. After color development in 0.05 M tris-HCl buffer(pH 7.4) containing 0.05% 3,3'-diaminobenzidine and 0.01% HCl, the cells were stained with hematoxylin.

2.3.5. Data analysis

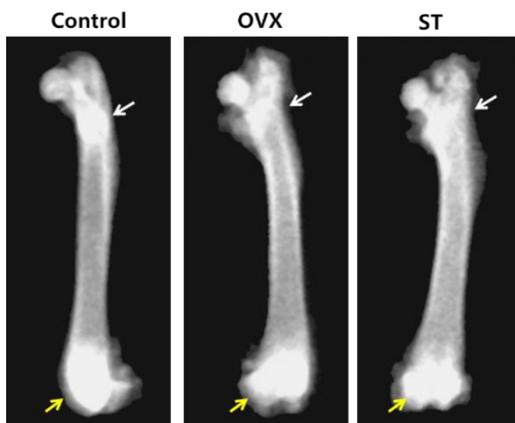
Immunohistochemical results were quantified(means \pm standard error) by image analysis using image Pro Plus(Media Cybernetics, USA). The mucosa, randomly selected from each group, was imaged at 400x magnification and at positive pixels / 50,000,000 pixels. Statistical analysis was performed using SPSS software(SPSS 23, SPSS Inc., USA). One-way ANOVA was performed to verify significance ($P < 0.05$) and post-test with least significant difference(LSD).

3. Results

3.1. Effect of SMO16 assessed through X-ray analysis in OVX rats

To investigate whether SMO16 can protect the loss of femur structure, we analyzed the bone using a soft X-ray system. As shown in <Figure 1>, the mass of bone decreased in the OVX group. In contrast, bone loss was inhibited in the ST group than in the OVX group.

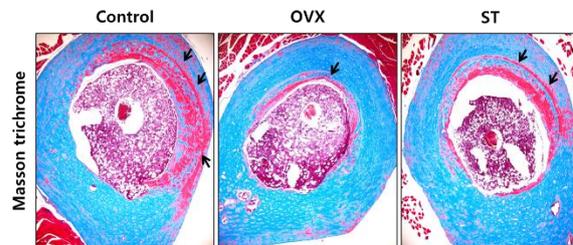
Figure 1. The therapeutic effect of SMO16 on ovariectomy-induced bone loss was analyzed by X-ray. Representative image of X-ray in the femur of control group, ovariectomized(OVX) group, and ST(SMO16 treated after OVX for 8 weeks) group. The white arrow points to the greater trochanter of proximal. The yellow arrows point to the epicondyle of distal.



3.2. Effect of SMO16 on proteoglycan expression in OVX

To determine whether SMO16 can regulate the formation of bone matrix, we examined proteoglycan expression using Masson's trichrome staining. OVX mice were treated with 2.25 g/kg SMO16 for 8 weeks. After 8 weeks, the untreated OVX group showed a decrease in proteoglycan than the control group did. However, the ST group showed a dramatic improvement in proteoglycan expression. The expression of proteoglycan extended from the spongy bone to compact bone <Figure 2>.

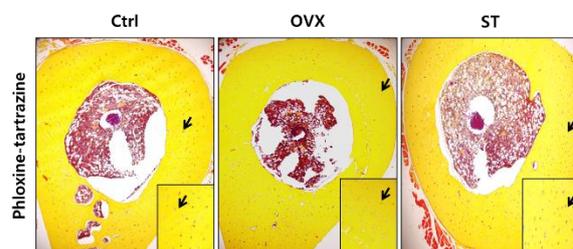
Figure 2. The effect of SMO16 on proteoglycan in ovariectomized rat. The panels represent the control group, ovariectomized group(OVX), and treated with SMO16 after ovariectomy(ST) group. The femur tissues were stained with Masson's trichrome. The black arrows indicate proteoglycan(4x magnification).



3.3. Effect of SMO16 on bone remodeling in OVX

To evaluate whether SMO16 can influence new bone formation, we performed phloxine-tartrazine(PT) staining on the bone from the experimental groups(control group, OVX group, and ST group). Both the control and ST groups had similar patterns, and showed the presence of Haversian canals, whereas in the femur from OVX group, the Haversian canals showed a decrease in staining <Figure 3>.

Figure 3. The effect of SMO16 on Haversian canals in ovariectomy rat. The photomicrographs showed Haversian canals in femur tissue. The tissue stained with phloxine-tartrazine. The black arrow indicates Haversian canals(4x and 200x magnification).

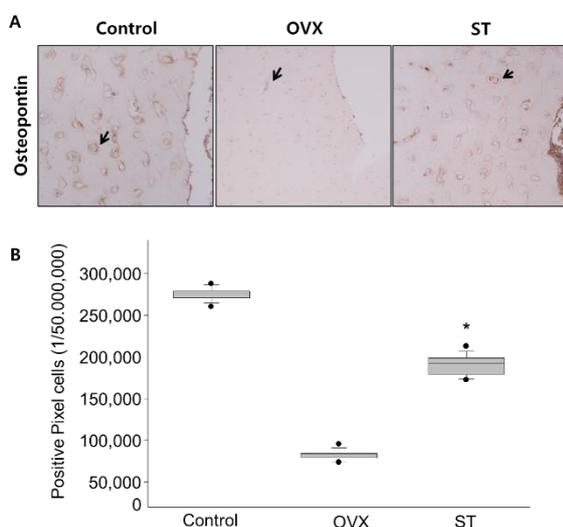


3.4. Effect of SMO16 on OPN expression in OVX rats

In order to understand the effect of SMO16 against osteoporosis, we performed immunohistochemistry with an antibody to OPN. The expression of OPN in the OVX group decreased compared to that in the control

group. In contrast, in the ST group, SMO16 significantly promoted the expression of OPN in the femur of the OVX rat <Figure 4>.

Figure 4. The histological analysis of the ovariectomized rat. The histological analysis of femur tissue. The femur tissue of control group, ovariectomy (OVX) group, and treated with SMO16 after OVX (ST group) was stained with specific antibody, anti-osteopontin(1:100). The black arrow indicates osteopontin-positive osteoclast cells (400 × magnification). The bar graphs were obtained from panel A. *, p < 0.05 versus the OVX group.



4. Discussion and Conclusion

Until now, all the available medicines for the treatment of osteoporosis have various side effects and are not suitable for long-term use. In the present study, we explored a medicinal product that combines not only the potential for long-term use, but also is a natural substance effective for osteoporosis prevention. We prepared and tested SMO16, a Korean poly-herbal medicine containing six natural compounds, including *C. tinctorius*, *C. sinica*, *A. aspera*, *P. umbrosa*, *E. ulmoides*, and *D. fortune*. Interestingly, all the formulations showed anti-osteoporosis property. *C. tinctorius* and *A. aspera* showed a protective effect on gastric ulcer[7].

Osteoporosis is commonly characterized by reduced bone mass, proteoglycan, and ex-

tracellular matrix. Furthermore, the Haversian canals, which consist of capillaries and nerve fibers in the bone, play a critical role in new bone formation by supplying nourishment to osteocytes. Our data show that SMO16 significantly regulates bone mass in OVX rats. In the histological analysis, SMO16 induced OPN expression. This suggests that SMO16 may have a potential effect of inducing the differentiation of osteoblasts, because OPN is an osteoblast marker.

In sports science, exercise exerts a sustained stress on the bones, increasing bone density. Regular exercise such as dancing, walking, and swimming is recommended for people with osteoporosis[8][9]. However, osteoblast damage with hormone abnormalities should be treated by medication[10]. Hence, we suggest exercise along with a balanced diet and health supplements for the prevention of osteoporosis.

Until now, all the available medicines for the treatment of osteoporosis have various side effects of SMO16 against osteoporosis in vivo. Our results suggest that SMO16 upregulates proteoglycan, the presence of Haversian canals, and OPN that is attributable not only to bone remodeling, but also to the regulation of osteoblasts. Therefore, SMO16 is a promising therapeutic agent against osteoporosis induced by ovariectomy.

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Research field

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The Comparative Analysis on Balance Ability of Throwers between Excellent ATHLETES and Non Excellent ATHLETES

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Abstract

This study aimed to provide fundamental data contributing of throwers between excellent athletes and non excellent athletes by investigating the influence on balance ability. Forty voluntary throwers (20 Excellent Athletes, 20 Non Excellent Athletes) with an understanding toward the aims of this study were selected in 2017 Gim-Cheon athletic championship, and their balance abilities were measured. As for the static balance ability, excellent throwers group was higher than non excellent throwers group in Up(U), Right(R), Down(D), and Left(L) static balance ability of body balance variables. Especially, there is a significant difference in Up(U) and Left(L) static balance ability of the body balance variables statistically. As for the dynamic balance ability, excellent throwers group was higher than non excellent throwers group in Up(U), Right(R), Down(D), and Left(L) dynamic balance ability of exercise balance variables. Especially, there is a significant difference in Up(U), Right(R), Down(D), and Left(L) dynamic balance ability of the exercise balance variables statistically. The study results indicate that body balance and exercise balance of thrower effected the athletic ability.

[Keywords] *Body Balance Ability, Exercise Balance Ability, Throwers, Excellent Athletes, Non Excellent Athletes*

1. Introduction

Athletics is one of the oldest competition in human competitions, with the most medals in the Olympic Games. These athletics are largely divided into track and field competition. Among them, throwing competitions belong to field competitions and are divided into discus, hammer throw, javelin throw, and shot throw[1]. Athletic throwing competitions are eccentric contraction before concentric contraction, so that the muscles are stretched rapidly to exert greater tension and apply the force to throwing tools to determine the game by flight distance. It is an athletic competition that requires strong muscular strength, power and high skill because the operation is completed in very short time[2].

Physical factors required for athletics require body balance and exercise balance in addition to behavioral fitness such as muscular strength, power, agility, speed, and flexibility. Exercise performance ability such as muscular strength, power, muscular endurance, and agility based on muscle contraction are considered to be essential part of athletic players performance[3]. In addition, the muscular nerve and muscle contraction type, which connects the power of the muscular function and the speed of exercise, is one of the important factors for improving the performance of the field throwing competition. Coordination of muscles and nerves is a stable factor for body center change, and body center change during the game plays is an important role in improving the performance of

a field-throwing competition[4]. In this way, the ability of muscular function in a field throwing competition is more important than other factors in performance. In particular, stabilization of muscular nerves based on stable muscle function and muscular function based on organic movement of the upper body and lower body was reported to help stabilize the body during the performance of the throwing competition and to help improve performance[5]. This causes the muscle to contract by transmitting a very strong force to the upper body through the thighs and the power zone of the core around the knee of the lower body. And the tension generated by the movement of the skeleton along the axis of the joint causes the acceleration at the movement part, which indicates the optimal kinetic energy[6].

As such, Athletic throwing competitions are extremely short time, so they need to be able to concentrate their maximum ability in a short time. Therefore, the best condition of throwing athletes in the competitions is a matter of concern to both throwers and leaders. However, it is not enough to study on the scientific basis of the physical factors necessary for the athletic throwing athletes, and the posture stabilization and balance ability to improve the performance and to prevent sports damage.

Therefore, this study aims to provide basic data that can help stabilize posture and improve performance of throwers by comparing the difference of body balance and exercise balance of throwers among three athletes in a round circle within a 2.5m of athletics, discus, hammer throw, shot-put.

2. Materils & Methods

2.1. Subject of study

This study was composed of participants in 2017 Kim-cheon Athletic Championship, and they were selected as athletes who have been registered as athletes in Korea Athletics Association for more than 5 years. Forty-two subjects who fully understood the purpose of the study and were willing to volunteer for the study were included. The participants were divided into two groups: Excellent Group(n=20 people) who were a prize winner and Non Excellent Group(n=20 people) who were not a prize winner. In order to facilitate the sampling of the subjects' data, the number of subjects per group was arbitrarily adjusted by the researcher and selected as 20 persons per group. The physical characteristics of the subjects are shown in <Table 1>.

Table 1. Physical characteristics of subjects.

Items	Age(yrs)	Height(Cm)	Weight(Kg)	Career(yrs)
Exercise group (N=20)	20.28±3.23	174.68±12.84	76.68±11.29	7.52±1.84
Non exercise group (N=20)	21.84±4.21	176.32±11.08	78.34±9.96	6.89±2.26

Note: M±SD.

2.2. Measure and method

Participants in this study were the athletes who were participating in 2017 Kim-cheon Athletic Championship and who finished pre-match warm-up. Before the measurement, the measurement equipment and the measurement method were fully explained. The body balance ability and the exercise balance

measured in this study are the balance board system. This study was performed to evaluate the balance ability of the musculoskeletal system and the nervous system patients and the elderly. The subjects were not able to influence the measured values by artificial action and the preliminary measurement was performed 3 times before the measurement.

2.2.1. Physical characteristics

The height of the subjects was measured using an automatic extensometer BSM330 (Biospace Co., Seoul, Korea). The body composition was measured after removing the metal from the body, and taking a rest after 5 minutes of urination. The body composition was measured using the Inbody 720 (Biospace Co., Seoul, Korea). The subjects were placed in an upright posture with their arms and legs slightly open. Body composition analysis was performed in the order of measuring the measurement manual.

2.2.2. Balance ability test

The balance ability test was performed using the Balance Board method using the Center of Pressure method and the Weight Bearing method of the Humac Norm Balance System (Computer Sports Medicine, Inc, Boston, USA). In order to maintain safety during measurement, a balance board with a width of 52cm, a length of 32cm and a height of 5.5cm was used to install a protection frame with a height of 86cm, width of 92cm and a length of 84cm. In addition, a flat mat was used to measure the static balance ability, and a balance mat was used to measure the dynamic balance ability.

The subject stood on the balance board and stared at the screen, and measured time which were keeping the balance in the center

+ shape of screen and keeping it constantly. After 3 exercises each before the test, this test was performed and a high value was selected after a total of 2 measurements.

2.3. Data process

For the data processing of the study, the mean and standard deviation of all collected data was calculated using SPSS 20.0 (window statistical package), and independent sample t-test was performed for the experiment between the groups. The significance level was $p < .05$.

3. Results

3.1. Change in body balance

Changes in static balance ability as measured by body balance measuring instrument are shown in <Table 2>. As for the static balance ability, Up was higher in the EG group (1.88 ± 0.84) than in the NEG group (0.92 ± 0.90), and Down was higher in the EG group (1.62 ± 0.68) than NEG group (1.43 ± 0.76). Also, Left was higher in the EG group (1.36 ± 0.92) than in the NEG group (0.02 ± 0.78), and Right was higher in the EG group (-0.89 ± 0.92), than in the NEG group (-1.19 ± 0.88). However, statistically significant differences in the static balance ability changes between groups were only found in Up ($p = .002$) and Left ($p = .000$).

Table 2. The change of body balance ability.

Items \ Groups	EG(n=20)	NEG(n=20)	t	p
Up	1.88±0.84	0.92±0.90	2.886	.002**
Down	1.62±0.68	1.43±0.76	1.008	.264
Left	1.36±0.92	0.02±0.78	3.226	0.00***
Right	-0.89±0.92	-1.19±0.88	1.102	.322

Note: M±SD.

EG/Exercise group, NEG/Non Exercise group.

*, ** and *** mean $p < 0.05$, $p < 0.01$, and $p < 0.001$, respectively.

3.2. Change in exercise balance

Changes in dynamic balance ability as measured by exercise balance measuring instrument are shown in <Table 3>. As for the dynamic balance ability, Up was higher in the EG group(11.28± 2.84) than in the NEG group(9.96±3.26). Down was higher in the EG group(13.82±4.94) than in the NEG group(8.08±2.66). Also, Left was higher in the

EG group(12.08±2.64) than in the NEG group(10.82±2.96), and Right was higher in the EG group(8.68±2.68) than in the NEG group(7.92±1.94).

In addition, statistically significant differences in the dynamic balance ability changes between groups were found in all variables of Up(p=.000), Down(p=.000), Left(p=.002), Right(p=.032).

Table 3. The change of exercises balance ability.

Items\Groups	EG(n=20)	NEG(n=20)	t	p
Up	11.28±2.84	9.96±3.26	3.864	.000***
Down	13.82±4.94	8.08±2.66	5.262	.000***
Left	12.08±2.64	10.82±2.96	2.886	.002**
Right	8.68±2.68	7.92±1.94	1.888	.032*

Note: M±SD.

EG/Exercise group, NEG/Non Exercise group.

*, ** and *** mean p<0.05, p<0.01, and p<0.001, respectively.

4. Discussion

As the result of analysis to compare body balance and exercise balance of 40 athletes throwers participating in 2017 Kim-cheon Athletic Champion ship(20 excellent athletes and 20 excellent athletes), the study discusses as below.

In athletics, throwing athletes require a great deal of anaerobic exercise ability to use their maximum capacity within a short period of time, and power, agility and maximum muscular strength are important factors in determining the performance of a throwing competition[7]. In addition, improvement of muscle coordination and muscle function is the most efficient training method of throwing athlete, and improvement of muscle nerve function by improvement of muscle function maintains stable body center change. Body-centered stability has been reported to have a direct impact on the prevention of sports injuries and improvement in performance of athletes[8]. Among such throwing

athletic competitions, discus, hammer throwing, and shot-put to rotate trunk occupy a larger proportion in the movement of waist center than the javelin throwing to perform straightly. The misalignment of the center of gravity during exercise is the main cause of the decrease of performance and the risk of sports injury. Besides, wrong center movement during exercise is a major cause of decrease in performance and risk of sports injury[9]. In addition, the throwing technique of throwing competition uses driving force of lower limb and turning force of the torso to transmit to the upper limb and generates the maximum power by using the repulsive force of the whole body strength. However, it has been reported that the maximum power using propulsion force of lower limbs and torso's rotational force is the highest power when prevent loss of body-centered stability and balance ability[7].

This study investigated to compare the effect of physical balance on physical fitness of

throwing athletes between Excellent Athletes and Non Excellent Athletes. Also, it was confirmed that the body balance ability shows the stabilization of the body center and body balance ability of EG is higher than NEG. This is consistent with the results of Park Jung-min and Lee Jung-heon[8] who reported changes in balance ability for athletes on the track, and this study is similar to those of Kim[6] who reported about factor that improves the performance of athletes. In addition, in this study, it was confirmed that the difference of exercise performance equilibrium is influenced. As a result, performance of excellent athlete is higher than non excellent athlete. These results are consistent with Kim's[3] that the axis of the muscle moves around the joints during muscle contraction and stably maintains the movement of the skeleton. The tension generated during muscle contraction causes the acceleration of the moving part. The centrifugal force due to the rotation of the torso during the pitching operation shows the highest kinetic energy in combination with the kinetic energy of acceleration. And the maximum power of the kinetic energy during the pitching operation of throwing competition contributes to stabilize exercise balance through to stabilize body balance.

The above results show that the balance of body performance through the center of body stabilization and the exercise performance balance ability which contributes to stabilization of central axis during exercise performance help to improve athletic ability. It is expected that a good performance can be achieved by harmonizing transformation of technical ability and power through stabilized posture and balanced operation of field throwing game. In addition, in order to perform such a detailed and stabilized operation, it is necessary to develop suitable training with repeated training.

This study investigated that stable center of body balance ability and exercise balance during performance can contribute to athletic ability, and identified that Physical, and exercise performance balancing ability had a great effect on athletic ability of throwers.

5. Conclusion

The purpose of this study is to investigate the effect of body balance(static balance ability) and exercise balance(dynamic balance ability) on throwers' athletic ability. The subject of study was composed of participants in 2017 Kim-cheon Athletic Championship, and they were selected as 40 throwers who have been registered as athletes in Korea Athletics Association for more than 5 years. In order to achieve this purpose, 40 throwers divided into two groups: Excellent Group who were a prize winner and Non Excellent Group who were not a prize winner. and the following results were obtained as a result of observation of static balance ability which is body balance ability and dynamic balance ability which is exercise balance ability.

1. As for the static balance ability of throwers, excellent throwers group was higher than non excellent throwers group in Up(U), Right(R), Down(D), and Left(L). Especially, there is a significant difference in Up(U) and Left(L) static balance ability of the body balance variables statistically.

2. As for the dynamic balance ability of throwers, excellent throwers group was higher than non excellent throwers group in Up(U), Right(R), Down(D), and Left(L). Especially, there is a significant difference in Up(U), Right(R), Down(D), and Left(L) dynamic balance ability of the exercise balance variables statistically.

In conclusion of this study, body balance which stabilize body center and exercise balance which contributes to the stabilization of central axis during performance are helpful for improving athletic ability of throwers. In addition, in order to perform detailed and stabilized motion during throwing competition, it is necessary to develop suitable training for throwers with repeated training.

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