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Investigation on the Recognition of Referees on the Scoring Rules for TAEKWONDO Demonstration Competition

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Abstract

Purpose: *This study is highly anticipated to reduce unfair judgment in Taekwondo demonstration games as a qualitative study done on the recognition, problems and development plans of Taekwondo breaking demonstration competitions through research subjects composed of referees with experience in Taekwondo breaking demonstration competitions. Furthermore, if unified competition rules are applied regardless of the event organizer, it can be used as basic data for establishing objective grounds for Taekwondo demonstration events as a sport.*

Method: *This study used the purposeful sampling method, a non-probability sampling method, as a representative method of qualitative research and selected 5 people who have experience as a referee in Taekwondo breaking demonstration competitions. The study participants include 4 men and 1 woman who are in their 30s and 40s. They possess Taekwondo Grade 6 or 7, and 2 of them have 5 years or less referee experience and 3 had 6 years or more referee experience. After explaining the purpose of the study and the contents of the interviews to the study participants, the participants were asked to respond through telephone recording in a stable atmosphere for the researcher to directly collect the data. The interviews were recorded using a call recording function of Samsung Galaxy S20 Ultra for about 40 minutes, and the recorded data were analyzed through a transcription process using an LG laptop.*

Results: *Breaking demonstration competition referees' perception of the competitions was found as follows; 'characteristics of Taekwondo breaking demonstration competition', 'advantages', 'disadvantages', and 'injury prevention and emergency response.' Breaking demonstration competition referees' perception of the scoring of the competition was found as follows; 'demonstration terminologies', 'evaluation methods', and 'referee qualifications.' Breaking demonstration competition referees' perception of the development plans of the competition was found as follows; 'development potentials', 'need for scoring criteria', 'establishment of scoring terminology', 'enhancement of referee expertise', and 'safety accidents.'*

Conclusion: *First, the perception of breaking demonstration competition referees toward the demonstration competitions was analyzed as the characteristics, advantages, disadvantages and emergency response of the breaking demonstration. Second, the perception of breaking demonstration competition referees toward the scoring was found to be demonstration terminologies, evaluation methods and referee qualifications. Third, the perception of breaking demonstration competition referees toward the development plan for breaking demonstration competitions was observed to be development potentials, need for scoring criteria, establishment of scoring terminology, enhancement of referee expertise and safety accidents.*

[Keywords] ***Taekwondo, Demonstration, Breaking Competition, Scoring Rules, Referee Recognition***

1. Introduction

There are different ways of determining win or loss during elite sports events; decisions on win or loss are made based on records for speed skating, swimming and track-and-field

whereas soccer, basketball, and handball games use score and figure skating, gymnastics, and diving use referee scoring to determine win or loss. Currently, Taekwondo game is divided into three major types: Gyeorugi, Poomsae, and demonstration. Gyeorugi is a sport in which win or loss is determined by scoring while referee scoring determines the win or loss in Poomsae and demonstration. Taekwondo has built a global infrastructure in which more than 10,000 people, including the members of the international sports development cooperation, from 210 countries are training[1].

Taekwondo is largely divided into sparring, poomsae, and breaking. In 1962, the Korea Taesoodo Association(the former entity of the Korea Taekwondo Association) joined the Korea Olympic Committee. In addition, the number of members of the World Taekwondo Federation is 209 countries as of 2019, more than 206 Olympic countries and 84 percent of 249 countries by the International Organiza-tion for Standardization[2][3].

Taekwondo demonstration has been transformed into a performing arts and sports event representing Taekwondo, beyond its role in promoting Taekwondo[4]. In addition, with the development of Taekwondo demonstration and the World Taekwondo Hanmadang Competition as the first demonstration competition, Taekwondo demonstration was adapted as a sport game at university competitions such as those sponsored by the president of Korea National Sport University, Kyunghee University, and Yongin University in 2014, directly affecting college admission and increasing the number of athletes and the level of technological difficulty. However, due to each competition's own game management method, the scoring rules are not unified nor the rules and evaluation criteria are sufficient[5]. Athletes continue to develop new skills in Taekwondo demonstration sport as they express themselves freely in their own way using the principle of attack in Taekwondo kicks, and skill proficiency is regarded important in the sport. It is true that even in gymnastics games, which show similar tendencies to the current Taekwondo demonstration sport, distrust of the scoring rules and scoring and referees' mistakes have been constantly occurring[6]. One of the most representative cases is the case of gymnast Tae-Young Yang at the Athens Olympics where the score determined was not corrected even after a question about the start value was raised. Even the referees of Taekwondo demonstration have difficulties in scoring the game as the scoring evaluation indicators are not objectively prepared irrespective of the increased demonstration techniques through grafting Taekwondo demonstration with other sports such as gymnastics and cheerleading. In addition, there is a growing need for clear technical terms and unification of game rules, as for Gyeorugi and Poomsae, and official referees.

With the founding of the Kukkiwon Demonstration Team in 1974, taekwondo demonstration played a significant role in promoting and disseminating taekwondo not only in Korea but also around the world. taekwondo demonstrations were carried out as a means to promote taekwondo as an official Olympic event[7][8]. Currently, referees must hold a certificate and complete referee training for the Taekwondo games of Gyeorugi and Poomsae. On the other hand, though the referees in Taekwondo demonstration competition is set to be those with profound knowledge in the demonstration, such as university professors and executives of a demonstration team belonging to a Taekwondo institution, the lack of referee certificate in this game, unlike the other two games of Taekwondo, causes difficulties even in referee training

Prior research on Taekwondo demonstration events studied athletic performance and technology[9][10][11][12][13] and demonstration competition[5][14][15][16](Kim et al., 2014; Kim and Jeon, 2018; Lee and Kim, 2019; Shin and Lee, 2015), was studied in terms of the activation and status of Taekwondo demonstration competitions. Nonetheless, There certainly is a lack of research on the fair scoring rules and scoring of Taekwondo breaking demonstration competitions that can be objectively recognized.

While Taekwondo demonstration competition and event are being revitalized and developing, the advancement of Taekwondo demonstration is faced with great difficulties due to unclear scoring evaluation indicators and technical terms. In addition, the perception of referees

employed in demonstration competitions organized by universities and institutions is also unclear. Therefore, this study investigates the perception of referees of Taekwondo breaking demonstration competitions and their view on scoring of the competitions and examines development measures for Taekwondo demonstration competitions.

Consequently, this study is highly anticipated to reduce unfair judgment in Taekwondo demonstration games as a qualitative study done on the recognition, problems and development plans of Taekwondo breaking demonstration competitions through research subjects composed of referees with experience in Taekwondo breaking demonstration competitions. Furthermore, if unified competition rules are applied regardless of the event organizer, it can be used as basic data for establishing objective grounds for Taekwondo demonstration events as a sport.

2. Research Method

2.1. Research subject

This study used the purposeful sampling method, a non-probability sampling method, as a representative method of qualitative research and selected 5 people who have experience as a referee in Taekwondo breaking demonstration competitions. The study participants include 4 men and 1 woman who are in their 30s and 40s. They possess Taekwondo Grade 6 or 7, and 2 of them have 5 years or less referee experience and 3 had 6 years or more referee experience. The characteristics of the study participants are as shown in <Table 1>.

Table 1. Characteristics of study participants.

Participant	Gender	Taekwondo Grade	Age	Referee experience	Remark
Poo	Male	7	Between 40~49	6 years or more	
Koo	Male	7	Between 40~49	6 years or more	
Joo	Male	6	Between 30~39	6 years or more	
Loo	Female	6	Between 30~39	5 years or less	
Noo	Male	6	Between 30~39	5 years or less	

2.2. Data collection

This study presented 2019 scoring criteria for competitions sponsored by the president of Korea National Sport University and Yongin University that implement the competition rules of the Korea Taekwondo Association and conducted in-depth interviews focusing on semi-structured questionnaires for general problems and solutions of Taekwondo breaking demonstration competitions. In addition, the contents of the interviews were recorded using a recording device with the consent of the research participants and then documented through a transcription process.

2.3. Research procedure

In this study, the researcher directly sought cooperation from the personnel who participated as a referee in the 2019 Taekwondo Breaking Demonstration Competition Sponsored by the President of Korea Sport University and Yongin University held between June to July 2020 and obtained consent for in-depth interviews.

After explaining the purpose of the study and the contents of the interviews to the study participants, the participants were asked to respond through telephone recording in a stable atmosphere for the researcher to directly collect the data. The interviews were recorded using a call recording function of Samsung Galaxy S20 Ultra for about 40 minutes, and the recorded data were analyzed through a transcription process using an LG laptop.

In addition, information that was not disclosed during the in-depth interviews was collected through additional phone calls which were recorded with prior consent. During all procedures, the research participants' information was kept anonymous.

2.4. Data analysis

This study conducted inductive category analysis through domain analysis and taxonomic analysis used in qualitative research to definitize observations made during the in-depth interviews, focusing on the subject and thematic categorization of the meanings in this study[17]. After the in-depth interviews, internal criticism was conducted on the summarized finding from the interviews by the researcher and expert groups. Also, the results of the study were derived by executing investigator triangulation, one of the sub-validation procedures for qualitative research, through expert meetings[18].

2.5. Data integrity and ethics

After collecting data through an open questionnaire, reviewing the meaning and analyzing the contents of the collected data, an expert meeting was held to secure the truthfulness of the study. A semi-structured interview was conducted based on the extracted factors. Data integrity of this study was secured through multilateral verification. In order to correctly understand and verify the perceptions of the research participants, a group composed of three members who are an expert in Taekwondo demonstration or Taekwondo professor was formed to exclude the researcher' prejudice and subjectivity. It consisted of a total of 4 individuals, including the researcher and three members – 1 Taekwondo professor, 1 executive from the National Demonstration Team, and 1 referee for Taekwondo breaking demonstration competition. Content validity and data integrity were secured through expert consultation for each research procedure, from data analysis to result interpretation, and the following steps were followed to minimize ethical issues in the qualitative research process. First, in the process of selecting the research participants, the consent from the study participants was obtained only after sufficiently explaining the contents of the study. Second, efforts were made to protect the personal information of research participants; the identity of the participants was kept anonymous to avoid identification exposure and the collected contents were kept confidential.

3. Results

Table 2. Referees' recognition and improvement measures for the scoring rules for taekwondo breaking demonstration competitions.

Category	Sub-category	Original data
Breaking demonstration competition referees' perception of the competition	Advantages of breaking demonstration competition	Arouse interest through various and dynamic techniques
		As a means to promote taekwondo worldwide, the development of taekwondo demonstration technique leads to the development of taekwondo
	Disadvantages of breaking	Technique increases, but the quality as a martial art declines

	demonstration competition	Emergence of breaking demonstration techniques imprudently combining other sports
	Injury prevention and emergency response	Athletes are seriously injured due to indiscreetly high-level breaking
		Rapid response to emergency situations by specialized medical staff
Perception toward the Scoring of taekwondo breaking demonstration competition	Demonstration terminologies	Unified terminologies for the sports
		Unified terminologies for the techniques
	Evaluation method	Allocated points according to complete breaking and technical difficulty
		Unification of criteria for important evaluation items
		Unification of clear deduction criteria
		Changes in scoring rules
	Referee qualification	Measures for fair judgment
		Evaluation of new techniques through referee training
		Enhancement of referee expertise
		Systematic referee education
Improvement measures	Development potential	Affecting college entrance with the specialization of taekwondo demonstration
		Exclusive admission for demonstrators through the establishment of university demonstration teams
		Taekwondo performance and development of demonstration competitions
		International exchange through taekwondo demonstration
	Need for scoring criteria	Complete breaking(pine board)
		Deduction criteria
		Technical standard
	Establishment of scoring terminology	New technique
		Same technique
		Same sport
	Enhancement of referee expertise	Referee qualifications identical to gyeorugi and poomsae
		Taekwondo experience and demonstration competition awards
		Revitalization of the referee education system
	Safety accident	Professional medical staff
		Use of safety landing mat
		Players' unskilled use of highly difficult techniques
		Need age restrictions for high-level techniques

3.1. Taekwondo demonstration competition referees' perception of the competition

Breaking demonstration competition referees' perception of the competitions was found as follows; ‘characteristics of Taekwondo breaking demonstration competition', 'advantages', 'disadvantages', and 'injury prevention and emergency response.' Among the characteristics of the breaking demonstration competition that the referees perceive, the dynamic characteristics of the competition, which Gyeorugi and Poomsae lack, was found to induce the interest of

the audience and enhances the value of being a spectator. The referees also perceived that as the number of Taekwondo demonstration competitions increase, the performance of Taekwondo demonstration and development of demonstration techniques advance, becoming a medium to promote Taekwondo to the world. However, highly difficult techniques that imprudently combine Taekwondo with other sports such as gymnastics and cheerleading were recognized as declining the quality of Taekwondo as a martial art. In fact, indiscreetly high level skills performed by unskilled players were recognized as leading to injuries to which emergency measures cannot be taken due to lack specialized medical staff.

Argued that Taekwondo demonstration serves an international role by inviting the International Olympic Committee(IOC) and each country's influential political and sports figures for demonstration, taking the lead in the central position to make Taekwondo a world-class cultural product and enhancing national prestige of Korea through sports diplomacy [18][19].

Criticized that the use of slightly different techniques obscures the identity of Taekwondo; though the component techniques belonging to Taekwondo which used to have the same terminology and movement[20].

Showed that unskilled players participating Taekwondo breaking demonstration competitions indiscriminately perform high-difficulty and demonstrated measures for injuries occurred during performance[5].

With splendid movements, high-difficulty techniques and dynamic performances that cannot be found in Gyeorugi and Poomsae, Taekwondo demonstration and the spirit of Taekwondo has a tremendous effect on the audience. In addition, it plays an important role in international exchange and the Korean Wave. However, there is a perception that the effects of these performances are losing the spirit of Taekwondo and declining the quality, as a martial art, of the movements and kicks of Taekwondo. It is also deemed necessary to have evaluation index for the quality as a martial art and dynamic performance skills in Taekwondo against the injuries caused by indiscreet high-difficulty techniques.

3.2. Perception toward the scoring of the taekwondo demonstration competition

Breaking demonstration competition referees' perception of the scoring of the competition was found as follows; 'demonstration terminologies', 'evaluation methods', and 'referee qualifications.' It was found that each competition of Taekwondo demonstration uses different names for the sport and technique, and the increased number of techniques that combine Taekwondo with other sports even worsened the situation for the referees and athletes. The referees recognized that for the development and fair scoring of Taekwondo demonstration its terms must be established. In addition, there also found a problem in the distribution of points in evaluation methods of Taekwondo demonstration. The referees found it difficult to fairly score players who completely broke pine boards with a low-level technique and who did not completely break pine boards with a high-level technique as there is no clear standard for point allocation. Although there are criteria for scoring for expressiveness, proficiency, completeness, artistry, and creativity, it was recognized that the concept of evaluation items was interpreted differently by hosting organizations, resulting in subjective evaluation by referees. In addition, the need to unify the criteria for point deduction was also recognized as different hosting organizations have different criteria. Moreover, the referees perceived that the scoring rules should clearly express the scoring criteria through separate scoring of referees and important evaluation items should be established appropriate to the purpose of breaking demonstration competitions. It was found that Kukkiwon, the government, agency for Taekwondo, needs to prepare measures for fair and systematic scoring. Also, enhancing expertise by appointing professional referees for Taekwondo demonstration events and establishing unified evaluation items and evaluation criteria for new technologies through systematic referee training were found to be necessary.

Argued that the technical terminology of each institution was not unified due to the rapid development of demonstration techniques, and the increasing number of new techniques

complicates the technical terminologies used in the demonstration. Also underlined that the government and institutions related to Taekwondo need to respond quickly[5].

Currently, the scoring rules for figure skating are divided into the first score and the second score, which is composed of the rule element and the directing element. Similarly, scoring breaking demonstration competitions by dividing it into the first score on complete breaking and the second score on the level of technique seems to help drawing concrete judgments. In addition, showed that the scoring and deduction criteria of the competition are different for each competition and they must be unified[5].

Emphasized the need for professional referees due to the lack of expertise in Taekwondo referees[5][21].

For the fairness of the current Taekwondo demonstration competition and the development of the Taekwondo breaking demonstration competition, Taekwondo institutions must establish accurate items and concepts, while showing clear evaluation items. In order to revitalize Taekwondo demonstration competitions, it is necessary to introduce a qualification system for referees. In addition, it is considered imperative for experts with profound knowledge in the demonstration to discuss for unified terminology, concept establishment and evaluation items.

3.3. Perception toward taekwondo demonstration competition development plans

Breaking demonstration competition referees' perception of the development plans of the competition was found as follows; ‘development potentials', 'need for scoring criteria', 'establishment of scoring terminology’, 'enhancement of referee expertise', and 'safety accidents.’ They recognized that as the demonstration competition is activated, athletes’ performance in such competition is directly linked to university admission, which, in turn, establishes and activates university demonstration teams and leads to the development of Taekwondo demonstration events and competitions, ultimately developing Taekwondo as a whole. In addition, Taekwondo demonstration performance in public can make the general public to be interested in Taekwondo demonstrations and make contributions to the country through international exchange. On the other hand, it was recognized that clear scoring criteria were needed in order to resolve the problems facing the current Taekwondo breaking demonstration competitions. Currently, the pine boards used in breaking competitions can be easily broken even by young children without difficulty, so to increase professionalism, different standards need to be set for elementary, middle school, high school, and college students by increasing skills and accuracy and differentiating the thickness of pine boards for each of the student groups. Moreover, it was found that clear scoring rules should be made according to clear criteria for point deduction and level of techniques, and for such clear scoring rules, the establishment of terminology should be given priority. Since the use of different names and terminologies for the same breaking techniques by different hosting organizations found to be a problem, it is necessary to discuss to have a framework for newly developed techniques. In addition, unlike the current Gyeorugi and Poomsae practice, Taekwondo demonstration was found to lack fairness in scoring because there is no referee license. Thus, it was recognized that there should be a referee license equivalent to that of Gyeorugi and Poomsae and the referees must be selected based on certified Taekwondo experiences and received awards to activate referee education system and lead to the development of breaking demonstration events and competitions. As the results of demonstration breaking competitions affect college admission, the number of taekwondo demonstration athletes increases and their age decreases, directly influencing the rapid development of high-skill techniques. Athletes tend to perform underdeveloped high-level techniques in consideration of college admission. This often leads to minor injuries to serious injuries, so hosting organizations should receive an oath of responsibility for safety accidents from athletes to arouse attention to injuries and avoid unreasonably high-skill techniques. In addition, the referees responded that a legal system for safety accidents must be established by limiting the techniques using obstacles according to age and deploying spe-

cialized medical staff in case of injury, while ensuring high level of completeness by installing safety landing mats at designated locations.

Starting with Korea Sport University in 2014, Taekwondo demonstration has been newly established as a general competition for games sponsored by the president of universities such as Yongin University and Kyunghee, directly affecting the admission into university. This, in turn, increased the number of young athletes and activated Taekwondo demonstration competitions. Also, with the increasing number of colleges specialized in Taekwondo, Taekwondo demonstrations are influencing Taekwondo.

Argued that in order for Taekwondo performances to become a public performance, the diversity of Taekwondo and its value as an art must be recognized[22]. Currently, Taekwondo performance contest(KTA Demonstration Contest) in the form of a musical that added a story to Taekwondo through the emergence of high-level Taekwondo demonstration techniques and the activation of the demonstration competitions has been held. In fact, story score has been added to the World Taekwondo Hanmadang Team Competition, revitalizing Taekwondo, not as a simple demonstration, but as a performance[23].

Claimed that the scoring standards should be established through systematic data accumulation by analyzing competitions techniques every year and argued that a unified and clear deduction standard is also necessary. In addition, if the standards of pine boards are differently set for each age group such as elementary, middle school, high school, and university students, along with clear scoring criteria, skilled techniques can reduce injuries. Underlined that officially granting qualifications through referee selection procedures, selecting dedicated referees and providing systematic referee training are necessary for consistent fair judgments of referees. In fact, argued that the efforts of each institution are also necessary[5][21].

Emphasized the necessity of institutionalizing safety accident prevention measures to revitalize demonstration competitions against injuries due to the advent of high-level techniques, and that safety accidents can be reduced if hosting organizations are obligated to use protective mats[5].

It was mentioned that the pine boards used in competitions directly connected to college admission is easily breakable even by young children, resulting in reckless high-difficulty techniques and poor accuracy. It is considered necessary to set the standard for pine boards for each division by Taekwondo institutions and establish technical terminology for Taekwondo demonstration in order to have consistent unified terminologies among different universities and institutions hosting the competitions and provide clear explanation of the system to the athletes, referees, and trainers. In addition, a system for referee qualifications and referee education should be prepared to make the game clearer and fairer, and young athletes should refrain themselves from unreasonable skills by placing appropriate age-restrictions. Moreover, mandating the installation of landing mats for high-level techniques, legalizing medical methods for emergency situations by hosting organizations and receiving an oath for safety accident responsibility are highly anticipated to reduce the risk of safety accidents.

4. Conclusion and Suggestions

This study demonstrated that unfair judgments on Taekwondo breaking demonstration competitions can be reduced by presenting fair scoring rules and scoring standards that can be objectively recognized and implementing verified scoring methods. In addition, the purpose of this study is to provide fundamental data to secure objective basis for Taekwondo demonstration events as a sport by applying unified competition rules regardless of the hosting organization based on the rules, standards and methods. As a result of conducting the study, the following conclusions were obtained;

First, the perception of breaking demonstration competition referees toward the demonstration competitions was analyzed as the characteristics, advantages, disadvantages and emergency response of the breaking demonstration.

Second, the perception of breaking demonstration competition referees toward the scoring was found to be demonstration terminologies, evaluation methods and referee qualifications.

Third, the perception of breaking demonstration competition referees toward the development plan for breaking demonstration competitions was observed to be development potentials, need for scoring criteria, establishment of scoring terminology, enhancement of referee expertise and safety accidents.

Controversy over judgments in sports events still exists. In the process of Taekwondo becoming a sporting sport, problems with judgment appeared in Gyeorugi, Poomsae, and demonstration games. However, as Taekwondo events develop, efforts have been made to make clear and reasonable competition scoring standards for the audience.

These efforts will lead to the development of the breaking demonstration competition, and detailed regulations and professional referees appropriate for the competition must be prepared as soon as possible. The breaking demonstration competition has been unbalanced competition without an exact frame; however, it is now at the transitional phase to transform into specialized and more subdivided professional sports and expand the base of sports Taekwondo through the splendid performance of the demonstration.

Therefore, it is necessary to prepare a uniform competition rule in the Taekwondo system as soon as possible, rather than settling down with the competition rules tailored to each hosting organization. In addition, professional referee selection methods and training are required, and such a system is expected to minimize unfair decisions and errors in judgments.

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7. Appendix

7.1. Authors contribution

	Initial name	Contribution
Author	HCS	-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑ -Make a significant contribution to collection ☑ -Final approval of the paper ☑ -Corresponding ☑ -Play a decisive role in modification ☑ -Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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The Effect of Sports Motivation of Middle School SOCCER Players on the Sports Goal Orientation

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Abstract

Purpose: *The study was conducted to verify how sports motivations affect sports goal orientations for middle school soccer players. In order to achieve the goal of this study, a survey was conducted on 338 middle school soccer players to analyze the collected data. The conclusions of the analysis are as follows.*

Method: *In this study, the data collected through the questionnaire was analyzed using SPSS 26.0. Frequency analysis was conducted to identify the demographic and statistical characteristics of the study participants, and the reliability coefficient(Cronbach'α) was calculated to determine the stability, consistency, and predictability of the measurement tools for each item. One-way ANOVA was conducted to find out how the demographic variables of middle school soccer players differed in sports motivation and sports goal orientation. In addition, multiple regression analysis was conducted to verify how sports motivations of middle school soccer players affect their sports goal orientations. The significance level of all the statistics was set at .05.*

Result**:** *First, the analysis of the differences in sports motivation according to the school year of middle school soccer players showed statistically significant differences in self-control and amotivation factors.*

Second, an analysis of the differences in sports motivation according to the athletic career of middle school soccer players showed statistically significant differences in intrinsic and extrinsic motivation and amotivation factors. Third, an analysis of the effect of middle school soccer players' sports motivation on sports goal orientation showed that self-control was a factor in task orientation and that there were statistically significant differences in intrinsic and extrinsic motivations on the ego orientation.

Conclusion: *Conclusions for future studies based on the results of this study include the following. This study was conducted only for middle school students, so subsequent studies would be meaningful if they were conducted on high school and college students as well. And a study on the differences between teenagers, college students, and regular soccer players will also be meaningful. It would also be meaningful if there were studies that identified not only sports motivation and sports goal orientation but also relationships with various variables and qualitative studies that could find in-depth causes.*

[Keyword] ***Golden Age, Soccer Players, Sports Motivation, Sports Achievement-Goal, Middle School***

1. Introduction

The period of middle school students growing up as soccer players can be seen as a time when skills are acquired quickly and effectively[1]. The Korea Football Association(KFA) considers the period of middle school soccer players to be so important that it calls it the "Golden Age"[2]. Middle school soccer players in the Golden Age are yet physically and mentally immature before they reach adulthood, and they acquire a sense of their identity experiencing emotional anxiety and confusion[3]. In particular, middle school students in adoles-

cence may be more immature than high school students physically and mentally, and it is also a time when instability is expressed through rebelliousness, narcissistic aggression, and fictional fantasies[4]. For middle school soccer players at this time, it is important to grow in harmony physically, mentally, and socially.

Motivations are generally classified as intrinsic, extrinsic, and amotivational. Intrinsic motivation refers to voluntary participation[5], and participation affected by extrinsic factors and constraints such as compensation is referred to as extrinsic motivation[6]. Motivational factors related to the start or continuation of middle school soccer players' athletic activities are likely to be linked to resilience to overcome adversity and stress in school life, training, and competitive situations. Motivational factors are also associated with task orientation and ego orientation of achievement-goal orientations in the achievement context such as in sports[7].

The achievement-goal orientation explains the differences in criteria considered in determining one's ability as a criterion for evaluating success and failure, and in sports situations, it is divided into the task and ego orientated achievement-goal based on the perception of ability to demonstrate one's ability and the subjective interpretation and judgment criteria of the individual. The task orientation is to evaluate one's ability by comparing oneself to a previous performance by focusing on proficiency and learning about the task, and the ego orientation is to evaluate one's ability by comparing oneself to others[8][9].

There are various achievement goals in the sports situation, the most important of which is considered to be the present state of competence in the sports situation[10]. Individuals oriented toward the task goal of the goal-oriented theory are showing adaptive patterns regardless of their high and low ability. However, individuals who are oriented toward self-target are more likely to show inappropriate performance patterns when they become less competent.

Looking at the relationship between goal orientation and emotion, it is believed that task-oriented goal orientation is closely related to positive emotions such as pleasure and fun[11], while self-oriented goal orientation is related to negative emotions such as depression or anxiety[11]. Motivation has an important influence on positive emotions such as pleasure and fun.

This study seeks to identify differences in sports motivation and sports goal orientation of middle school soccer players and to find out how motivation affects their goal orientation. The results of this study are meant to be provided to the coaches and players as a basis for improving their performance.

2. Research Method

2.1. Research participants

Participants in the study were middle school soccer players in K area, and a survey was conducted on them. Prior to conducting the survey, the coaches and players of each team were fully explained the purpose of the research and consented to the collection and utilization of personal information before conducting the survey. The general characteristics of the research participants are as shown in <Table 1>.

Table 1. The general characteristics of the research participants.

Description	Description	Frequency	Percentage (%)
School year	First year	115	34.0
	Second year	120	35.5
	Third year	103	30.5

Athletic career	1 year to less than 2 years	27	8.0
	2 years to less than 3 years	78	23.1
	3 years to less than 4 years	47	13.9
	4 years to less than 5 years	174	51.5
	Longer than 5 years	12	3.5
Total		338	100.0

2.2. Date collection

2.2.1. Measuring sports motivation

To measure the motivational factors of middle school soccer players, a questionnaire for intrinsic motivation developed by McAuley, Duncan, and Tammen[12] was transformed to suit the sports situation to measure the condition of the person who was intrinsically motivated in sports situation, and a scale was used to measure the four factors of intrinsic motivation, self-control, extrinsic motivation, and amotivation. The reliability coefficient(Cronbach'α) for each subfactor was .73 for intrinsic motivation, .79 for self-control, .81 for extrinsic motivation, and .82 for amotivation.

2.2.2. Measuring sports goal orientation(TEOSQ)

In order to measure the goal orientation of middle school soccer players, a questionnaire for sports goal orientation by Duda(TEOSQ)[13] was translated and used, measuring the goal orientation, or subjective definition of success, held by sports participants. The scale could measure the two factors of task orientation and ego orientation, consisting of a total of 13 questions. The reliability coefficient(Cronbach'α) of each subfactor was .83 for task orientation and .79 for ego orientation.

2.3. Data analysis

In this study, the data collected through the questionnaire was analyzed using SPSS 26.0. Frequency analysis was conducted to identify the demographic and statistical characteristics of the study participants, and the reliability coefficient(Cronbach'α) was calculated to determine the stability, consistency, and predictability of the measurement tools for each item. One-way ANOVA was conducted to find out how the demographic variables of middle school soccer players differed in sports motivation and sports goal orientation. In addition, multiple regression analysis was conducted to verify how sports motivations of middle school soccer players affect their sports goal orientations. The significance level of all the statistics was set at .05.

3. Result and Discussion

3.1. The differences in the sports motivation and goal orientation of middle school soccer players according to their school year

The results of analyzing the differences in sports motivation by the school year of middle school soccer players are as shown in <Table 2>. There were statistically significant differences in self-control(F=6.801, p=.001) and amotivation factors(F=3.482, p=.032) among the sports motivation factors of middle school soccer players. In contrast, the intrinsic motivation(F=.271, p=.763) and extrinsic motivation(F=2.293, p=.103) showed no statistically significant differences. These findings support a prior study that showed that the stronger the self-control the higher the academic performance and motivation[14][15] and this study that

showed the higher the school year, the stronger the self-control and the lower the school year the more the a motivation.

Table 2. The differences in sports motivation by the school year.

Area	School year	*n*	*M*	*SD*	*F*	*p*	*post-hoc*
Intrinsic motivation	First year	115	3.5870	.62657	.271	.763	a, b<c
	Second year	120	3.6271	.79256			
	Third year	103	3.6602	.77874			
Self-control	First year	115	4.2065	.50138	6.801**	.001	
	Second year	120	4.2813	.68719			
	Third year	103	4.4830	.47905			
Extrinsic motivation	First year	115	2.4696	1.00936	2.293	.103	
	Second year	120	2.7208	1.01986			
	Third year	103	2.7257	1.06844			
Amotivation	First year	115	1.6696	.78608	3.482*	.032	a>b, c
	Second year	120	1.4625	.49008			
	Third year	103	1.6383	.63567			

Note: *p<.05, **p<.01, ***p<.001.

The results of an analysis of the differences in sports goal orientation of middle school soccer players according to their school year are as shown in <Table 3>. There were statistically significant differences in task orientation(F=3.567, p=.029) and ego orientation(F=6.762, p=.001) for the sports goal orientations of middle school soccer players. Prior studies [16][17] supports the results of this study, saying that the higher the task-orientation, the better the skill acquisition and relationship with the team members and more efforts without interruption even if they experienced difficulties.

Kang[18] reports that the results of a study on the relationship between middle and high school soccer players' achievement goals and their immersion in sports show that middle and high school soccer players have significantly higher achievement goals than high school students, while middle and high school soccer players have significantly higher achievement goals than midfielders.

Table 3. The differences in sports goal orientation by the school year.

Area	School year	*n*	*M*	*SD*	*F*	*p*	*post-hoc*
Task orientation efforts	First year	115	4.2050	.53691	3.567*	.029	a, b<c
	Second year	120	4.2393	.51829			
	Third year	103	4.3870	.53663			
Ego orientation display	First year	115	3.4957	.82995	6.762**	.001	a>b, b<c
	Second year	120	3.2514	.74910			
	Third year	103	3.6505	.88639			

Note: *p<.05, **p<.01, ***p<.001.

3.2. The differences in the sports motivation and goal orientation of middle school soccer players according to their athletic career

The results of analyzing the differences in sports motivation by the athletic career of middle school soccer players are as shown in <Table 4>. There were statistically significant differences in intrinsic motivation(F=5.180, p=.000), extrinsic motivation(F=3.033, p=.018), and

amotivation(F=4.178, p=.003). These results are in part consistent with previous research results[19][20], in which athletes showed higher levels of a motivation than those participating in sports for all, supporting the results of this study.

Table 4. The differences in sports motivation by the athletic career.

Area	The athletic career	n	M	SD	*F*	*p*	*post-hoc*
Intrinsic motivation	1 year to less than 2 years	27	3.4352	.38351	5.180***	.000	a<b, d, a, d, e<c
	2 years to less than 3 years	78	3.7724	.65736			
	3 years to less than 4 years	47	3.9574	.77375			
	4 years to less than 5 years	174	3.5086	.77809			
	Longer than 5 years	12	3.4375	.38620			
Self-control	1 year to less than 2 years	27	4.1204	.58165	1.446	.218	
	2 years to less than 3 years	78	4.2660	.46525			
	3 years to less than 4 years	47	4.2926	.62840			
	4 years to less than 5 years	174	4.3693	.61161			
	Longer than 5 years	12	4.4375	.46619			
Extrinsic motivation	1 year to less than 2 years	27	3.1944	.54302	3.033*	.018	a>b, c, d,
	2 years to less than 3 years	78	2.4712	1.01848			
	3 years to less than 4 years	47	2.4628	1.14206			
	4 years to less than 5 years	174	2.6552	1.05296			
	Longer than 5 years	12	2.8750	.91391			
Amotivation	1 year to less than 2 years	27	1.9537	.68303	4.178**	.003	a>b, c, d, b, c,<d
	2 years to less than 3 years	78	1.4519	.48022			
	3 years to less than 4 years	47	1.4149	.48700			
	4 years to less than 5 years	174	1.6336	.72309			
	Longer than 5 years	12	1.6250	.67840			

Note: *p<.05, **p<.01,***p<.001.

The results of an analysis of the differences in sports goal orientation according to the athletic career of middle school soccer players are as shown in <Table 5>. The result showed a statistically significant difference in the factors of the ego orientation of middle school soccer players(F=5.282, p=.000). On the other hand, the task orientation showed no statistically significant difference(F=.285, p=.888). These results indicate that athletes tend to participate in sports due to extrinsic motivational factors and there are differences in the ego orientation by their athletic career as also reported by a prior study[21][22][23].

Duda & Nicholls[24] reports that research on goal orientation and sincerity among high school and non-high school players found that task-related goal-oriented students put the cause of success in their efforts, while self-contained goal-oriented students put high-skill ownership as the reason for their success.

Table 5. The differences in sports goal orientation by the athletic career.

Area	The athletic career	*n*	*M*	*SD*	*F*	*p*	*post-hoc*
Task orientation efforts	1 year to less than 2 years	27	4.1799	.59113	.285	.888	
	2 years to less than 3 years	78	4.2802	.56276			
	3 years to less than 4 years	47	4.2827	.53824			
	4 years to less than 5 years	174	4.2750	.51543			
	Longer than 5 years	12	4.3571	.53278			
Ego	1 year to less than 2 years	27	3.9259	.96336	5.282***	.000	a>b, d,

orientation display	2 years to less than 3 years	78	3.3056	.74604		c>b, d, b, d<e
	3 years to less than 4 years	47	3.6879	.77055		
	4 years to less than 5 years	174	3.3592	.82596		
	Longer than 5 years	12	3.8750	.86493		

Note: *p<.05, **p<.01,***p<.001.

3.3. The effect of sports motivation of middle school soccer players on the sports objectives

The results of multiple regression analysis to verify whether the sports motivation of middle school soccer players affect their sports goal orientation are as shown in <Table 6>.

First, a regression analysis of the effect of sports motivation of middle school soccer players on sports goal orientation showed statistically significant differences in the self-control of the task orientation, indicating positive effects. Also, the F value of the regression model is 6.347 at p<.01 with R2=.071, showing 7.1% of the explanatory power of the total variable.

Second, a regression analysis of the effect of sports motivation of middle school soccer players on sports goal orientation showed statistically significant differences in the intrinsic motivation of the task orientation, indicating positive effects. Also, the F value of the regression model is 8.993 at p<.01 with R2=.097, showing 9.7% of the explanatory power of the total variable. This means that the higher the self-control, the higher the task orientation, and the stronger the intrinsic motivation, the lower the ego orientation.

These results are consistent with the preceding studies[25][26][27][28][29] that reported that the goal orientation had a positive effect on the intrinsic motivation, supporting the results of this study.

In addition, the findings of Han[30], Lim[31] and Ahn[32] partially support the study, as both the sub-variates of achievement goals and internal motivations report statistically significant effects.

Table 6. The effect of sports motivation on the sports goal orientation.

	Task orientation			Ego orientation		
	B	Beta	t	B	Beta	t
(Constant)	3.339		13.336	2.895		7.515
Intrinsic motivation	.011	.015	.264	-.147	-.130	-2.301*
Self-control	.195	.211	3.690***	.082	.057	1.002
Extrinsic motivation	.052	.101	1.633	.191	.237	3.895***
Amotivation	-.054	-.066	-1.124	.150	.117	2.013
	R^2=.071, F=6.347***			R^2=.097, F=8.993***		

Note: *p<.05, **p<.01,***p<.001.

4. Conclusion and Suggestions

The study was conducted to verify how sports motivations affect sports goal orientations for middle school soccer players. In order to achieve the goal of this study, a survey was conducted on 338 middle school soccer players to analyze the collected data. The conclu-

sions of the analysis are as follows.

First, the analysis of the differences in sports motivation according to the school year of middle school soccer players showed statistically significant differences in self-control and amotivation factors.

Second, an analysis of the differences in sports motivation according to the athletic career of middle school soccer players showed statistically significant differences in intrinsic and extrinsic motivation and amotivation factors.

Third, an analysis of the effect of middle school soccer players' sports motivation on sports goal orientation showed that self-control was a factor in task orientation and that there were statistically significant differences in intrinsic and extrinsic motivations on the ego orientation.

Suggestions for future studies based on the results of this study include the following. This study was conducted only for middle school students, so subsequent studies would be meaningful if they were conducted on high school and college students as well. And a study on the differences between teenagers, college students, and regular soccer players will also be meaningful. It would also be meaningful if there were studies that identified not only sports motivation and sports goal orientation but also relationships with various variables and qualitative studies that could find in-depth causes.

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6. Appendix

6.1. Authors contribution

	Initial name	Contribution
Lead Author	SJL	-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑ -Make a significant contribution to collection ☑ -Final approval of the paper ☑
Corresponding Author*	JPS	-Corresponding ☑ -Play a decisive role in modification ☑ -Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑
Co-Author	JSK	-Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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Comparison of Body Composition, Physical Fitness, and Knee Joint Isokinetic MUSCULAR FUNCTION of Middle School Soccer Players by Grade

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Abstract

***Purpose**: This study compared the characteristics of body composition, physique, physical fitness factors, and isokinetic muscle function by grade in middle school soccer players.*

***Method**: The results of analyzing differences in body composition and physique, physical fitness factors, and isokinetic muscle function by grade(38 in 1st grade, 46 in 2nd grade, 21 in 3rd grade) targeting 105 soccer players in S city middle school are as follows.*

***Results**: Body composition and physique factors there were significant differences by grade in height, weight, upper limb length, lower limb length, sitting height, and arm span. The post-verification of the main effects showed that height and weight were significantly higher for the second and third graders than for the first graders. For upper and lower limb length, the third graders were significantly longer than the first graders, while for sitting height, the second and third graders were significantly higher than the first graders. Fingertips were found to be significantly longer in the third graders than in the first and second graders. In physical strength factors, back muscle strength, grip strength, push-ups, sargent jump, standing long jump, side steps, shuttle run, and trunk forward flexion, trunk backward flexion, visual perception reaction, lung capacity showed significant differences by grade. As a result of post-hoc verification of the main effects by grade, the second and third graders were significantly higher than the first graders in back strength, grip strength(left, right), push-ups, and standing long jump. Sargent jump and side steps were found to be significantly higher as the grade increased, and shuttle run, visual perception reaction, and lung capacity were significantly higher for the third graders than for the first graders. Compared to the first and second graders, the third graders were significantly higher in trunk forward and backward flexion. In isokinetic muscular functions measured at 60 degrees of angular velocity, there were significant differences by grade in left extensor per weight(%BW), right extensor(Nm), left extensor(Nm), left flexor per weight(%BW), right flexor(Nm), and left flexor(Nm). As a result of the post-hoc verification of the main effects by grade, the third graders were significantly higher than the first graders in left extensor per weight(%BW), and the second graders were significantly higher than the first graders in right extensor(Nm), left extensor(Nm), left flexor per weight(%BW), right flexor(Nm), and left flexor(Nm).*

***Conclusion**: Based on the results of this study, the body composition, physique, physical strength factors, and isokinetic muscle function of middle school soccer players differed by grade, and considering that the less than four years of their career during the fast-growing period, the results of this study should be fully reflected in the planning of the training program.*

[Keywords] ***Middle School, Soccer Players, Body Composition, Physical Fitness, Isokinetic Muscle Function***

1. Introduction

While most people understand that the modern game of soccer is originated from the U.K., Shin Hyeon-gyu(2005)[1] in a prior study titled "Consideration of the Origin and Formation Process of Soccer" suggests that it cannot be denied that modern soccer has developed in the U.K., but considering the Chinese and Islamic cultures already traded with each other through various channels including the Silk Road since before the birth of Christ, soccer might be transferred from China to Europe across the Islamic culture through routes on the sea, grassland, or the Silk Road. Through the FIFA World Cup, which is a worldwide soccer competition, soccer has developed into one of the largest sports events in the world for a single sports event, and the public's interest in soccer has increased significantly in Korea, especially since the 2002 Korea-Japan World Cup. In addition, in the 2002 Korea-Japan World Cup, Korean players advanced to the semi-finals with excellent performance, which led to a large number of players entering the overseas leagues. FIFA, which has 211 member countries, has more than 200 million active players[2], and currently has 163,338 players from 5,054 teams, including professional team and community club members(Korea Football Association, 2020)[2]. Among them, for U15, which includes middle school male athletes, there are 4,404 active players from 119 middle schools (Korea Football Association, 2020)[3]. Stratton, Williams, and Richardson(2004)[4] reported that, based on the age of 13-14 when height growth is at its peak, technique-oriented training before the peak and training for developing physical strength after peak should be organized. They also reported that excessive training focused on developing physical strength during childhood and adolescence can increase the risk of injury, so technique-oriented training at this time is more important to foster successful football players. Bompa(2001)[5] also emphasized that differentiated training approaches are required for each stage by dividing the developmental stage into four stages: initialization stage, athletic formation stage, specialization stage, and high-performance stage.

There may be some differences depending on the positions or the level of the opposing team[6], but soccer is a ball game that requires 90 minutes of dribbling, passing, shooting, and fast and continuous movement to defend the opponents. Therefore, physical strength[7][8][9][10], muscle endurance, muscle power, cardiopulmonary endurance, anaerobic power[11][12][13][14], as well as balance[14] and physical coordination for ball handling, are important physical strength factors as reported in a number of prior studies. In addition, while there have been prior studies comparing and analyzing the differences between physical factors affecting soccer players' performance[2][6][15][16][17][18][19][20][21], studies comparing the physique and physical strength characteristics of middle school soccer players who are growing rapidly in physique and physical strength are insufficient. Therefore, this study aims to provide basic data for the composition of optimized training programs by analyzing the physique and physical characteristics of middle school soccer players by grade.

2. Research Method

2.1. Research subjects

This study was conducted to compare the body composition, physical strength factors, and the characteristics of isokinetic muscle function by grade(38 first graders, 46 second graders, and 21 third graders) in 105 S city middle school soccer players. To the research subjects, the purpose and contents of the experiment were clearly explained in advance, and it was conducted after getting their written consent. The general characteristics of the study subjects are shown in <Table 1>.

Table 1. General characteristics of research participants(N=105).

Items	Height(cm)	Weight(kg)	BMI(kg/m2)	%Fat	Career (years)

Grade	1(38)	161.99 ±8.65	51.53 ±8.54	19.39 ±2.02	12.42 ±3.89	3.13 ±0.99
	2(46)	167.77 ±7.13	57.31 ±9.44	20.99 ±2.14	12.66 ±3.30	3.39 ±0.88
	3(21)	171.76 ±7.49	59.28 ±11.22	19.87 ±1.39	12.04 ±2.82	3.62 ±0.97

Note: mean±SD.

2.2. Measurement items and methods

2.2.1. Body composition

Body weight, body fat percentage, and BMI were measured using InBody 720 (Biospace, Korea). In order to increase the reliability of the measurement results, all metals attached to the human body were removed, and the measurement posture suggested in the equipment manual was maintained, and measurements were taken at rest.

2.2.2. Physique measurement

Height was measured in centimeters using a height meter, and the forearm and thigh were measured in centimeters using a tape measure. The circumference of the thickest part of the forearm was measured as the forearm circumference, and the area perpendicular to the femur at the center of the greater trochanter and the knee joint was measured as the thigh circumference. The length of upper and lower limbs, sitting height, and both fingertips was measured in centimeters using a Martin-type human measuring instrument. For the length of the upper limb, the straight line distance between the acromion point and the middle finger was measured in an upright position. The length of the lower extremities was measured from the bottom to the superior anterior iliac spine. The sitting height was measured by measuring the vertical distance from the sitting side to the apex while sitting on the left altimeter. Arm span collected both feet, attached the shoulders and hips to the wall, stretched both arms to the sides as much as possible at the height of the shoulders, and measured the length to the ends of the middle fingers of both hands.

2.2.3. Physical fitness factor

To check the differences in physical strength factors between groups, muscle strength(back muscle strength, grip strength), muscle endurance(sit-ups, push-ups), muscle power(sargent jump, standing long jump), agility(side steps), systemic reaction(sound), cardiopulmonary endurance(shuttle run), balance(one leg standing with eyes closed), flexibility(trunk flexion, trunk extension), coordination(visual perception), lung capacity were measured. All measurements were performed twice and better values were used as actual values[22][23][24].

2.2.4. Isokinetic muscle function test of the knee joint

For the isokinetic muscle function test, the isokinetic muscle function measurement system(CSMI, USA) was used to measure the muscle function of the knee joint according to the manual. The muscle strength of the knee joint was measured by performing flexion and extension movements of the knee joint three times at an angular velocity of 60°/sec and five times of the muscle power at 180°/sec. After performing three preliminary exercises, measurements were made, and peak torque, average power, total work, ratio of left and right(%), and flexor and extensor ratio were calculated through the measurement results[20].

2.3. Data processing

The data processing of this study was performed using the SPSS 26.0 statistical program to obtain the mean and standard deviation of each measurement item. One-way ANOVA was performed to verify the difference in measurement items by grade(the first, second, and third

graders), and the Tukey HSD method was used for post-test. The statistical significance level was set to p<.05.

3. Results

3.1. Comparison of characteristics of body composition and physique by grade

The results of comparing the characteristics of body composition and physique by grade of middle school soccer players are shown in <Table 2>. For height(p<.001), weight(p<.01), upper limb length(p<.01), lower limb length(p <.05), sitting height(p<.001), and fingertips(p<. 001), there were significant differences for each grade level. As a result of post-hoc verification of the main effects, the height and weight were significantly higher in the second and third graders than in the first graders. Arm span was considerably longer in the third graders compared to the first and second graders.

Table 2. Comparison of characteristics of body composition and physique by grade.

Items		Grade(n=105)			F Value	Post-hoc
		1(38)	2(46)	3(21)		
Height(cm)		161.99±8.65	167.77±7.13	171.76±7.49	11.772***	a<b, c
Weight(kg)		51.53±8.54	57.31±9.44	59.28±11.22	5.803**	a<b, c
%fat(%)		12.42±3.89	12.66±3.30	12.04±2.82	.237	-
BMI(kg/m2)		19.39±2.02	20.99±2.14	19.87±1.39	1.332	-
Forearm circumference (cm)	L	22.94±1.12	23.13±1.08	22.76±0.54	.962	-
	R	23.21±1.38	23.64±1.20	23.92±1.55	2.079	-
Thigh circumference(cm)	L	49.29±2.44	49.70±2.39	48.85±1.25	.997	-
	R	49.00±3.66	49.88±2.83	50.55±3.45	1.603	-
Arm length(cm)		71.61±4.19	73.78±3.58	74.93±4.04	5.717**	a<c
Leg length(cm)		86.17±4.11	88.01±4.51	89.16±4.18	3.697*	a<c
Sitting height(cm)		87.69±3.19	89.94±3.86	91.17±2.95	7.666***	a<b, c
Arm span(cm)		164.46±9.97	168.86±7.69	174.63±8.12	9.421***	a, b<c

Note: values are mean±SD, a: 1st graders, b: 2nd graders, c: 3rd graders, * p<.05, ** p<.01, *** p<.001.

3.2. Comparison of characteristics of physical fitness factors by grade

The results of comparing the characteristics of physical strength factors by grade of middle school soccer players are shown in <Table 3>. Back strength(p<.001), grip strength (left, right)(p<.001), push-ups(p<.001), sargent jump(p<.001), standing long jump(p<.001), side steps(p<.001), shuttle run(p<.05), trunk forward flexion(p<.001), trunk backward flexion(p<.001), visual perception response(p<.01), and lung capacity(p<. 05) showed significant differences between grades. As a result of post-hoc verification of the main effects by grade, the second and third graders were significantly higher than those of the first graders in back strength, grip strength(left, right), push-ups, and standing long jump. Sargent jump and side steps were significantly higher as the grade increased, and shuttle run, visual perception response, and lung capacity were significantly higher in the third graders than in the first graders. Trunk flexion and trunk extension, which are evaluation items of flexibility, were significantly higher in the third graders than in the first and second graders.

Table 3. Comparison of characteristics of physical fitness factors by grade.

Items		Grade(n=105)			F Value	Post-hoc
		1(38)	2(46)	3(21)		
Back strength(Kg)		69.83±16.94	85.23±15.99	86.33c±23.58	9.253***	a<b, c
Grip strength(kg)	L	26.94±6.19	32.82±6.47	35.36c±7.49	10.000***	a<b, c
	R	27.87±6.17	33.99±5.67	32.53c±6.63	10935***	a<b, c
Sit-ups(reps)		47.53±7.44	49.39±10.00	50.90±13.24	.840	-
Push-ups(reps)		22.34±11.43	33.15±12.02	39.14c±13.60	14.994***	a<b, c
Sargent jump(cm)		35.68±3.84	38.85±5.02	42.62c±4.06	16.846***	a<b<c
Long jump(cm)		196.05±15.52	207.30±13.48	215.05c±10.93	13.971***	a<b, c
Side steps(reps)		41.53±2.88	44.52±3.35	47.38c±3.89	22.170***	a<b<c
Sound reaction(sec)		0.27±0.03	0.26±0.03	0.26±0.02	2.590	-
Shuttle run(reps)		80.83±10.88	86.67±13.62	90.05c±10.70	4.481*	a<c
One leg standing with eyes closed(sec)		46.15±35.42	64.79±34.97	55.41±40.46	2.722	-
Trunk flexion(cm)		8.11±5.41	11.05±5.95	16.29c±5.07	14.449***	a, b<c
Trunk extension(cm)		42.10±7.23	45.56±6.85	50.01c±7.11	8.399***	a, b<c
Visual perception reaction(total time)		53.65±6.61	50.33±4.17	48.94c±5.73	5.917**	a<c
Lung capacity(ml)		3328.76±689.63	3579.97±484.90	3787.22c±643.52	4.152*	a<c

Note: values are mean±SD, a: 1st grade, b: 2nd grade, c: 3rd grade, * p<.05, ** p<.01, *** p<.001

3.3. Comparison of characteristics of 60° isokinetic muscle function by grade

<Table 4> shows the comparison of the knee joint isokinetic muscle function characteristics by grade of middle school soccer players. Of the knee joint measured at an angular velocity of 60 degrees there were significant differences between grades in left extensor(%BW)($p < .01$), right extensor(Nm)($p < .01$), left extensor(Nm)($p < .01$), left flexor (%BW)($p < .05$), right flexor(Nm)($p < .001$), and left flexor(Nm)($p < .001$).

Table 4. Comparison of characteristics of 60° isokinetic muscle function by grade.

Items	Grade(n=105)	F Value	Post-hoc

	1(38)	2(46)	3(21)		
Right extensor(%BW)	260.01±27.32	273.14±35.84	273.01±11.61	2.295	-
Left extensor(%BW)	243.36±23.59	256.38±38.83	275.48±27.72	6.571**	a<c
Right extensor(Nm)	139.03±23.95	159.19±30.66	150.13±4.86	6.475**	a<b
Left extensor(Nm)	134.54±21.92	154.88±31.49	144.60±5.65	6.710**	a<b
Left/right extensor(deficit)	2.72±7.39	2.45±9.97	2.96±1.00	.029	-
Right flexor(%BW)	156.77±25.52	156.35±22.25	153.87±12.78	.121	-
Left flexor(%BW)	144.15±14.95	155.67±23.57	150.68±10.55	3.874*	a<b
Right flexor(Nm)	82.29±13.19	93.30±14.59	88.01±1.13	7.706***	a<b
Left flexor(Nm)	78.50±13.95	92.64±15.09	86.30±1.99	11.630***	a<b
Left/right flexor(deficit)	4.58±8.09	0.42±8.81	1.94±1.13	2.993	-
Flexor/extensor left ratio(%)	58.99±6.44	61.99±12.91	60.86±0.35	1.017	-
Flexor/extensor right ratio(%)	59.92±5.97	59.81±7.69	59.46±1.28	.034	-

Note: values are mean±SD, a: 1st graders, b: 2nd graders, c: 3rd graders, * p<.05, ** p<.05, *** p<.001.

4. Discussion

This study compared and analyzed the characteristics of the physique, physical strength factors, and isokinetic muscle function of middle school soccer players by grade. According to the study, in terms of body composition and physique, height, weight, and sitting height were significantly higher for the second and third graders than for the first graders. For upper and lower limb length, the third graders were significantly longer than the first and second graders, and for fingertips, the third graders were significantly longer than the first and second graders. These results were partly consistent with a longitudinal study on the development of the physique and physical strength factors of adolescent soccer players[25]. Prior studies compared the difference between 13-14 years old, 14-15 years old, 16-17 years old, and 17-18 years old with middle and high school soccer players as the subjects and reported that height and weight grow the most at 14-15 years old and sitting height at 13-14 years old. Those aged 13-14 are in the sixth grade of elementary school and first grade of middle school, while those aged 14-15 are in the second and third years of middle school. The results of this study also support the results of the second and third graders significantly higher than in the first grade. However, in the case of left and right thighs, the statistical significance was not identified in this study, unlike the prior study which reported the greatest growth at the age of 14-15[25]. In the length of fingertips, nothing was reported in the prior study results, so a direct comparison could not be made.

In terms of physical fitness factors, the second and third graders were significantly higher than the first graders in back strength, grip strength(left, right), push-ups, and standing long jump. Sargent jump and side steps were found to be significantly higher as the grade increased, and shuttle run, visual perception reaction, and lung capacity were significantly higher for third graders than for first graders. Compared to the first and second graders, the third graders were significantly higher in trunk forward and backward flexion. Compared to the previous study[26] conducted to develop standards for physical strength assessment for middle and high school students, most of the physical strength factors were evaluated as "fair," among the five levels of "very poor, poor, fair, good, and excellent." In terms of differences by grade, the third graders were "fair" whereas the first and second graders were "poor" in push-ups. However, considering that the results of the prior study were based on the mean values of teen athletes in various sports by grade, it is difficult to make a direct comparison. A prior study done by Lee Young Soo and Ha Min Soo(2001)[25] in part support this study in that

agility increased significantly between the ages of 14 and 15, muscle endurance between 17 and 18, sargent jump between 13 and 14, and standing long jump between 14 and 15, and in particular quick response between 13 and 15. In the prior study, a direct comparison was difficult due to differences in measurement items and methods, but compared in terms of physical strength factors, agility and muscle endurance increased the most between 14 and 15 years old and quick response between 13 and 14, while muscle strength, response time, cardiopulmonary endurance, balance, and flexibility were difficult to discuss directly.

For isokinetic muscle functions measured at angular velocity of 60 degrees, the third graders were significantly higher than the first graders in left extensor per weight(%BW), and the second graders were significantly higher in right extensor(Nm), left extensor(Nm), left flexor per weight(%BW), right flexor(Nm), and left flexor(Nm) than the first graders. A prior study by Lee Young Soo and Ha Min Soo(2001)[25] showed significant differences in right flexor and extensor at 60 degrees angular velocity and reported significant improvement in flexor between 17 and 18 years of age and extensor between 14 and 17 years of age. In detail, flexor was reported to have developed the most between the ages of 17 and 18 and extensor between the ages of 14-15, and compared with this study, there were some differences in the maximum period of increase in isokinetic muscle function measured at 60 degrees angular velocity. What's interesting, however, is that a study on the isokinetic muscle strength comparison of adolescent soccer players by Lee Young Soo and Lee Yong Jin(1999)[27] reported that left and right extensor strength of middle school students measured at 60 degrees of angular velocity was 106.2±20.6 and 106.6±26.6Nm, respectively, and for flexor strength of 64.7±15.1 and 59.9±13.9Nm, respectively. This confirms that more than two decades later, the knee joint isokinetic muscle strength of modern middle school soccer players has increased significantly. Experts in each sport know that the physique and physical strength factors of athletes in various sports events affect their performance beyond the level of skill in each sport. A number of prior studies have reported that such information is very important in discovering outstanding athletes in each sport and planning training to improve their performance[28][29][30]. The results of this study were intended to identify the physique and physical strength factors of middle school soccer players, who are in the fast-growing period, but the results proved to be not sufficient. As a number of prior studies has confirmed[6][17][19][20], given that elite soccer players have different body composition as well as physique and physical strength factors depending on their positions, it is judged that identifying differences by position by grade is suitable for achieving the purpose of this study. Nonetheless, the results of this study have confirmed that there are differences in physique, physical strength factors, and isokinetic muscle function of middle school soccer players by grade, and if these differences are fully considered when planning physical strength training, the training effect will be maximized.

5. Conclusion

This study compared the characteristics of body composition, physique, physical fitness factors, and isokinetic muscle function of middle school soccer players by grade. The study has shown statistically significant differences in body composition, physique, physical fitness factors, and the knee joint isokinetic muscle strength measured at 60 degrees of angular velocity. Although there were some differences depending on the items measured, most of the measurements indicated that the differences between the first and second graders were greater than the differences between the second and third graders. It is believed that the results of this study should be fully reflected in the various training plans for middle school soccer players, and to provide more specific information, follow-up studies comparing the differences by grade according to positions are needed.

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7. Appendix

7.1. Authors contribution

	Initial name	Contribution
Lead Author	JSP	-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑ -Make a significant contribution to collection ☑ -Final approval of the paper ☑ -Corresponding ☑ -Play a decisive role in modification ☑ -Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑
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The Effect of the Isokinetic Muscle Function of the Shoulder Joint of Amateur Club Baseball Pitchers in Their 20s on the Speed of a PITCHED BASEBALL

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Abstract

Purpose: *This study analyzed the effect of the isokinetic muscle function of the shoulder joint on the speed of a pitched baseball with 21 amateur club baseball players in their 20s in the D city area as subjects.*

Method: *The subjects played the sport for between two years and seven years, have no pain or disease in their upper and lower limbs over the past year, and are divided into three groups: S1 for the maximum ball speed of 110 km/h or faster, S2 for 100 km/h or faster to slower than 110km/h, and S3 for slower than 100km/h in their pitched ball speed. The data for this study were processed using SPSS 18.0, calculating mean and standard deviations. One-way ANOVA was conducted to compare the differences between each item between the groups, and the Tukey method was used for follow-up analyses between the groups. In addition, multi linear regression was used to determine the effect of the isokinetic muscle function of the shoulder joint on the speed of a pitched baseball by angular velocity. The statistical significance level was set to p<.05.*

Results: *The faster the pitching speed, the higher the statistical significance of the isokinetic muscle function of the shoulder joint (at an angular velocity of 60 degrees, 180 degrees, and 240 degrees). Among the isokinetic muscle function factors, it was shown that the extensor of the shoulder joint had a high explanatory power. Peak torque of right shoulder joint at 180 degrees angular velocity had 44.9%, and work per repetition at 240 degrees had 54.2% had 54.2% explanatory power. To sum up the above results, the better the muscle function the group has, the faster the speed of a pitched baseball, and especially extensor showed higher statistical significance than flexor.*

Conclusion: *It was also shown that the isokinetic muscle function of the shoulder joint showed a stronger effect on the ball speed in extensor than in flexor of the right shoulder joint.*

[Keywords] ***Baseball Players, Shoulder Joint, Isokinetic Muscle Function, Speed of a Pitched, Muscle Function Test***

1. Introduction

Various physical movements involved in playing baseball not only develop each aspect of the physical ability, such as endurance, quick response, agility, and flexibility, but also help develop quick and accurate judgment and determination[1]. Since baseball has characteristics such as teamwork, sacrifice, determination, endurance, and fighting spirit as hitters and runners between offense and defense, it also helps to cultivate mental and social skills as well as physical skills[2].

The pitching thrown by a pitcher is the most important factor in the game of baseball, and about 80% of the winning or losing depends on the pitcher's ability[3]. Therefore, pitchers are the most popular position among baseball players because a team with strong pitchers can lead an absolutely advantageous game[4]. Some enthusiastic amateur club baseball players want to

improve their speed and become an outstanding pitcher by visiting experts to take lessons and get trained. One of the purposes of training for a pitcher is to improve control and ball speed and to keep the speed of a fastball steady throughout the game without losing control[5]. One of the most important factors for a pitcher's success is the ball speed[6], and the top speed is one of the success factors as a baseball pitcher[7]. In baseball, a pitcher is a position that has a static and dynamic aspect at the same time, requires muscle strength and power from the entire body, and also requires balance, agility, equilibrium, and coordination that must be harmonized[8][9][10]. In baseball, hitting or pitching is not done with arms alone, but starts with legs and hip. Legs and hip are the "power zone" and provide more than 50% of the force generated for hitting and pitching[11]. In addition, the speed of a pitched baseball by an overarm pitcher is influenced by the pitchers' steps and hip rotation[12]. The acquisition of correct balance and pitching skills through proper training is an important factor in improving the ball speed, but that alone limits the improvement of the ball speed and control. It essentially requires muscle function[13]. The ball speed of a pitcher is correlated with anaerobic power, and anaerobic training is the main factor for the increase in the ball speed[14]. For baseball players as well as athletes in most sports, anaerobic power is the factor that best predicts success[15][16][17], and for baseball players, especially the power of the shoulder joint is absolutely necessary[18][19].

amateur club baseball pitchers absolutely lack the strength and muscle endurance to maintain the ball speed and accuracy throughout the game, and the longer they pitch, the more they lose form and balance. This can be seen as a result of the difference in the amount of training and practice, as unlike elite athletes, there is absolutely no time for amateur players to invest in training and practice[2]. Many of the prior studies were conducted on professional or varsity baseball players, especially on elite players with more than five years of experience. In addition, these studies were on elite baseball players' anaerobic power and the effect of muscular strength on the ball speed, or simply whether or not muscle strength is related to the ball speed, and research on the relationship between isokinetic muscle strength and the ball speed have been insufficient. Therefore, the purpose of this study is to analyze the effect of the isokinetic muscle function of the shoulder joint on the speed of a pitched baseball as amateur club baseball players as subjects and to provide the basic data for the training approaches for them.

2. Research Method

2.1. Research subjects

This study was conducted on 21 amateur baseball pitchers in their 20s who had no pain or medical history in the upper and lower limbs over the past year and with two to seven years of experience living in D city. Seven players were assigned to each of the three groups, S1, S2, and S3, by measuring their ball speed <Table 1>.

Table 1. The physical characteristics of the research subjects.

Group	Age(yr)	Height(cm)	Weight(kg)	Body fat(%)	BMI(㎏/㎡)	Experience(yr)
S1(n=7)	24.57 ±1.99	178.29 ±3.77	80.00 ±19.22	19.98 ±9.12	25.73 ±5.97	4.43 ±1.99
S2(n=7)	23.14 ±1.77	177.86 ±4.56	80.86 ±16.09	20.50 ±4.15	25.93 ±4.36	3.14 ±0.90
S3(n=7)	22.57 ±2.70	176.00 ±4.32	67.00 ±7.28	17.12 ±5.97	21.95 ±3.29	3.57 ±1.81

Note: Values: mean±SD, S1 = The fast speed group(110/km/h or faster), S2 = The middle speed group(100km/h to 109km/h), S3 = The slow speed group(slower than 100km/h).

2.2. Measuring units and items

Table 2. Measuring unit and items.

Description	Item	Measuring units and items
Physique	Physique, body composition	Height, weight, body fat, BMI
Isokinetic muscle function	Shoulder joint	Isokinetic muscle function (left and right extensor and flexor)

2.3. Method of measuring physique and basic physical strength

Heights were measured using a height measuring device(SH-9600A, Sewoo, Korea) with the shoes off, and the weight and body fat rate were measured using the InBody 3.0(Biospace, Korea) with minimal clothing while limiting food and water intake at least two hours prior to measurement and the bottom of feet and palm wiped with tissue wet with electrolyte. BMI was calculated using measured height and weight[20].

2.4. Method of measuring isokinetic muscle function

Isokinetic muscle function was measured at the angular velocity of 60°, 180°, and 240° for the peak torque and work per repetition of extensor and flexor, and the unit was recorded in Nm.

2.5. Statistical processing

The data processing of this study was done using SPSS 18.0. The mean and standard deviation of each item were calculated to analyze the sub-factors of the isokinetic muscle function of the shoulder joint affecting the speed of a pitched baseball, and one-way ANOVA was performed to compare the differences by each item between groups. The Tukey method was used for post-hoc analysis. Multiple linear regression was used to determine the effect of the isokinetic muscle function of the shoulder joint on the ball speed. The statistical significance level was set to $p<.05$.

3. Results

The results of analyzing the isokinetic muscle function of the shoulder joint by the pitching speed groups with amateur club baseball players as subjects are as follows.

3.1. Isokinetic muscle function

3.1.1. Peak torque measured at the angular velocity of 60 degrees

The mean and standard deviation of the peak torque of the isokinetic muscle function of the shoulder joint among the pitchers by each group measured at the angular velocity of 60 degrees are shown in <Table 3>. As shown in <Table 3>, it was significantly higher in S1 group than in S3 group for extensor of left and right should joint($p<.05$).

Table 3. Comparison between the groups for peak torque measured at the angular velocity of 60 degrees.

Group	Shoulder(RE)	F	Shoulder(LE)	F	Shoulder(RF)	F	Shoulder(LF)	F
S1	94.00±9.62		93.00±19.86		73.00±16.40		63.00±17.20	
S2	93.00±15.48	4.086*	87.17±19.75	4.668*	66.50±19.41	2.571	65.00±23.08	1.233
S3	73.33±15.03		64.17±9.39		52.00±10.71		57.50±10.97	

post-hoc	S3 < S1	S3 < S1

Note: Values: mean±SD, *p<.05
RE=Right extensor, RF=Right flexor, LE=Left extensor, LF=Left flexor, E=Extensor, F=Flexor

3.1.2. Work per repetition measured at the angular velocity of 60 degrees

The mean and standard deviation of work per repetition of the isokinetic muscle function of the shoulder joint among the pitchers by each group measured at the angular velocity of 60 degrees are shown in <Table 4>. As shown in <Table 4>, it was significantly higher in S1 group than in S3 group for extensor of left and right should joint(p<.05).

Table 4. Comparison between the groups for work per repetition measured at the angular velocity of 60 degrees.

Group	Shoulder(RE)	F	Shoulder(LE)	F	Shoulder(RF)	F	Shoulder(LF)	F
S1	113.17±18.73		112.50±24.87		87.17±23.27		86.17±27.65	
S2	100.60±29.36	5.472*	99.60±37.15	5.764*	75.20±32.35	3.582*	70.00±29.44	2.198
S3	73.33±15.03		64.17±9.39		52.00±10.71		57.50±10.97	
post-hoc	S3 < S1		S3 < S1		S3 < S1			

Note: Values: mean±SD, *p<.05.

3.1.3. Peak torque measured at the angular velocity of 180 degrees

The mean and standard deviation of the peak torque of the isokinetic muscle function of the shoulder joint among the pitchers by each group measured at the angular velocity of 180 degrees are shown in <Table 5>. As shown in <Table 5>, it was significantly higher in S1 group than in S3 group for extensor of left and right should joint(p<.05).

Table 5. Comparison between the groups for peak torque measured at the angular velocity of 180 degrees.

Group	Shoulder(RE)	F	Shoulder(LE)	F	Shoulder(RF)	F	Shoulder(LF)	F
S1	86.80±16.18		82.20±19.83		66.40±16.92		63.00±16.93	
S2	82.50±17.73	4.648* S1>S3	79.33±18.28	3.996* S1>S3	57.50±12.69	1.678	61.33±13.38	.534
S3	61.00±11.61		57.50±9.33		52.17±8.66		55.33±8.76	
post-hoc	S3 < S1		S3 < S1					

Note: Values: mean±SD, *p<.05.

3.1.4. Work per repetition measured at the angular velocity of 180 degrees

The mean and standard deviation of work per repetition of the isokinetic muscle function of the shoulder joint among the pitchers by each group measured at the angular velocity of 60 degrees are shown in <Table 6>. As shown in <Table 6>, there were no significant differences in all items.

Table 6. Comparison between the groups for work per repetition measured at the angular velocity of 180 degrees.

Group	Shoulder(RE)	F	Shoulder(LE)	F	Shoulder(RF)	F	Shoulder(LF)	F
S1	97.20±19.55		96.40±27.18		73.40±20.60		69.60±18.09	
S2	99.17±18.57	3.697	94.17±19.84	3.472	65.00±18.60	.728	70.17±16.42	.210
S3	72.00±19.18		67.67±14.35		61.00±11.88		64.83±11.91	

3.1.5. Peak torque measured at the angular velocity of 240 degrees

The mean and standard deviation of the peak torque of the isokinetic muscle function of the shoulder joint among the pitchers by each group measured at the angular velocity of 240 degrees are shown in <Table 7>. As shown in <Table 7>, it was significantly higher in S1 and S2 group than in S3 group for extensor of left and right should joint(p<.05) and higher in S1 group than in S3 group for extensor of left should joint(p<.05).

Table 7. Comparison between the groups for peak torque measured at the angular velocity of 240 degrees.

Group	Shoulder (RE)	F	Shoulder (LE)	F	Shoulder (RF)	F	Shoulder(LF)	F
S1	90.40±15.69		83.80±18.73		67.80±17.06		63.40±14.47	
S2	88.00±15.52	4.974*	81.00±15.61	4.162*	59.00±12.70	1.440	61.17±11.72	1.149
S3	66.50±11.15		59.33±13.05		55.00±7.27		53.67±7.39	
post-hoc	S3 < S1, S2		S3 < S1					

Note: Values: mean±SD, *p<.05.

3.1.6. Work per repetition measured at the angular velocity of 240 degrees

The mean and standard deviation of work per repetition of the isokinetic muscle function of the shoulder joint among the pitchers by each group measured at the angular velocity of 240 degrees are shown in <Table 8>. As shown in <Table 8>, it was significantly higher in S1 group than in S3 group for extensor of right should joint (p<.05).

Table 8. Comparison between the groups for work per repetition measured at the angular velocity of 240 degrees.

Group	Shoulder (RE)	F	Shoulder (LE)	F	Shoulder (RF)	F	Shoulder (LF)	F
S1	82.20±13.75		83.00±23.37		52.00±26.45		54.20±18.85	
S2	82.83±16.14	3.929*	78.67±15.33	3.389	43.17±19.94	.278	50.33±16.66	.087
S3	62.00±13.13		56.50±16.84		46.83±10.82		51.17±12.30	
post-hoc	S3 < S1							

Note: Values: mean±SD, *p<.05

3.2. Effect of flexor and extensor in the shoulder joint muscle strength on the ball speed by angular velocity

Multiple linear regression was conducted to determine the effect of flexor and extensor in the shoulder joint muscle strength on the ball speed by angular velocity. The analysis of the effect of each factor on the ball speed is as follows. <Table 9> <Table 10> show the results of the analysis of the effect of peak torque and work per repetition of the left shoulder joint measured at the angular velocity of 60 degrees on the ball speed, and it was shown that the peak torque and work per repetition of the left shoulder joint measured at the angular velocity of 60 degrees had no significant effect on the ball speed.

Table 9. Effect of the peak torque of the right shoulder joint measured at the angular velocity of 60 degrees on the ball speed.

Terminal speed / Independent	Maximum speed			
	b	SE	β	t
(Constant)	70.223	11.631		6.037
Shoulder_RE	.245	.234	.382	1.047
Shoulder_RF	.189	.220	.313	.858

R2	.444
F	5.581*

Note: *p<.05.

Table 10. Effect of work per repetition of the right shoulder joint measured at the angular velocity of 60 degrees on the ball speed.

Terminal speed / Independent	Maximum Speed			
	b	SE	β	t
(Constant)	76.119	8.933		8.522
Shoulder_RE	.373	.219	.908	1.707
Shoulder_RF	-.111	.219	-.269	-.505
R2		.444		
F		5.600*		

<Table 11> shows the results of the analysis of the effect of the peak torque of the right shoulder joint measured at the angular velocity of 180 degrees on the ball speed. It was shown that the intercept(β=.554) of the extensor of the right shoulder joint had a significant effect at the 5% level, and the explanatory power of the regression model that explained the change of the ball speed by the extensor of the right shoulder joint was R2=.542, having the 54.2% explanatory power.

Table 11. Effect of the peak torque of the right shoulder joint measured at the angular velocity of 180 degrees on the ball speed.

Terminal speed / Independent	Maximum Speed			
	b	SE	β	t
(Constant)	72.416	8.518		8.502
Shoulder_RE	.470	.218	.829	2.159*
Shoulder_RF	-.084	.300	-.107	-.278
R2		.542		
F		8.284*		

Note: *p<.05.

<Table 12> shows the results of the analysis of the effect of work per repetition of the right shoulder joint measured at the angular velocity of 180 degrees on the ball speed. It was shown that the intercept(β=.747) of the extensor of the right shoulder joint had a significant effect at the 5% level, and the explanatory power of the regression model that explained the change of the ball speed by the extensor of the right shoulder joint was R2=.449, having the 44.9% explanatory power.

Table 12. Effect of work per repetition of the right shoulder joint measured at the angular velocity of 180 degrees on the ball speed.

Terminal speed / Independent	Maximum Speed			
	b	SE	β	t
(Constant)	75.864	8.985		8.443
Shoulder_RE	.355	.153	.747	2.322*
Shoulder_RF	-.062	.200	-.101	-.313

R2	.449
F	5.714*

Note: *p<.05.

<Table 13> shows the results of the analysis of the effect of peak torque of the right shoulder joint measured at the angular velocity of 240 degrees on the ball speed, and the muscle strength of the right shoulder joint was found to have no significant effect on the ball speed.

Table 13. Effect of the peak torque of the right shoulder joint measured at the angular velocity of 240 degrees on the ball speed.

Terminal speed / Independent	Maximum Speed			
	b	SE	β	t
(Constant)	69.453	9.969		6.967
Shoulder_RE	.440	.215	.727	2.049
Shoulder_RF	-.030	.287	-.037	-.104
R2		.485		
F		6.583		

<Table 14> shows the results of the analysis of the effect of work per repetition of the right shoulder joint measured at the angular velocity of 240 degrees on the ball speed. It was shown that the intercept(β=.732) of the extensor of the right shoulder joint had a significant effect at the 5% level, and the explanatory power of the regression model that explained the change of the ball speed by the extensor of the right shoulder joint was R2=.449, having the 44.9% explanatory power.

Table 14. Effect of work per repetition of the right shoulder joint measured at the angular velocity of 240 degrees on the ball speed.

Terminal speed / Independent	Maximum Speed			
	b	SE	β	t
(Constant)	72.728	9.510		7.647
Shoulder_RE	.455	.145	.732	3.138**
Shoulder_RF	-.077	.131	-.138	-.591
R2		.449		
F		5.703*		

Note: *p<.05.

4. Discussion

This study analyzed the differences in the isokinetic muscle function of the three groups(S1, S2, and S3) assigned by measuring their maximum ball speed. Based on the results of the isokinetic muscle function factors of the shoulder joint by the ball speed presented in this study, we compare and analyze them with preceding studies. A study to establish the relationship between anaerobic power and the pitched ball speed of baseball players reported that anaerobic training could be the main factor of the increase in the ball speed[11], and this study found that in all items, the isokinetic muscle function of the fast-pitching group was higher than that of the slow-pitching group, with the largest statistical difference in the extensor of the left and right shoulder joints. These results are considered to be the characteristics of baseball players with higher isokinetic muscle strength in the extensor rather than flexor. In addition, multiple linear regression analysis of the effects of isokinetic muscle function on the ball speed

showed that the extensor of the right shoulder joint had 44.4% to 54.2% of explanatory power in peak torque measured at 60, 180, and 240 degrees and work per retention at 180 and 240 degrees of the angular velocity. In this study, the isokinetic muscle function of the shoulder joint was shown to affect the ball speed, but conflicting results from preceding studies were also reported. A prior study[13], which analyzed the correlation between the ball speed and the isokinetic muscle function of the shoulder joint of varsity baseball players, and another prior study, which compared and analyzed the ball speed and isokinetic rotational force of professional baseball pitchers, reported no correlation between the ball speed and the isokinetic muscle function[18]. In addition, an analysis of the isokinetic torque of the shoulder joints of professional overarm pitchers reported that there is no link between the ball speed and the peak torque of the shoulder joints[12]. However, this study found that the fast-pitching groups had higher isokinetic muscle function in the shoulder joints compared to the slower-pitching groups and that it affected the ball speed. This is interpreted as a significant difference in the isokinetic muscle function of the shoulder joint, counter arguing the results of preceding studies, as elite baseball pitchers spend a lot of time training, perform daily weight training, and maintain overall muscle function as pitchers, while amateur club baseball pitchers are inferior to elite baseball pitchers in all categories, including overall muscle function and physical condition.

5. Conclusion

This study analyzed the isokinetic muscle function of the shoulder joints of amateur club baseball pitchers by the ball speed and drew the following conclusion:

First, the faster the ball speed, the higher the isokinetic muscle function of the shoulder joints measured at the angular velocity of 60, 180, and 240 degrees, compared to the slower pitching speed groups, and there were statistically significant differences in the extensor muscle strength of left and right shoulder joints.

Second, the peak torque of extensor of the right shoulder joint measured at the angular velocity of 180 degrees had 54.2% of explanatory power, and work per repetition measured at the angular velocity of 240 degrees had 44.9% of explanatory power.

Combining the above results, the better the muscle function, the faster the speed of a pitched ball, and it especially showed a higher statistical significance in extensor than in flexor. It was also shown that the isokinetic muscle function of the shoulder joint had a stronger effect on the ball speed in the extensor of the right shoulder joint than in the flexor.

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7. Appendix

7.1. Authors contribution

	Initial name	Contribution
Lead Author	WKC	-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑ -Make a significant contribution to collection ☑ -Final approval of the paper ☑ -Corresponding ☑ -Play a decisive role in modification ☑
Corresponding Author*	JSP	-Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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The Effect of 12-Weeks of Fitness Program on Physical Fitness Metabolic Risk Factors, and COGNITIVE FUNCTION of Aged Women with Mild Dementia

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Abstract

Purpose: *This study analyzed the effects of a Fitness Program, which combines anaerobic and aerobic exercises applied for 12 weeks, on changes in physical fitness, metabolic risk factors, and cognitive function of elderly women aged 65 or older.*

Method: *20 elderly women aged 65 or older were recruited as the subjects of the study and assigned into 2 groups: the Control Group and the Fitness Program Group, which carried out the exercise. The Fitness Program Group carried out exercises the full-body resistance exercise using a weight machine for the upper and lower extremities, working on from large to small muscles under the supervision of a professional sports instructor, four times a week for 12 weeks. After the resistance exercises were carried out, walking was performed for 30 minutes on a treadmill without slope at a speed of 5.4(km/h). The intensity of the exercise was reset by measuring the RM (repetition maximum) every three weeks.*

Results: *The Fitness Program Group showed a decrease in weight, body fat, and body mass index compared to the Control Group. The Fitness Program Group showed an increase in muscle mass and displayed interactional effects between the group and repeated measurements($p<0.05$). In terms of cognitive function, the Fitness Program Group showed an increase in memory over the Control Group, and both groups showed an increase in treatment at neural reaction speed and displayed statistically significant($p<.05$) interactional effects. Both groups showed positive increases in simple and selective reaction times($p<.05$).*

Conclusion: *It could be confirmed that systematic and regular exercise in old age has a positive effect on body composition and physical fitness. It is predicted that the nerve reaction time, especially in cognitive function factors, has been improved by nerve stimulation. It would be meaningful if future studies compare various aspects of the study subjects, analyze physical fitness factors related to aging, and evaluate cognitive function factors for the prevention of dementia.*

[Keywords] ***Elderly Women with Mild Dementia, Fitness Program, Physical Fitness, Metabolic Risk Factors, Cognitive Function***

1. Introduction

The performance of age-appropriate exercise and regular participation in physical activity give one's life a boost and have a positive effect on health. Regular exercise is known to be effective in delaying physical and mental aging[1]. Since modern medical technology developed and the positive effects of exercise became known to the public, the average life expectancy has been increasing due to the interest in health and active participation[2].

The decrease in physical fitness among older people leads to a decrease in the ability of physical activity, which is known to be about 25% lower than in their youth[3]. The decrease in the ability of

physical activity may lead to difficulties in carrying out normal daily life or even death due to weakened cardiovascular and musculoskeletal systems[3].

As such, physical changes due to aging are likely to result in decreased physical activity and obesity caused by an imbalance in energy consumption[4]. And it turned out that older women have a higher average life expectancy than men and have a higher incidence of dementia due to metabolic risks and decreased cognitive function[5].

A major cause of obesity is known to be the intake of excessive energy and an imbalance in consumption[6][7]. Complications due to obesity vary widely and mainly related to dyslipidemia with the increase in low-density lipoprotein cholesterol(LDL-C) and the decrease in high-density lipoprotein cholesterol(HDL-C)[8]. These complications lead to various diseases and lowering quality of life and often result in death[9][10]. Therefore, the need to lower the prevalence of obesity is emphasized and much attention is required for active management and prevention of obesity.

Recent reports have suggested that the symptoms that are becoming more serious than obesity are sarcopenia[11]. Sarcopenia inhibits the ability to perform physical activities and independently leading one's daily life, which, along with the reduction of lean body mass and the increase in body fat, results in physical weakness[12]. Regular physical activity and exercise have been reported to improve muscle strength, muscle endurance, and flexibility even in old age[13][14]. In particular, referring to prior studies on the effect of carrying out exercises fitted to individual characteristics using scientific measuring tools, Park(2017) conducted a combined exercise program three times a week for 12 weeks with 60-70% HRR, Jeong(2017) conducted a circular exercise program three times a week for 12 weeks with 60-80% HRR, and Lee(2019) conducted Pilates exercise three times a week for 12 weeks to analyze changes in physical fitness factors, which all produced different results[15][16][17]. The increase in obesity caused by lack of physical activity and exercise for the elderly is a social problem, and more research and support related to physical fitness is needed to provide Fitness Programs by setting the types, frequencies, forms, and times of various exercises, especially for the elderly women.

A study by Dufour AB(2013) suggested that a decline in physical activity resulted in a negative change in body composition due to a decrease in lean body mass and an increase in body fat[12]. The imbalance in body composition caused by changes in lean body mass and body fat is especially responsible for the increase in cardiovascular disease prevalence, which can cause metabolic risk factors resulting from reduced physical fitness[18][19][20]. Long-term metabolic risk factors are related to the risk of developing disorders resulting from complications and aftereffects and tend to occur with the risk of high blood pressure and glucose levels, so continuous care is needed[21]. Ahn(2020) that the elderly with obesity who performed a 12-week exercise program had significantly improved waist measure, systolic blood pressure, and HDL-C concentrations, as well as significantly improved physical fitness-related factors[22]. These results show that exercise is an effective way to treat and prevent metabolic risk factors in older women.

Cardiovascular risk factors such as hypertension, diabetes, and hyperlipidemia are known to affect the pathological mechanisms of cognitive function degradation[23]. The increase in body mass index also increases brain health risk factors, which are more pronounced in women than in men[24]. Meanwhile, studies have shown that cardiovascular diseases caused by metabolic risk factors are associated with stroke and cerebral infarction with no symptoms Galego J(2005) and that the higher the prevalence of cardiovascular diseases, the more pigmentation in gray substance of the brain[25][26]. It has been reported that the pathogenesis is that it is caused by ischemic damage to the subcortical gray matter and the white matter of the brain, which is responsible for sensory, motor, and speech functions, caused by the stenosis of the vascular lining and abnormality of automatic regulation of brain blood flow[27]. These factors may cause dementia, among which most common types are Alzheimer's and vascular dementia, and other neurological disorders include Parkinson's disease[28].

Dementia begins with a decline in cognitive function, resulting in multiple cognitive disorders, such as time and space disorders and speech disorders, resulting in constraints on daily activities[29]. Physically, it may cause accidents such as falls, which in turn increase the risk of fractures, and also cause mental disorders, affecting independent activities[30]. It is difficult to distinguish between dementia and memory loss from normal aging, as the decline in cognitive function due to aging appears in the

form of memory impairment and orientation disorder, which are also minor symptoms in the early stages of dementia. However, if these symptoms occur continuously in everyday life, one should pay attention to them because they can be seen as symptoms of mild dementia[31]. Many pharmacological studies are underway to delay dementia, but they do not provide clear and definite results, and the methods applied to prior studies in non-pharmacological ways are focused on a uniform and fragmentary activity program that identifies physical, visual, or auditory stimuli reactions occurring in daily life[32]. Studies on improving cognitive function for the elderly are actively being conducted, but mainly the results for the cognitive function of the healthy elderly are being published. In particular, there is a lack of research on elderly women, especially on those with mild dementia.

In a prior study, Kwak(2005) that memory and cognitive function improved when aerobic exercise was applied to dementia patients, and Ahn(2017) showed positive results by analyzing changes in BDNF and Tau, which involved the action of the brain's neuroendocrine system and complex pathogenesis, in saliva after applying resistance exercise using an elastic band to the elderly with dementia[33][34].

Therefore, this study analyzed how changes in body composition and metabolic risk factors were related to cognitive function in the process of regularly carrying out the Fitness Program, which combined resistance and aerobic exercises, for elderly women with mild dementia symptoms. In particular, it was analyzed to derive the results of changes in memory, nerve movement speed, simple reaction time, and selective reaction time, indicating the brain neuro-functions.

Thus, the purpose of this study is to provide basic data for designing exercise programs suitable for the physical fitness and metabolic risk factors of female senior citizens by verifying that changes in the physical and metabolic risk factors of female senior citizens through the implementation of a 12-week Fitness Program are related to their cognitive function.

2. Research Methods

2.1. Research subjects

The subjects of this study were female elderly people aged 65 or older living in D Metropolitan City and those who had no internal or surgical problems in medical interviews and examinations over the past six months but had mild dementia symptoms. 20 elderly women with no exercise experience were randomly selected and divided into the Control Group(n=10) and the Fitness Program Group(n=10). After fully explained the purpose and method of the study, they wrote a consent form and participated in the experiment. The characteristics of the study subjects are as follows <Table 1>.

Table 1. The characteristics of the study subjects.

	Age(yr)	Height(cm)	Weight(kg)	%fat
Control group	66.1 ±2.51	152.1 ±4.08	60.6 ±5.36	37.5 ±4.70
Fitness program group	66.7 ±2.79	152.0 ±4.37	59.0 ±6.27	38.9 ±3.62

2.2. How the fitness program were conducted

The exercise program for this study was carried led by a professional sports instructor who holds a certificate of first aid in case of on-site emergencies. A weight machine and treadmill were used for the exercise and applied only to the Fitness Program Group. The study subjects did not have experience in exercising using a weight machine, so they were instructed by the professional sports instructor for a week and began exercising after being familiar with it. At 9 a.m., all members of the Fitness Program Group gathered to stretch for 10 minutes before the start of the main exercise, and the resistance exercise using the weight machine was divided into the upper and lower body and conducted

four times a week for 12 weeks. The exercise was done in the order of large to small muscles, and abdominal exercise was performed whenever the Fitness Program was conducted, regardless of the progress of upper and lower body exercises. Following the end of the weight machine exercise, aerobic exercise was performed at a speed of 5.4(km/h) for 30 minutes on a treadmill with no slope. The intensity of exercise was reset by measuring the Repetition Maximum(RM) every three weeks. The details of the Fitness Program is as follows <Table 2>.

Table 2. Fitness program.

<table>
<tr><th></th><th>Type</th><th>Intensity</th><th>Time(min)</th></tr>
<tr><td>Warm Up</td><td>Stretching</td><td>-</td><td>10</td></tr>
<tr><td rowspan="5">Upper body
(1Day)</td><td>Flat bench press machine</td><td rowspan="10">1RM 60~70%
15rep, 3set</td><td rowspan="12">30</td></tr>
<tr><td>Lat pull down machine</td></tr>
<tr><td>Shoulder press machine</td></tr>
<tr><td>Cable biceps curl</td></tr>
<tr><td>Cable triceps curl</td></tr>
<tr><td rowspan="5">Lower body(2-Day)</td><td>Stead leg press machine</td></tr>
<tr><td>Smith machine squat</td></tr>
<tr><td>Leg extension machine</td></tr>
<tr><td>Leg curl machine</td></tr>
<tr><td>Standing calf raise machine</td></tr>
<tr><td rowspan="2">Abdominal exercise
(4-Day)</td><td>Crunch</td><td rowspan="2">30rep, 3set</td></tr>
<tr><td>Leg raise</td></tr>
<tr><td rowspan="2">Aerobic exercise</td><td rowspan="2">Treadmill</td><td>Grade(%) 0.0</td><td rowspan="2">30</td></tr>
<tr><td>Speed(km/h) 5.4</td></tr>
<tr><td>Cool down</td><td>Stretching</td><td>-</td><td>10</td></tr>
</table>

2.3. Measurement items and analysis methods

2.3.1. Body composition

Body composition was measured by using Inbody 720(Inbody, Korea) for weight, body fat, and lean body mass through microcurrent of at least 1 kHz up to 1000 kHz.

2.3.2. Measuring physical fitness

The physical fitness measurement was based on studies by Ahn(2019), including Grip Strength, Back Muscular Strength, Sit Up, and Sit and Reach. After the Harvard Step Test used for whole-body endurance measurement, the formula for cardiopulmonary endurance measurement was applied to calculate the value of the Physical Efficiency Index(PEI)[35]. To measure muscular strength, the average

value of grip strength was recorded by using an electronic grip force gauge(TKK, Japan) for 2 to 3 seconds from the left and right hand. To measure back muscular strength, a measured value using an electronic back muscular strength meter(TKKK, Japan) was recorded, and sit-ups were performed for 60 seconds to measure the muscular strength and endurance of the abdomen. For flexibility measurement, Sit & Reach was performed using a long-sitting trunk forward flexion gauge. The subjects straightened their knees with bare feet and raised their ankles to reach the vertical surface of the measuring instrument, and then put their hands together to bend their upper bodies forward to record the measurements in 0.1cm increments when the upper body was extended as much as possible with both middle fingers. The measurements for all the items were taken twice and the highest was used.

Harvard Step Test was conducted to assess cardiopulmonary endurance. At the speed of 30 steps per minute on the 35cm-high platform, the subjects were made to continue the steps for exactly 5 minutes. Immediately after the Harvard Step Test, PEI was calculated by recording the pulse rate measured in the radial artery for a period of 1 minute to 1 minute 30 seconds, 2 minutes to 2 minutes 30 seconds, 3 minutes to 3 minutes 30 seconds as soon as the test was completed.

PEI = (180 seconds / 2 × 3 times the total of beats) × 100

2.3.3. Analysis of metabolic risk factors

When the subjects were stable, they maintained an empty stomach for 12 hours and collected 10 ml of blood from the upper arm veins using a syringe. Immediately after the blood collection, it was heparin treated to prevent coagulation, and centrifugation was performed for 10 minutes at a temperature of 4°C at 3,000 rpm. The plasma and serum were separated from the centrifuged blood and stored in a deep freeze at –80°C. Total cholesterol(TC), high-density lipoprotein cholesterol(HDL-C), triglyceride(TG), and blood glucose were analyzed with COBAS 111, an electrodynamic analyzer(the U.S.A.).

Systolic and diastolic blood pressure were measured with a mercury blood pressure gauge (MDF 800, USA) at a sitting position that matched the cardiac height and arm height of the subject. A total of two measurements were taken two to three minutes apart, and if there was a difference of 5mmHg or more, an additional one was re-measured and the average value of the 3 measurements was calculated.

The waist measure was measured to assess abdominal obesity. Measurements were made using a tape measure in the middle of the lowermost rib region and pelvic iliac crest with both feet 25 to 35 cm apart from each other with the upright position where the subject gazed forward[36]. Measurements were taken so that the tape measure did not put pressure on the soft tissue and were recorded up to 0.1cm.

2.3.4. Cognitive function test

The cognitive function test was conducted using the Concussion Vital Sign Test, which was used as a cognitive function evaluation tool in the United States. A total of four types of measurement items were evaluated: memory, nerve movement speed, simple reaction speed, and selective reaction time. The subject entered a one-person intensive training room with a computer with the program connected to it, and the test was conducted, and the manager monitored it in real-time on the screen. After the test was completed, the items' scores were added together and the values sent to the central control unit were analyzed.

2.3.4.1. Memory

This is a test to assess whether language or shapes are well recognized, remembered, and recalled, and conducted with topics such as language learning, language memory, word recognition, short-term memory, long-term memory, graphic knowledge memory, image recall, and mechanical device manipulation. Measurements were made for three minutes.

2.3.4.2. Nerve movement speed

This was done by checking for problem recognition, perception of received information, response, and participation, including distraction, driving motor nerves, work capability accuracy, and obsessive-compulsive disorder. Measurements were made for four minutes.

2.3.4.3. Simple reaction time

This examined the ability to respond to and process simple information quickly within a given time frame, with items of time taken to engage in dialogue, track simple instructions, and respond or make decisions. Measurements were made for one minute.

2.3.4.4. Selective reaction time

This examined the ability to continuously respond and process simple information over a given period of time, with items of time taken to make simple command reactions and decisions. Measurements were made for five minutes.

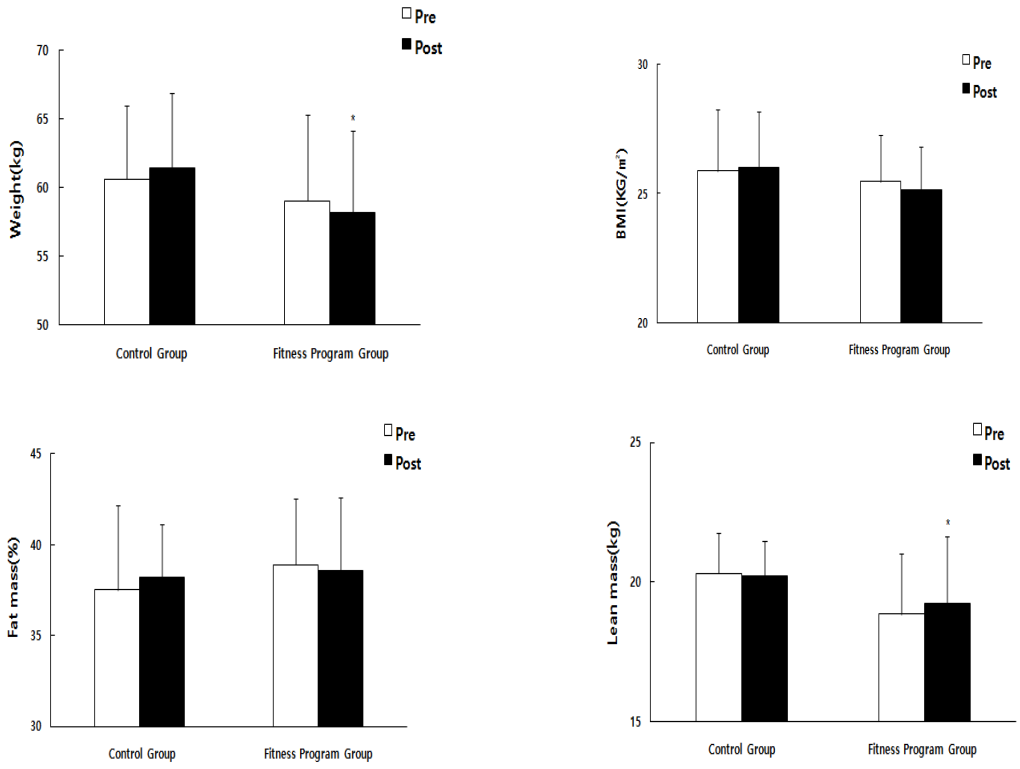
2.4. Data processing method

In this study, data processing was used to calculate the mean and standard deviation of each measurement item using the SPSS 20.0 statistical program. A two-way ANOVA (RG (2) × RM (2)) was performed to analyze the main effects and interactional effects to verify the differences between groups and repetitions during the 12-week Fitness Program. For significant interactional effects, a post-test was performed between paired t-test and inter-group t-test by period. All statistical significance levels are set to $p<0.05$.

3. Results

3.1. Changes in body composition

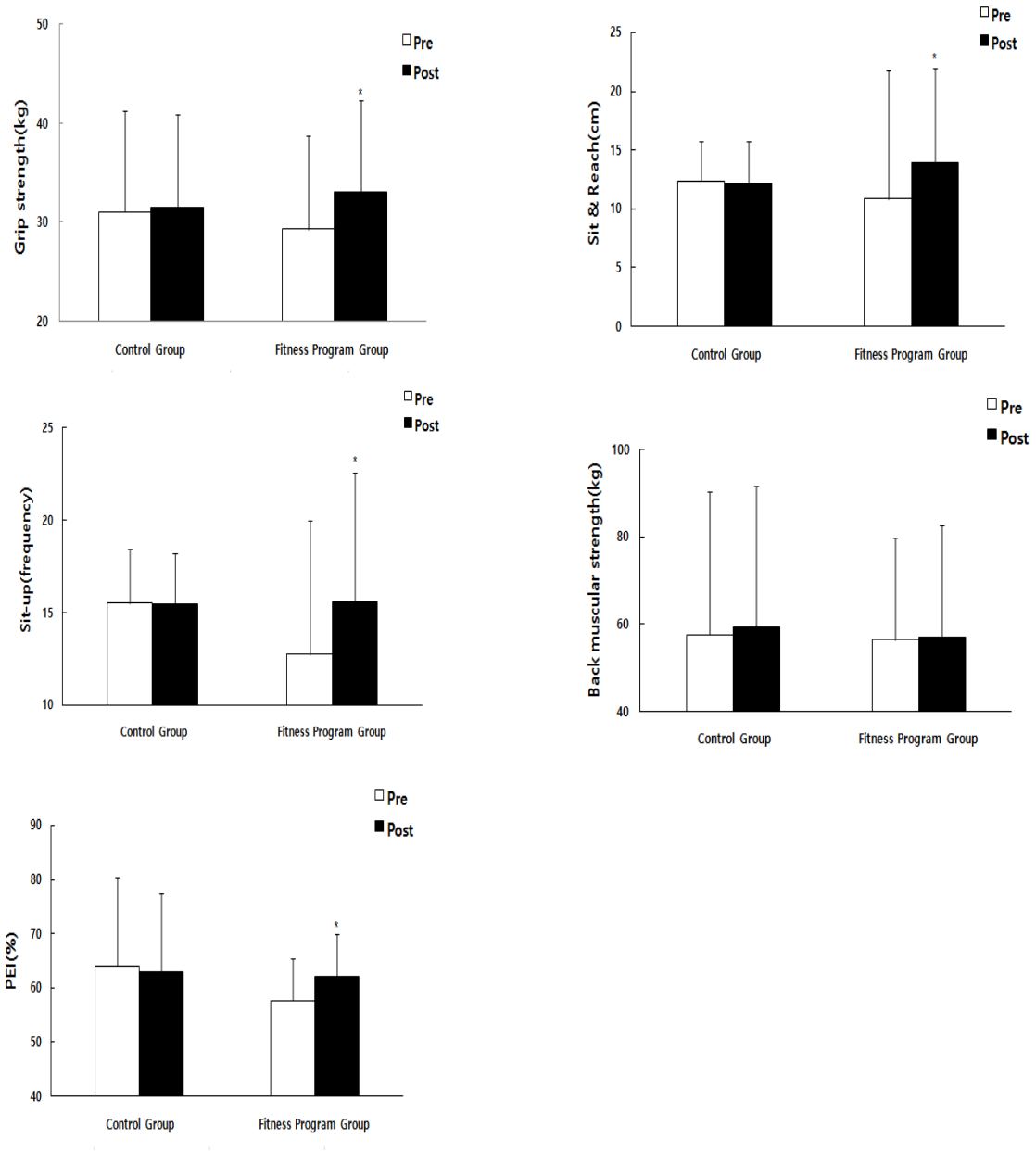
Figure 1. Changes in body composition.



Note: Values are mean and SD, * p<0.05. As shown in Figure 1, the analysis of the changes in body composition resulting from the implementation of the Fitness Program for 12 weeks in older women with mild dementia showed a decrease in body fat and body mass index in the Fitness Program Group and a slight increase in the Control Group as shown in Figure. 1, but there was no statistically significant difference. As to the body weight, the Fitness Program Group decreased, and the Control Group increased, resulting in a significant interaction between the groups and the periods(p<.001). In terms of lean body mass, the Fitness Program Group increased, and the Control Group showed a slight increase, showing an interactional effect between the groups and periods(p<0.05).

3.2. Changes in physical fitness

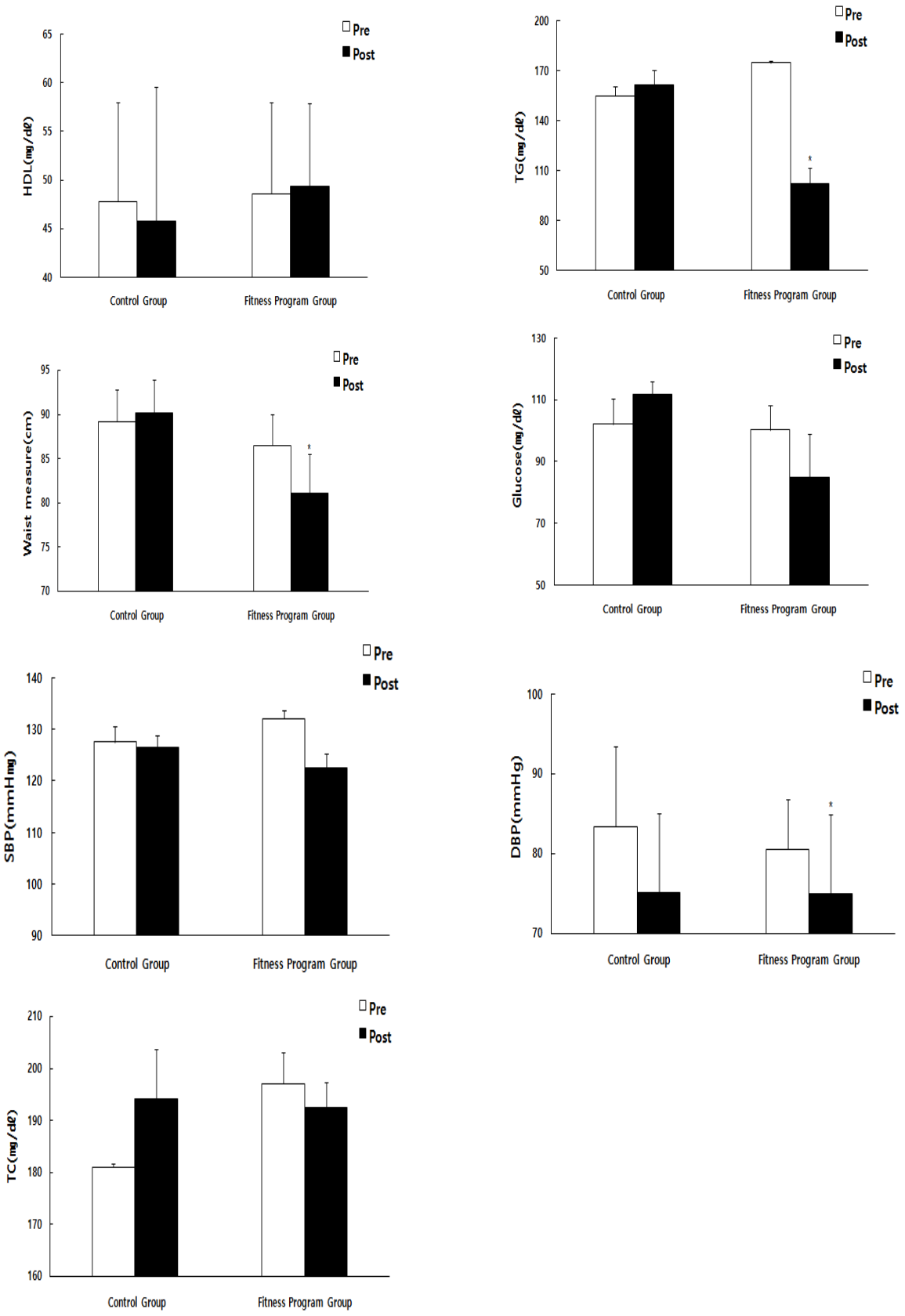
Figure 2. Changes in physical fitness.



Note: Values are mean and SD, * p<0.05, PEI : physical efficiency index. As shown in Figure 2, as a result of analyzing the changes in physical fitness from the implementation of the Fitness Program for 12 weeks in older women with mild dementia, in the muscle strength measurement item of Grip Strength, the Fitness Program Group showed significant effects over time(p<0.05). The back muscular strength indicated a small increase over time, but no significant difference was seen. In the muscle endurance measurement item of Sit-up and the flexibility measurement item of Sit & Reach, the Fitness Program Group showed significant effects(p<0.05). After the Harvard Step Test to measure cardiopulmonary endurance, PEI, which was measured in the radial artery, showed significant effects in the Fitness Program Group(p<0.05).

3.3. Changes of metabolic risk factors

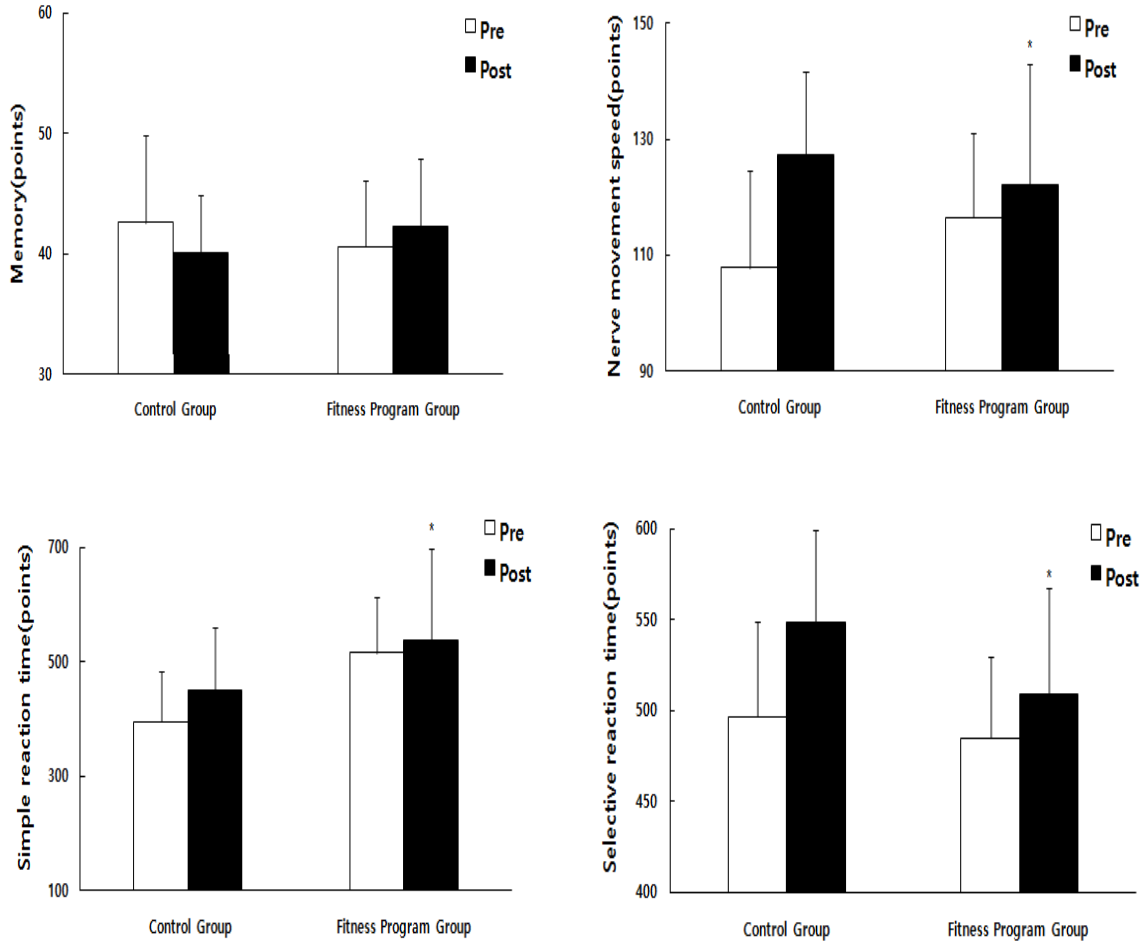
Figure 3. Changes of metabolic risk factor.



Note: Values are mean and SD, * p<0.05. As shown in Figure 3, an analysis of changes in metabolic risk factors from the implementation of the Fitness Program in older women with mild dementia for 12 weeks showed increases and decreases in the results of blood pressure and TC, but no statistically significant interactional effects. For TG, there was a statistically significant interactional effect(p<0.05), showing a significant decrease in the Fitness Program Group. For HDL-C and glucose when the stomach was empty, it showed positive changes in the group that performed the Fitness Program, but there were no statistically significant interactional effects. The waist measure of the Fitness Program Group was significantly reduced, and a small increase in the Control Group, showing the interactional effect between the group and periods(p<0.05).

3.4. Changes in cognitive function

Figure 4. Changes in cognitive function.



Note: Values are mean and SD, * p<0.05. As shown in Figure 4, an analysis of changes in metabolic risk factors from performing the Fitness Program for 12 weeks in older women with mild dementia showed no statistically significant interactional effects, although for memory, the Fitness Program Group increased and the Control Group decreased. For nerve movement speed, both the Fitness Program Group and the Control Group showed an increase with the exercise and displayed statistically significant interactional effects(p<0.05). Meanwhile, both groups showed positive increases in simple and selective reaction times, and only repeated measurements showed statistically significant differences(p<0.05).

4. Discussion

The results have been published in many prior studies on changes in the proportion of body composition, such as weight, body fat, and lean body mass, after diet control and continuous physical activity or steady exercise participation. A decrease in weight and body fat and an increase in lean body mass result in a change in appearance, which brings emotional stability. A lot of women said that they felt a gap between the ideal body required by society and the body in reality[37]. When participating in sports for the purpose of changing body composition and managing body shape, they

recognize participation in the exercise as a means of consuming calories and once the goal of reducing weight is achieved, they tend to neglect exercise. So, a systematic and continuous exercise program is required[38]. To compensate for the problems pointed out in the preceding studies, this study provided a 12-week Fitness Program to elderly women with mild dementia to provide a program for the persistence of exercise and to verify changes in body composition and their effects. As a result, the body fat and mass index decreased in the Fitness Program Group, and the lean body mass increased slightly. Ahn(2020), who reported the results of a study where exercise treatment was applied to obese women, is believed to be able to support these findings. As these studies have shown, the stimuli of exercise have a positive effect on body composition, which in turn affects physical, physiological, and neurological changes[22].

The practice of regular exercise, which is a non-pharmacological approach, has been shown to improve physical function including muscle strength, muscle endurance, cardiopulmonary endurance, flexibility, and body composition, and positive changes to pathological factors such as IGF-1, an independent risk factor for sarcopenia, and IL-6, an inflammatory cytokine, have affected aging delays[39]. In this study, the average grip strength of both hands was measured as a muscle strength factor, muscle endurance was measured with sit-ups. Trunk forward flexion was performed to measure flexibility. Harvard step was performed to measure the systemic endurance, and the PEI indicating cardiopulmonary endurance was measured. All these indicate that there were significant changes after performing the exercise program. Although there was no significant difference in back muscular strength, it resulted in a small increase in the Fitness Program Group, which was consequently consistent with a prior study by Jorge(2011) The Fitness Program, conducted in this study, is thought to have improved physical abilities such as muscle strength, muscle endurance, the systemic endurance, and flexibility with resistance exercise using a weight machine stimulating the musculoskeletal system and the aerobic walking exercise on a treadmill with a constant speed of 5.4 km/h[39]. These results are considered to be applicable to programs that would improve the physical fitness of older women to prevent sarcopenia.

The decline in physical fitness is caused by environmental changes, especially constraints on physical activity and dietary habits, which cause metabolic diseases, but exercise improves or delays metabolic risk factors. There are prior studies that have identified the effects of exercise related to these findings. Ahn(2020)'s study showed that the medium-strength elastic band exercise program was applied to the elderly for 16 weeks, and the concentration of plasma SAA-C, a non-functional HDL-C, which is a metabolic risk factor, and plasma HSP70, a cell recovery factor, were improved after exercise[22]. In a study by Kim(2017), the interactional effect between groups and periods was shown in glycated hemoglobin, a metabolic risk factor in the blood, as a result of walking exercise in medium intensity for eight weeks considering individual differences among elderly women[40]. In this study, the levels of waist measure, blood pressure, total cholesterol in the blood, triglycerides, and glucose were analyzed to determine the effect of the implementation of the Fitness Program on metabolic risk factors. The analysis showed statistical differences in waist measure, triglycerides, and diastolic blood pressure. Other factors indicated positive increases and decreases, but there were no statistically significant differences.

A prior study by Katzmarzyk(2003) of 105 participants with metabolic syndrome also demonstrated that exercise had positive effects on waist measure, blood pressure, HDL-C, triglycerides, and fasting blood sugar[41]. Jeong(2010) conducted an experiment on 104 elderly people with anaerobic exercise using elastic bands and aerobic exercise of sports dance for 24 weeks and found that internal fat and diastolic blood pressure decreased significantly[42]. These inconsistencies with the results of this study can be seen in the preceding studies, which are believed to have differed between the characteristics of the study subjects to slightly lower risk levels in the metabolic risk criterion and the duration of the treatment. Interestingly, statistically significant differences in waist measure, blood pressure, and triglycerides could prove that the application of the Fitness Program to older women is effective to improve metabolic risk factors.

An increase in metabolic risk factors can lead to decreased physical fitness, which begins with sedentary life habits and inadequate nutrition and in turn leads to deterioration of cognitive function[43].

Reduced cognitive abilities accelerate dementia and degrading brain health, causing nerve damage[44]. However, regular exercise is part of a healthy lifestyle and can not only improve cognitive function but also delay the development of dementia[45]. A prior study to support these findings reported that regular aerobic exercise on a treadmill done by young and old rodents significantly improved brain nerve function[46]. As a result of the cognitive function identified in this study, the cognitive function of performing the Fitness Program for 12 weeks in older women with mild dementia showed positive effects in memory, nerve movement speed, simple reaction time, and selective reaction time. It also showed interactional effects at nerve movement speed and statistically significant differences in simple and selective reaction time. Looking at prior studies to support this result, Ahn(2019) reported that the elderly women's resistance exercises using bands and walking for 60 minutes three times a week resulted in improved physical fitness and cognitive function, while Teri L(2015) reported that the combined exercise of 153 subjects suffering from dementia had improved their behavioral disorders and cognitive function[35][47].

In Korea, the Mini Mental State Examination Dementia Screening(MMSE-DS) method, which is conducted under the supervision of experts, is most commonly used to analyze cognitive function, but there are some difficulties to discuss compared to the results of this study without clarifying the distinct expertise, reliability, and validity of the evaluation method. It is thought that the MMSE-DS used in the preceding study of Ahn(2019) was composed to evaluate with a total of 19 questions in five sections, including orientation, memory recall, and concentration(3 questions), language function(3 questions), and composition interpretation and judgment(3 questions), showing a similar tendency to this study[35].

Cechetti(2012) supports the results of this study by reporting in the exercise program set considering the characteristics of the elderly that anaerobic exercise could prevent sarcopenia by maintaining muscle mass and strength and aerobic exercise could have a positive effect on antioxidation, nerve development, and cognitive function. Prior studies that evaluated the cognitive function of the elderly through the Concussion Vital Signs Test used in this study are insufficient, so it is difficult to verify the effects[48]. However, the results of neural velocity transferred from the central nervous system to the peripheral nervous system for muscular contraction and exercise with a weight machine applied in this study could indirectly confirm the effects of muscle fiber contraction speed reduction, and it is believed that aerobic exercise on a treadmill improved the plasticity of the brain nerve. However, it is judged that the improvement of results from adaptation to the Concussion Vital Signs Test program through repeated measurements cannot be ruled out. The active use of this research method would provide the basic data for cognitive function tests using non-face-to-face methods considering COVID-19 in addition to using face-to-face questionnaires conducted by experts.

5. Conclusion

This study analyzed the changes in body composition, physical fitness, metabolic risk factors, and cognitive function in elderly women with mild dementia with 12 weeks of a Fitness Program, and the results are as follows. In all items of body composition, changes in weight and lean body mass were statistically significant through the performance of the Fitness Program, confirming the interactional effects of exercise. For changes in physical fitness, there were significant effects($p<0.05$) in the Grip strength, Sit-up, Sit & Reach, and PEI. Although no significant differences were found in the back muscular strength, the results showed an increase. The changes in metabolic risk factors can be seen as interactional effects of increased physical fitness, with significant interactional effects in TG and waist measure. However, there were no statistically significant differences in TC, HDL-C, and blood glucose, but positive results are judged to be the result of performing the Fitness Program. Among the cognitive function assessment items, significant differences($p<0.05$) were found in nerve movement speed, simple reaction time, and selective reaction time, confirming the effectiveness of the 12-week Fitness Program.

The decisive factor in these findings is thought to be the nature and intensity of the exercise

program. In further research, it is thought to be able to get a clearer analysis of cognitive function and brain function if various subjects and more specialized exercise programs are developed and applied, and the intensity of application by type of exercise is specified. Further research on pathophysiological mechanisms related to brain function would also be meaningful.

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7. Appendix

7.1. Authors contribution

	Initial name	Contribution
Lead Author	GHL	-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑ -Make a significant contribution to collection ☑ -Final approval of the paper ☑ -Corresponding ☑ -Play a decisive role in modification ☑
Corresponding Author*	KJK	-Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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The Influencing Factors on the Development of Chinese SPORTS Industry in Digital Era: A Systematic Review

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Abstract

Purpose: *With the introduction of the concept of "digital sports" in 2012, Chinese sports industry has begun to enter the digital era and the original business model, market structure and other have been changed. After more than ten years development, digital sports industry has made remarkable achievements, but also exposed some problems. In order to find the answer to the problem, this paper conducted a descriptive statistical research on the factors impacting the digital development of Chinese sports industry. Through the analysis of the influencing factors, it hoped to put forward some suggestions to improve the digital development of Chinese sports industry benign.*

Method: *To descriptive statistics result objective and accurate, this study discussed the factors impacting the digital development of Chinese sports with a systematic review. It selected 770 articles from CNKI database from January 1st, 2012 to November 21st, 2020 for sorting and summary. After the screening with strict standards, 20 articles were left for information extraction. The extracted information was mainly used to explain the types of factors impacting the digital development of Chinese sports industry, and what factors are included in the different types.*

Results: *It showed that the factors impacting the digital development of Chinese sports industry could be divided into three types: political factors, economic factors, and technical factors. Different types contain different number of specific factors. Some of these factors contributed to the digital development of Chinese sports industry, while some of them had a diminishing or even negligible impact on the digital development of Chinese sports industry. After comprehensive consideration of the research topic, benign factors and ineffective factors were eliminated in this study, and the remaining factors were analyzed according to the actual situation. The analysis results showed that the main factors impacting the digital development of Chinese sports industry at the present stage were: sports policies, unbalanced consumption of population proportion and lack of regulatory rules.*

Conclusion: *Based on the results, this study proposed targeted suggestions, expanding the scope of sports welfare policy, enhancing the popularization intensity of sports science and technology, and strengthening the supervision of digital sports field. Among them, expanding the implementation scope of sports welfare policy aimed at welfare policies for emerging industries or trends. Enhancing the popularization intensity of sports science and technology targeted on the serious aging problem in China. The effective popularization can stimulate the elderly sports consumption, thus achieving the goal of promoting the development of sports industry. Strengthening the supervision was mainly reflected in the establishment of joint supervision by the government, the market and the society to ensure the healthy and orderly development of Chinese sports industry.*

[Keywords] ***Digital Technology, Intelligent Sports, Chinese Sports Industry, Influencing Factor, Systematic Reviews***

1. Introduction

The success of the 2008 Beijing Olympic Games has brought Chinese sports industry into a flourish period of development. By 2018, its total scale has reached 2,657.9 billion Yuan (US$372.1 billion), accounting for 1.1% of the GDP, officially becoming one of Chinese pillar industries[1]. Looking back on this period of development, the 2008 Beijing Olympic Games provided an opportunity for the development of Chinese sports industry, and the Chinese government's strong advocacy provided a prerequisite for the development of it. Then the integration of digital technology and Chinese sports industry is an important means to promote its rapid development. This fusion in the development of Chinese sports industry began in 2012 smart sports and digital sports, and the Chinese government promulgated 'the document on accelerating the development of sports industry, promote the sports consumption of several opinions' by the State Council in 2014 to encourage wearable sports equipment, sports fitness guidance function of technology and equipment, sports drinks and nutritional health food and others, which formed strategic target officially[2]. Since then, Chinese sports industry and digital technology have integrated comprehensively, from 'Tencent' sports getting NBA network exclusive broadcast rights in the mainland area to create interactive stereoscopic live, to the App changing the participation way of Chinese mass sports like Keep and 'Tic Tok' and digital marathon held by 'Alisports'. Chinese sports gradually step into the digital era[3].

However, digital technology contributes to the rapid development of Chinese sports industry, but some problems causing by low technology, popularization of sports science and technology to be improved, lack of relevant regulatory laws and others also restricts the development speed of digital sports[4]. Especially after the outbreak of COVID-19, the inadequate integration of the sports industry and digital technology and other problems have caused a huge impact on small and medium-sized sports enterprises[5]. In order to ensure the benign development of Chinese sports industry in the digital era, many Chinese scholars directly or indirectly explored the influencing factors of development of Chinese sports industry in the digital era, and obtained a large number of research achievements. In order to have a more comprehensive and intuitive understanding of these factors, this study integrated and analyzed many viewpoints, and put forward corresponding suggestions according to the actual situation at this stage, aiming to provide practical suggestions for the sustainable development of Chinese sports industry in the digital era and theoretical guidance for further research on this issue.

2. Research Methods

From different perspectives and methods, Chinese scholars have directly or indirectly analyzed the factors impacting the development of Chinese sports industry in the digital era. This study employed the method of systematic review to make a comprehensive and objective synthesis of these viewpoints. Compared with traditional literature review methods, systematic review is more scientific and objective, which can ensure the accuracy of results[6]. It can be subdivided into qualitative and quantitative comments. The former is a qualitative evaluation and summary of the results and conclusions of the original literature. The latter is the process of combining results using statistical methods, also known as meta-analysis. In some research areas where it is difficult to combine analysis with statistical methods, qualitative retrospective method is more appropriate. Therefore, this study adopted qualitative research method to carry out descriptive statistics on existing text conclusions. In order to explain the research topic more comprehensively, after searching the current situation of development, development characteristics, development trend and development path of Chinese sports industry in the digital era, this study finally determined the research questions as: What types of factors impact the development of Chinese sports industry in the digital era? What are the specific factors?

2.1. Search strategy and study inclusion criteria

As an important part of systematic review, document standard plays a decisive role in the final result[7]. In order to ensure the accuracy and strictness of research results, this study sets the following standards from the following aspects to ensure the quality of literature retrieval : (1)database. In this study, CNKI(China National Knowledge Infrastructure) was used as the source of articles. With an internationally leading digital library and a resource sharing platform, CNKI is the largest monopolistic website that integrates all kinds of full-text academic information in China, which can guarantee the comprehensibility and reliability of the data[8]; (2)Key words. According to the research questions, after multiple screening, digitization AND sports industry development, intelligence AND sports industry development and other keywords were retrieved in CNKI; (3)Retrieval time. "Digital sports" was first proposed in 2012, and the integration of sports industry and digitization also started that year, so the start time was set as 2012; (4)Retrieve the type of document. This search includes only articles in core database and does not include other publications.

2.2. Data extraction and synthesis

Literature retrieval is the second step of systematic review, which is mainly about the thorough retrieval of relevant literature. This study was limited in Chinese language and data parameters from the start of January 1st, 2012 to November 21st, 2020. The search terms were chosen with digitization AND sports industry development, intelligence AND sports industry development and other keywords. The initial search returned 770 articles and these were narrowed down to 179 articles based on the information contained in their titles and abstracts by one researchers. The remaining 179 articles were cross reviewed by the other two researchers. It was reduced to 20articles by full paper screening. The information about factors and main contents were collected and scanned by two researchers and reexamined by another one. All the information were collected by a single researcher. The information extracted was identified by another researcher. As shown in the following <Table 1>.

Table 1. The information of articles.

Authors	Year	Topic	Corresponding contents
Lv C [9]	2016	Development of the Winter sports industry in China in "Internet + "	- More sports policies, marketing model innovation and multi-terminal interconnection technology platform construction were the impetus to the development of ice and snow sports industry
Chen XD [10]	2016	Opportunities and challenges brought by the internet to the operation mode of sports industry	- The increase of sports consumption demand, diversification of consumption, innovation of marketing model and sports policy brought opportunities for sports industry operation - Uneven population consumption ratio and unitary business model brought challenges to sports industry operation
Wang ZX [11]	2016	Innovation of sports service development model under the internet environment	- The increase of per-capita income, sports consumption demand and the innovation of marketing mode were conducive to the innovation of sports industry
Bai L, Sun CC [12]	2016	study of sports industrial talent cultivation in the internet era	- Lack of professional talents hindered the development of sports industry

Li H [13]	2016	Internet reconstruction of sport industry and its future trend	- Diversification of consumption and innovation of marketing model were the foundation of the future development of sports industry - Uneven population consumption ratio and unitary business model were the disadvantages of the sports industry
Xia YQ [14]	2016	Ecology of the sports industrial background the “internet + ”	- The construction of online quick marketing platform, product technology innovation and multi-terminal platform were the development trend of sports industry
Yan XY [15]	2017	Study of innovation-driven development of the sports industry promoted by “internet+ ” and related	- The increase of per-capita income, sports consumption demand and the diversification of consumption were conducive to the innovation of sports industry
Liu YF [16]	2017	Sports industry ecosystem in the era of “internet plus”	- Increasing consumer demand, big data, cloud computing and other technology applications, platforms and integration advantages promoted the development of the sports industry
Chen FY, Bu T [17]	2017	Sports industry development strategy under the background of “internet plus”	- Mobile Internet communication technology, online quick marketing platform, big data, cloud computing and other technologies and sensing technologies to increase the value of sports products were not advanced enough, hindering the development of sports industry
Li DP, Liang XJ, Deng CL [18]	2017	“Internet + ” background leisure sports industry development trends, power and innovation path	- The construction of online quick marketing platform, the diversification of consumption and the innovation of marketing mode were conducive to the development of sports industry
Zhang B, Rao R [19]	2017	Sports industry development strategy study under the background of “internet plus”	- Mobile Internet dissemination technology, product technology innovation were conducive to the development of the sports industry
Wu CX [20]	2017	SWOT analysis and countermeasure research on the development of internet+ sports tourism industry	- Sports welfare policy, multi-terminal platform building and increasing consumer demand were opportunities for the development of sports industry - Regulatory rules, lack of professional talent, single operation mode hindered sports industry development
Zhang XY, Shao GT [22]	2017	Present situation and characteristic of the new sports industrial form under "internet + " environment	- Lack of professional talents restricted the development of sports industry - Uneven population consumption ratio and unitary business model hindered the development of sports industry - There are deficiencies in technology fusion
Zhang HR, Liu MH, Peng LF [21]	2018	Path choice of sports industry development under the background of “ internet plus“	- Big data, cloud computing and other technologies accelerated the development of the sports industry - The multi-terminal interconnection technology platform improved sports consumption - There are deficiencies in technology fusion
Yang J [23]	2019	Development of leisure sports industry in Jiangxi province under the "internet plus" era	- The construction of multi-terminal interconnection technology platform and the widespread use of mobile Internet communication technology promoted the development of sports industry - Inadequate technological integration, lack of professionals and lack of regulatory rules were major obstacles

Chen M, Zhang JQ [24]	2019	Internet + and the development of sports industry	- The comprehensive application of big data, cloud computing and sensing were the foundation of the development of sports industry
Jiang XJ [25]	2019	Development of Sports industry: New Opportunities and Challenges	- The sports welfare policy, the widespread use of mobile Internet communication technology and the innovation of marketing mode were opportunities for the development of sports industry - The large gap between urban and rural consumption, the unbalanced consumption of population proportion and the single business model were the challenges of the development of sports industry
Liu JH [26]	2019	Sports industry in the network and digital age	- Increasing per-capita income, sports consumption demand and marketing model innovation were the characteristics of digital sports industry - Lack of sports welfare policies and insufficient technology integration hindered development speed
Wang XR [27]	2020	Development of ice and snow sports industry in "internet+" era	- Insufficient technical integration and lack of professional talents hindered the development of ice and snow sports industry - The construction of terminal interconnection technology platform and the increase of per-capita income were the driving forces for the development of ice and snow sports industry
Ren B, Huang HY [28]	2020	The power, mechanism and mode of the integration of Chinese digital economy and sports industry	- The sports welfare policy, the increase of per-capita income, the increase of sports consumption demand and the diversification of consumption were the driving forces for the development of the sports industry

3. Result

By summarize the articles, this study found that the factors impacting the development of Chinese sports industry in the digital era could be divided into three parts: political factors, economic factors and technical factors. As shown in the following <Table 2>.

Table 2. Summary of Influencing Factors.

No.	Types	Factors
1	Political factors	- Sports welfare policies still need to be strengthened
2	Economic factors	- Increasing per-capita income - Increasing demands for sports consumption - Diversification of consumption - Innovation of marketing model - large gap between urban and rural consumption levels - Uneven proportion of the population - Unitary business model

3	Technical factors	- Big data, cloud computing and other technologies and sensors are fully applied - Construction of multi-terminal interconnection technology platform - widely used Mobile Internet communication technology - Construction of online quick marketing platform - Product technology innovation - Insufficient technology convergence - Lack of professional talents - Lack of regulatory rules

After summarizing, the following phenomena were found: 1. In the continuous development of digital sports industry, some factors had been solved or could not have an important impact on the development of Chinese sports industry; 2. Some influencing factors were benign factors, which were beneficial to the digital development of Chinese sports industry. In order to put forward more accurate and objective suggestions to promote the digital development of Chinese sports industry, this study eliminated all the benign factors in the following analysis, and screened the influencing factors according to the actual situation and relevant policies, regulations and other documents, and eliminated some ineffective influencing factors. The details are as follows:

(1)Political factors: The research results showed that the political factors impacting Chinese sports industry development was mainly reflected as sports welfare policies should be strengthened. The promulgation and implementation of sports policies was not only the internal driving force for the rapid improvement of Chinese sports consumption, but also an important guarantee for the healthy and sustainable development and high-quality development of Chinese sports industry[29]. After the integration of sports industry and digitalization, the Chinese government had repeatedly adopted measures and policies to encourage digitalization of Chinese sports industry, as shown in Table 3. Therefore, the development of Chinese sports industry need the support of sports policies. It will always be the primary factor affecting the digital development of Chinese sports industry. As shown in the following <Table 3>.

Table 3. Corresponding policies encouraging the digital development of sports industry

Year	Policies	Main contents
2014	Several Opinions of the State Council on Accelerating the Development of Sports Industry and Promoting Sports Consumption	Encouraging research and development of smart products such as wearable sports devices
2016	Notice of the State Council on the Issuance of the National Fitness Plan (2016-2020)	Encouraging the development of new forms of fitness for all, including online fitness training and education
2016	Guidelines of the General Office of the State Council on accelerating the Development of the Fitness and Leisure Industry	Encouraging the development of fitness and leisure services supported by mobile Internet, big data and cloud computing technologies
2016	The Outline Plan of 2030 Healthy China	Developing and applying big data of national physical health monitoring, and carrying out risk assessment of sports
2018	Guidelines of the General Office of the State Council on Accelerating the Development of the Sports Competition Performance Industry	Valuing and encouraging new technology of rebroadcast, safe monitoring and artificial intelligence applying in sports competition performance industry
2019	Opinions on Taking The 2020 Beijing Winter Olympics as an Opportunity to Vigorously Develop Ice and Snow Sports	Supporting new technology of ULTRA HD video and virtual reality applying in the live and broadcast of ice and snow sports events

2019	The Notice on Printing and Distributing the Outline of Building a Sports Power by the General Office	Using new information technologies such as the Internet s and cloud computing to promote the booking of sports venues and the distribution of event information, business service statistics
2019	Opinions of the General Office of the State Council on Promoting National Fitness and Sports Consumption and Promoting the High-quality Development of the Sports Industry	Promoting the application of emerging technologies such as intelligent manufacturing, big data and artificial intelligence in sports manufacturing.

(2)Economic factors: Economic development is one of the important factors impacting the development of the sports industry. Only with the stability of the national economy, the improvement of national income and consumption level, sports consumption would have a solid foundation[30]. According to the summary of the information, the main economic factors impacting the digital development of Chinese sports industry were the large gap between urban and rural consumption, the unbalanced consumption of population proportion and the single business model.

The gap between urban and rural consumption before the integration of digitization and sports industry was an important sports consumption problem. The digital technology had gradually solved collaborating marketing combining online and offline. It created more choices for consumers, so the factors barely impact on the development of Chinese sports industry at present. The consumption imbalance of population was caused by the fact that after the aging of Chinese population becomes serious year by year, the elderly had less understanding of sports science and technology and less acceptance. According to the current situation, this problem will still have an impact on the digital development of sports industry. The problem of single business mode is due to the short development time and weak foundation of Chinese sports industry. Many small and medium-sized sports enterprises can only carry out traditional business mode, which hinders the development progress of digital sports. But the Chinese government issued the Notice on Printing and Distributing the Outline of Building a Sports Power by the General Office to promote the transformation of small and medium-sized sports enterprises. Therefore, the influence of this factor on the digital development of Chinese sports industry is gradually diminishing.

(3) Technical factors: Technology is the direct driving force to promote the growth of sports industry. In sports industry, the emergence of any new technology and using can improve the quality of the products, production efficiency, reduce cost, and even promotes the emergence of new products. It might break the existing division of labor system in the sports industry, caused the expansion of the sports industry structure and complicated and stimulate the development of sports industry and related industry[31]. The integration of digital technology and sports industry is the proper way. But in this process, due to insufficient technology integration, lack of professional personnel, lack of regulatory rules and other factors, digital development of Chinese sports industry occurred problems frequently. However, with the intervention of the government and the adjustment of Chinese sports industry itself, the investment in digital technology innovation has been increased, and the training of professional talents in universities and other educational departments has been enhanced. From the current situation, all the rest problems will be solved, except regulatory rules still need to be clarified.

To sum up, the main factors impacting the digital development of Chinese sports industry at present were: sports policies, unbalanced consumption of population proportion and lack of regulatory rules.

4. Suggestions

4.1. Expand the implementation scope of sports welfare policy

The strong support of national policies is the foundation of the development of Chinese sports industry[32]. The development of new technologies and sports industry can be still improved based on several documents encouraging the digital development of Chinese sports industry. Reviewing the welfare policies of digital sports industry issued by government in recent years, most of them focused on the promotion of mature technologies and sports industry, rather than some emerging trends or industries, such as sports e-sports. E-sports sports, one of the sports industry in China, is on the rise in recent years and popular among the younger generation in China from the beginning of the development, but it does not be support by some corresponding welfare policy. It will develop better and improve the diversified development of Chinese sports industry with some policies more than indirect benefit policies and wide potential market. Therefore, it is suggested to expand the implementation scope of sports welfare policies and issue targeted welfare policies for emerging industries and emerging trends.

4.2. Enhance the popularization of sports science and technology

At present, Chinese society is facing the serious aging problem. According to the National Bureau of Statistics of the People's Republic of China, the population of elderly will continuously increase. It is expected to surpass 410 million in 2036, with a population of more than 25.6% [33]. This phenomenon not only means that the elderly will become a major part of the social consumption group in the next 10 to 20 years, but also means that the proportion of the population consuming sports will continue to be unbalanced during this period. The elderly must be listed as the promotion target to achieve breakthrough progress at this stage by Chinese digital sports industry. Due to the poor receptivity and less contact channel to sports technology by the elderly, it is suggested that popularization activities of science and technology are held in the whole society. There are still some other ways to promote the popularization to introduce the advantages of sports technology changing life, such as helping the elderly to learn by young people, someone who have already learnt it or the community. It can attract accept and consumption of the elderly, also promote the development of digital sports, even stabilize society and improve living standards.

4.3. Strengthen supervision in digital sports field

The infringement of sports intellectual property rights occurs from time to time in the process of digital communication in China. Although digital information is simple to copy, carry, modify and disseminate, it also reflects the imperfect supervision system to some extent[34]. If Chinese digital sports industry wants to develop healthily and benign, it is suggested to establish a governance mode dominated by government, supplemented by market and regulated by social participation, and to establish strict industry standards to prevent the occurrence of unstable risks. First of all, the government should strengthen the rule of law supervision, increase punishment, such as the digital fraud, smart theft of information, network dishonesty and other problems to provide a good development environment for the digital sports industry. At the same time, the sports industry market has also set up risk management or risk identification programs due to its strict requirements on itself and joint efforts to resist digital criminal behaviors based on legitimate competition. A risk management plan can reduce loss[35]. Risk identification can effectively detect risks in advance and achieve the purpose of prevention[36]. In addition, the society should also play the role of supervision by means of public opinion echo and information sharing.

5. Conclusions

Network and digital technology not only promote productivity as a technical factor, but also shape the economic and social form as an economic development model and way of thinking[37]. The integration of Chinese sports industry and digital technology conforms to this form. From

the data of the existing industry and policy, the combination of network and digital technology and sports industry will improve in the future. In the network digital era, the production efficiency, market structure and business model of the sports industry will also be changed. In order to explore the way for the benign development of combination, this study, based on the total number of the system, conducted a descriptive research on the factors impacting the digital development of Chinese sports industry, and put forward corresponding development suggestions for the main factors. However, due to the descriptive statistics of the existing textual conclusions and the lack of quantitative analysis, there are still some limitations. It is hoped that it can be made up in the following research and the results of this study can provide some theoretical basis for further research.

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7. Appendix

7.1. Authors contribution

	Initial name	Contribution
Lead Author	XFB	-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑
Corresponding Author*	HBS	-Make a significant contribution to collection ☑ -Final approval of the paper ☑ -Corresponding ☑ -Play a decisive role in modification ☑
Co-Author	XMZ	-Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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Eucommiae Cortex(Eucommia Ulmoides Oliver) Modulates MUSCLE Atrophy In Aged Mice

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Abstract

Purpose: *Although exercise is the only way to suppress sarcopenia, using it for treating sarcopenia in the elderly is very difficult. Sports supplements used for the purpose of maximizing the benefits of exercise may include drugs that directly modulate sarcopenia. Therefore, the intake of sports supplements can be expected to have a synergistic effect of strengthening muscles in combination with exercise.*

Methods*: In this study, we attempted to find a candidate adjuvant that might have a synergistic effect in the treatment of sarcopenia. To test the effect of Eucommiae(Eucommia ulmoides Oliver) cortex extract, which is used in Korean herbal medicines, in the treatment of sarcopenia, mice were divided into 3 groups: a control group(CON), a sarcopenia model group (age-elicited group; AEG), and a group consisting of sarcopenia model mice being administered with Eucommiae cortex extract(ECTG).*

Results: *We identified muscle loss in aged mice and applied this mouse model to evaluate the efficacy of sports supplements. Muscle loss was reduced as a result of treatment with Eucommiae cortex extract to aging mice. The expression of Caspase-3 was measured in the femur using specific antibodies. Muscle mass was analyzed using dual-energy X-ray absorptiometry. In the AGE group, protein expression of Caspase-3 was increased; however, in the ECTG group, Caspase-3 expression was significantly reduced.*

Conclusion: *These findings suggested that Eucommiae cortex extract decreased muscle loss and muscle cell death by regulating Caspase-3.*

[Keywords] ***Sarcopenia, Muscle Atrophy, Caspase-3, Eucommiae Cortex, Eucommia Ulmoides Oliver***

1. Introduction

World Health Organization, in 2017, formally classified and defined sarcopenia as a disease characterized by less than normal muscle mass. Furthermore, the main cause of sarcopenia is decreased number of muscle cells because of aging and lack of physical activity[1]. Sarcopenia can be exacerbated by a nutritional imbalance in the muscles. After the onset of sarcopenia, rapid muscle loss is observed. Eventually, the ability to store energy also decreases, leading to fatigue. In addition, because basal metabolism decreases, weight can change frequently. In the case of diabetic patients, it is difficult to control blood sugar, leading to increased mortality[2]. Thus, one of the greatest challenges in treatment of sarcopenia lies in controlling the gradual loss of skeletal muscle mass and function because of aging.

To the best of our knowledge, exercise therapy is considered to be the only treatment for sarcopenia at present. Furthermore, there have been no reports of sarcopenia treatments approved by the U.

S. Food and Drug Administration. Exercise therapy is based on the study of the dynamics of body movements, to provide information on the health of all organs and systems, and it is considered to play a central role in the treatment of sarcopenia[3]. Therefore, exercise program development must be appropriately designed, accounting for the differences in individual's ability to exercise. Moreover, the importance of the intake of sports supplements to support the exercise program must also be emphasized.

In this study, we tried to demonstrate the effects of a candidate adjuvant mentioned in traditional Korean medicine that can modulate sarcopenia. Eucommiae cortex(*Eucommia* ulmoides Oliver) extract exhibits various effects in vivo, such as antioxidant, anti-osteoporosis, anti-diabetic, and anti-cancer[4]. In addition, it has been reported to be effective in treating depression caused by aging. There has been no in vivo study on Eucommiae cortex(*E.* ulmoides Oliver) extract to see if its effects, including antioxidant and anti-osteoporosis, can be effective against sarcopenia-induced muscle loss. Therefore, this study investigated whether Eucommiae cortex extract could be as effective as a prescription drug for sarcopenia, a senile disease.

2. Materials

2.1. Chemicals

Vectastain ABC kits and DAB kit were obtained from Vector Laboratories(Burlingame, CA, USA). Trichome stain kit and caspase antibody were purchased from Abcam(Cambridge, UK).

2.2. Water extraction of eucommiae cortex extract

The aqueous extract from the plant material was obtained by slightly modifying the methods described previously[5][6]. Eucommiae cortex(EC)(400 gm) was placed in 3,000 mL of distilled water and heated for 2 h at 100 °C. The water with the extract was filtered using a rotary evaporator. Using this method, we obtained 45.1 g of extract(yield: 11.3%).

2.3. In vivo study

The ICR mice(male; Jung-a bio, Gyeonggi-do, Korea) were maintained at 23 °C ± 2 °C with a 12 h light/dark cycle. All animal experiments and care were performed in accordance with institutional guidelines(SEMCARE 18-12-04). The mice were divided into 3 groups: control group(CON;8-week-old mice),; Aging-elicited group(AEG;50-week-old mice treated with normal saline),; AEG mice treated with EC(ECTG; 50-week-old mice treated with 0.51 g/kg/daily of EC extract).

2.4. Muscle mass analysis

This analysis was performed as described in a previous study[7]. The mice were anesthetized using sodium pentobarbital, and the muscle mass was analyzed using X-ray absorptiometry(Medikors Inc., Seoul, Korea). The bone mass was analyzed using dual-energy X-ray absorptiometry(DXA, Medikors Inc., Seoul, Korea).

2.5. Immunohistochemistry analysis

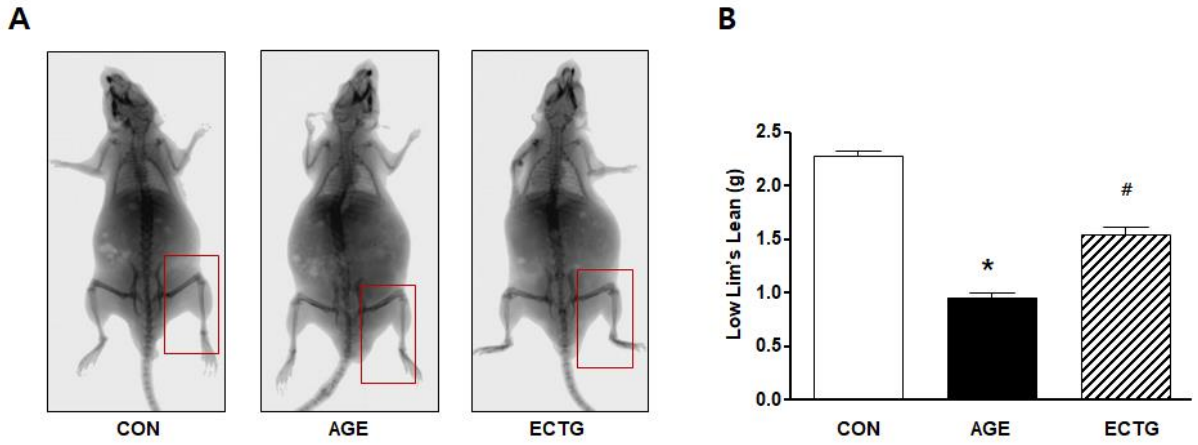
Immuno-histochemistry analysis was performed as described in a previous study[8][9]. Immunohistochemical results were quantified(means ± standard deviation) by image analysis using Image-Pro Plus(Media Cybernetics, USA). In the positive spots, randomly selected from each group, were imaged at a 400× magnification and at positive pixels/50,000,000 pixels. Statistical analysis was performed using SPSS ver. 23.0(IBM Corp., Armonk, NY, USA). One-way ANOVA was performed to verify significance ($P < 0.05$), followed by the least significant difference test.

3. Results and Discussion

3.1. Eucommiae cortex extract regulates muscle atrophy in aged mice

The double-energy X-ray absorptiometry used in this study can determine the degree of bone density and muscle atrophy. To investigate the effect of EC extract on muscle mass and muscle atrophy in an in vivo model, we analyzed muscle mass around the femur. As shown in <Figure 1>, the level of muscle mass in the CON group was 2.28 ± 0.05 g. In AEG (sarcopenia-induced muscle loss group) muscle mass was 0.96 ± 0.04 g, whereas ECTG had a muscle mass of 1.54 ± 0.08 g. These results suggested that muscle loss in aged mice was consistent, and the administration of EC extract suppressed this muscle loss.

Figure 1. Effects of eucommiae cortex extract on muscle atrophy in mice.

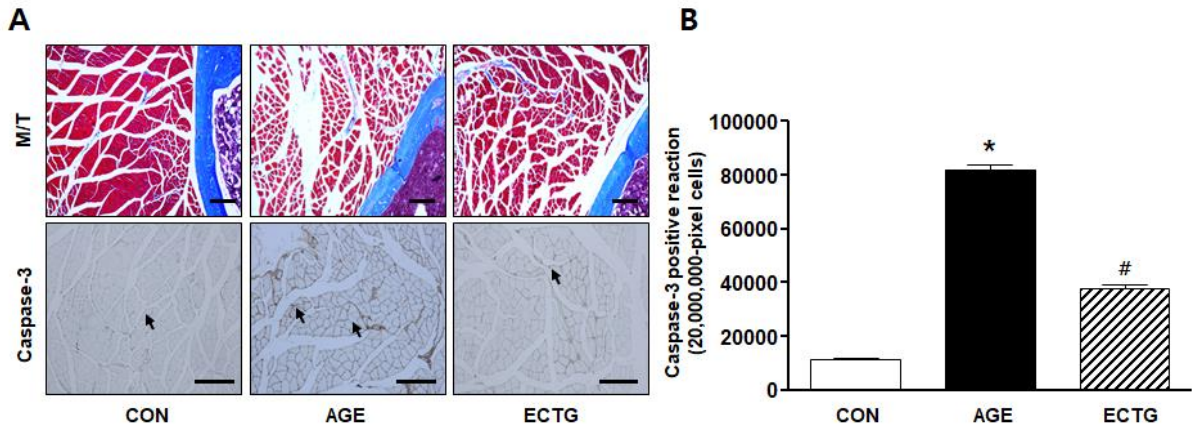


Note: (A) Representative photographs of DAX image; the red colored squares indicate muscle area. (B) Bar graphs indicate the muscle mass of each mouse in panel A. Data are expressed as means ± standard deviation. *p < 0.05 vs. CON. CON, control group; AGE, aging-elicited group; ECTG, Eucommiae cortex treatment group.

3.2. Eucommiae cortex extract modulates muscle atrophy in aged mice by inhibiting caspase-3

Apoptosis performs important biological functions during regeneration and proliferation. However, apoptosis in muscle cells can induce muscle atrophy[10]. Furthermore, Siu et al. reported that inhibition of apoptosis attenuated muscle atrophy[11]. Therefore, controlling apoptosis of muscle cells may be one of the methods to control sarcopenia. The main signals of apoptosis pathway lead to the activation of caspases such as caspase-8, caspase-9, and caspase-12. Consequently, the upstream signals of these activated caspases stimulate the downstream caspase-3 to trigger apoptosis[12]. To determine whether *EC* extract can regulate aged-muscle death, we performed masson's trichrome stain (M/T) staining and immunohistochemistry using specific antibodies. As shown in <Figure 2A>, AGE showed significantly reduced muscle mass compared to that in CON. In contrast, muscle loss in ECTG was reduced as compared to that in AGE. As shown in <Figure 2B>, Caspase-3 expression in CON, AGE, and ECTG was 11,523 ± 466 pixels, 81,787 ± 2022 pixels, and 37,651 ± 1,460 pixels, respectively.

Figure 2. Effect of eucommiae cortex extract on caspase-3 expression.



Note: (A) Representative photographs of masson's trochrome stain(M/T) and Caspase-3 immunohistochemical staining in rat skeletal muscle. The arrows indicate OPC positive regions. (B) Bar graphs indicate the brown intensity of each caspase-3 photograph in panel (A). Data are expressed as means ± standard deviation. *p < 0.05 vs. CON. CON, control group; AGE, aging-elicited group; ECTG, Eucommiae cortex treatment group.

Although exercise is a treatment modality for sarcopenia, vigorous exercise for patients with senile diseases or degenerative diseases is harmful. Therefore, we propose that the standard treatment of sarcopenia should be a combination of sports supplements and exercise. We suggest that *EC* extract might be a sports supplement for preventing sarcopenia.

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4. Appendix

4.1. Authors contribution

	Initial name	Contribution
Author	SHA	-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑ -Make a significant contribution to collection ☑ -Final approval of the paper ☑ -Corresponding ☑ -Play a decisive role in modification ☑ -Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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The Comparison of MUSCLE POWER Related Main Techniques and Exercise Ability according to the Athletic Capacity of Male Middle School Handball Player

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Abstract

Purpose: *The present research aimed to analyze the breech between various groups under differing conditions by estimating and comparing the use of main techniques and exercise ability related to muscle power, which has influences on the athletic capacity of major and minor male middle school athletes for handball games. It also aims to offer rudimentary data for the fostering of muscle power of such athletes in the future, and enhance their capacity midst games.*

Method: *The subject of the research consisted of 8 major handball athletes and 8 minor handball athletes of N middle school in G district. The position of players in the 49th National Gymnastics Competition for Boys which took place in 2019 served the criteria with which major and minor athletes were divided: the main players midst the winning of the finals were classified as major, and the substitute players were classified as minor. For the estimation of muscle power, tests in hurling, jumping, short distance running and muscle endurance were conducted. The data processing was analyzed using the SPSS 18.0 statistics program, and the average and standard deviation were calculated per section. In order to find the difference between major and minor athletes, independent t-tests were conducted and all statistical significance level was set at $p<.05$.*

Results: *Among 7 categories of muscle power estimation related to major techniques which determine the winning or losing of handball games, the major players' records displayed a meaningful superiority in vertical jumping, standing long jumps, 30 meter sprints and 30 seconds push ups. Also, in other categories of muscle power estimation, the major athletes showed capacities exceptionally superior to that of minor athletes, although not amounting to a meaningful difference.*

Conclusion: *Conclusively, we can analyze that regarding the muscle power which has major influences on the handball playing ability of male middle school students, the ability to jump, sprint short-distance, and foster upper body muscle endurance are important since they contribute to major and specialized movements related to scoring.*

[Keywords] ***Male Middle School Handball Players, Muscle Power, Jumping Ability, Ability to Sprint Short Distance, Upper Body Muscle Endurance***

1. Introduction

Handball is a game in which sprinting, running, throwing, consistent jumping and stepping is done in a field of endline 20m and sideline 40m, and one which consists of a combination of muscle power related techniques and the tactical enacting of movements. In a handball game, the strikers reach the goal area of the opponent through dribbles and passes and makes a shot against the defence in front of them, or with swift passes and feinting, overtakes the final defender, goes through, and jumps in from outside the goal area and succeeds in scoring. As for the defense players, they are expected to halt the strikers with forceful body slamming

and fouls as much as the rules of the game allows, and hinder or block the connecting of the passes to not allow the opponents the chance to score, and relay the ball to the goal keeper of the defending team so that the ball would belong to the defending team which would then be converted to the side striking. Thus, handball games can be seen one in which there is an intense struggle between the strikers and the defense players near the goal area line and free throw line, and in which swift attack movements continue in a turnover[1].

Handball games allow fouls according to the attributes of the game and thus physical contact such as fierce body slamming occurs quite often, and a prior research has validated that Korean handball players have good muscle traits, since much time and effort is spent in order to improve maximum strength and the power of muscles to overcome the inferiority in terms of body build in matches against European players[2]. Thus, the coaches and players on site are keenly interested in ways in which muscle power could be enhanced[3].

Muscle power has to do with the ability to make possible the execution of large amounts of tasks in limited time in active movements, such as jumping high or far, moving swiftly, and throwing an object. It is one of the most consequential element of body strength which affects ability in sports games and even results in victory or failure. Muscle power also has a keen relationship with agility, and is a kind of power exerted by momentary muscle contraction while the player is in movement. Muscle power has to do with the ability in which the muscle contracts instantly and exerts much power, and is often determined by how effective is the balance between the functional faculties of the nervous system and the muscles. The form in which such an energy is expressed is determined by the stimulation threshold of the sensory system, the amount of time taken to determine judgement by the central nervous system, and finally, the speed of neuro-transmission and muscle contraction[4].

Muscle power becomes necessary when the concentration of nervous impacts causes the muscles to contract, and the more the momentary contraction of the muscles, the more the physical ability to act. Muscle power is divided into the transverse power and vertical power, and is the ability to wield maximum ability in the shortest possible time, and also can be seen as the rate of the task done within a time unit. Muscle power, according to the strength and speed, could differ in two-folds and three-folds[5][6][7].

According to a previous research, the muscle power midst the process of exercise can be measured according to the distance in which the body and objects can be propelled through a certain space. It can also be affected by body structure and the viscosity of muscle weight. According to the research, there is a high level of relevance between muscle power and jumping trials[8]. Also muscle power can be examined through having subjects jumping backwards from a fixed position, and checking the power to throw balls and the ability to run short distances. In particular, midst matches, muscle power is one of the most important physical attributes which determines the ability to exercise, and serves a major part in running, jumping and throwing, all of these the basic activities which forms all sport techniques and consists active exercise[9].

The enhancing of muscle power have a toll on the ability to play in all kinds of sports, and it is the ability to exert maximum strength in minimum time, including many kinds of movements which use much muscle force in an instant among moves in gymnastic and sports. That is to say, taking into account the total amount of work in which a determined weight will move a certain distance during what span of time, the intention is to maximize muscle power used within a minimum span of time, the ultimate goal being intensifying muscle power and enhancing the speed. Muscle power is deemed an important bodily factor which affects the performance of elite players[10]. However, regarding the researches in which the relationship between the variables of techniques, which influences handball games, and physical ability, scarce is a research taking into account major and minor athletes in middle school(7th-9th grade, American system) Thus, the present research compares major techniques and exercise abilities related to muscle power, which massively affects the ability for taking part in handball games, among major players and minor players in middle school handball games for boys,

taking note of discrepancies between groups, and offering rudimentary data for improvements in techniques and ability to play related to muscle power.

2. Research Method

2.1. Subjects

The subjects of the present research consisted of 8 major players and 8 minor players among the 16 handball athletes in N middle school, G district as recorded by the Korean Sport and Olympic Committee. The criteria determining major and minor athletes was the position they took in the 49th National Gymnastic Competition for Boys year 2019, where those who were main players were classified as major, and the substitutes minor. The subjects got full explanations prior to the research on its purpose and procedures and took part voluntarily, and they participated 1 week after the competition ended. <Table 1> describes the physical attributes of subjects.

Table 1. The physical traits of subjects.

Trait / Group	Age	Height (㎝)	Weight (㎏)	Muscle amount (㎏)	Body fat (%)	Lean mass (㎏)	Body mass rate (㎏/㎡)	Player
Major athletes	14.03 ±0.92	168.29 ±6.48	57.99 ±7.29	47.88 ±6.89	7.55 ±6.25	50.91 ±6.86	20.47 ±3.56	8
Minor athletes	14.02 ±0.79	168.78 ±5.34	57.98 ±6.58	46.69 ±4.62	8.12 ±4.26	50.85 ±3.79	20.65 ±2.05	8

2.1.1. Body composition

On the day of the experiment, the subjects participated 10 hours after the last meal, after relaxing in a lab in a state of fasting for 15~20 minute. We used the product from the Inbody 720 Biospace firm(KOR), and had the subject dress as lightly as possible as to not hinder body weight estimation, and with them climbing atop the device and contacting hands and feet to the circuits, the body fat, lean mass, body mass rate, and muscle amount were measured.

2.2. Muscle power capacity

In order to estimate muscle power a number of tests were conducted. An evaluation on the ability to throw took place with basketballs and handballs. One evaluation on jumping ability was done with tests on jumping high or far in place, and one was done on speed through 30 meter running which took place twice, among which the maximum rate was recorded. Recorded were the muscle power in gripping, in consideration of the power to take hold of the ball in order to throw it, and the muscle power of the abdomen, in consideration of fierce and continual struggles in defence and attack moves. Taking into account the muscle power and muscle endurance of the upper body which are necessary in the first and second half related to swift passes and shooting, records of sit-ups and push-ups were taken.

2.2.1. Basketball throwing

The subject had his back at a right angle, leaning on a flat bench fixed against a wall, and was asked to push the basketball with only the power of the upper limb. As for the order of estimation, the baseball was grasped at both sides with both hands, held at the right angle from the chest, and with the back pressed against the surface, with only the muscle power of

the arm, the ball was handled by the subject. Here, the subject was controlled to not have his back off the wall. The distance of estimation was measured determining the distance from the tip of the subject's hand to the place where the basketball landed, and was recorded by centimeters with a tape measure. Tests were done three times and the maximum rate was recorded.

2.2.2. Handball throwing

Handball throwing is one of the most important functions of a handball player, and it is crucial that an accurate throw at a fast speed be done midst passes or shootings. It is the skill of relaying explosive power to the ball in minimum time, with the lower body, the waist, the muscle power of the upper limb and others working together, and can be seen appropriate for measurement in this particular study. As for the way in which the measurement was made, the subjects were allowed free movements in a circle of a diameter of 2 meters, and were asked to throw the handball with the movement they made in their training, without the jump. The estimation of the distance was made from the beginning of the foothold to the place the ball first landed with a tape measure(Komelon, Korea) in centimeters. The records were taken three times and the maximum rate was recorded.

2.2.3. Vertical jump

This is a means of estimation where vertical jumping ability is recorded, taking use of JS-D80 of Yagami, by having the subject spread his arm upward, and taking use of the location and rebound, evaluate the most prominent difference between the height reached and the initial height. In order to estimate, the subject stood in front of the device with both feet together, and after raising the arm near the device and by touching and recording the tip of the hand with both feet on the ground, jumped using the rebound of knee, waist and arm, and reached for the touchpad at the highest spot. The digital jump meter of the recording were in centimeter units, and the maximum record midst 3 trials was taken as the estimate.

2.2.4. Standing long jump

The standing long jump was done with the feet fixed on the treading block without a running start, with appropriate rebounds front and back, up and down, and finally through jumping. After warming up on the measuring board with feet at shoulder width, and after 2 to 3 rebounds using the knee, arm and waist, the subject was asked to jump. The distance between the starting line and the nearest ankle which reached the measuring board was recorded. The unit were centimeters, and the maximum record midst 3 trials was taken as the record.

2.2.5. 30m running

The above means of recording was done on the international athletic standard track, where after the distance was estimated beforehand, laser sensors were installed on the starting and finish line, and once the subject was ready he was asked to run at fastest rate. After passing the laser sensor at start line and end line, the rate was recorded automatically. The unit was in seconds(m/s), and the maximum record midst 2 trials was taken as the estimate.

2.2.6. 30 second sit-ups

Fixing the feet on one side of the measuring instrument(Welltech Co, Korea) and with two hands folded behind the head, the subjects were asked to have their elbows touch their knees for 30 seconds after the starting call. The maximum rate of repetition was recorded.

2.2.7. 30 second push-ups

The subjects were expected to have both hands at shoulder width, join their feet together, and have arms at a right angle. With the starting call, they were expected to have elbows at more than 90 degrees and the chests lightly touch the floor. Such movements were executed for 30 seconds, and the maximum rate of repetition was recorded.

2.3. Data analysis

In order to manage the data for this research, the SPSS 18.0 statistic program was used for analysis, and the average and standard deviation was calculated. An independent T-test was used in order to find the difference in muscle power between major and minor athletes, and all the level of statistical relevance was set at $p<.05$

3. Results

3.1. Throwing ability

<Table 2> is the result on the throwing ability among muscle power evaluations of major and minor athletes. There was no relevant difference in the two group's ability to throw basketballs and handballs.

Table 2. Comparison of throwing ability(unit: cm).

Sector	Category	Minor athletes	Major athletes	*p*
Throwing ability	Basketball throwing	540.87±51.66	562.68±88.29	.568
	Handball throwing	3321.54±38.65	3669.35±692.78	.349

3.2. Jumping ability

<Table 3> is the result on the jumping ability among muscle power evaluations of major and minor athletes. The category of vertical jump displayed a meaningful difference($p<.01$), with major athletes at 48.75±3.44cm, and minor athletes at 40.89±4.35cm. Standard long jump also displayed a meaningful difference($p<.05$) with major athletes at 235.78±13.48cm, and minor athletes at 210.53±16.51cm.

Table 3. Comparison of jumping ability(unit: cm).

Category	Minor athletes	Major athletes	*p*
Vertical jump	40.89±4.35	48.75±3.44*	.001
Standard long jump	210.53±16.51	235.78±13.488*	.029

Note: *p<.05.

3.3. Speed

<Table 4> is the result on speed among muscle power evaluations of major and minor athletes. In the sprint test evaluating speed showed a meaningful difference with major athletes at 4.59±1.25sec, and minor athletes at 4.96±0.21sec.

Table 4. Speed comparison(unit: sec).

Category	Minor athletes	Major athletes	*p*
30m Sprint	4.96±0.21	4.59±1.25*	.014

Note: *p<.05.

3.4. Muscle endurance

<Table 5> is the result on muscle endurance among muscle power evaluations of major and minor athletes. In 30 second sit-ups, no meaningful difference was derived with major athletes at 33.51±4.51회, and minor athletes at 31.05±3.87. In 30 second push-ups, major athletes scored 39.58±5.24 times, and minor athletes scored 29.45±8.35 times, a meaningful difference.

Table 5. Comparison of muscle endurance.

Category	Minor athletes	Major athletes	*p*
30 second sit-ups	31.05±3.87	33.51±4.51	.756
30 second push-ups	29.45±8.35	39.58±5.24*	.028

Note: *p<.05.

4. Conclusion

In order to lead a handball match to victory, it is necessary to score the most and lose points the least. To score, a shooting which can lead to a goal-in is needed. Among shootings, there are 1:1 no-mark shootings, done against the goal keeper after a swift attack, and powerful jump-shootings and diving shootings, formed through tactical movements and passes. To keep from losing score, continual and fierce body slamming with strikers in the defense zone, and blocking jumps to halt shooting and to retrieve the right to attack, needs to be done consistently. Also, after succeeding in blocking or after losing score, a sprinting at maximum speed needs be done to the opposition's den before the opponents can reach it. That is to say, handball games consist of movements of running, jumping and throwing, some before shooting which are close linked with scoring, some intended to keep from losing scores.

While movements of muscle endurance, a parameter of muscle power measurement, can be done with a single movement, namely the blocking jump to keep the opposition striker from scoring, in handball matches most of the movements are combinations of more than two skills among running, jumping and throwing. When rushing towards the opposition den for a rapid deployment, for instance, swift passes are made while running, and before a powerful strike, with a rapid sprint, athletes make a running start then proceed to a shoot. Taking into account the attributes of handball games in which all movements related to the winning and losing include those of muscle endurance, the present research estimated and compared the factors of muscle power in male adolescent major and minor handball athletes.

According to the present research, among the seven major muscle power abilities which affect handball games, major athletes proved a meaningful statistical superiority against minor athletes in categories such as vertical jumps, standing long jumps, 30 meter running, and

30 second push ups. Also, since major athletes achieved better records in all fields of estimation than the minor athletes, we could conclude that muscle power ability and techniques have an important effect on the ability to excel in handball games, which is why the importance in training for muscle power needs emphasis.

The standard makings of an accomplished striker in handball games is the ability to score or assist, and in a research between the physical abilities of handball athletes and the accuracy of a medium-distance shoot, there is a relevance between medium distance shoots and vertical jumps[11]. This denotes that the ability to jump, higher and with more force, enhances the accuracy of a shooting which may lead to scoring, and have the opposition defence come forth, so assisting a goal. In the present research, the ability to jump vertically on the part of major athletes was far better than that of minor athletes, which coincides with the results of the prior research.

Diving shoot is a movement as frequently made as the jump-shoot, which leads to scoring. It is a shoot made by jumping nearest to the goal post from outside the goal area, and, assisted by fellow players, throwing the ball before landing on the ground. Since this movement is not assisted by a running start, the possibility of scoring is enhanced by jumping the farthest and highest, maximizing the time in the air. In standing long jumps, measured by making such specifics of technique into account, meaningful superiority was found in major athletes in comparison with minor athletes, in which the prior and present research agrees that muscle power had high relevance with the ability to jump.

In 30 meter running, the major athletes had meaningfully higher statistics than the minor athletes. Often, in handball games, after a rapid deployment and scoring during the first and second half, athletes participate full speed in defence to halt opposition attacks. In international handball games, the average distance moved during one time midst the first and second half were 14~23 meters for 70% of the subjects, and movements were made by 6.5~9 meters per second[12]. In the present research too, in the ability to sprint short distance, a crucial element determining the capacity for handball games, meaningful superiority was found in major athletes compared to minor athletes.

The ability to jump vertically and execute 30 meter sprints usually involve movement of the same sort, and take use of a corresponding body part[13]. In fact, the report that the athletes with better vertical jumping ability is also found to have exceptional ability in maximum speed sprinting[14], and the report emphasizing the importance of power evaluation of adolescent athletes and one that says vertical jumping and standing long jumps have relevance to 30 meter running, advocates the present research[15]. Also, as a factor which affects muscle power, muscle fiber composition ratio can be mentioned. It is presumed that according to the attributes of the game, handball games which has similarities with basketball games, will have higher usage of fast muscle fiber among the muscle fibers deemed important in games lasting for a long time. As it is known that a basketball player's gross fast muscle fiber reaches the percentile of 45~69%[16][17], it can be presumed that handball athletes are of similar conditions. It is thought that there is a need to study fast muscle fibers, which affect muscle power, in detail.

Handball games require the muscle power of the upper body, where body slamming in which the opposition must be pulled and pushed midst attack and defense, and where fast passes and shootings must be done consistently. In the 30 second push-up estimation, the major athlete had meaningful superiority against the minor athletes. Taking into account the importance of shoulder and swing movements in handball games, a big breech between major athletes and minor athletes was expected but there was no meaningful statistic relevance. In a previous research the endurance level and anaerobic power differs according to muscle mass[18], and in teenage years the height of adolescents increase rapidly while the lean mass including muscles did not increase significantly, developing at later teenage years[19]. The physical attributes of major and minor groups of the research almost coincided in terms of muscle amount and lean mass. While adolescents about 14 years old see their muscle power

and muscle contraction rate in their lower body improve and that of the upper body develop late, once taking into account the enhancing of muscle contraction speed, a result like that of the present research was derived.

Muscle power can be seen in concepts of power and speed which involves the concentration of nervous shock, and is the ability to swiftly enact a power of a muscle contraction within a limited time. The power aforementioned denotes that of a muscle and the speed has to do with the speed of muscle contraction[20][21]. In the present research, the categories of muscle power estimation in which major athletes scored higher than minor athletes were closely related to main movement techniques which determine winning or losing in handball games. In vertical jumping, standing long jumps, 30 meter sprints and 30 second push ups, the major group showed better results in comparison to the minor group, and while there was no significant difference in terms of the unit of muscles involved, it can be concluded that, due to repeated training and experience, the central nervous system's judgement processing time and nerve transmission speed of the major athletes had advanced and with the muscle contraction rate quickening the muscle power overall have improved[22]. Also, according to the physical development of adolescence, it is seen that the muscle power and muscle endurance of the upper and lower body will be relatively different between stages, and detailed research seems necessary.

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6. Appndix

6.1. Authors contribution

	Initial name	Contribution
Lead Author	THK	-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑ -Make a significant contribution to collection ☑ -Final approval of the paper ☑ -Corresponding ☑
Corresponding Author*	KJK	-Play a decisive role in modification ☑ -Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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A Study on the DEMENTIA Awareness and the Dementia Needs in a District

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Abstract

Purpose: *Since the level of positive perception of dementia in Korean society is still very insufficient, it is difficult to detect diseases early and actively intervene in treatments. Supporting this situation, many studies have shown that there is a lack of basic knowledge and a lack of proper perception of dementia. This study is to investigate basic data for presenting the direction of establishing and developing the dementia policy in the future by seeking the effective operational plan for a dementia care center through surveying the dementia awareness and needs in a region.*

Method: *This study is a cross sectional study. This study targeted 498 people who are dwelling in G city of Gyeonggi Province. The research period is from May 1, 2018 to September 15, 2018. The data were analyzed by SPSS Win. 21.0 program.*

Results: *The dementia perception questions showed a significant difference according to participants' age, education level, interest degree, dementia knowledge level, and information contact appearance. As a result of surveying the demand for the dementia-related policy that is most necessary for research participants, a support for medical expenses had the highest need.*

Conclusion: *A large-scale research has rarely been done at home so far targeting city citizens in a region excluding Seoul Metropolis. Hence, this study will be able to be applied to useful basic data afterward for the establishment of a domestic dementia policy and for a dementia-related research. Especially, a change in the perception on dementia and in the use of a care service will become a very important source data.*

[Keywords] ***Dementia, Awareness, Needs, Satisfaction, Demand***

1. Introduction

Owing to the economic growth and the medical technology development throughout the world, the average life expectancy of a human being was extended, resulting in being increased the population aged over 65 years. This rapid aging led to a continuous rise in dementia prevalence rate. Even patients are predicted to likely grow about twice as much every 20 years with 540,000 people in 2012, about 1,270,000 people in 2030, and around 2,710,000 people in 2050[1]. According to this, the number of families taking care of the elderly with dementia are also presumed to probably reach approximately 2,700,000 people[2].

A surge in the elderly population brought about an increase in number of dementia patients. Thus, total annual medical expenses due to dementia mounted as well. Total annual national dementia management expenses for dementia patients in 2018 amounted to 15.3 trillion won, thereby having possessed nearly 0.8% of GDP(gross domestic product)[3]. The social cost caused by dementia for 2050 is estimated to increase even to about 1.5% of the real GDP[4]. Especially, a family caregiver of a dementia patient for 2017 was surveyed to use around

20,740,000 won per annum in order to take care of a dementia patient. Thus, a disease burden as of 2017 was reckoned to probably reach approximately 15 trillion won. Furthermore, the problem is that the comprehensive cost comes to double every year because the bigger economic scale leads to the more growth in medical care cost. In terms of this, the upsurge in dementia patients caused by aging will lead to the more rise in relevant expense hereafter. Hence, there is necessity for the development in community-oriented services and for the national countermeasure preparation available for maintaining and improving the function of patients who are in the early stage of dementia, not the service of centering on protecting and supervising dementia patients.

Dementia has no certain treatment method yet. Thus, early detection is crucial above all. And because our society is lacking in the understanding or the positive prevention activity and in the early discovery & treatment in terms of dementia, there are many cases of being not involved proactively in early detection and treatment. In the survey of National Dementia Awareness that was conducted by the central dementia center in 2014, dementia was selected as the scariest disease in more than 50 years old. Even in all age groups less than 50 years old, it was picked as the second scariest disease after cancer. Thus, even if the national fear of dementia is great, the half among dementia patients or families were grasped to fail to use due to having no information on whether the services required by them exist.

The awareness on dementia may be varied depending on individual factors(gender, age, education level, a coping style, etc.) and social elements(family function, medical system level, social publicity level, etc.). In addition, the perception on illness can be changed through the social publicity even though the individual factor is important as well[5].

Therefore, to make our society recognize a fact that dementia is 'one of the diseases available for prevention and treatment,' not 'an aging phenomenon that naturally occurs when one is old,' the Ministry of Health & Welfare(2008) is making a positive effort of proceeding with guiding in order to improve the social atmosphere that has concealed the dementia disease of the person in question or of the family so far in our society, and to be capable of receiving early medical checkup and cure. As part of this exertion, the government enacted and proclaimed the Dementia Management Act in August of 2011, established a national dementia center in 2012, and declared 'National Responsibility for Dementia' in 2017. The Metropolitan Center for Dementia has been established and operated 17 places including Ulsan and Sejong so far. The operation of 256 Dementia Care Centers[3] leads to giving a help to families as well as to the elderly with dementia.

Despite this endeavor, though, the awareness level on dementia in Korean society is in the real situation of being very deficient yet. Thus, it is difficult to detect a disease early and to actively engage in therapeutic intervention. As if backing up this situation, it was indicated to be short of basic knowledge on dementia and to be ill-conceived in correct perception on dementia. For this, the necessity was suggested for the development and publicity of a program, for the improvement in the standardized tool available for understanding the knowledge and attitude toward dementia, and for the education in relation to the proper knowledge based on the medical grounds, to a precautionary measure, and to an early detection.

Accordingly, this study is aimed to offer basic data for presenting the direction of establishing and developing the dementia policy in the future by seeking the effective operational plan for a dementia care center through surveying the dementia awareness and needs in a region.

2. Research Method

2.1. Research design

This study is a descriptive survey research in order to analyze the perception on dementia, the use of care services, and the demand & satisfaction for the dementia works.

2.2. Research subjects and period

This study targeted 498 people who are dwelling in G city of Gyeonggi Province. The research period is from May 1, 2018 to September 15, 2018.

2.3. Instrument

The research tool that measures the dementia knowledge level was used 12 items, which were developed by conducting a preliminary survey targeting 50 people as for the tool that was verified by receiving the content validity test from 4 professors of psychiatry with a major in dementia and 1 professor with a major in nursing science that were composed of experts relevant to the corresponding field at the Seoul Metropolitan Dementia Center in 2010. The items of the measurement tool on the awareness of dementia comprise 5 questions about the knowledge on disease, 3 questions about the knowledge on symptom, 2 questions about the knowledge on treatment, and 2 questions about the knowledge on nursing. The question about the dementia perception level was set to be a 'yes' or 'no' answer. With being set to be 1 point given being right and to be 0 point given being wrong, the scope of the total score becomes 0-12 points. It implies that the higher score leads to the higher knowledge level. And the tool on the demand and satisfaction for a dementia-related project was used by modifying and supplementing the tool that the Seoul Metropolitan Dementia Center itself developed.

2.4. Data analysis

The collected data were analyzed by using SPSS for windows 21.0 program that is a statistical program. The research subjects' demographic characteristics, dementia-related features, use of care services, and demand & satisfaction for a dementia project were parsed with frequency and percentage. The dementia knowledge level was resolved with the mean and the standard deviation by item. The difference verification in dementia knowledge level according to the demographic characteristics and the dementia-related features was unpacked by using t-test, ANOVA. The analysis of factors, which showed a significant difference in a percentage of correct answers to the dementia awareness question, was made by using multiple regression. The difference verification in a percentage of correct answers to the dementia awareness question was analyzed by using t-test, ANOVA.

3. Results

3.1. Dementia awareness level

3.1.1. General characteristics

Research subjects' general characteristics are as follows <Table 1>. Examining the research subjects' gender, women were 433 people(86.9%). Men were 65 people(13.1%). Thus, there were more males than females. Age ranged from more than 10 years old to more than 80 years old. The ages of 50-59 years stood at 189 people(37.9%), thereby having been the highest. The ages of 60-69 years amounted to 112 people(22.5%). The ages of 40-49 years came to 77 people(15.5%). The ages of 70-79 years stood at 55 people(11.0%). The ages of over 80 years amounted to 36 people(7.2%). The ages of 10-19 years reached 2 people(0.4%), thereby having been the fewest. The education level was the most in 10 years~above 12 years with 195 people(39.1%). The next came to more than 13 years with 156 people(31.3%). 7 years~9 years took up 92 people(18.4%). Even illiteracy possessed 14 people(2.8%). Job was occupied by a housewife with 288 people(57.8%), joblessness with 67 people(13.6%), and a student with 17 people(3.4%). Monthly income was held by less than 1 million won with 139 people(27.9%), 2,010,000-3,000,000 won with 115 people(23.1%), and 1,010,000-2,000,000 won with 114 people(22.9%). The research subjects with the experience of giving a care to a dementia

patient were 136 people(27.3%). The research subjects without the experience of giving a care were 362 people(72.7%).

Table 1. The characteristics of the study subjects. (n=498)

Variable	Categories	n	%
Gender	Male	65	13.1
	Female	433	86.9
Age(years)	10-19	2	0.4
	20-29	18	3.7
	30-39	9	1.8
	40-49	77	15.5
	50-59	189	37.9
	60-69	112	22.5
	70-79	55	11.0
	over 80	36	7.2
Education(years)	0	14	2.8
	1-6	32	6.4
	7-9	92	18.4
	10-12	195	39.1
	≥13	156	31.3
Occupation	Employee	41	8.2
	Self-employment	43	8.6
	Housewife	288	57.8
	Student	17	3.4
	Inoccupation	67	13.6
	Other	42	8.4
Income (ten thousand won)	≤100	139	27.9
	101 - 200	114	22.9
	201-300	115	23.1
	301-400	49	9.8
	401-500	50	10.1
	≥501	31	6.2
Care experience for dementia	Yes	136	27.3
	No	362	72.7

3.1.2. Demographic difference in dementia awareness level

In terms of the difference level in the dementia perception, women stood at 8.9±1.9 points, thereby having been higher than 8.6±2.0 points in men and having been statistically significant. Seeing it by age, the older age led to the lower dementia recognition level. The average score in their 10s reached 11.0±0.0 point. The average score in their 20s came to 10.2±1.6 points. The average score in their 30s accounted for 8.8±3.1 points. The average score in their 40s stood at 9.2±1.6 points. The average score in their 50s reached 9.1±1.7 points. The

average score in their 60s amounted to 8.9±1.9 points. The average score in their 70s stood at 8.2±2.4 points. The average score in more than 80 years old came to 8.5±2.4 points.

Even a difference in dementia awareness depending on age was statistically significant. Even a difference in dementia perception according to education level was indicated to be statistically significant. A case of illiteracy stood at 9.3±2.5 points. Academic career in less than 6 years amounted to 8.8±2.3 points. 7 years~9 years reached 8.83±1.9 points. 10 years~12 years came to 8.7±1.8 points. A case of more than 13 years stood at 9.5±1.6 points. In addition, a difference in dementia awareness level according to medical security was also shown to be 9.0±1.9 points in medical insurance, 8.3±2.5 points in Type-1 medical aid, 7.8±1.5 points in Type-2 medical aid, and 8.4±2.1 points in others, but appeared not to be statistically significant. A difference in recognition depending on the interest level in dementia came to 9.0±2.0 points in 'indifferent, 9.0±1.9 points in 'interested,' and 8.9±2.0 points in 'very interested.' A difference according to dementia knowledge showed 8.8±1.9 points in the average score of respondents with the answer saying 'don't know well,' 9.1±1.8 points in the respondents with the answer saying 'know a little,' and 8.5±2.2 points in the respondents with the answer saying 'know very well.' Even in the score of dementia recognition depending on whether or not having the information contact, the case of having ever received information relevant to dementia amounted to 9.1±1.8 points, thereby having been higher than 8.4±2.0 points in the case of having never received information. The interest & knowledge level on dementia, the dementia-related information contact appearance, and the difference in dementia perception were not all statistically significant <Table 2>.

Table 2. Relationship between knowledge scores and demographic characteristics. (n=498)

Variable	Categories	Mean±SD	t or F
Gender	Male	8.6±2.0	17.231*
	Female	8.9±1.9	
Age (years)	10-19	11.0±0.0	76.78**
	20-29	10.2±1.6	
	30-39	8.8±3.1	
	40-49	9.2±1.6	
	50-59	9.1±1.7	
	60-69	8.9±1.9	
	70-79	8.2±2.4	
	over 80	8.5±2.4	
Education (years)	0	9.3±2.5	57.401**
	1-6	8.8±2.3	
	7-9	8.8±1.9	
	10-12	8.7±1.8	
	≥13	9.5±1.6	
Health insurance system	Medical insurance	9.0±1.9	13.584
	First class of medical protection	8.3±2.5	
	Second class of medical protection	7.8±1.5	
	Other	8.4±2.1	
Interest in dementia	Not interested	9.0±2.0	1.295
	Neutral	9.0±1.9	
	Interested a lot	8.9±2.0	
Knowledge of dementia	None	8.8±1.9	21.372

	a Little	9.1±1.8	
	Very well	8.5±2.2	
Information contact status	Yes	9.1±1.8	26.382
	No	8.4±2.0	

Note: *p<.05; **p<.01; ***p<.001.

3.1.3. Factors of affecting the dementia awareness

A percentage of correct answers to the dementia perception questions showed a significant difference according to subjects' age, education level, interest degree, dementia knowledge level, and information contact appearance. To evaluate the influence of the above elements upon dementia perception, the total score of dementia recognition was set to be a dependent variable. Age, education level, interest degree, dementia knowledge level, and information contact appearance were set to be an independent variable and then were transformed into dummy variable. After it, the regression analysis was carried out. R^2 value of the model was 0.059. As a result of the analysis, The regression equation of the model in order to explain the total recognition score was statistically significant(F=5.432, *p*<.001). Multicollinearity between each independent variables was not problematic(the tolerance limit range in 0.712-0.948, the scope of dispersion expansion factor in 1.054-1.405). In consequence of the regression analysis, if each age, education level, interest degree, dementia knowledge level, and information contact appearance are all included in regression equation, the dementia awareness score gets higher in the younger age, in the higher dementia knowledge level, and in case of having the information contact experience on dementia. This was statistically significant <Table 3>.

Table 3. Demographic characteristics affect knowledge about dementia. (n=498)

Variable	B	SE	β	t
(constant)	9.782	.832		11.761***
Age	-.212	.076	-.153	-2.780**
Education	.083	.100	.046	0.836
Interest in dementia	.018	.098	-.187	-.187
Knowledge of dementia	.374	.177	.106	2.113*
Information contact status	.515	.172	.143	2.991**

Note: p<.05; **p<.01; ***p<.001.

3.2. Dementia needs

3.2.1. Recognition level on a dementia-related institution

A case of knowing a dementia care center possessed 304 people(61.0%). An institution that the person in question or a family member visits first of all when being doubtful of dementia was in order of a public health center with 247 people(49.6%), a neighboring hospital·clinic with 95 people(19.1%), a dementia care center with 91 people(18.3%), a university hospital with 54 people(10.8%), and an internet with 5 people(1.0%). Among respondents, the people who gave the answer as saying of having ever used a dementia care center amounted to 135 people (27.1%). The people who gave the answer as saying of having never used reached 363 people(72.9%) <Table 4>.

Table 4. Degree of awareness of dementia-related organizations. (n=498)

Variable	Categories	n(%)
Dementia center awareness	Yes	304(61.0)
	No	194(39.0)
Priority visit facility rank	Public Health	247(49.6)
	Dementia safety center	91(18.3)
	City office	4(0.8)
	Nearby Hospital	95(19.1)
	University Hospital	54(10.8)
	Nursing hospital, nursing home	2(0.4)
	Internet	5(1.0)
	Other	0(0)
Use of dementia center	Yes	135(27.1)
	No	363(72.9)

3.2.2. The actual condition of using dementia-related institutions and services

Among 135 people who have the experience of using a dementia care center in G city, the respondents who have ever used the dementia-related facility came to 72 people(52.9%). The service to use was the most in counseling(a public health center, a dementia center, a community welfare center, etc.) with 37 people(30.6%). The next was the larger in order of the hospital care with 26 people(23.6%), the facility use(daytime/nighttime/short-term/long-term facility) with 25 people(20.7%), and the in-home care service(a caregiver/a visiting nursing service) with 23 people(19.0%). A reason of having rejected the use of the relevant service included the lack of information on the facility and the program with 15 people(30.6%) and an economic burden with 10 people(20.4%). What there is no appropriate facility or program in a near place or the failure to recognize the need to use was surveyed to be 7 people, respectively(14.3%) <Table 5>.

Table 5. Dementia-related institutions and services. (n=135)

Variable	Category	n(%)
Use of dementia facilities	Yes	72(52.9)
	No	64(47.1)
Use service*	Counselling(public health, dementia center, welfare center)	37(30.6)
	Hospital treatment(outpatient or admission)	26(23.6)
	Facility use(day/night/short/long term care facility)	25(20.7)
	Home care service(caregiver/visiting nursing service)	23(19.0)
	Provision of sanitary goods(diper ect.)	5(4.1)
	Free dementia screening service	2(1.7)
	Provide wondering rescue bracelet	1(0.8)
	Other	2(1.7)
Reasons for denying service*	Lack of facility/program information	15(30.6)
	No suitable facility/program nearby	7(14.3)
	Because of the social aspect	1(2.0)
	Economic burden	10(20.4)
	Failure to recognize the need to use	7(14.3)
	Other	9(18.4)

3.2.3. A demand for the dementia-related policy

As a result of surveying the demand for the dementia-related policy that is most necessary for research participants, a support for medical expenses had the highest need with 271 people(22.5%). And it was in order of the expansion in the dementia-related facilities with 252 people(20.9%), a support for the nursing expenses for dementia patients with 238 people(19.8%), training of dementia specialists with 142 people(11.8%), free examination for dementia with 119 people(9.9%), establishment of a dementia counseling center with 90 people(7.5%), and a perception change project with 88 people(7.3%) <Table 6>.

Table 6. Policy needs of dementia patient and family. (n=498)

Category	n(%)
Dementia-related recognition conversion project	88(7.3)
Expansion of dementia-related facility	252(20.9)
Supporting the cost of treating dementia patients	271(22.5)
Supporting the cost of caring dementia patient	238(19.8)
Training of dementia specialists	142(11.8)
Establishment of counseling center(or telephone, homepage) for dementia	90(7.5)
Free dementia screening service	119(9.9)
Other	·4(0.3)

Note: Multiple response.

4. Discussion

This study is a descriptive survey research in order to grasp the dementia awareness and the needs for the community care service and for the dementia project in a region targeting G city of Gyeonggi Province. At the point of time that develops the integrated support project ranging up to dementia-related counseling, checkup, management and service connection through opening a dementia care center at 252 public health centers nationwide as one of the National Responsibility Plan for Dementia that was enforced from September of 2017, the inspection on the dementia awareness and the dementia demand are needed.

Total average score of dementia awareness in the subjects of this study stood at 8.9±1.9 points(12-point perfection), thereby having reached 74.1 points given coming to be converted into a perfect score of 100, resulting in having appeared to be higher than 51.9 points[6] in dementia awareness, which was executed targeting post-75 years of age or older people in a district, and 61.9 points[7] of corresponding to the dementia perception, which was implemented targeting six regional groups over the age of 65. It was indicated to be similar to 74 points[8] of corresponding to the outcome of the dementia recognition that was conducted targeting Seoul citizens. This is analogized to be the result that was shown because of being the similar research subject groups as this study and the research by Lee Dong-yeong et al.[8] are involved in the research that was carried out targeting citizens in a region without age limit.

A difference in dementia awareness according to subjects' general characteristics was indicated to have a significant difference depending on gender. This was seen to be consistent with what[9] was executed targeting Irish citizens. What appeared to be significant in the dementia perception depending on age backed up a previous research[10][11]. The higher education level led to the higher dementia awareness, thereby having supported the outcome of a preceding research[9][11][13].

Factors of influencing the dementia recognition appeared to include age, the dementia knowledge level, and the dementia information contact experience. The elements of affecting the dementia awareness in a research that was conducted targeting health professionals in China were indicated to be age and the experience of having looked after a dementia patient[14]. In a research that was carried out targeting citizens in Germany, the subjects with the experience of having attended to a dementia patient were reported to have influence upon the dementia recognition[15]. In this way, the dementia awareness was understood to be influenced by the experience of having taken care of a dementia patient or by the experience of contacting information on dementia.

As a result of analyzing the demand level for a dementia-related project in research subjects, the subjects with the response as saying of 'knowing a dementia care center' accounted for 61%. An institution with the first visit when being doubtful of dementia was the most in a public health center, a dementia center, and a community welfare center with 49.6%. This is considered to be settled citizens' recognition on a dementia care center.

As for the highest demand for the future dementia-related policy, the demand degree was higher in order of a support for medical expenses with 22.5%, the expansion of the dementia-related facilities with 20.9%, a support for the nursing expenses with 19.8%. The objective of National Responsibility for Dementia, which is in progress from 2017, is to give a help to patients and families who suffer a difficulty caused by dementia, thereby being driven the contents such as strengthening a medical support for dementia patients and mitigating the burden of medical and nursing expenses for dementia. In case of the expenses for treating dementia, the self-burden rate of medical expenses for severe dementia patients was reported to have been lessened in August of 2018. There is current implementation in order to expand even the subjects for the cost sharing reduction benefit out of the long-term nursing insurance[16][17][18]. However, a proper support fails to be received sometimes because there are also citizens who do not know the appearance of this policy. Hence, it is considered to require the offer of information on the dementia-related policy along with the perception education.

Accordingly, based on the results of this study, an opportunity was arranged that recognizes the importance of an effort to get rid of a prejudice, along with the right perception on dementia, through developing dementia-related programs and services, improving the customized education by education level and by age group, and continuing the dementia awareness education.

5. Conclusion and Suggestion

Through this study, the following conclusions will be able to be elicited.

First, the factors, which have influence upon the dementia awareness in a region, appeared to include the age, the knowledge level on dementia, and the experience of the dementia information contact. Thus, the subjects require the dementia perception education in consideration of these things.

Second, citizens are demanding the dementia policies such as backing up medical expenses, expanding the dementia-related facilities and supporting the care expenses for dementia patients. The policy relevant to a cost support is being requested because of a rise in the social economic cost caused by dementia patients and of a climb in a family burden according to this.

Third, a cause for refusing the use of the dementia-related services appeared to be high in the lack of information on facilities and programs and in the economic burden. This needs to make it available for reducing a family burden by being offered the information on both facilities and programs in which the dementia-related services can be used given the dementia

awareness education. Also, to mitigate the economic burden for dementia-related services, even the policy support available for assisting this is considered to be necessary.

A large-scale research has rarely been done at home so far targeting city citizens in a region excluding Seoul Metropolis. Hence, this study will be able to be applied to useful basic data afterward for the establishment of a domestic dementia policy and for a dementia-related research. Especially, a change in the perception on dementia and in the use of a care service will become a very important source data.

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7. Appendix

7.1. Authors contribution

	Initial name	Contribution
Lead Author	MRS	-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑
Corresponding Author*	SYP	-Make a significant contribution to collection ☑ -Final approval of the paper ☑ -Corresponding ☑ -Play a decisive role in modification ☑
Co-Author	YJS	-Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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The Effects of Telephone Consultation after Discharge on the Secondary PREVENTION Knowledge and the Medication Adherence in STROKE Patients

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Abstract

Purpose: *This study investigated the effects of Telephone Counseling on Secondary Prevention Knowledge and Medication Adherenc after Discharge in Stroke Patients*

Method: *Data were collected from April 19 to August 25, 2018 from patients who were diagnosed with stroke at a general hospital and were discharged from hospital after individual discharge education. The collected data were analyzed by SPSS/WIN 23.0 program for descriptive statistics, x^2-test, Fisher's Exact, independent t-test.*

Results: *Secondary prevention knowledge increased in experimental group(15.06±0.24) more than a control group(8.09±3.21)(t=-8.96, p<.001). A medication adherence for secondary prevention increased in experimental group(6.34±0.69) more than a control group(3.40±1.99)(t=-5.94, p<.001).*

Conclusion: *The results of this study suggest that once-call counseling after discharge of primary stroke patients increases knowledge of secondary prevention and drug use, which may increase the efficiency of nursing work.*

[Keywords] ***Counseling, Stroke, Knowledge, Medication, Adherence***

1. Introduction

Domestic stroke patients as of the year in 2014 are about 690,000 people, thereby having been indicated to include 380,000(1.90%) men 310,000(1.52%) women. Nearly 105,000 new stroke patients are occuring every year[1]. Also, the stroke prevalence rate in more than fully 50 years old are growing from 1.6% in 2009 to 1.8% in 2018[2].

A stroke is left with physical and functional disorders in over 50% after its outbreak. The stroke recurrence is up by 1.7% within the first 30 days, by 6~13% within 1 year, and by 5~8% annually after this. The recurrent rate accumulated over five years accounts for 19~42%[3]. After the stroke occurrence, around 18% of the patients come to the death[4]. Approximately 73% of the patients have various functional disorders such as exercise, sensation, cognition and language depending on the degree of brain damage[5]. Also, a cerebral stroke is a disease with very high recurrence rate even after a full recovery[6]. The recurrence rate within 5 years amounts to 20~40%[7]. In this way, a stroke not only brings about physical damage and disorder but also extends the hospitalization period[8], thereby being a disease in which the continuous care is critical in order to prevent a stroke.

Especially, the prevention is important through improving the living attitudes such as high blood pressure, diabetes, a heart disease, hyperlipidemia, smoking, drinking, etc[8]. Even as for a patient who first suffered a stroke, the enhancement in the living attitudes for the secondary prevention is becoming more important.

What is crucial along with the betterment in the living attitudes for the secondary prevention

is to take drugs consistently. Out of these, the intake of medicines such as antithrombotic agents(antiplatelet drug, anticoagulant drug), blood lipid lower agents is being selected as an efficient strategy for reducing a risk factor[9]. Furthermore, what prevents the recurrence of stroke patients through taking a drug continuously and steadily is becoming a very significant task individually, socially and nationally[10]. Especially when randomly stopping a platelet agent or halting in relation to invasive procedures, it is known to promote embolism within a week[11]. Thus, the constant use of antithrombotic agents is being recognized as an important matter for the secondary prevention of a stroke.

However, a stroke occurs mostly in the old age. There is a difficulty for enhancing the living attitudes or taking a drug regularly for the secondary prevention after discharge. The major causes for this failure to take medication are reported to include a slip of the moment, a difficulty for setting the dosing time in daily life, and the lack of an education program for patients[12].

Accordingly, the continuous follow-up care is needed through the telephone consultation in order to acquire knowledge available for decreasing a controllable stroke risk factor targeting stroke patients, to improve the living attitudes, and to do medication adherence. The telephone consultation is what the phone call leads to being available for exchanging information, managing symptom, and proposing a nursing direction in case of emergency[13], thereby being a good method that can prevent complications because of being able to give relief to a patient after discharge and because of offering the education relevant to symptom management and health[14][15].

Looking into the individual education, into the telephone consultation with totally 3 times once a week targeting stroke patients[16], into the research on the patient compliance, the dialysis adequacy and the infection occurrence through the telephone consultation for 8 weeks targeting the peritoneal dialysis subjects as a visiting outpatient[17], into the research on the subjects with Parkinson's disease[18], and into the research through the telephone consultation using the web-based education program targeting the discharged acute stroke patients[19], the telephone consultation led to providing the continuous education information to the discharged patients requiring a long-term care. This showed the research result as saying of enhancing the self-care performance level. In particular, the subjects who first suffered a stroke are at the time that an interest in own disease is higher than ever. Thus, it is thought to be important more than anything to educate the contents on the knowledge offering for the secondary prevention and on the medication adherence through carrying out the telephone consultation during a blank period from the discharge to the next hospital visit. However, like the research[17] that carried out 8 times for totally 12 weeks with once a week for about 10 minutes each time for 4 weeks and with once per two weeks for about 10 minutes each time for 8 weeks after it as for the telephone counseling cycle in the above researches[16][17][18][19], and like the research that conducted totally 6 times(2nd week, 4th week, 6th week, 8th week, 10th week, 12th week) with once per two weeks for 3 months[18], the multi-session continuous telephone consultation showed the effect of the better living for the secondary prevention. The more rise in an education frequency leads unavoidably to the more increase in an educational effect. But for the telephone consultation, it may be considered the residence of professional medical personnel or the rise in a nurse's work burden[20][21][22][23]. Hence, a research of examining an educational effect through the one-session telephone consultation is in a deficient condition. In this study, it is thought to likely have a critical significance even to see a change in the knowledge related to the secondary prevention and in the medication adherence of the subjects who first suffered a stroke through applying the one-session telephone consultation that is regularly executed primarily after discharge.

Therefore, this study aimed to raise the nursing work efficiency of the secondary prevention education regarding a cerebral stroke through the appropriate periodic telephone consultation by verifying the effects on the stroke-related secondary prevention knowledge and on the medication adherence after allowing the patients who first suffered a stroke to be offered the one-

session telephone consultation after discharge.

2. Purpose of Research

The purpose of this study is to increase the nursing work efficiency of the secondary prevention education relevant to a stroke through the appropriate periodic telephone consultation by closely examining the impacts on the improvement in the knowledge related to the stroke-related secondary prevention and on the promotion in medication adherence after allowing the patients who first suffered a stroke to be offered the one-session telephone consultation for the secondary prevention after discharge. Specific objectives are as follows.

First, It verifies the effect of the one-session telephone consultation after discharge in the patients who first suffered a stroke on the knowledge level related to the secondary prevention.

Second, It inspects the impact of the one-session telephone consultation after discharge in the patients who first suffered a stroke on the medication adherence relevant to the secondary prevention.

3. Hypothses of Research

The following are the concrete hypotheses of this study.

3.1. Hypothesis 1

The experimental group that received the one-session telephone consultation after discharge in the patients who first suffered a stroke will have the higher knowledge score related to the secondary prevention than the control group.

3.2. Hypothesis 2

The experimental group that received the one-session telephone consultation after discharge in the patients who first suffered a stroke will have the higher medication adherence level than the control group.

4. Definition of Terminology

4.1. Stroke patient

As a clinical sign of showing a suddenly local or general disorder of brain function that leads to being continued for more than 24 hours or to death due to a vascular cause, a cerebral stroke implies a case[24] that was partially damaged the brain, which had been supplied blood by its blood vessel, owing to the clogged blood vessel.

In this study, it means a patient who was treated by a neurologist after being hospitalized to be carried out MRI(Magnetic Resonance Imaging) test as a patient who was first diagnosed with a stroke.

4.2. Telephone consultation

Telephone consultation implies to exchange information, offer health education & advice and manage symptom over the telephone, or to provide a necessary level of the nursing direction through classifying priority in case of emergency[13]. In this study, it implies the nursing intervention that was implemented for 10~15 minutes by giving a call in the second week to the subjects with the execution of the discharge education through an individual discharge paper.

4.3. Knowledge related to secondary prevention

Secondary prevention signifies what is carried out for preventing relapse in transient cerebral ischemia or ischemic stroke patients[25], and implies what a patient with a stroke is allowed to steadily control risk factors such as hypertension, diabetes, hyperlipidemia and smoking along with antithrombotic therapy[26].

In this study, the knowledge on a stroke related to secondary prevention stands for what was measured by using the tool that Kim[10] modified and supplemented the disease-related knowledge tool for an acute ischemic stroke patient that Ham[27] developed.

4.4. Medication adherence

Medication adherence implies a consistent level between the prescribed drug and the patient's dosage[28]. Medication adherence in this study means a score that measured the subjects' adherence implementation and compliance level with the drug that was prescribed by using the self-report tool in Korean version of MMAS-8(Morisky Medication Adherence Scale) that Morisky et al[29] developed.

5. Research Method

5.1. Research design

This study is a quasi-experimental research that was conducted with the nonequivalent control-group post design in order to verify the effects of the one-session telephone consultation in the patients who first suffered a stroke on the knowledge related to secondary prevention and on the medication adherence <Table 1>. As the experimental treatment is the education through telephone consultation, the post design was carried out in order to see the medication adherence related to knowledge available for causing the testing effect due to the pre survey.

Table 1. Research design.

	Treatment	Post test	
		Secondary prevention related knowledge	Medication adherence
Control group		C_1	C_2
Experimental group	X	E_1	E_2

Note: X : Telephone counseling, C_1 : Secondary prevention related knowledge E_1 : Secondary prevention related knowledge C_2 : Medication adherence E_2 : Medication adherence

5.2. Research subjects and period

The subjects in this study included the patients who were diagnosed with a stroke for the first time at a tertiary general hospital where is located in I city, who were hospitalized in a neurological ward, and who were discharged from the hospital after treatment from April 19, 2018 to August 25. The specific criteria are as follows.

First, A person who was diagnosed with cerebral infarction for the first time at a tertiary general hospital in I city.

Second, A patient from over 30 years old to under 85 years old.

Third, A person who has a normal consciousness level and is able to communicate.

Fourth, A person who can perform self-care with a little help.

Fifth, A person who has no experience of the stroke education before hospitalization.

Sixth, A person who received the basic stroke discharge education individually upon discharge from a hospital.

Seventh, A person who understood the purpose of the study and agreed to participate in it.

5.3. Data collection method

A research sample included totally 34 people with the test power(1-β) 0.9, the significance level 0.05, and the effect size 0.5 based on the previous research[10], which used the t-test analysis method through G power analysis, and was selected 17 people, respectively, in the experimental group and the control group. The control group was set to include the patients who were first diagnosed with a stroke and then discharged after treatment from April 19 to May 25 in order to prevent the spread of experiment among the hospitalized patients from April 19, 2018 to August 25. The experimental group was carried out convenience sampling as for the patients who were first diagnosed with a stroke and then discharged after treatment from July 19 to August 25 with a difference in hospitalization period.

This study included 17 people in the experimental group and 17 people in the control group, proceeded with finally choosing 34 research subjects without omission in the experimental group and the control group.

5.4. Research process

5.4.1. Prior education

Targeting both the experimental group and the control group, the research assistant 1, 2 individually performed the education for the stroke secondary prevention by using an educational booklet related to a stroke together with the discharge education before discharge, and distributed an educational booklet. At this time, a consent form for the utilization of personal information was received after notifying that the call is due in the fourth week after discharge to the control group, and in the second week and the fourth week to the experimental group.

5.4.2. Experimental treatment

The telephone consultation was conducted once in the second week after discharge in the experimental group from July 19 to August 25, and was explained the knowledge related to secondary prevention by using the distributed stroke-related educational booklet, and was educated about the importance of the constant drug intake, the difficulty on this, and the solution. As the totally telephone consultation time is from 10 minutes to 15 minutes, the direct counseling was executed through the research assistant 3. The schedule of telephone consultation after discharge was coordinated in advance with the subject upon discharge from hospital and was progressed mainly between noon and 1:00 p.m. at lunchtime.

5.4.3. Post survey

Through the phone call to the experimental group and the control group in the fourth week after discharge following the telephone consultation treatment, it notified the objective of the research, explained the collection of general information through medical charts, and sought the consent for this. Also, the research assistant 1, 2 did read the questionnaire on the secondary prevention knowledge and the medication adherence and allowed them to respond to this.

5.5. Research tool

5.5.1. Secondary prevention knowledge

The tool was used what Kim[10] modified and supplemented the Knowledge Measurement Tool for a Disease in Acute Stroke Patients that Ham[27] developed. This tool was composed of totally 15 items with 4 questions about a diseases such as type, symptom and recurrence related to a stroke, 3 questions about a physiological risk factor, 5 questions about a lifestyle factor, 2 questions about precautions in daily life, and 1 question about a symptom of appearing given taking a drug.

A score was processed ‘correct answer’ with 1 point, ‘wrong answer’ and ‘don’t know’ with 0 point, is available for 0 point~15 points, and implies that the higher score leads to the higher knowledge related to secondary prevention. In Ham[26]’s research, Cronbach's α value was .89. Even in this study, Cronbach's α value was .89.

5.5.2. Medication adherence

This study was used MMAS-8 that was improved it with 8 items by supplementing an item of testing a psychological characteristic to MMAS-4(4-item Morisky Medication Adherence Scale) that Morisky et al.[29] developed in 1986. This tool consists of totally 8 items. Among these, 7 items are responded with ‘yes’ or ‘no,’ and were scored ‘yes’ with 0 point and ‘no’ with 1 point. Item No. 5 was reversely converted. Item No. 8 was measured with the 4-point scale from 0 point in ‘very little’ to 4 points in ‘always so.’ Each point was multiplied by 0.25, thereby having been scored from 0 point in ‘very little’ to 1 point in ‘always so.’ Total score is from 0 point to 8 points. It implies that the higher score leads to the better medication adherence. Also, it stands for ‘low compliance’ in less than 6 points, ‘moderate compliance’ in 6~7 points, and ‘high compliance’ in 8 points. At that time of developing the tool on medication adherence, it was Cronbach’s α=.83. In this study, it was Cronbach’s α=.78.

5.6. Data analysis method

The collected data were statistically analyzed as follows by using SPSS WIN 23.0 program.

First, The general·morbid characteristics, the secondary prevention knowledge and the medication adherence in the experimental group and the control group were analyzed with descriptive statistics such as error, percentage, the mean and standard deviation.

Second, The pre homogeneity test in the experimental group and the control group was parsed with x^2-test, Fisher’s Exact, independent t-test.

Third, To compare a difference in the secondary prevention knowledge and the medication adherence between both groups for inspecting hypotheses between the experimental group and the control group, independent t-test was used for the verification.

5.7. Ethical consideration

This study carried out convenience sampling targeting subjects at a tertiary general hospital in I city. In addition, the stroke-related education may exist during hospitalization·right after discharge·after experimental treatment in the subjects who first suffered a stroke. Thus, the close attention needs to be paid to generalizing and analyzing the findings.

5.8. Research limitations

This study was screened and approved after passing through IRB(Institutional Review Board) of W hospital(2018-03-006). Data collection was made after explaining the research objective and method to the head of the related hospital's nursing department. The subjects were explained the research plan. To protect the research subjects’ ethical problems, the questionnaire through telephone consultation was executed targeting the persons who agreed on the subject's description and consent form when discharging. The content as saying of assuring anonymity was clarified. The explanation was given with saying you can withdraw your participation at any time if you don't want to, and saying the collected materials are used only for the research purpose only.

Also, the control group, which did not take part in the telephone consultation education, was carried out the education with the same contents as the experimental group based on an educational booklet given the outpatient’s revisit after the end of the program.

6. Results

6.1. Pre homogeneity test of research subjects

With regard to the research subjects' demographic and disease-related characteristics, the outcome of homogeneity test in the experimental group and the control group is as <Table 2>.

The subjects' age-based distribution corresponds to 66.52±7.01 years old in the experimental group and 71.59±8.59 years old in the control group. Thus, the age-based distribution in the experimental group and the control group did not show a statistically significant difference(t=1.88, p=.690).

As for gender, there were 11 men(64.7%) and 6 women(35.3%) in case of the experimental group. There were 11 males(64.7%) and 6 females(35.3%) in case of the control group. Thus, a difference in gender between the experimental group and the control group was not statistically significant(X^2=0.00, p=.640).

In terms of education level, there were 9 people(52.9%) for below middle school graduation, 6 people(35.3%) for high school graduation, 2 people(11.8%) for university graduate or higher in case of the experimental group. There were 7 people(41.2%) for below middle school graduation, 9 people(52.9%) for high school graduation, and 1 person(5.9%) for university graduate or higher in case of the control group. Thus, the education level in the experimental group and the control group was not statistically significant(X^2=1.26, p=.598).

As to a job, there were 11 people(64.7%) for having a job and 6 people(35.3%) for having no job in case of the experimental group. There were 6 people(35.3%) for having a job and 11 people(64.7%) for having no job in case of the control group. Thus, a difference in whether or not having a job between the experimental group and the control group was not statistically significant(X^2=2.94, p=.085).

In terms of religion, there were 8 people(47.1%) for having religion and 9 people(52.9%) for having no religion in case of the experimental group. There were 9 people(52.9%) for having religion and 8 people(47.1%) for having no religion in case of the control group. This was statistically insignificant(X^2=0.12, p=.500).

Regarding the marital status, there were 5 people(29.4%) for the unmarried, 8 people(47.1%) for the married, and 4 people(23.5%) for divorce/bereavement in case of the experimental group. There were 12 people(70.6%) for the unmarried, 0 person(0%) for the married, and 5 people(29.4%) for divorce/bereavement in case of the control group. Thus, a
difference in the marital status between the experimental group and the control group was not statistically significant(X^2=5.80, p=.066).

In terms of the subjects' diagnosis name, there were 12 people(70.6%) for a cerebral stoke and 5 people(29.4%) for transient ischemic attack in case of the experimental group. There were 16 people(94.1%) for a cerebral stroke and 1 person(5.9%) for transient ischemic attack in the control group. Thus, there was no statistically significant difference in diagnosis name between the experimental group and the control group(X^2=3.24, p=.078).

As for a case of the diabetes appearance, there were 13 people(76.5%) for having diabetes and 4 people(23.5%) for having no diabetes in case of the experimental group. There were 10 people(58.8%) for having diabetes and 7 people(41.2%) for having no diabetes in case of the control group. Thus, whether or not having diabetes in the experimental group and the control group was not statistically significant(X^2=1.21, p=.162).

In terms of the heart disease appearance, there were 12 people(70.6%) for having heart disease and 5 people(29.4%) for having no heart disease in the experimental group. There were 12 people(70.6%) for having heart disease and 5 people(29.4%) for having no heart disease in the control group. Thus, whether or not having a heart disease in the experimental group and the control group was not statistically significant(X^2=0.00, p=.292).

As for the obesity appearance, there were 9 people(52.9%) for having obesity and 8 people(47.1%) for having no obesity in the experimental group. There were 8 people(47.1%) for having obesity and 9 people(52.9%) for having no obesity in the control group. Thus, whether or not having obesity in the experimental group and the control group was not statistically significant(X^2=0.12, p=.500).

As to the smoking appearance, there were 10 people(58.8%) for a smoker and 7 people(41.2%) for a non-smoker in the experimental group. There were 6 people(35.3%) for a smoker and 11 people(64.7%) for a non-smoker in the control group. Thus, whether or not smoking in the experimental group and the control group was not statistically significant(X^2=1.89, p=.151).

Given drinking, the experimental group appeared to include 5 people(29.4%) in 'not drinking at all,' 4 people(23.5%) in 'less than two glasses a day,' and 8 people(47.1%) in 'more than 3 glasses a day.' The control group was indicated to include 6 people(35.3%) in 'not drinking at all,' 9 people(52.9%) in 'less than two glasses a day,' and 2 people(11.8%) in 'more than 3 glasses a day.' Thus, the drinking aspect in the experimental group and the control group was not statistically significant(X^2=5.61, p=.056).

In case of exercise, the experimental group included 1 person(5.9%) in taking exercise and 16 people(94.1%) in not taking exercise. The control group included 0 person(00%) in taking exercise and 17 people(100%) in not taking exercise. Thus, whether or not taking exercise in the experimental group and the control group was not statistically significant(X^2=1.03, p=.500).

In case of the exercise frequency, the experimental group was shown to include 16 people(94.1%) in 'no exercise,' 1 person(5.9%) in 'less than 3 times a week,' and 0 person(0%) in 'more than 3 times a week.' The control group included 17 people(100%) in 'no exercise,' and 0 person(0%) in 'less than 3 times a week' and in 'more than 3 times a week.' Thus, the exercise frequency in the experimental group and the control group was not statistically significant(X^2=1.03, p=.500).

The subjects' hospitalization period corresponded to 17.12±18.59 days in the experimental group and 18.00±15.61 days in the control group. Thus, the hospitalization period in the experimental group and the control group was not statistically significant(t=0.15, p=.882).

Accordingly, both the experimental group and the control group conform to the homogeneous group in the aspects of age, gender, education level, job, religion, marital status, diagnosis name, high blood pressure, diabetes, heart disease, hyperlipidemia, obesity, drinking, smoking, exercise frequency, and hospitalization period.

6.2. Hypothesis verification

6.2.1. Hypothesis 1

To examine the effect in the one-session telephone consultation offer after discharge to the patients who first suffered a stroke on the knowledge related to secondary prevention, the knowledge relevant to secondary prevention was inspected in the experimental group and the control group. The outcome is as <Table 3>.

Looking into the knowledge relevant to secondary prevention in the experimental group and the control group, it stood at 15.06±0.24 points in the experimental group and 8.09±3.21 points in the control group. Thus, the group with the telephone consultation offer after discharge to the patients who first suffered a stroke had the higher secondary prevention knowledge score than its opposite group. This had a statistically significant difference(t=-8.96, p=.001). Hence, what "the experimental group with the one-session telephone consultation offer after discharge to the patients who first suffered a stroke will have the higher secondary prevention knowledge score than the control group" was supported.

6.2.2. Hypothesis 2

To examine the influence in the one-session telephone consultation offer after discharge to the patients who first suffered a stroke on the medication adherence, the medication adherence was checked in the experimental group and the control group. The result is as <Table 3>. Inspecting the medication adherence in the experimental group and the control group, it came to 6.43±0.69 points in the experimental group and 3.40±1.99 points in the control group. Thus, the group with the telephone consultation offer after discharge to the patients who first suffered a stroke had the higher medication adherence level than its opposite group. This had a statistically

significant difference(t=-5.94, *p*=.001).

Table 2. Homogeneity test of general gharacteristics between two groups. (n=34)

Characteristics		Exp.(n=17)	Cont.(n=17)	t or x^2	*p*
		n(%) or mean±SD	n(%) or mean±SD		
Age		66.52±7.01	71.59±8.59	1.88	.690
Gender*	Male	11(64.7)	11(64.7)	0.00	.640
	Female	6(35.3)	6(35.3)		
Education*	≥Middle school	9(52.9)	7(41.2)	1.26	.598
	High school	6(35.3)	9(52.9)		
	≤College	2(11.8)	1(5.9)		
Occupation*	Employed	11(64.7)	6(35.3)	2.94	.085
	None	6(35.3)	11(64.7)		
Religion*	Yes	8(47.1)	9(52.9)	0.12	.500
	No	9(52.9)	8(47.1)		
marital state*	Single	5(29.4)	12(70.6)	5.80	.066
	Married	8(47.1)	0(0)		
	Divorce/separation	4(23.5)	5(29.4)		
Diagnosis*	Cerebral infarction	12(70.6)	16(94.1)	3.24	.078
	Transient Ischemic attack	5(29.4)	1(5.9)		
Diabetes*	Yes	13(76.5)	10(58.8)	1.21	.162
	No	4(23.5)	7(41.2)		
Cardio disease*	Yes	12(70.6)	12(70.6)	0.00	.292
	No	5(29.4)	5(29.4)		
Obesity*	Yes	9(52.9)	8(47.1)	0.12	.500
	No	8(47.1)	9(52.9)		
Smoking*	Yes	10(58.8)	6(35.3)	1.89	.151
	No	7(41.2)	11(64.7)		

Drinking*	None	5(29.4)	6(35.3)	5.61	.056
	≤Two cups a day	4(23.5)	9(52.9)		
	≥ Three cups a day	8(47.1)	2(11.8)		
Exercise*	Yes	1(5.9)	0(0)	1.03	.500
	No	16(94.1)	17(100)		
Frequency of exercise*	None	16(94.1)	17(100)	1.03	.500
	< 3 Times a week	1(5.9)	0(0)		
	≥ 3 Times a week	0(0)	0(0)		
Hospitalization period		17.12±18.59	18.00±15.61	0.15	.882

Note: *Fisher's Exact test, Exp.=Experimental group, Cont.=Control group.

Table 3. Effects of secondary prevention-related knowledge and medication administration after telephone counseling between experimental groups and control group. (N=34)

Characteristics	Groups(n)	M±SD	t	*p*
Secondary prevention related knowledge	Exp.(17)	15.06±0.24	-8.96	<.001
	Cont.(17)	8.09±3.21		
Medication adherence	Exp.(17)	6.43±0.69	-5.94	<.001
	Cont.(17)	3.40±1.99		

Note: Exp.=Experimental group, Cont.=Control group.

Therefore, what "the experimental group with the one-session telephone consultation offer after discharge to the patients who first suffered a stroke will have the higher medication adherence than the control group" was backed up.

7. Discussion

This study was conducted in order to increase the nursing work efficiency of the secondary prevention education about a stroke through the appropriate periodic telephone consultation by verifying the effects on the stroke-related secondary prevention knowledge and on the medication adherence after allowing the patients who first suffered a stroke to be offered the one-session telephone consultation after discharge. The research subjects were divided into the experimental group and the control group and were verified the hypotheses on the secondary prevention knowledge and the medication adherence.

In this study, the secondary prevention knowledge score appeared to be 15.06±0.24 points in the experimental group and 8.09±3.21 points in the control group. The secondary prevention knowledge score between two groups was indicated to have a statistically significant difference(t=-8.96, p<.001).

In this study, the outcome of Hypothesis 1 showed that the secondary prevention knowledge rose when carrying out the telephone consultation treatment after two weeks of discharge in

the patients who first suffered a stroke[10]. This result was consistent with the researches[16] by Kang and Yeun in which the secondary prevention knowledge grew through the individual education for ischemic stroke patients and the 3-time telephone consultation once a week. In light of these findings, the secondary prevention knowledge is thought to be accredited to being strong in a will to know about stroke-related knowledge because of having targeted the patients who first suffered a stroke as in Kim[10]'s research, and to be powerful in an intention of acquiring knowledge related to a stroke owing to being full of fear and awakening as saying of being able to recur during being hospitalized. This may be considered to suggest that the secondary prevention education before the next outpatient's visit after discharge is the important period for the subjects who first suffered a stroke. In addition to this, for the synchronization of knowledge acquisition aiming at the secondary prevention in the subjects who first suffered a stroke, an effort will need to be made in order to be possibly applied the program, which can be utilized anytime and anywhere, by applying various educational methods using web, video production, app as well as the education through telephone consultation.

Also, as in this study and in Kim[10]'s research, when comparing the researches by Kang and Yeun[16] that were made the education through telephone consultation in which the secondary prevention knowledge on the first-time stroke was implemented after two weeks of discharge, and that were made the individual education and the totally three-time telephone consultation once a week, even the secondary prevention knowledge score increases through the one-session telephone consultation as in this study. Considering this, the efficient and short-time education available for reducing a burden of nursing work is thought to be likely necessary as well.

As for the outcome of Hypothesis 2 in this study, the medication adherence stands at the average 8-point perfection. The medication adherence appeared to be 6.43±0.69 points in the experimental group and 3.40±1.99 points in the control group. The medication adherence level between two groups was shown to have a statistically significant difference($t=-5.94$, $p<.001$).

This medication adherence was consistent with the researches[19] by Kim and Park, which carried out telephone consultation using the web-based education program, and with Kim's research[30] of targeting the hypertensive elderly. It is lower than 6.6 points as the research result in Morisky et al.[29] of having targeted hypertension patients.

This is thought[30] to be because of comprising the subjects in much higher age group than 52.5 years old as the average age in the research by Morisky et al.[29] while the average age of this study is 69.1 years old. As I city is a regional small and medium city, there is a growing trend in the number of elderly people and even in stroke population. Accordingly, the considerations that will need to be made given applying the education on medication adherence are thought to be likely important for the necessities of being made with educational contents and method in line with age given education, of the education of visual approach notifying the importance of drugs to the stroke patients during staying in the hospital, of being educated a medication guide along with the explanation about specific drugs even in the discharge nursing note given living hospital, and of being secured the resources that will help the medication adherence.

Also, the research implemented the education related to medication adherence by directly visiting for 3 weeks once a week and then executed the telephone monitoring for 2 weeks once per two weeks after the end of the visiting education. Resultantly, as in the research[31] that was decreased the misuse & abuse of drugs and was grown the medication knowledge, the ongoing management is crucial for the subjects with a chronic disease. But considering the outpatient's revisit within 4 weeks after discharge in case of the patients who first suffered a stroke, the process of recalling it again will be important in the education on the secondary prevention knowledge and the medication adherence through the telephone consultation in the second week as the intermediate period. A quick educational approach is considered to be likely needed.

Nevertheless, considering the realistic clinical situation, there is a practical problem as saying that the professional nursing staff residence and the nursing work may grow more than necessary for proceeding with the education through telephone consultation. The more rise in educational frequency may lead to the better educational effect. But considering the real problem

of nursing, a realistic alternative plan is thought to be probably needed in the education through telephone consultation.

The above findings led to having verified the effects of the one-session telephone consultation offer after discharge to the patients who first suffered a stroke on the secondary prevention knowledge and the medication adherence relevant to a cerebral stroke. This led to having proved that the appropriate periodic telephone consultation may raise the nursing work efficiency regarding the secondary prevention education on a stroke.

Consequently, it seems to be likely necessary for arranging the guidelines related to the symptom management and the medication adherence in line with the one-session telephone consultation targeting the patients who first suffered a stroke. What makes this available for being applied to the nursing service is considered to be likely able to contribute to making it possible for increasing the efficiency of the nursing work and for enhancing the self-care ability in stroke patients.

8. Conclusion and Suggestion

This study was attempted to increase the efficiency of nursing work by inspecting the impacts of the one-session telephone consultation on the secondary prevention knowledge and the medication adherence in the patients who first suffered a stroke. The findings are as follows.

A. Hypothesis 1 as saying that “the experimental group with the one-session telephone consultation offer after discharge to the patients who first suffered a stroke will have the higher secondary prevention knowledge score than the control group” was supported.

B. Hypothesis 2 as saying that “the experimental group with the one-session telephone consultation offer after discharge to the patients who first suffered a stroke will have the higher medication adherence than the control group” was backed up.

Synthesizing the above results, the one-session telephone consultation after discharge in the patients who first suffered a stroke appeared to heighten the secondary prevention knowledge and the medication adherence. Thus, the one-session telephone consultation after discharge in the patients who first suffered a stroke was indicated to have the effect on the secondary prevention knowledge and the medication adherence. It is thought to be likely capable of boosting the efficiency of nursing work compared to the nursing intervention through the multi-session telephone consultation. The education related to the secondary prevention for the subjects who first suffered a stroke through the one-session telephone consultation after discharge will make the subjects available for having a habit of acquiring and practicing the knowledge relevant to secondary prevention as well as reducing the burden of nursing work and raising the work efficiency.

Based on the results of this study, the following suggestions are aimed to be made.

The education on the secondary prevention knowledge and the medication adherence through the telephone adherence in the patients who first suffered a stroke is proposed a comparative research between the research of the one-session education and the research of the education in multi-session such as two sessions.

As the medication adherence in the patients who first suffered a stroke is what is relevant to a change in a living habit, there is a need to confirm a change through a continuous research following 3 months and 6 months.

There is a limit to generalization because of having targeted the hospitalized patients at a tertiary general hospital that is located in Jeonbuk. Hence, a replicate research is recommended to be executed by randomly assigning representative samples.

A follow-up research is proposed to be necessary regarding a complementary therapy that affects the secondary prevention knowledge and the medication adherence in the subjects who first suffered a stroke.

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10. Appendix

10.1. Authors contribution

	Initial name	Contribution
Lead Author	MIL	-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑ -Make a significant contribution to collection ☑ -Final approval of the paper ☑ -Corresponding ☑ -Play a decisive role in modification ☑
Corresponding Author*	GWL	-Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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The Experience of Husband Caring for Wife with Early-Onset DEMENTIA

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Abstract

Purpose: *Recently, Korea's rapid increase in the elderly population and the prevalence of dementia have emerged as a serious social problem due to the world's fastest aging population. Moreover, as the number of dementia patients is increasing rapidly among people in their 30s and 50s, interest in early onset dementia and the burden of caregivers for dementia patients are increasing.*

Method: *Participants in this study were 7 spouses who have been taking care of early onset dementia wives who was diagnosed with dementia before the age of 65 for more than one year. Data were collected through in-depth interviews and analyzed using the grounded theory method suggested by Strauss and Corbin(1998).*

Results: *The experience of going through process of husbands caring for early-onset dementia wives proceeds through four stages of 'recognizing the change', 'denying', 'trying', and 'accepting', and the core category is 'accepting the wife's dementia. Types of accepting dementia were classified into three types: 'active coping type', 'accommodative type', and 'helpless type'.*

Conclusion: *Through this research, the characteristics of early-onset dementia patients were understood, the theoretical basis for the caring process was established, and the importance of professional education and active promotion on early dementia was suggested for early detection and accurate diagnosis of diseases. Also, this study is expected to be a good foundation for the development of specialized programs that consider the characteristics of early onset dementia, establishment of nursing strategies and national support system.*

[Keywords] ***Dementia, Early-Onset Dementia, Experience, Husband, Grounded Theory***

1. Necessity and Purpose of Research

In Korea, where the elderly population is rapidly increasing, elderly diseases are becoming a social issue. Moreover, as news reports that the number of dementia patients among people in their 30s and 50s is increasing rapidly, interest in early onset dementia[1] is increasing.
Dementia is a syndrome that impairs overall brain functions such as memory, mental ability, thinking ability, learning ability, and judgment[2]. Although age is not an important criterion for diagnosing dementia, dementia has been generally considered to be predominantly occurring in the age group over 65.

Early-onset dementia is occurs before the onset age of 65 years and it is not easy to obtain an accurate diagnosis and implies the possibility of receiving several different diagnoses[3]. Misdiagnosis is also common, and 30% to 50% of early onset dementia patients are reported as misdiagnosis[4]. Also, it is common to apply the same diagnostic criteria for senile dementia and early-onset dementia even though differences in clinical symptoms have been identified [5].

Moreover, the diagnosis of early onset dementia is much more diverse than that of senile dementia and the symptoms of remarkable cognitive dysfunction except memory deterioration, convulsive major failure paralysis, convulsions, and myoclonic muscle spasms appear, along with neuropsychiatric features beyond cognitive impairment[6]. Therefore, since accurate diagnosis is very important in the management of not only the patient's plan but also the family's caring for the patient, an accurate diagnosis of early onset dementia is necessary.

Dementia is a representative chronic progressive disease that causes a severe psychological, physical, and economic burden on the patient as well as his family[7]. Just as the caregivers of elderly dementia patients, it is reported that even the caregivers of early-onset dementia patients, it is a difficult task that gives physical and emotional burden. In a study comparing the caregivers of patients with early-onset dementia and elderly dementia[8], caregivers of early-onset dementia patients had a higher burden.

A large number of studies on the experience of taking care of dementia patient have mainly been conducted on female caregivers such as daughter-in-law and daughter[9][10][11][12], recently, a study on the husband's caring experience of dementia in elderly couples[13], a phenomenological study on the caring experience of husbands caring for a spouses with presenile dementia[13][14] and other research on husband's caregivers are also being conducted. However, these are studies that suggest approaches and policy alternatives in the aspect of social welfare, and to provide effective nursing intervention for them, an approach is needed in the nursing aspect.

There have been many studies related to dementia in Korea, but most of them focused on the age group of 65 or older, and it is no exaggeration to say that there has been little research done on early onset dementia.

Therefore, in order to inductively derive the nature and variables of the care experience of early-onset dementia patients based on the experiences of the subjects, this study intends to develop a substantive theory by conducting the grounded theory research method, one of the qualitative research methods, the research question for this is 'What is the empirical structure of the caring process of a husband with an early onset dementia?'

2. Research Method

This study is a qualitative study to derive substance theory from data obtained through in-depth interviews with husbands caring for early-onset dementia wives with dementia before age 65 by applying Strauss & Corbin's(1998) grounded theory method.

2.1. Research design

This study is a descriptive survey research in order to analyze the perception on dementia, the use of care services, and the demand & satisfaction for the dementia works.

2.2. Data collection

2.2.1. Selection of research participants

Participants in this study are those who have been introduced and accessible by the researcher as the subjects of the study, but among spouses who have been caring for early onset dementia wives diagnosed with dementia before the age of 65 for more than one year, those who could communicate and have in-depth interviews were selected as participants in this study. Most of the participants' spouses were being treated at the hospital's mental health or neurology department, and only one of them was using the dementia support center.

2.2.2. Method and period of data collection

The data collection period of this study was conducted for a total of 6 months from November

2012 to May 2013, and interviews were conducted over 1~2 rounds. Prior to the interview, after calling in advance and confirming the availability of the interview, the one-on-one personal interview method was implemented for the person who agreed to the interview on the possible date. An interview took about 2 to 2 hours and 30 minutes, and with the consent of the patient, the contents of the interview were recorded, using a portable recorder. The contents of the interviews with 7 participants were directly transcribed on a computer after the researcher listened. The part that was not clear or considered insufficient at the time of the interview was confirmed through supplementary questions at the time of the additional interview, and analyzed together with the on-site note, and the interview was conducted until the saturation was reached where new contents were no longer coming out from the participants.

2.2.3. Research questions

Specific research questions were different depending on the communication method with the participants, but examples of semi-structured questions are as follows.

'How long has your wife been diagnosed with dementia?'
'How did you find out that your wife had dementia?'
'How did you feel when you heard the story of dementia?'
'What are the symptoms of dementia that your wife shows?'
'How do you cope with your wife's behavior?'
'What has changed from taking care of your wife?'
'What are the challenges of taking care of your wife?'
'What do you think is necessary to take care of your wife?'
'What are your plans for the future?'

2.3. Ethical consideration of research

In order to protect the subjects, this study was conducted after deliberation and approval by the research subject protection review committee of the university to which the researcher belongs(IRB approval number: HYI-12-040-Supplementary3). The purpose of the study, the method of proceeding, and the method of use were explained to all participants in the study, and consent was asked to record the interview contents. Since this study guarantees anonymity and confidentiality, it was explained that the interviewed data should be discarded after the study is completed.

Consent was obtained in writing, including that it is also possible to withdraw participation during the study if not desired.

2.4. Data analysis

The collected data was analyzed by continuously and systematically conducting comparisons and questions. The analysis was conducted cyclically with data collection, and the procedure followed the methods of open coding, axis coding, and selective coding suggested by Strauss and Corbin(1998).

3. Results

3.1. General characteristics of participants

The general characteristics of the subjects participating in this study are as follows <Table 1>. Participants' age ranged from 59 to 64, and the period of support was from 1 to 7 years. Participants' wives' onset of dementia ranged from 54 to 61 years, diagnosed in 5 patients with Alzheimer's Disease(AD) and 2 patients with Frontotemporal Dementia(FTD). As for the family living together, two people lived only with their spouses, and five also lived with their children.

Before being diagnosed with dementia, participants' wives ran a restaurant, represented a clothing company, worked as a cook at a school, worked as an office worker, and operated a beauty salon and shop and most of the participants' wives had jobs and were active in social activities.

Table 1. General characteristics of research participants.

Participants	Age	Education level	Period of support	The age at which dementia occurred	Diagnosis	Status of cohabitation with family	Previous job	Economic level
1	59	College graduate	5 years	54	Alzheimer's disease	With wife and one daughter	Clothing company representative	Upper-intermediate
2	61	High school graduate	3years	55	Frontotemporal dementia	With wife and one son	a cook at a school	Intermediate
3	64	College graduate	1years	61	Frontotemporal dementia	With wife and one daughter and one son	Restaurant operation	Upper-intermediate
4	64	Middle school graduate	4years	60	Alzheimer's disease	With wife	Beauty salon operation	Low
5	60	High school graduate	6years	60	Alzheimer's disease	With wife and two daughters	Store operation	Low-intermediate
6	61	High school graduate	3years	57	Alzheimer's disease	With wife and one daughter and two sons	Housewife	Low
7	64	High school graduate	7years	57	Alzheimer's disease	With wife	Office worker	Low-intermediate

3.2. Open coding

In the open coding process, concept extraction and categorization were performed through analysis of the original data. In this process, 102 concepts were created, and 36 subcategories were created by grouping each concept into the same context, and then reorganized into 15 categories <Table 2>. The categories created through open coding are ‘Unaware', ‘Deny’, 'State before the onset', 'Social perception', 'couple relationships', 'Disappearance of hope', 'Support system', 'clearing the mind', 'adapting to the reality',' barely holding on','going through the situation', 'Trying to find hope', 'becoming a meaning of life', 'Becoming exhausted', and 'feeling sad'.

Table 2. Categorization of base data.

Paradigm element	Category	Subcategory	Concept
Causal condition	Unaware	Cannot recognize	There was no problem
			People around the subject noticed first

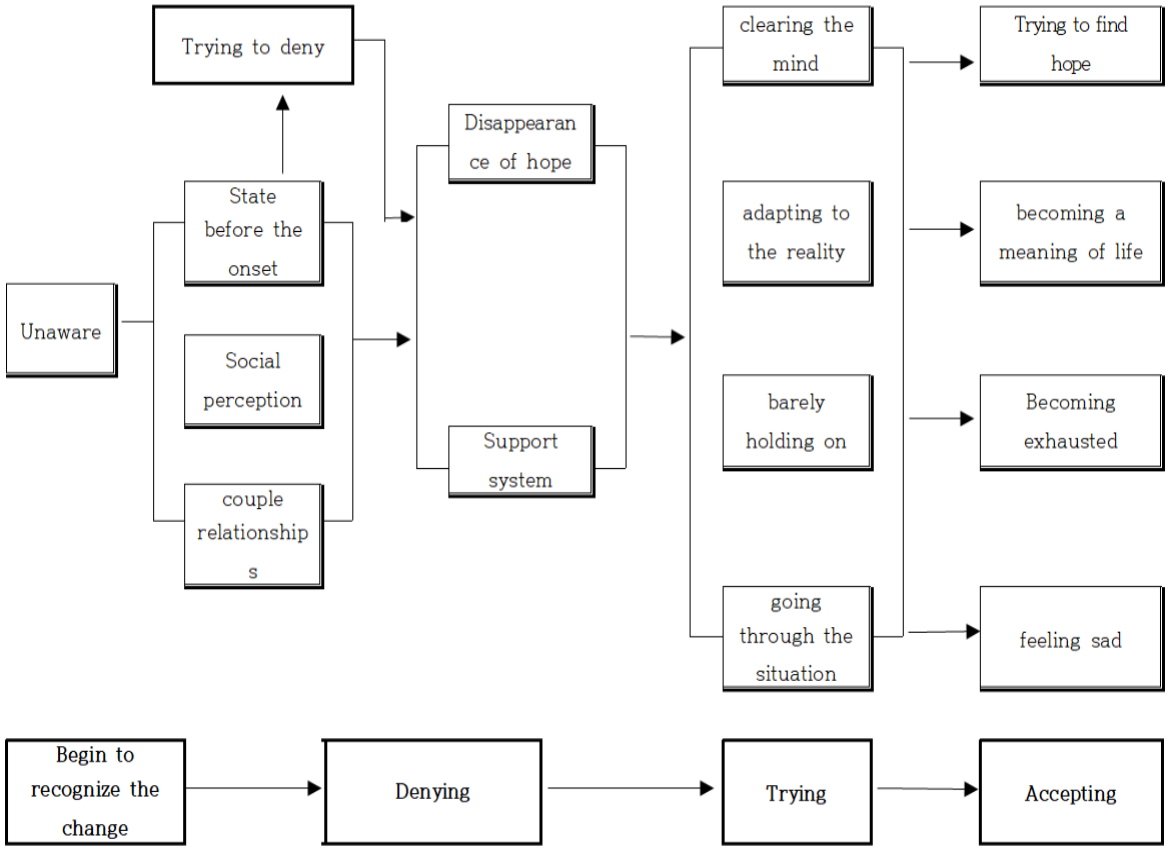
		Not considering it serious	Blamed the regular medicine
			Considering changes in wife as no big deal
		Experience of sudden change	Occurrence of problems with wife's work life
			Experience the sudden abnormal behavior of wife
			Noticing the difference in wife's behavior
Actual state	Rying to deny	Difficulty in diagnosis	Gotten a contradictory diagnosis
			Diagnosed with depression
			Late visit to hospital
			Diagnosis of dementia given late after highly proceeded
		The situation that makes no sense	Unthinkable wife's illness
			Collapsed in shock
			No reason to get sick
		Shopping of hospital services	Moving around hospitals
			Visiting famous hospitals
		Denial of reality	Regarded as just sick
			Considered just temporary problem
			Blaming the God
			Feeling lost
Context	State before the onset	Degree of social activity	The wife who used to be smart
			The wife whose social position used to be high
		Usual personality	Bright and cheerful personality
			Quiet and introverted personality
	Social perception	Geriatric disease	The disease for the elderly
		Negative perception	The disease worse than cancer
			Psychosis
			Incurable disease without cure
	couple relationships	The degree of attachment between couples	Wife is mine
			The affection of a couple
Intervention	Disappearance of hope	Finding other treatment options	Receiving oriental medicine treatment
			Receiving the laying on hands
			Doing an exorcism
			Praying at a temple
			Moving parents grave
			Doing every good thing
		Rapid progression of the disease	Sudden decline in memory
			Decreased concentration
			Disorientation
			Getting worse every year
		No more solution	Effort has been in vain
			No more way to do
	Support system	Lack of information	The only information was from doctors
		Social isolation	No one to open up
			The relationships around become estranged

			Avoiding friends meeting
		Nowhere to go	No facilities to go
Action/ interaction	Clearing the mind	Emptying the mind	Abandoning pride and face
			Changing the mind
			Shifting the ground
			Accepting as the destiny given to me
			Thinking that it came a little faster than others
		Guilty conscience	All this is my responsibility
			Punishment for my sins
			Sorry for not being good to wife
	Adapting to the reality	Wife-centered life	Determination to do my best
			Focusing on wife's health
			Daily life that everything is tailored to wife
		Adding roles	Learning to housekeeping
			Dedicated to what wife was doing
			Taking the place of mother
		Undertaking	Quitting work
			Taking care of wife alone
	Barely holding on	wanting to hide	Feeling like falling to the floor in one moment
			Fear to be honest to tell
		worry about children	Worry about the possibility of passing on to the children
			Worry about the possibility of being an obstacle to children's marriage
		Hardship	No control of behavior
			Difficulty in communication
			Feeling like he will have dementia too
			Repression of emotions dozens and hundreds of times a day
			Economic difficulty
		Fear	The speed of the disease too fast
			Fear that the wife forgets one by one
			Fear to be left alone
			Start of writing a diary
			Remingding children to do well when they can
	Going through the situation	Finding a way	Sending to a nursing hospital
			Request for a care worker
			kindness to those around
			Getting help from a friend or neighbors
		Encouraging my energy	Paying attention to health management
			Taking time for me
Result	Finding hope	Expectation	really want to heal
			Looking forward to the development of new drugs
			Comforting not being alone
	Becoming a meaning of life	Being the reason I live	A life that wife became everything
			wanting to let go but not being able to let go
			wanting to go back to those difficult times
		Gratitude	Satisfied with current status

		Rather feeling grateful that I can take care of wife
	Hoping it goes slowly	Hope it goes slowly
		Hope to keep this state as it is
Becoming exhausted	Reaching the limit	Body is destroyed
		Death impulse
		barely endured while doing just this much
	Inability to control himself	Just living without a plan
		The vague future make him feel more and more difficult
		Not lingering in life
Feeling sad	Pognant sadness	Heartbroken for being still young
		Tears pouring out just by thinking
		Sorry for not being able to heal it

3.1.3. Conceptual framework

Figure 1. Conceptual framework of a husband's "accepting to the wife's dementia" who cares for a wife with early onset dementia.



3.1.4. Analysis of the type of 'accepting wife's dementia'

In this study, the types of "accepting the wife's dementia" of husbands caring for early-onset dementia wives were identified in three types: active coping type, accommodative type, and helpless type <Table 3>.

Table 3. Types of 'accepting wife's dementia'.

	Active confrontation	Accommodative type	Helpless type
Causal condition	Not finding out(strong)	Not finding out(strong)	Not finding out(strong)
Core category	Receiving dementia (active, positive)	Receiving dementia (inactive, positive)	Receiving dementia (inactive, negative)
Contextual condition	State before onset(good) Social perception(negative) Couple relationships(strong)	State before onset(good) Social perception(negative) Couple relationships(strong)	State before onset(good) Social perception(negative) Couple relationships(weak)
Interventional condition	Disappearance of hope(weak) Support system(wide)	Disappearance of hope(strong) Support system(narrow)	Disappearance of hope(strong) Support system(narrow)
Action/ interaction strategy	Clearing the mind(active) Adapting to the reality(active) Barely holding on(weak) Going through the situation (active)	Clearing the mind(active) Adapting to the reality(active) Barely holding on(weak) Going through the situation (inactive)	Clearing the mind(inactive) Adapting to the reality(inactive) Barely holding on(strong) Going through the situation (inactive)
Result	Trying to find hope(strong) Becoming a meaning of life(strong) Becoming exhausted(weak) Feeling sad(strong)	Trying to find hope(weak) Becoming a meaning of life(strong) Becoming exhausted(weak) Feeling sad(strong)	Trying to find hope(weak) Becoming a meaning of life(weak) Becoming exhausted(strong) Feeling sad(strong)

4. Discussion

Participants of this study experienced changes in their wives due to dementia insignificantly or without notice. In the case of early-onset dementia, cognitive function, especially frontal lobe function, is reported to be significantly impaired compared to senile dementia[16][17], and the pre-temporal dementia, which is more common among younger patients shows BPSD(Behavioral and Psychological Symptoms of Dementia) remarkably, such as abnormal behavior or personality change from the beginning[18]. Therefore, participants in the study may experience changes in their wives' behavior unexpectedly. If the deterioration of memory, known as the initial symptom of dementia, was not noticeable and there was a lack of prior knowledge that dementia can develop at a young age regardless of age, the abnormal behavior of the wife would not have been considered dementia.

In a study by Werner and so on, the clinical difficulties encountered in early onset dementia are concentrated between the time from the initial signs of dementia to the diagnosis. This may be due to the fact that the patient is still young, and the participant does not think he or his family have dementia, and in general, dementia is related to age, so the primary specialist does not tend to diagnose young patients as dementia.

It is necessary to change the social awareness that dementia is a disease that occurs in the elderly, and for this, education should be conducted in various aspects along with active promotion, and to receive an appropriate diagnosis early, the professional knowledge and training

of medical personnel should be expanded.

To detect dementia early, local public health centers and dementia support centers in 25 autonomous districts in Seoul are conducting early dementia screening programs, but the target of the project is over 60 years of age, and management of patients with early-onset dementia that occurs before that time is insufficient. Therefore, it is necessary to expand the target of early dementia screening programs and services of management programs.

The state before the onset, social perception of the disease, and the couple relationship acted as contextual conditions for participants to recognize dementia. A study also reported that the main provider's marital relationship before and after support affects the support[19]. Most of the participants in this study showed being not able to let go of hope while looking forward to the development of new drugs rather than despair due to dementia is believed to be due to the love and affection between couples that have been accumulated over a long period of time and is considered a strength that only spouse care giver can have.

Participants do not want to admit their wives' dementia but have experienced progress of the disease such as acceleration of symptom onset that leads to difficulties in daily life, sudden decline in memory, loss of direction due to disorientation, aggressive behavior, difficulty in communication due to loss of words and their meanings. This is consistent with previous studies showing that early onset dementia occurs relatively quickly, and rapid progression of disease compared to senile dementia[20]. In a study comparing cognitive function and daily life performance ability of early onset Alzheimer's disease and delayed-onset Alzheimer's disease in homogeneous conditions such as gender, educational background, disease severity, depression level, and duration of disease(Sujin Kang, Sumi Choi, 2007), it was found to be more degraded than the delayed expression of Alzheimer's disease, indicating that early-onset dementia progressed more severely and rapidly than that of senile dementia.

Participants endeavor to heal their wife's illness, but in a situation where there is no support system at all, they experience extreme pain while taking care of themselves and the heavy role of husband and parent. Isolation that comes from not being able to live in social life as a head of a family at the age where they have to play an active role in society, the financial difficulties and the burden of raising children are thought to be much more severe than supporters of elderly dementia patients.

Participants had negative perceptions of current nursing homes and welfare facilities operated for dementia patients and were also not active about the services available. In the absence of other services for patients with early-onset dementia, currently available services are inevitably insufficient to properly support early-onset dementia patients and their families. Participants had a critical mind about the quality aspects of current services, the possibility of patient abuse, and the lack of specialized programs for patients with early onset dementia. Therefore, the needs of patients with early onset dementia and their care givers are different from those with senile dementia, and a different approach is needed.

Therefore, crisis intervention of care givers for early-onset dementia, establishment of social resources, and support systems available to them are urgently needed. Providing effective interventions to reduce the care giver's burden of care is essential to providing high-quality care to both patients and care givers.

5. Conclusion and Suggestion

This study applies a grounded theory research method to develop a substantive theory about the husbands' experience of caring for wives with an early-onset dementia by exploring the experience of husbands' caring for wives with an early onset dementia and identifying the relationship between the nature and concept of caring experience, 36 subcategories and 15 categories were derived from the participants with 7 participants, and the results are as follows.

The causal condition leading to the phenomenon of ‘Deny' appeared as ‘Unaware’, and the phenomenon was confirmed that the context as 'State before the onset', 'Social perception',

'Couple relationships,' and the interventional condition as 'Disappearance of hope', 'Support system', and the action/interaction as 'clearing the mind', 'adapting to reality',' barely holding on', 'going through the situation'.

The 'accepting dementia', a core category of the experience of husbands' caring for wives with early onset dementia, was analyzed into three types, focusing on attributes and the dimensions. The first type is 'active coping type', which shows a active attitude rather than being inactive about the problem situation, the second type is the 'accommodative type', which accepts the current state as it is and adapts to the reality with the best possible effort, and the third type is the 'helpless type', which is exhausted by the limitations of care and passive coping.

As a result of this study, since husbands' caring for wives with early onset dementia spend a long time before being diagnosed with dementia in their wives without an accurate understanding of the disease and social awareness of dementia, it was shown that early recognition and active intervention of experts are very important for early detection of disease and delaying progression. Also, since husbands caring for wives with early onset dementia are inevitably more suffering such as feeling of bondage due to inability to work at the age of social activity, financial difficulties, and burden of raising children, so developing specialized nursing and specialized programs and support groups that fit the characteristics of early-onset dementia that reduces their burden of care, and the need to establish support systems and services designed for them are necessary.

Based on the above results, I would like to make the following proposals.

1. In this study, since the husbands of Alzheimer's disease patients, who have the highest proportion of senile dementia, were the majority of all subjects, a study to confirm the experiences of supporters according to each causative disease including more diverse causative diseases as subjects in the future.
2. The subjects of this study are husbands who cares for wives with Alzheimer's disease and anterior temporal dementia. As the clinical characteristics of Alzheimer's disease and anterior temporal dementia are different, there may be differences in the experiences of care givers. Therefore, I propose to conduct a follow-up study comparing the differences in experiences between these care givers.
3. This study was conducted on spouses of early onset dementia patients diagnosed with dementia before 65 years of age, but the average onset age was 57 years old, and I propose to conduct a study to compare and analyze the differences between care givers and young patients in their 30s and 40s.
4. Since the participants of this study have good marital relationships and are mainly interested in the treatment of their wives, I propose to conduct a study to check the experiences of husbands who do not, and what circumstances and conditions affect them.

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7. Appendix

7.1. Authors contribution

	Initial name	Contribution
Author	SYP	-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑ -Make a significant contribution to collection ☑ -Final approval of the paper ☑ -Corresponding ☑ -Play a decisive role in modification ☑ -Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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This Paper Summarizes Soyoung Park's Hanyang University Doctoral Thesis.