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Corresponding author  
E-mail: [kjk744@kmu.ac.kr](mailto:kjk744@kmu.ac.kr)

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## Sport Scientification of TAEKWONDO for the 4.0 Generation

Kijin Kim

*Keimyung University, Daegu, Republic of Korea*

### Abstract

**Purpose:** Taekwondo is gaining global popularity as a sport through gyeorugi, poomsae, and demonstrations. As a proposal for the better development of Taekwondo, I would like to emphasize the importance of scientification.

**Methods:** There is a need for systematic efforts to create a new Taekwondo for sports science that integrates with artificial intelligence, virtual reality, the robot industry, big data, and biological chemistry. Above all, we must not forget the essence of human-centered Taekwondo. The development of contents as an educational program centered on the moral value of Taekwondo and the development of Taekwondo in fusion with culture must be emphasized continuously.

**Results:** As a specific project, scientific research on Taekwondo to present evidence for health promotion and academic research for cutting-edge science in competition sports are representative. In order to establish itself as a sport and improve performance, more intensive efforts on the use of cutting-edge science are emphasized to solve the abundance of problems such as stadium specifications, game time, scoring type, judgment method, and electronic tooling of sportswear and shoes. The development of a taekwondo program as a rehabilitation sport for the recovery of human inner and physical function can be a new attempt in consideration of changes in the times including low birthrate and aging.

**Conclusion:** Taekwondo should play a role in protecting human body shape in excellent form while converging with more diverse disciplines to promote health and improve athletic performance. Just as many changes in human science have been accompanied by culture and religion, efforts to find human-centered Taekwondo science should also be attempted.

**[Keywords]** Taekwondo, Scientification, Health Promotion, Performance, Humanity

## 1. Introduction

The origins of sports can be traced to various traces of ancient physical education in BC or in the history of BC in China. Sports have important and diverse values that are indispensable in the history of human change, but the most core values are human health promotion and performance improvement. An important factor in the process to further increase these values is more active scientification. The scientification of sports has been progressed through the process of subdividing various fields and convergence with various surrounding disciplines. This scientification has led to the development of sports and the creation of new genres in modern society through the help of advanced science. Taekwondo is a modern creative martial art representing Korea, and since advancing to the Olympics as a sporting event, Taekwondo has been playing a role as a global sport beyond the scope of martial arts. Beginning with the origin of the Three Kingdoms period, Taekwondo has 209 member countries around the world, and it has been established the central position of global sport through the process

of an official national sporting event in 1963, the designation of the Korean flag in 1971, the establishment of Kukkiwon in 1972, a pilot event for the 88 Seoul Olympics, and an official event for the Sydney Olympics. In addition, it has established itself as a global sport that produced 100 million Taekwondo people.

Taekwondo has been popularized around the world, and has a shape as a sport through gyeorugi, poomsae, and demonstrations. In addition, it has already occupied the position of a global sport, and scientification has also played an important role in the development of Taekwondo through continuous efforts. Despite the remarkable development so far, it has not been able to clearly solve many problems such as renovating the face of the suspicion country, internal factions, misjudgment of the gyeorugi event, game manipulation, foot fencing and improvement of electronic guards to overcome tedious game management, and new changes in game rules. In addition, in preparation for the 4.0 era, which emerged as a new engine of industrialization, in order to advance to a new Taekwondo, along with the existing difficulties such as the scientification of the newly emerged sport, poomsae, and the promotion of Korean culture in relation to internationalization of Taekwondo. I would like to further emphasize the importance.

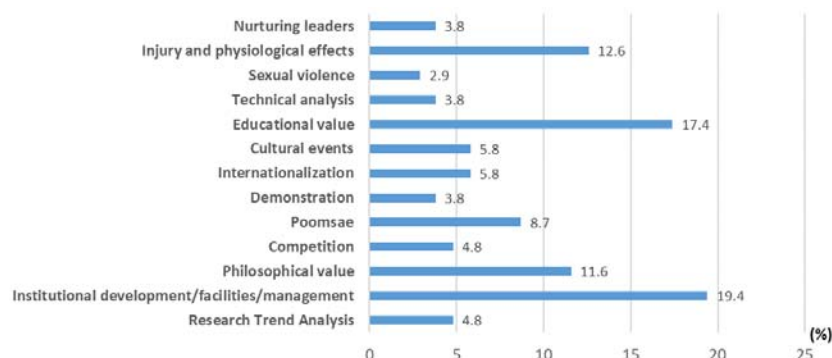
## 2. Main Contents

### 2.1. Academic change of taekwondo

The academic development of Taekwondo has been active with active academic research since the establishment of the university's Taekwondo department in 1982. In particular, scientific studies have been conducted in various fields of Taekwondo, and qualitative and quantitative studies on values, history, spirit, and problems as well as gyeorugi, poomsae, and demonstrations are being activated. The characteristics of Taekwondo include men and women of all generation, no difficulty in places, growth and development, social enhancement and physical fitness improvement, and Taekwondo's martial arts philosophy is summarized as 'Strong but not reckless, prudent but not passive'.

Looking at the results related to marshall art's academic efforts, it can be seen that the most research results related to Taekwondo were made. Full-scale academic research for the scientification of Taekwondo has continued to develop through the process of establishing the Taekwondo department in the university in 1982, the founding of the Korean Martial Arts Association in 1999, and the establishment of the Kukkiwon Taekwondo Research Center in 2006. In fact, the first publication of taekwondo-related research papers can be seen around 1974. Until the 1990s, it was somewhat insufficient, but after 2000, Taekwondo students began to increase rapidly as they entered graduate school[1][2]. Looking at the analysis results for each research subject before and after the 2000s until 2009, research topics for improving athletic performance showed a decreasing trend of 58.2% before 2000 and 29.6% after 2000, but the most researches were conducted overall. As of the 2000's year, attitudes, perceptions, facilities, systems, and administrative sectors, as well as usefulness and popularization, show a remarkable increase[1][3]. In particular, looking at the publication status of 'The Journal of Korean Martial Arts' and 'Kukkiwon Taekwondo Research', which have been the main focus of research papers related to Taekwondo since 2010, as shown in <Figure 1>, 19.4% of thesis on the institutional development and management of Taekwondo indicating that interest in efforts for economic development, including institutional change for new development and the operation of a studio, is increasing. In addition, the research on the educational application plan centering on moral values also showed a high ratio of 17.4%, indicating the importance of the value of character education through Taekwondo. It is believed that the developmental future of Taekwondo is being pioneered as researches in various fields including scientification have been widely conducted. However, it seems that the attempt to respond widely to the changes of the new era is somewhat insufficient.

**Figure 1.** Distribution of research topics in recent taekwondo journals.



## 2.2. The 4th industrial revolution and the scientification of taekwondo

The opinions of various business scholars are divided around 2015, but it is generally evaluated that the 4.0 era, which is the era of the 4th industrial revolution, has been reached worldwide. In the era of the 3rd industrial revolution driven by computers and the internet, each field is making rapid progress with millennials such as ICT, IOT, robots, AI and 3D printers. Taekwondo is required to establish itself as a new and important discipline for the general public as well as athletes and leaders, and various convergence and evolution with advanced science are required. In the flow of sports science, the convergence of the cultural industry, the realization of healthy life through sports activation, ICT innovation capabilities and the use of IT and software, the increasing affinity of the elderly population, the establishment of a global sports network, sports science to strengthen the competitiveness of the tourism industry and development of realistic virtual sports services are being emphasized as important fields[4]. In particular, sports science is expanding to a diverse spectrum based on the convergence of culture, construction, technology, services, and media, and the national growth with high value-added sports industry fostering and global competitiveness through the convergence of industrialization technology and marketing know-how and sports. The need for intensive nurturing as a driving force is being emphasized. Therefore, Taekwondo is required to build a system to be able to maintain an equal position like this, and it is required to discover various fields based on Taekwondo. For the better development of Taekwondo, which is the most scientifically advanced among marshall arts, research to seek convergence with advanced science including ICT in research fields and competition management methods is needed. Based on this, other marshall arts fields are also 2.0 Apart from the times, active progress toward the 4.0 era is required along with benchmarking centered on Taekwondo.

## 2.3. Scientification of taekwondo for health promotion

The traces of the use of exercise as a means of disease treatment around 1800 BC can be said to be the origin of exercise is medicine[5], first proposed by ACSM in 2007. Recently, the role of sports has come to play a very important role in relation to the importance of human life. It is necessary to be able to present evidence related to the value of sports as a condition required to satisfy this trend. In order to further revitalize the role and evolution of 'Exercise is Medicine', it is necessary to be able to provide a detailed basis for the level and range of the exercise and physical activity performed according to the type and the most effective. The personality program with philosophical values and moral perspective is close to the roots of Taekwondo, and is emphasized as a field of high value as a way to solve the ill factors of modern society. However, the limitations and difficulties of scientific and systematic approaches can be regarded as due to their own properties, but they have a weakness in that the subdivision and systematization of the basis is inferior[6]. For example, it is thought that there is a desperate need for an evidence-based academic study on how the training of Taekwondo can

show the difference in effect at the cellular level of our body according to more subdivided factors and types. After emphasizing the evidence-based principle in clinical decision-making focusing on treatment in the past, medicine has applied it as a clinical practice guideline, systematic review, medical technology and qualitative evaluation, and has made efforts to more actively realize and expand this[7]. In the course of attempting evidence-based sports science for the scientification of Taekwondo, questions about the approach to field use are drawn and answers are collected, and the validity of the collected evidence and the possibility of field use are analyzed and evaluated. It should be conducted as a process that combines training or stadium experience. In addition, since Taekwondo requires field use more than any other field, it should be possible to find ways to further improve the process of integrating evidence-based information and field experience.

With the advent of the 4th industrial revolution in Taekwondo, there will be a need for active use of big data[8] and artificial intelligence, which have been expected for a long time. Of course, there will be conflicts with arguments emphasizing the importance of human-centeredness, but more advanced Taekwondo will enter a new stage of convergence with virtual reality and robot sports. If machine learning and deep learning are applied to sports science along with the use of big data, the role of sports science will be further expanded, and a new aspect of Taekwondo science will be required to improve health and exercise performance[9]. The main role of the use of big data is to predict the future through correlations, and the value of using future-oriented big data to solve the question of Taekwondo until now can be presented as 'why'.

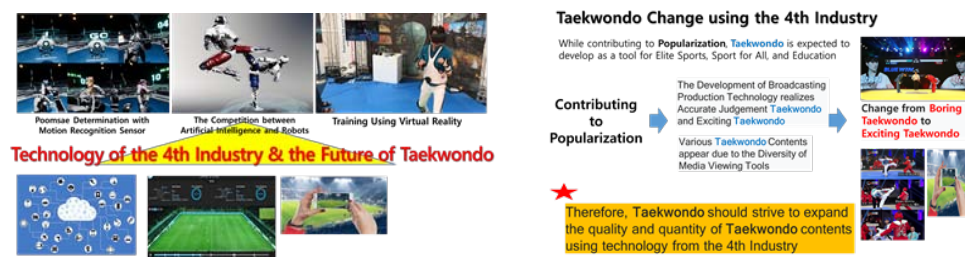
#### **2.4. Scientification of taekwondo to improve performance**

In relation to sports science, it is possible to propose the science of Taekwondo centering on gyeorugi and poomsae. Sports science has been widely attempted to make scientific efforts through training grounds and stadium facilities, development of new training methods[10], nutritional approach and changes in sports equipment in relation to the improvement of athletic performance[11]. In particular, the development of equipment for measuring and analyzing human capabilities have been the core of science. Taking these perspectives into account, Taekwondo gyeorugi has been tried various changes. For example, we are constantly trying to change and develop through the standardization of the stadium, the game time, the match score type, the method of judging, and the electronic tooling of the game clothes and shoes. In the process, the scientific approach has played an important role. In this process, a more systematic approach is required on how to use and converge artificial intelligence, virtual reality, robot industry, big data, and biological industry, which are the main factors of the 4th industrial revolution in Taekwondo as summarized in <Figure 2>.

Cybathlon, created on the basis of bionics, which combines biotechnology and electronics, is a representative example of Taekwondo in the future. Cybathlon, in which robots and human rehabilitation in virtual reality, may be a new look of Taekwondo. Sports science is required to produce new knowledge and values through various convergence with surrounding disciplines including ICT, and to evolve into sports science with a new system through active academic consolidation.



**Figure 2.** Basic focus for the scientification of taekwondo for the 4th industrial revolution.



The main achievements of the 'Sports Science Convergence Research Project' recently made in Korea were the development of new technologies, precise control of various sports environments, and the development of sports events that combine the ultra-lightweight Internet of Things(IoT) platform. In the case of Taekwondo, it is also required to develop a new sport that is fused with these technologies[12]. For example, we can suggest the development of the gyeorugi relative tactic analysis program, the simulation program for the development of Taekwondo technology through the modernization of the electronic protector, the development of a platform that integrates analysis and feedback of physiological, biochemical, and physical human effects by poomsae type, and the development of a Taekwondo training program for poomsae that combines artificial intelligence and biotechnology[13][14][15].

## 2.5. Humanity and science

There are also stages in sports science. It has been through stages that have focused on improving athletes' performance, promoting human health, and activating human welfare and economy. In the process of experiencing this stage, sports science has made efforts to overcome difficult problems while experiencing changes and development centered on elite sports. Excessive sports science, such as political abuse, drug doping, distortion of the essence of sports and loss of humanity, has been denied the value of existence of sports. The problem arising from the focused on elite sports is that it may lead to serious drug contamination, the development of full body swimsuit and advanced equipment as it flows to sports science focused on excessive victory, while on the one hand, it may lead to a revival period of sports science and on the other hand, perhaps a dark period in sports. However, this step would be an inevitable step if sports science exists alongside the human environment and evolving science. In the case of Taekwondo, it is also going through these stages. Taekwondo's concerns on how to change these stages should be emphasized. In order to develop Taekwondo as an essential sport of character training and physical reinforcement, above all, it must be human-centered.

With the increase of the elderly population and the increase of the sports active population, the incidence of sports injuries has also rapidly increased, and the importance of scientific rehabilitation training related to this is being emphasized, and the role of sports science in rehabilitation medicine is also increasing. In particular, sports damage is emphasized as the most important limiting factor in the process of exercising athletes' performance, and prevention and rehabilitation of sports damage are very important to improve the quality of life of the general public. Since all human functions decrease from the twenties, even if they are not damaged, effective rehabilitation is an inevitable program, and the need for a rehabilitation program based on sports science is required. All human beings must perform sports science evidence-based exercise programs for lifelong rehabilitation. Taekwondo is a martial arts sport in the training process and is evaluated as a core sport for human function rehabilitation. Considering the new role of rehabilitation sports, Taekwondo is expected to occupy a pivotal position.

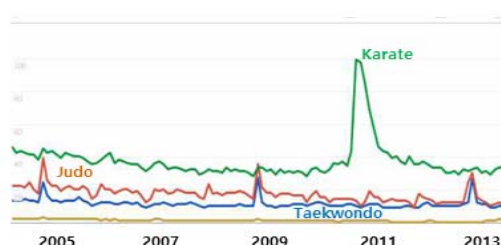
The complex promotion of elite sports, sports health industry, ICT convergence science, and sports culture through sports science research will be activated[16]. Sports science in the f-

uture will require more diverse academic approaches and harmony, and will require the use of advanced science, diversified information, and sharing with surrounding sciences[17][18][19]. The emphasis is on promoting active linkages between sports science and sports culture and industry. By encouraging the sports and tourism industries to have a close relationship, it can further enhance the brand value of sports and help revitalize the economy. Considering the importance of cultural content that can be fused with Taekwondo, comparing with other martial arts sports in previous studies[20], as shown in <Figure 3>, it is related to cultural contents compared to karate and judo.

### 3. Conclusion

Considering the role and social flow of Taekwondo, it is predicted that the scientification of Taekwondo will further expand its literal role in terms of economic, social and cultural as well as academic status. From this point of view, fusion and complex scientific research is required to achieve integration with various academic fields and social flows. In this process, it is necessary to establish an effective cluster system with advanced science and industry along with systematic and future-oriented activation for health promotion and athletic performance improvement. What should be considered important in the advanced science of Taekwondo is the restoration of humanity. Changes in human form and body shape require efforts to regain human-centeredness while harmonizing with culture. Through various changes, the human body has a nice and beautiful appearance, but there is also the worry of getting deformed. Taekwondo should play a role in protecting human body shape in excellent form while converging with various disciplines along with scientification of health promotion and performance improvement. In addition, just as many changes in human science have been accompanied by culture and religion, efforts to seek human-centered taekwondo science should also be attempted.

**Figure 3.** Comparison of martial arts content on google[8].



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## 5. Appendix

### 5.1. Authors contribution

Initial name	Contribution
Lead Author & Corresponding Author*	-Set of concepts <input checked="" type="checkbox"/> -Design <input checked="" type="checkbox"/> -Getting results <input checked="" type="checkbox"/> -Analysis <input checked="" type="checkbox"/> -Make a significant contribution to collection <input checked="" type="checkbox"/> -Final approval of the paper <input checked="" type="checkbox"/> -Corresponding <input checked="" type="checkbox"/> -Play a decisive role in modification <input checked="" type="checkbox"/>
KK	



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Corresponding author  
E-mail: [shc0601@hanmail.net](mailto:shc0601@hanmail.net)

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## The Influence of Leader's Leadership Type on Psychological Factors of University TAEKWONDO Demonstration Team

Hochul Shin

*Kyungmin University, Uijeongbu, Republic of Korea*

### Abstract

**Purpose:** Competitive anxiety is a state in which an athlete feels threat, fear, and pressure from the fierce competition and difficulty of winning, which inevitably accompanies an athletic event. This study seeks to delve into the influences of leadership on the competition status anxiety and psychological factors of university taekwondo demonstration teams, and examine the relationship between them.

**Method:** Data collected through the questionnaire in this study was analyzed using SPSS 26.0. Frequency analysis was performed to find out the general characteristics of the study participants, and exploratory factor analysis and Cronbach's  $\alpha$  coefficient, an internal consistency test, were used to verify the validity and reliability of the measurement tool. In addition, correlation analysis and multiple regression analysis were performed to determine the influence between variables of self-management, exercise commitment, and perceived athletic performance, and the significance level was set to .05.

**Results:** First, it was found that the leadership of the leader had a statistically significant effect on cognitive state anxiety and state confidence among the competing state anxiety factors of university taekwondo demonstrators, and there was statistically no significant level in physical state anxiety. Second, it was found that leadership had a statistically significant effect on crisis management and confidence/achievement motivation among the psychological factors of the university taekwondo demonstrators, and there was no statistically significant level in anxiety control. Third, it was found that, among the elements of competition state anxiety of the university taekwondo demonstration team, cognitive state anxiety had a statistically significant effect on anxiety control, and there was no statistically significant level in physical state anxiety and state confidence.

**Conclusion:** It can be said that the anxiety and psychological factors of the university taekwondo demonstrators' competition status according to leadership behavior style an effect. Accordingly, the results show that the positive behavioral pattern of the leader is related to the confidence of the athletes, the ability to cope with crisis, anxiety, and competition anxiety. It was determined that in order to improve athletes' performance and achieve good results in a perfect taekwondo demonstration situation, various behavior patterns of the leaders are necessary.

**[Keywords]** Leader's, Leadership, Psychological Factors, Taekwondo, Demonstration

## 1. Introduction

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 trainin[1]. 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 Organization for Standardization[2]. Taekwondo is one of the world's most popular martial arts sports, and as a cultural content representative of Korea which status is increasing even further, taekwondo demonstrations are considered a key element in its growth and development[3]. In general, a Taekwondo demonstration is a comprehensive technical expression program that presents to the public various and colorful techniques, and has played an important role in the spread and expansion of this sport[4]. Taekwondo demonstrations are considered to have played a large role in the development of taekwondo for promoting demonstration techniques, and creating new demonstration culture and performance contents, along with promoting Korea and this sport through domestic and international activities acquiring a diplomatic and cultural role[5][6].

Taekwondo is largely divided into sparring, poomsae, and breaking. In 1962, the Korea Tae-soodo Association(the former entity of the Korea Taekwondo Association) joined the Korea Olympic Committee[7].

If until now its rapid quantitative growth has been promoted, in the future qualitative growth is becoming increasingly important. Taekwondo's leadership style, as a sport that has great importance and influence as a leader among the sports events, is meaningful[8].

Leadership in a sports situation reinforces the change of mood and motivation of the team, and this strengthened motivation is the ultimate basis for the efficiency of improving performance. Since in sports, leadership affects the individual player's satisfaction, etc., research on it plays a very important role in understanding various areas such as athletic performance[9]. In particular, the reason that the leadership style is important in academical and practical terms is that it affects athletes' attitude change, repetitive training behavior, training integrity, and the degree of complaining. The application of feedback, such as motivation, is an important factor in successfully and efficiently leading the athletes' training, so research on the leadership style of a leader is of great significance[10].

For its importance, a study related to the leadership style of taekwondo leaders was conducted where its importance was emphasized by stating that, if the most important thing for a taekwondo leader is guiding by selecting the correct type of leadership in harmony with the players, it is possible to present an efficient image with which both the leader and the athlete can be satisfied[11]. Since the leadership style has a significant effect on the athletes' performance, today's taekwondo leaders are required to have a high level of expertise, as well as a variety of leadership styles related to the player's psychology, social aspects, and personality education[12].

As such, according to the leadership, taekwondo requires focus and contemplation of internal and external aspects, and psychological factors, so that the influence of psychological factors such as anxiety in competition can be seen.

Competitive anxiety is a state in which an athlete feels threat, fear, and pressure from the fierce competition and difficulty of winning, which inevitably accompanies an athletic event. It particularly refers to a state of psychological anxiety that an athlete feels before, during, and after a match[13]. Competitive anxiety varies in degrees, but since it is a psychological anxiety experienced by all athletes in a universal, general, and fatal way, it has been a core object of analysis in sports psychology, and most of the psychological anxiety covered in many previous studies so far has been competitive anxiety[14].

Competitive anxiety is divided into competitive trait anxiety and competitive state anxiety[15]. Competitive trait anxiety refers to an inherently innate potential tendency or characteristic anxiety to perceive a competitive situation as a threat and competitive state anxiety can be said to be a situational anxiety that occurs to players in a specific situation of competition[16]. There has been a lot of research on competitive anxiety and exercise performance in sports situations[17]. Martens et al. developed the Competitive Trait Anxiety Scale (SAS) and the Competitive State Anxiety Scale(CSAI-2) to measure competitive anxiety in sports situations. Studies have reported that competitive anxiety negatively affects performance[15][18]. Maintaining excessive competitive anxiety can result in injuries as inability

to display the highest skills. As a result, competitive anxiety can be summarized as exaggerated thoughts about success and failure, fear of injury, excessive expectations, and physical limitations[19].

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[20].

In order for athletes to demonstrate their best performance in the game, psychological abilities that can be implemented without error are essential, and the importance of psychological skill training to cultivate such psychological abilities is increasingly emphasized, so that athletes can properly manage and control their competitive anxiety, maintain a high level of attention, and use skills and tactics on their own through accurate recognition and confidence in their own performance[21].

taekwondo demonstrations were carried out as a means to promote taekwondo as an official Olympic event[22]. Taekwondo demonstrations and psychological skill training are essential. Skills, physical strength, and psychological abilities are important in order to continuously and safely perform highly difficult skills[23]. In the process of performing a taekwondo demonstration, failures may occur even when performing simple acts due to psychological factors. As such, it is believed that psychological as well as technical and physical factors will play an important role in expressing the best skills in performing taekwondo demonstrations[24].

Therefore, this study seeks to delve into the influences of leadership on the competition status anxiety and psychological factors of university taekwondo demonstration teams, and examine the relationship between them.

## 2. Research Method

### 2.1. Research subject

This study intended to collect 198 copies using the convenience sampling method after selecting the national university taekwondo demonstration team with coaches as a population. When looking at the general characteristics of the study subjects, in regards to gender, males amounted to 79.3 and females to 20.7, on average, and were surveyed from the first to the fourth year of university taekwondo demonstration teams, where the proportions were as follows: freshman, 58.1; sophomore, 33.8; junior, 6.6; senior, 1.5. The training period was 64.1 for 1 to 3 years, 23.7 for 4 to 6 years, 6.6 for 7 to 9 years, and 5.6 for more than 10 years. The general characteristics of the research subjects are shown in <Table 1>.

**Table 1.** Characteristics of study participants.

Classification		Number of cases(persons)	Percentage(%)
Gender	Man	157.	79.3.
	Woman	41.	20.7.
Year	Freshman	115.	58.1.
	Sophomore	67.	33.8.
	Junior	13.	6.6.
	Senior	3.	1.5.
Experience in demonstrations	1-3 years	127.	64.1.
	4-6 years	47.	23.7.

	7-9 years	13.	6.6.
	10 years or more	11.	5.6.

## 2.2. Data collection

For this study, the purpose and objective were sufficiently explained to the supervisors and coaches of each university team to which the national university taekwondo demonstrators belonged to secure their cooperation and surveys were conducted through in-person visits. Members who agreed to participate in the study were asked to fill out the questionnaire after explaining the points to note and the purpose of the study.

## 2.3. Measuring tool

The leadership scale consists of a total of 20 questions to be answered based on a 5-point scale where 1 point meant 'Completely disagree' and 5 points meant 'Completely agree'. As shown in <Table 2>, the reliability coefficient(Cronbach'α) of the sub-factor was found to be .971 for Leadership.

**Table 2.** Leadership scale.

Factor	Question	Factor 1	Question	Factor 1	Cronbach' α
Leadership	Leadership 1	.861	Leadership 11	.816	.971
	Leadership 2	.860	Leadership 12	.814	
	Leadership 3	.857	Leadership 13	.813	
	Leadership 4	.849	Leadership 14	.812	
	Leadership 5	.836	Leadership 15	.794	
	Leadership 6	.831	Leadership 16	.785	
	Leadership 7	.829	Leadership 17	.760	
	Leadership 8	.828	Leadership 18	.741	
	Leadership 9	.828	Leadership 19	.712	
	Leadership 10	.820	Leadership 20	.693	
Inherence	13.060				
Dispersion	65.300				
Total	65.300				

In order to measure anxiety and tension temporarily felt in a specific competitive situation through exercise, Competitive State Anxiety Inventory-2(CSAI-2) is modified and supplemented according to domestic circumstances creating 13 questions with a scale where “Completely disagree” equals 1 point and “Completely agree” equals 5. It consists of three factors: cognitive state anxiety, state confidence, and physical state anxiety. As shown in <Table 3>, the reliability coefficient(Cronbach'α) of each sub-factor was .820 for cognitive state anxiety, .785 for state confidence, and .792 for physical state anxiety.

**Table 3.** Analysis of the validity and reliability of anxiety in the competitive state.

Factor	Question	Factor 1	Factor 2	Factor 3	Cronbach' α
Cognitive state anxiety	Cognitive state anxiety 4	.795	-.084	.261	.820
	Cognitive state anxiety 2	.724	.028	.160	
	Cognitive state anxiety 1	.699	-.067	.126	

	Cognitive state anxiety 5	.680	-.134	.269	
	Cognitive state anxiety 3	.619	-.011	.499	
State of confidence	State confidence 2	-.072	.817	-.168	.785
	State confidence 4	.015	.792	-.152	
	State confidence 1	-.256	.702	.026	
	State confidence 5	.099	.690	-.126	
	State confidence 3	-.524	.587	.327	
Physical anxiety	Physical state anxiety 1	.223	-.206	.834	.792
	Physical state anxiety 2	.211	-.167	.774	
	Physical state anxiety 3	.277	.008	.732	
Inherence		3.018	2.709	2.436	
Dispersion		23.218	20.841	18.736	
Total		23.218	44.059	62.795	

The Athletics Coping Skills Inventory(ACSI-28) was revised and supplemented in accordance with the domestic situation in order to more accurately verify the effectiveness of the psychological skills training program, and a total of 10 questions, with a scale where “Completely disagree” equals 1 point and “Completely agree” equals 5. It consists of three factors: anxiety control, crisis management, and confidence/achievement motivation. As shown in <Table 4>, the reliability coefficient(Cronbach'α) of each sub-factor was .786 for anxiety control, .744 for risk management, and .715 for confidence/achievement motivation.

**Table 4.** Analysis of the validity and reliability of athletics coping skills.

Factor	Question	Factor 1	Factor 2	Factor 3	Cronbach' α
Anxiety control	Anxiety control 3	.832	-.050	.051	.786
	Anxiety control 1	.800	.259	-.048	
	Anxiety control 2	.772	-.180	.153	
	Anxiety control 4	.704	.077	.038	
Crisis management	Crisis management 1	.050	.821	.058	.744
	Crisis management 3	.071	.769	.303	
	Crisis management 2	-.052	.724	.319	
Confidence achievement motivation	Confidence-achievement motivation 2	.046	.113	.816	.715
	Confidence-achievement motivation 3	.155	.184	.772	
	Confidence-motivation for achievement 1	-.024	.280	.707	
Inherence		2.460	2.024	1.989	
Dispersion		24.599	20.235	19.891	



Total	24.599	44.834	64.725	
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## 2.4. Data Analysis

Data collected through the questionnaire in this study was analyzed using SPSS 26.0. Frequency analysis was performed to find out the general characteristics of the study participants, and exploratory factor analysis and Cronbach'  $\alpha$  coefficient, an internal consistency test, were used to verify the validity and reliability of the measurement tool. In addition, correlation analysis and multiple regression analysis were performed to determine the influence between variables of self-management, exercise commitment, and perceived athletic performance, and the significance level was set to .05.

## 3. Results

### 3.1. Correlation analysis

The results of verification through Pearson's correlation coefficient for each of the factors of the taekwondo demonstration team's leadership, competition status anxiety, and psychological factors are shown in <Table 5>. Leadership showed a significant positive(+) correlation between state confidence, risk management, and confidence/achievement motivation, and a significant negative(-) correlation between cognitive state anxiety, physical state anxiety, and anxiety control.

Cognitive state anxiety, a sub-factor of competitive state anxiety, showed a significant positive(+) correlation for physical state anxiety and anxiety control, and a significant negative(-) correlation for state confidence, crisis management, and confidence/achievement motivation. Physical state anxiety showed a significant positive(+) correlation for anxiety control, and a significant negative(-) correlation for state confidence, crisis management, and confidence/achievement motivation. State confidence showed a significant positive(+) correlation between crisis management and confidence/achievement motivation, and a significant negative(-) correlation on anxiety control.

Anxiety control, a sub-factor of sports coping skills, showed a significant positive(+) correlation in confidence/achievement motivation, and a significant negative(-) correlation in risk management. Crisis management showed a significant negative correlation with confidence/achievement motivation.

**Table 5.** Results of correlation analysis between variables.

Classification	Leadership	Cognitive state anxiety	Physical anxiety	State of confidence	Anxiety control	Crisis management	Confidence/ achievement motivation
1. Leadership	1.						
2. Cognitive state anxiety	-.144*	1.					
3. Physical anxiety	.060	.560**	1.				
4. State of confidence	.152*	-.267**	-.218**	1.			
5. Anxiety control	.044	.545**	.385**	-.170*	1.		
6. Crisis management	.257**	-.159*	-.050	.377**	.080	1.	
7. Confidence/ achievement motivation	.437**	-.181*	.067	.377**	.139	.479**	1.

Note: \*\*p<.01

### 3.2. The influence of leadership on competition status anxiety of university taekwondo demonstration team

The results of a multi-session analysis on the influence of leadership on the competition status anxiety of the university taekwondo demonstrators are shown in <Table 6>.

First, as a result of regression analysis on the influence of leadership on the cognitive state anxiety of the university taekwondo demonstrators, it was found that this factor had a positive(+) effect on academic adaptation under a statistically significant level. In addition, the regression model shows a value of 4.142 in the F value of p<.001, and  $R^2=.021$  for the regression equation shows 2.1% of the explanatory power of the total variance.

Second, as a result of regression analysis on the influence of the leadership on the physical state anxiety of university taekwondo demonstrators, it was found that it did not have a statistically significant effect. Also, in the regression model, the F value is from p<.001 to .715, and  $R^2=.004$  for the regression equation shows 0.4% of the explanatory power of the total variance.

Third, as a result of regression analysis on the influence of leadership on the state confidence of the university taekwondo demonstrators, it was found that this factor had a positive(+) effect on academic adaptation under a statistically significant level. In addition, the regression model shows a value of 4.646 in the F value of p<.001, and  $R^2=.023$  for the regression equation shows 2.3% of the explanatory power of the total variance.

**Table 6.** The influence of leadership on competition status anxiety of university taekwondo demonstrators.

	Cognitive state anxiety			Physical anxiety			State of confidence		
	B	Beta	t	B	Beta	t	B	Beta	t
(constant)	.343		10.688	.377		7.788	.279		8.381
Leader leadership	.082	-.144	-2.035*	.090	.060	8452	.067	.152	2.155*
	$R^2=.021$ , F=4.142*			$R^2=.004$ F=.715			$R^2=.023$ F=4.646*		

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

### 3.3. The influence of leadership on psychological factors of university taekwondo demonstration team

The results of a multi-session analysis on the influence of leadership on psychological factors of the university taekwondo demonstration team are shown in <Table 7>.

Second, as a result of regression analysis on the influence of the leadership on the physical state anxiety of the university taekwondo demonstration team, it was found that it did not have a statistically significant effect. In addition, the regression model shows a value of 0.374 in the F value of p<.001, and  $R^2=.002$  for the regression equation shows 0.2% of the explanatory power of the total variance.

Second, as a result of regression analysis on the influence of leadership on crisis management of the university taekwondo demonstrators, it was found that this factor had a positive(+) effect on academic adaptation under a statistically significant level. In addition, the regression model shows a value of 13.887 in the F value of p<.001, and  $R^2=.066$  for the regression equation shows 6.6% of the explanatory power of the total variance.

**Table 7.** The influence of leadership on psychological factors of university taekwondo demonstration team.

	Anxiety control			Crisis management			Confidence/ achievement motivation		
	B	Beta	t	B	Beta	t	B	Beta	t
(constant)	.329		9.082	.328		6.050	.265		6.677
Leadership leader	.079	.044	.612	.079	.257	3.726***	.063	.437	6.802***
	R <sup>2</sup> =.002, F=.374			R <sup>2</sup> =.066 F=13.887***			R <sup>2</sup> =.191 F=46.271***		

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

### 3.4. The influence of competition status anxiety of university taekwondo demonstration teams on psychological factors

The results of a multi-session analysis on the influence of competition state anxiety of the university taekwondo demonstration team are shown in <Table 8>.

First, as a result of regression analysis on the influence of competition state anxiety on anxiety control of university taekwondo demonstration teams, cognitive state anxiety had a positive(+) effect on academic adaptation under a statistically significant level. In addition, the regression model shows a value of 28.655 in the F value of p<.001, and R<sup>2</sup>=.307 for the regression equation shows 30.7% of the explanatory power of the total variance. However, among the sub-factors of competitive anxiety, physical state anxiety and state confidence did not have a statistically significant effect.

Second, as a result of regression analysis on the influence of competition state anxiety on crisis management of university taekwondo demonstration teams, state confidence had a positive(+) effect on academic adaptation under a statistically significant level. In addition, the regression model shows a value of 11.572 in the F value of p<.001, and R<sup>2</sup>=.152 for the regression equation shows 15.2% of the explanatory power of the total variance. However, among the sub-factors of competitive anxiety, cognitive state anxiety and physical state anxiety did not have a statistically significant effect.

Third, as a result of regression analysis on the influence of competition state anxiety on confidence/achievement motivation of university taekwondo demonstration teams, cognitive state anxiety, physical state anxiety, state confidence had a positive(+) effect on academic adaptation under a statistically significant level. In addition, the regression model shows a value of 16.522 in the F value of p<.001, and R<sup>2</sup>=.203 for the regression equation shows 20.3% of the explanatory power of the total variance. However, among the sub-factors of competitive anxiety, physical state anxiety did not have a statistically significant effect.

**Table 8.** The influence of competition status anxiety of university taekwondo demonstration teams on psychological factors.

	Anxiety control			Crisis management			Confidence/ achievement motivation		
	B	Beta	t	B	Beta	t	B	Beta	t
(constant)	.332		4.747	.379		5.160	.319		7.198
Cognitive state anxiety	.070	.476	6.497***	.080	-.113	-1.390	.067	-.239	-3.038

state anxiety physical	.063	.115	1.583	.072	.093	1.166	.061	.283	3.642***
State of confidence	.073	-.018	-.284	.083	.367	5.334***	.070	.375	5.615***
	R <sup>2</sup> =.307, F=28.655***			R <sup>2</sup> =.152 F=11.572***			R <sup>2</sup> =.203 F=16.522***		

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

## 4. Discussion

The purpose of this study is to investigate the influence of leadership on the competition status anxiety and psychological factors of university taekwondo demonstrators. Based on the results of this study, we will argue the following.

First, as a result of examining the influence of leadership on the competitive state anxiety of the university Taekwondo demonstration teams, it was found that it had an effect on cognitive state anxiety and state confidence among the sub-factors of competition state anxiety. According to the results of this study, in taekwondo demonstrations with many high-difficulty movements, not being nervous can lead to injury, so a high degree of concentration and coping skills are required, and the commanding ability of the leader has a great influence, and the training and instructional behavior of the leader improves state confidence[25][26]. It is reported that a 2. behavioral pattern has a significant effect on cognitive anxiety and confidence, and that the leader should show a mentally satisfactory instructional behavior as well as skill improvement through sufficient compensation for the players' behavioral results. It is suggested that the ability to express leadership ability, human relations with players, and dedication and effort are qualities that a leader must have[27]. It is said that the leadership behavior pattern of the leader has a significant influence on the competitive anxiety of the players, and it is necessary to observe the players' coping according to the leadership method and to improve the coping ability[28].

Second, as a result of examining the influence of the instructor's university taekwondo leadership on the psychological factors of the demonstration teams, it was found that among the sub-factors of the psychological factors, crisis management and confidence/achievement motivation were affected. Previous studies have shown that leadership has an influence on the psychological factors, and among the sub-factors, the individual ability to control anxiety or tension arising from training or competition can be controlled by the leader's determination[29]. In terms of self-confidence, it was reported that intuition, determination, and analysis of the leader's training or game influence the control of the players' self-esteem.

Looking at the effect of the athlete's psychological perception on the performance, it was said that if the leader gave instruction in excessive tension, anxiety, and silence, the athlete's psychological perception level was lowered and it was said to act as an obstacle to performance. It is believed that the leadership style of will also play an important role in order to induce the athletes' psychological level to the highest state[30].

Third, as a result of examining the effect of competition state anxiety on psychological factors of university taekwondo demonstration teams, it was found that anxiety control among the sub-factors of psychological factors affects cognitive state anxiety among competition state anxiety factors. Crisis management was found to have an effect on state confidence, and in self-esteem/achievement motivation, cognitive state anxiety and state confidence. Previous studies also reported that competitive anxiety affects psychological factors, and it appears that the clearer the goals of the players, the higher their concentration and self-confidence, which has a great influence in training or competitions, and the train effect is maximized when motivating them with goal setting[31][32]. As such, it is believed that

training and competition by reducing anxiety and increasing confidence and ability to cope with crisis will have a better effect.

## 5. Conclusion And Suggestions

The purpose of this study was to investigate the influence of leadership on the competition status anxiety and psychological factors of university taekwondo demonstration teams, and the results are as follows.

First, it was found that the leadership of the leader had a statistically significant effect on cognitive state anxiety and state confidence among the competing state anxiety factors of university taekwondo demonstrators, and there was statistically no significant level in physical state anxiety.

Second, it was found that leadership had a statistically significant effect on crisis management and confidence/achievement motivation among the psychological factors of the university taekwondo demonstrators, and there was no statistically significant level in anxiety control.

Third, it was found that, among the elements of competition state anxiety of the university taekwondo demonstration team, cognitive state anxiety had a statistically significant effect on anxiety control, and there was no statistically significant level in physical state anxiety and state confidence. In crisis management, state confidence was found to have a statistically significant effect, and cognitive state anxiety and physical state anxiety did not show statistically significant levels. Confidence/achievement motivation was found to have a statistically significant effect on cognitive state anxiety and state confidence, and physical state anxiety did not show a statistically significant level.

Through this study, it can be said that the anxiety and psychological factors of the university taekwondo demonstrators' competition status according to leadership behavior style an effect. Accordingly, the results show that the positive behavioral pattern of the leader is related to the confidence of the athletes, the ability to cope with crisis, anxiety, and competition anxiety. It was determined that in order to improve athletes' performance and achieve good results in a perfect taekwondo demonstration situation, various behavior patterns of the leaders are necessary.

The generalization of the subject of this study to taekwondo demonstration teams nationwide should be limited. In a follow-up study, the behavioral patterns of the leaders of the Kukkiwon Taekwondo Demonstration Team, the Taekwondo Association Demonstration Team, and the Taekwondo Demonstration Team of the World Taekwondo Federation, and the behavior of the leaders of the middle and high school taekwondo demonstration teams, which are the most frequent taekwondo demonstration teams in Korea and abroad, will be investigated.

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## 7. Appendix

### 7.1. Authors contribution

Initial name		Contribution
Author	HS	-Set of concepts <input checked="" type="checkbox"/>
		-Design <input checked="" type="checkbox"/>
		-Getting results <input checked="" type="checkbox"/>
		-Analysis <input checked="" type="checkbox"/>
		-Make a significant contribution to collection <input checked="" type="checkbox"/>
		-Final approval of the paper <input checked="" type="checkbox"/>
		-Corresponding <input checked="" type="checkbox"/>
		-Play a decisive role in modification <input checked="" type="checkbox"/>
		-Significant contributions to concepts, designs, practices, analysis and interpretation of data <input checked="" type="checkbox"/>
		-Participants in Drafting and Revising Papers <input checked="" type="checkbox"/>
		-Someone who can explain all aspects of the paper <input checked="" type="checkbox"/>

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Corresponding author  
E-mail: [parkjs@kmu.ac.kr](mailto:parkjs@kmu.ac.kr)

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## Analysis on Difference in the Importance of Attack and Defense Techniques of JUDO Players in Middle and High Schools and Universities

Byeongchan Kim<sup>1</sup>

*Kyungwoon University, Gumi, Republic of Korea*

Jusik Park<sup>2\*</sup>

*Keimyung University, Daegu, Republic of Korea*

Sunggu Jo<sup>3</sup>

*Kyungwoon University, Gumi, Republic of Korea*

### Abstract

**Purpose:** In this study, 198 judo players from middle, high school, and university in Daegu and North Gyeongsang Province were analyzed for differences in the importance of attack and defense techniques by gender, grade, athlete experience and selection of representative athletes.

**Method:** Data processing in this study was conducted using the SPSS 23.0 Program to identify the general characteristics of the subjects and the Cronbach's  $\alpha$  coefficient was calculated to verify the reliability of the questionnaire. T-test was conducted to identify differences in the importance of attack and defense techniques based on gender and standing experience, and One way ANOVA was conducted to identify differences in the importance of attack and defense techniques by grade and player experience.

**Results:** As a result of this study, no statistical difference in the importance of attack and defense techniques was found by gender, grade, athlete experience, and selection experience of representative athletes. Although it was not statistically significant, the importance of attack and defense techniques by gender was high for male and female players with high hand and waist techniques. In terms of the importance of attack techniques by grade, the first and second graders in middle school showed high hand techniques, while the second and first graders in middle school showed high back techniques and foot techniques. In terms of defense techniques depending on the grade, the first and second graders in middle school showed high hand techniques, the second and first graders in middle school for waist techniques and the second graders in high school and middle school for foot techniques. In terms of the importance of attack techniques according to the player's experience, hand techniques, waist techniques, and foot techniques were all high under two years of player experience. In terms of the importance of defense techniques depending on the player's career, hand and waist techniques were higher than two years of player experience and foot techniques were higher than three years of player experience and five years of player experience. In terms of the importance of attack and defense techniques based on the winning experience, both attack and defense techniques showed that players who did not win prizes were higher than those who had won prizes. In terms of the importance of attack and defense techniques based on the experience of selecting representative players, both attack and defense techniques were higher than those with experience in selecting representative players.

**Conclusion:** The results of this study are believed to be used as basic data for systematic training and player management to improve the performance of Judo athletes in middle and high schools and universities.

**[Keywords]** Judo Player, Judo Technique, Middle School, High School, University

## 1. Introduction

As with all sports, Judo is known as a sport that can be trained at various ages and is also positive for personality and emotional development along with fitness[1][2][3][4][5][7][8]. A number of prior studies have indicated that Judo training has a positive effect on the forma-

tion of values in life[9] and self-confidence promotion through competitive winning experience[10][11] as well as self-management[12]. There may be differences between the factors affecting performance and the influence of each factor depending on the sport, but physical and technical factors will be the top priority. In particular, the combination of the applicability of instantaneous techniques[13] and the type of techniques according to the opponent's movement has the most important impact on performance[14][15]. Judo is an interpersonal fighting game that uses a variety of strategies and attack and defense techniques over a fixed period of four minutes[16]. Unlike in the past, in the case of official Olympic events, it is hard to find the higher strength of the host country in each event and its performance level is being standardized around the world wide. In this regard, relevant researchers and leaders evaluate the techniques and strengths and weaknesses of athletes through performance analysis of excellent athletes[17]. If you look at prior studies related to the performance of judo players, Kim et al(2019)[18] is a prior study related to techniques and tactics which is about research on the techniques and development of elite female judo players, and Adam et al(2011)[19] research on judo players' techniques and tactical training at the 2009 and 2010 World Championships. Furthermore, prior studies[20][21] on technical and tactical variables of Judo athletes by gender and age have been conducted, and various prior studies have been reported regarding competition rules[22][23], attack effects[24], catching techniques[25] and training effects[26]. In addition, various prior studies have been reported on psychological factors that can affect performance[27][28][29][30]. With regard to the subject of this study, the techniques classification system of Judo competitions can be distinguished in traditional Judo techniques by standing matchers and stiffeners lying on mats [31], Brouse & Matsumoto(1999)[32] distinguished hammering techniques(Tachil-waza) by foot(ashi waza), hand(te waza), waist(koshi waza), and lay-down hammering techniques(sutemi waza), while grappling techniques(Katame-waza) by holding or pinning techniques(osaekomi waza), strangulation techniques(shime waza), and Joint techniques(kansetsuwaza).

Although it has not been used in official competitions since, Doppico et al(2014)[33] has developed nine new techniques classification systems that have improved traditional techniques classification schemes. However, the World Judo Federation still records official records of judo matches according to the traditional techniques classification system. Therefore, this study aims to classify attack and defense techniques of middle and high school judo players according to the traditional techniques classification system and analyze differences in importance to provide optimal technical training plans and basic data for athletes management.

## 2. Method of Study

### 2.1. Research subjects and labeling methods

In this study, 200 people were surveyed by Self-administration method through Convenience sampling method based on the population of judo players in Daegu and North Gyeong-sang Province as of 2020. Of the 200 questionnaires retrieved, 198 questionnaires were set as effective samples, except for data that showed insincere responses or missed part of the survey. The general characteristics of this subject are shown in <Table 1>.

**Table 1.** General characteristics of the subject.

	Sortation	N(%)	Total
Gender	Male	119(60.1)	198

	Female	79(39.9)	
Grade	1st grade in middle school	18(9.1)	198
	2nd grade in middle school	20(10.1)	
	3rd grade in middle school	22(11.1)	
	1st grade in high school	17(8.6)	
	2nd grade in high school	24(12.1)	
	3rd grade in high school	22(11.1)	
	Freshmen in university	19(9.6)	
	Sophomore in university	13(6.6)	
	Junior in university	27(13.6)	
	Senior in university	16(8.1)	
Athlete's experience	Not more than two years	52(26.3)	198
	More than 3 years, less than 5 years	48(24.2)	
	More than 6 years	98(49.5)	
Experience of winning a prize	Yes	148(74.7)	198
	No	50(25.3)	
Representative experience status	Yes	118(59.6)	198
	No	80(40.4)	

## 2.2. Composition of the questionnaire

The questionnaire was used as a research tool in this study, which was drafted based on the rules of the judo competition, discussed with the leaders and athletes, modified and supplemented to form attack techniques(hand, waist, foot techniques) and defense(hand, waist, foot techniques) as detailed in <Table 2>.

**Table 2.** Composition of questionnaire.

Sortation	Attack techniques	Defensive techniques
Hand technique	Morote – seoi - Nage	Double - armed seoinage - gaeshi (double - armed shoulder throw reaping)
	One-arm shoulder throw	One - armed seoinage - gaeshi (one - armed shoulder throw reaping)
	Tai - otoshi	Tai - otoshi - gaeshi (body drop reaping)



	Kata - guruma	Shoulder – tachi - gaeshi
	Yama - arshi	Yama - arshi - gaeshi
Waist technique	Hip sweeping (harai - goshi)	Harai - goshi - gaeshi
	Floating hip (uki - koshi)	Uki - koshi - gaeshi
	O - goshi (large hip)	O - goshi - gaeshi
	Tsuri - komi - goshi (life - pull hip)	Tsuri - komi - goshi - gaeshi
	Tsuri – goshi (life - pull up)	Tsuri – goshi - gaeshi
Foot technique	Uchi - mata(inner thigh reaping)	Uchi - mata - gaeshi
	Okuri - ashi - barai	Tsubame - gaeshi
	Ko - uchi - gari	Ko - uchi - gari - gaeshi
	The (major) outer reaping throw	Osoto - gari - gaeshi
	Ouchi - gari	Ouchi - gari - gaeshi

### 2.3. Feasibility and reliability of questionnaires

In this work, we select the appropriate method for each verification method to increase the content validity of the questionnaire and to verify the construction validity. In order to adopt a questionnaire suitable for the purpose of this study, the content feasibility was obtained through consultation with experts in the relevant field of study. Reliability is the degree to which an individual's score is consistent when the same test or homomorphic test is repeated. Because reliability is one of the most important factors in that it is related to stability and consistency in establishing a research method and it is a matter of whether a manipulated definition or indicator has consistently and reliably measured the target of the measurement, in this work, we validate the reliability based on the results of the questionnaire and analyze the reliability using the Cronbach's  $\alpha$  coefficient.

### 2.4. Data processing

The data processing of this study was carried out using the SPSS 23.0 program for the purpose of the research hypothesis and data analysis as follows: Frequency analysis was conducted to determine the general characteristics of the subjects, and the Cronbach's  $\alpha$  coefficient was calculated to verify the reliability of the questionnaire. T-test was conducted to find out differences in attack and defense techniques based on gender, competition experience, and experience in being selected as a representative athletes. One way ANOVA was conducted to find out the differences in attack and defense techniques based on grade and player experience.

### 3. Research Results

#### 3.1. Differences in importance of attack and defense techniques by gender

The results of the analysis of differences in importance of attack and defense techniques by gender are shown in <Table 3>. In attack techniques, hand and waist techniques were found to be higher than women, while in foot techniques, women were found to be higher than men. In defense techniques, men were found to be higher than women in hand and waist techniques, while women were found to be higher than men in foot techniques. However, there was no statistical significance difference in the overall question.

**Table 3.** Differences in the importance of attack and defense techniques by gender.

Techniques		Gender	N	Mean (M)	Standard deviation (SD)	t-value	Sig
Attack techniques	Hand techniques	Male	119	1.0924	.29087	.091	.927
		Female	79	1.0886	.28599		
	Waist techniques	Male	119	1.3277	.47137	.541	.589
		Female	79	1.2911	.45719		
	Foot techniques	Male	119	1.6218	.92966	-.082	.935
		Female	79	1.6329	.93613		
Defense techniques	Hand techniques	Male	119	2.1345	1.40775	.164	.870
		Female	79	2.1013	1.37370		
	Waist techniques	Male	119	1.3277	.47137	.541	.589
		Female	79	1.2911	.45719		
	Foot techniques	Male	119	1.5126	1.04853	-.759	.449
		Female	79	1.6329	1.15667		

#### 3.2. Differences in importance of attack techniques by grade

The results of the analysis of the difference in importance of attack techniques by grade are shown in <Table 4>. The first and second graders in middle school showed high hand

techniques, while the second and first graders in middle school showed high back and foot techniques. However, there was no statistical significant difference in the overall question.

**Table 4.** Differences in the importance of attack techniques by grade.

		N	M	SD	F	sig	post hot
Hand techniques	1st grade in middle school	18	1.1667	.38348	.401	.933	
	2nd grade in middle school	20	1.1500	.36635			
	3rd grade in middle school	22	1.0909	.29424			
	1st grade in high school	17	1.1176	.33211			
	2nd grade in high school	24	1.0833	.28233			
	3rd grade in high school	22	1.0909	.29424			
	Freshmen in university	19	1.0526	.22942			
	Sophomore in university	13	1.0769	.27735			
	Junior in university	27	1.0370	.19245			
	Senior in university	16	1.0625	.25000			
Waist techniques	1st grade in middle school	18	1.3889	.50163	.288	.978	
	2nd grade in middle school	20	1.4000	.50262			
	3rd grade in middle school	22	1.3636	.49237			
	1st grade in high school	17	1.2353	.43724			
	2nd grade in high school	24	1.3333	.48154			
	3rd grade in high school	22	1.2727	.45584			
	Freshmen in university	19	1.2632	.45241			
	Sophomore in university	13	1.3077	.48038			
	Junior in university	27	1.2963	.46532			
	Senior in university	16	1.2500	.44721			
Foot techniques	1st grade in middle school	18	1.7778	1.00326	.288	.978	
	2nd grade in middle school	20	1.8000	1.00525			
	3rd grade in middle school	22	1.7273	.98473			
	1st grade in high school	17	1.4706	.87447			

	2nd grade in high school	24	1.6667	.96309			
	3rd grade in high school	22	1.5455	.91168			
	Freshmen in university	19	1.5263	.90483			
	Sophomore in university	13	1.6154	.96077			
	Junior in university	27	1.5926	.93064			
	Senior in university	16	1.5000	.89443			

### 3.3. Differences in the importance of defense techniques by grade

The results of the analysis of the difference in the importance of defense techniques by grade are shown in <Table 5>. The first and second graders in middle school showed high hand techniques, the second and first graders in middle school for waist techniques, and the first and second graders in high school for foot techniques. However, there was no statistically significant difference in the overall question.

**Table 5.** Differences in the importance of defense techniques by grade.

		N	M	SD	F	sig	post hot
Hand techniques	1st grade in middle school	18	2.5000	1.42457	.536	.847	
	2nd grade in middle school	20	2.5000	1.43270			
	3rd grade in middle school	22	2.2727	1.45346			
	1st grade in high school	17	1.9412	1.34493			
	2nd grade in high school	24	2.1667	1.43456			
	3rd grade in high school	22	2.0000	1.38013			
	Freshmen in university	19	1.8947	1.37011			
	Sophomore in university	13	2.0769	1.44115			
	Junior in university	27	1.9630	1.40004			
	Senior in university	16	1.8750	1.36015			
Waist techniques	1st grade in middle school	18	1.3889	.50163	.288	.978	
	2nd grade in middle school	20	1.4000	.50262			
	3rd grade in middle school	22	1.3636	.49237			
	1st grade in high school	17	1.2353	.43724			
	2nd grade in high school	24	1.3333	.48154			

	3rd grade in high school	22	1.2727	.45584			
	Freshmen in university	19	1.2632	.45241			
	Sophomore in university	13	1.3077	.48038			
	Junior in university	27	1.2963	.46532			
	Senior in university	16	1.2500	.44721			
Foot techniques	1st grade in middle school	18	1.6667	1.13759	.365	.950	
	2nd grade in middle school	20	1.7500	1.20852			
	3rd grade in middle school	22	1.5909	1.14056			
	1st grade in high school	17	1.7647	1.25147			
	2nd grade in high school	24	1.5417	1.10253			
	3rd grade in high school	22	1.5909	1.14056			
	Freshmen in university	19	1.4211	1.01739			
	Sophomore in university	13	1.6154	1.19293			
	Junior in university	27	1.2963	.86890			
	Senior in university	16	1.5000	1.09545			

### 3.4. Differences in the importance of attack techniques according to the athlete's experience

The results of the analysis of differences in the importance of attack techniques according to the athlete's experience are shown in <Table 6>. Hand techniques, waist techniques, and foot techniques were all high under two years of player experience. However, there was no statistical significant difference in the overall question.

**Table 6.** Differences in the importance of attack techniques according to the athlete's experience.

		N	M	SD	F	sig	post hot
Hand techniques	Not more than two years	52	1.1346	.34464	1.171	.312	
	Not less than 3 years but not more than 5 years	48	1.1042	.30871			
	Not less than 6 to 10 years	98	1.0612	.24097			
Waist techniques	Not more than two years	52	1.3654	.48624	.692	.502	
	Not less than 3 years but not more than 5 years	48	1.3333	.47639			



	Not less than 6 to 10 years	98	1.2755	.44907			
Foot techniques	Not more than two years	52	1.8077	.99091	1.516	.222	
	Not less than 3 years but not more than 5 years	48	1.6250	.93683			
	Not less than 6 to 10 years	98	1.5306	.88753			

### 3.5. Differences in the importance of defensive techniques according to the athlete's experience

The results of the analysis of differences in the importance of defense techniques according to the athlete's career are shown in <Table 7>. Hand and waist techniques were high in two years or less of the athlete's career, and foot techniques were high in three or five years or less of the athlete's career. However, there was no statistical significant difference in the overall question.

**Table 7.** Differences in the importance of defensive techniques according to the athlete's experience.

		N	M	SD	F	sig	post hot
Hand techniques	Not more than two years	52	2.4423	1.39204	2.384	.095	
	Not less than 3 years but not more than 5 years	48	2.1667	1.41922			
	Not less than 6 to 10 years	98	1.9286	1.35654			
Waist techniques	Not more than two years	52	1.3654	.48624	.692	.502	
	Not less than 3 years but not more than 5 years	48	1.3333	.47639			
	Not less than 6 to 10 years	98	1.2755	.44907			
Foot techniques	Not more than two years	52	1.6731	1.14996	2.283	.105	
	Not less than 3 years but not more than 5 years	48	1.7708	1.24182			
	Not less than 6 to 10 years	98	1.3980	.96045			

### 3.6. Differences in importance of attack and defense techniques based on winning experience

The results of the analysis of differences in importance of attack and defense techniques based on the winning experience are as shown in <Table 8>. In both attack and defense techniques, players with no prize-winning experience were higher than those with prize-winning experience. However, there was no statistical significant difference in the overall question.

**Table 8.** Differences in importance of attack and defense techniques based on standing experience.

Techniques		Award-winning experience	N	M	SD	t-value	Sig
Attack techniques	Hand techniques	Yes	148	1.0743	.26319	1.950	.164
		No	50	1.1400	.35051		
	Waist techniques	Yes	148	1.3041	.46157	.223	.638
		No	50	1.3400	.47852		
	Foot techniques	Yes	148	1.5811	.91111	1.386	.240
		No	50	1.7600	.98063		
Defense techniques	Hand techniques	Yes	148	2.0338	1.38709	2.331	.128
		No	50	2.3800	1.38343		
	Waist techniques	Yes	148	1.3041	.46157	.223	.638
		No	50	1.3400	.47852		
	Foot techniques	Yes	148	1.5135	1.06577	1.091	.298
		No	50	1.7000	1.16496		

### 3.7. Differences in importance of attack and defense techniques based on experience in being selected as representative athletes

The results of the analysis of differences in importance of attack and defense techniques based on the experience of being selected as representative athletes shall be as shown in <Table 9>. In both attack and defense techniques, players with no experience in being selected as national players were higher than those with experience in being selected as national players. However, there was no statistical significant difference in the overall question.

**Table 9.** Differences in importance of attack and defense techniques based on experience in being selected as national players.

Techniques		The experience of being selected as a representative player	N	M	SD	t-value	Sig
Attack techniques	Hand techniques	Yes	118	1.0678	.25247	-1.374	.171
		No	80	1.1250	.33281		
	Waist techniques	Yes	118	1.2712	.44647	-1.547	.123
		No	80	1.3750	.48718		
	Foot techniques	Yes	118	1.5424	.89294	-1.547	.123
		No	80	1.7500	.97435		
Defense techniques	Hand techniques	Yes	118	1.9492	1.35146	-2.133	.034
		No	80	2.3750	1.41757		
	Waist techniques	Yes	118	1.2712	.44647	-1.547	.123
		No	80	1.3750	.48718		
	Foot techniques	Yes	118	1.4661	1.02684	-1.484	.139
		No	80	1.7000	1.17355		

## 4. Discussion

Based on the results of analyzing the difference in the importance of attack and defense techniques by gender, grade, and player experience and whether or not being selected as the national player, this study will discuss through comparative analysis with prior research.

The results of this study indicated no statistical significant differences in the importance of gender-specific attack and defense techniques. However, in attack techniques, men were found to have higher hand and waist techniques than women, and in foot techniques, women were found to have higher hand techniques than men. In defense techniques, men were found to be higher than women in hand and waist techniques, while women were found to be higher than men in foot techniques. It is believed that some of the research results are supported because Pereira Martins et al.(2019)[34]'s prior research focused on the techniques used at the 2017 World Judo Championships found that more than half of the scoring techniques were Tachil-waza techniques and that there were obvious differences in techniques type depending on gender and weight.

Furthermore, according to Lee(2020)[31]'s prior study of athletes participated in the 2016-2020 World Judo Major Competition, the clusters of hand techniques include 36.1% of all male athletes and 36.9% of all female athletes, showing gender differences. In addition, differences in performance according to gender have been reported in a number of prior studies[30][35][36].

Analysis of the importance of attack and defense techniques by grade showed no statistical significant differences. In both attack and defense techniques, the first and second graders in middle school showed higher hand techniques and waist techniques, while the second and first graders in middle school showed higher defense techniques in high school

and second graders in middle school. There is no prior study to analyze the importance of attack and defense techniques in sports of interpersonal fighting, so it is difficult to compare directly, but the prior study shows that high school students have higher achievement goals, athleticism, and motivation than elementary and middle school students[6], and business team players report higher achievement goals than lower grades[37] and in the case of martial arts players, they report that relative factors play a role between techniques, suggesting that there may be differences in the importance of attack and defense techniques by grade. The analysis of the importance of attack and defense techniques based on the athlete's career showed no statistical significant differences. However, in the case of attack techniques, hand techniques, waist techniques, and foot techniques were all higher than two years of player experience, while in the case of defense techniques, hand techniques and waist techniques were higher than three or five years of player experience. Prior studies have shown that differences in the frequency and effectiveness of the athletes' techniques are highly relevant to their weight class[38], and that for domestic female athletes at the 2012 London Olympics, leg techniques was mainly used.

Lee(2020)[31] reported that lightweights use a lot of hand techniques and middleweights and heavyweights use a lot of foot techniques, suggesting that the importance of attack and defense techniques is more influenced by the weight class than the athlete's career.

The analysis of difference of importance in attack and defense techniques based on the experience of winning prizes and being selected as a representative athlete showed no statistical significant differences. These results are considered too natural considering that the subject of this study is an elite judo player in middle, high school and university regardless of whether he or she has won a prize or being selected as a representative player.

## 5. Conclusion

Statistically significant results were not identified in this study according to the analysis of 198 judo players from middle, high school, and university in Daegu and North Gyeongsang Province based on the difference in importance of attack and defense techniques by gender, grade, athlete experience, and whether being selected as representative athletes. However, the importance of attack and defense techniques by gender was higher for male and female players, and for attack and defense techniques by grade, hand, waist and foot techniques were higher for middle school students than for high and university students.

In terms of the importance of attack techniques depending on the player's career, hand techniques, waist techniques, and foot techniques were all high under two years of player experience. In terms of importance related to defense techniques according to the athlete's career, hand and waist techniques were high in the player's experience of less than two years, and foot techniques were high in the player's experience of more than three to five years. In terms of importance of attack and defense techniques based on winning and being selected as a representative player, both offense and defense skills were higher than those with having experience of winning and being selected as representative players. Considering the above results, the results of this study are believed to be used as basic data for systematic training and player management to improve the performance of judo players in middle and high schools and universities.

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## 7. Appendix

### 7.1. Authors contribution

	Initial name	Contribution
Lead Author	BK	-Set of concepts <input checked="" type="checkbox"/> -Design <input checked="" type="checkbox"/> -Getting results <input checked="" type="checkbox"/> -Analysis <input checked="" type="checkbox"/>
Corresponding Author*	JP	-Make a significant contribution to collection <input checked="" type="checkbox"/> -Final approval of the paper <input checked="" type="checkbox"/> -Corresponding <input checked="" type="checkbox"/> -Play a decisive role in modification <input checked="" type="checkbox"/>
Co-Author	SJ	-Significant contributions to concepts, designs, practices, analysis and interpretation of data <input checked="" type="checkbox"/> -Participants in Drafting and Revising Papers <input checked="" type="checkbox"/> -Someone who can explain all aspects of the paper <input checked="" type="checkbox"/>

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## The Influence of Sports Confidence of High School TAEKWONDO Breaking Athletes on Exercise Continuation

Jongsoo Kim<sup>1</sup>

*Keimyung University, Daegu, Republic of Korea*

Jusik Park<sup>2\*</sup>

*Keimyung University, Daegu, Republic of Korea*

Sunjang Lee<sup>3</sup>

*Keimyung University, Daegu, Republic of Korea*

### Abstract

**Purpose:** The study was conducted to verify how sports confidence affects the continuation of exercise for high school student breaking athletes participating in the national-scale Taekwondo breaking competition. In order to achieve the purpose of the study, a questionnaire was conducted on 364 high school student breaking athletes who have participated in a national Taekwondo breaking contest and analyzed the collected data.

**Method:** In the study, the data collected through the questionnaire were analyzed using SPSS 26.0 and a Frequency analysis was performed to find out the general characteristics of the study participants. Correlation analysis was conducted to determine the influence relationship between the variables of the measurement tool. In addition, Multiple regression analysis was conducted to analyze the effect of sports confidence on the continuation of exercise. All statistical significance levels were set to .05.

**Results:** First, as a result of verifying the difference between sports confidence and exercise continuation according to the gender of high school breaking athletes who participated in the Taekwondo breaking contest, there were statistically significant differences in coach leadership of sports confidence, physical and mental preparation factor, and exercise friend factor in exercise continuation. Second, as a result of verifying the difference between sports confidence and exercise continuation according to grades of high school breaking athletes participating in the Taekwondo breaking contest, statistically significant differences were found in the factors of exercise interest in exercise continuation. On the contrary, there was no statistically significant difference in all factors of sports confidence. Third, as a result of verifying the difference between sports confidence and exercise persistence according to the winning experience of high school breaking athletes participating in the Taekwondo breaking contest, there were no statistically significant differences in all factors of sports confidence and exercise persistence.

**Conclusion:** as a result of the study, the recent increase in the sports confidence of Taekwondo-breaking players was identified and the conclusion that the sports confidence of high-school Taekwondo-breaking players could have an effect on the continuation of the exercise was drawn. Based on this, if Taekwondo practitioners of various age groups, from adults to adolescents and adolescents to youths, participate in the breaking contest and find a way to continue their Taekwondo training, it is thought that it could be a meaningful study not only for the Taekwondo demonstration field but also for the overall development of Taekwondo.

**[Keywords]** Taekwondo Demonstration, High School Student, Taekwondo Technical Breaking Athletes, Sports Confidence, Exercise Continuity

## 1. Introduction

The Taekwondo demonstration has played a large role in promoting and distributing Taekwondo both domestically and abroad, and has been developing into a various style of Taekwondo demonstration in combination with external factors such as various music, act-

ing, and B-boys with the basic demonstration form. Unlike sparring and form, Taekwondo demonstrations have many competitions where adults, adolescents, and youth can participate together. Therefore, participants compete for their training skills, universities with Taekwondo-related departments hold total long-term competitions and win prizes. By granting benefits for college entrance exams through achievements, the interest in the Taekwondo demonstration competition and the competition among participating athletes were increased[1].

With the expansion of Taekwondo demonstration performances, the activities of the Taekwondo demonstration team are becoming more active[2]. With the revitalization of the Taekwondo Demonstration Team, in recent years, techniques that rotate in the air using mechanical gymnastics techniques and techniques of breaking Taekwondo using acrobatic movements appeared[3]. Sports confidence is considered the most important for athletes to overcome failure and success factors of breaking, physical injuries and unstable emotions in the game due to these high-level skills.

Confidence is the belief in success and the confidence to successfully carry out the movement necessary to achieve the desired result[4]. In order to find a way for athletes to improve their self-confidence, various and continuous research efforts are needed[5][6]. As a result of analyzing the factors of sports confidence of Korean athletes targeting high school athletes in consideration of cultural differences in sports confidence, four factors were suggested: competency proof, coach leadership, social support, and physical/mental awakening. In addition, 8 techniques are reported to be the high effect, such as successful image use, verbal persuasion, positive self-praising induction, high-intensity physical training, emphasis on technical improvement over results, modeling of successful or similar players, and confident behavior are effective as a way to improve confidence[7]. In addition, it is reported that they exhibit the best performance and act as an important factor in inducing exercise continuation[8][9].

Exercise continuation refers to the attachment, persistence, and attachment of exercise by directly participating in exercise through the continuous performance of the physical activity and performing the activity regularly[10][11]. In addition, it refers to the constant participation in the exercise, including the exercise intensity, and is called the participation rate or participation rate[12]. It is also an important factor in minimizing abandonment of participants participating in sports and continuing the training period[13].

Exercise continuation is a basic and important task for athletes, and it is thought to be a major area that leaders should be interested in[14]. However, although the effect of exercise should be maximized through participation in sports, many athletes drop out or give up permanently due to the influence of personal environmental factors in the course of continuing exercise[15]. Stress, injury, and loss of self-confidence were suggested as factors in which youth athletes could not continue and give up exercise in sports situations[16].

In this sense, the study attempts to examine the athletes' confidence and exercise continuation from the perspective of athletes. This is because research on athletes' self-esteem and athletic continuation is still lacking compared to other sports. Therefore, the purpose of the study is to analyze how high school student Taekwondo-breaking athletes' self-esteem affects their athletic continuation and provide the analyzed results are provided to athletes and leaders in the sports field, and used as basic data for training and development of athletic performance in the Taekwondo breaking competition, and for improving athletes' performance.

## **2. Research Method**

### **2.1. Research participants**

Participants of the study surveyed 364 high school students who have participated in the national Taekwondo breaking contest. The characteristics of the study participants were classified into gender, grades in school, and the winning experience, and the results of frequency analysis on the general characteristics of the study participants are shown in <Table 1>. The survey was conducted by creating an online survey based on previous research[17][18][19][20].

**Table 1.** General characteristics of the study participants.

	Division	Frequency	Percentage(%)
Gender	Male	278	76.4
	Female	86	23.6
Grade	Grade 1	90	24.7
	Grade 2	131	36.0
	Grade 3	143	39.3
Winning experience	Yes	165	45.3
	No	199	54.7
	Sum	364	100.0

## 2.2. Data collection

### 2.2.1. Sports confidence scale(sources of sport confidence questionnaire: SSCQ)

The Sources of Sport Confidence Questionnaire(SSCQ), which was a scale developed by Vealey et al.[21] and adapted as a Korean version by Kim[22] was used to measure the sports confidence of youth breaking athletes. The Sports Confidence Scale is a scale that can measure four factors: ability proof, physical/mental preparation, coach leadership, and social support. It consists of a total of 15 questions. The reliability coefficient(Cronbach's $\alpha$ ) of each sub-factor was .79 for ability proof, .78 for physical/mental preparation, .81 for coach leadership, and .75 for social support.

### 2.2.2. Exercise continuation scale

The Korean version of the exercise continuation questionnaire developed by Choi[23] was used to measure the exercise continuation factors of high school student Taekwondo breaking athletes. Exercise ability 4 questions, exercise habits 3 questions, exercise environment 4 questions, exercise interest 3 questions and it consisted of 3 questions for exercise friends and 17 questions for exercise continuation. The exercise continuation questionnaire was evaluated on a 5-step Likert scale, and it consists of no(1), no(2), moderate(3), yes(4), and very yes(5).

## 2.3. Data analysis

In this study, the data collected through the questionnaire were analyzed using SPSS 26.0 and a Frequency analysis was performed to find out the general characteristics of the study participants. Correlation analysis was conducted to determine the influence relationship between the variables of the measurement tool. In addition, Multiple regression analysis was conducted to analyze the effect of sports confidence on the continuation of exercise. All statistical significance levels were set to .05.

## 3. Result and Discussion

### 3.1. Correlation analysis

As a result of examining the Pearson correlation coefficient of each factor in the sports confidence of high school Taekwondo breaking athletes, some variables were found to have a significant relationship under .01. The results of the correlation analysis are shown in <Table 2>.

**Table 2.** Results of the correlation analysis.

Division	1	2	3	4	5	6	7	8	9
1. Proof of ability	1								
2. Social support	.790**	1							
3. Coach leadership	.523**	.711**	1						
4. Physical and mental preparation	.568**	.720**	.765**	1					
5. Athletic ability	.414**	.544**	.501**	.577**	1				
6. Exercise habits	.255**	.283**	.225**	.290**	.300**	1			
7. Exercise environment	.190**	.364**	.345**	.314**	.387**	.374**	1		
8. Exercise interest	.300**	.378**	.397**	.505**	.538**	.336**	.431**	1	
9. Exercise friend	.317**	.448**	.426**	.467**	.467**	.333**	.507**	.493**	1

Note: \*\* $p < .01$ .

### 3.2. Differences in sports confidence and exercise continuation by gender of high school breaking athletes

A t-test was conducted to analyze differences in sports confidence and exercise persistence according to the gender of high school Taekwondo players, and the results are shown in <Table 3>. In sports confidence, there were statistically significant differences in coach leadership( $t=2.441$ ,  $p=.019$ ) and physical/mental preparation( $t=2.519$ ,  $p=.020$ ). On the other hand, there was no statistically significant difference in the ability proof( $t=.353$ ,  $p=.091$ ) and social support( $t=1.341$ ,  $p=.605$ ). It was found that there was a statistically significant difference in exercise friends( $t=2.648$ ,  $p=.018$ ) in exercise continuation. On the other hand, there was no statistically significant difference in exercise ability( $t=5.322$ ,  $p=.136$ ), exercise habit( $t=1.853$ ,  $p=.838$ ), exercise environment( $t=4.317$ ,  $p=.154$ ), exercise interest( $t=2.581$ ,  $p=.108$ ). These results are in line with the results of the study of Cha & Shin & Kim[24] that the anxiety of the competitive state of high school breaking athletes affected sports confidence. It is thought that athletes with high sports confidence will be able to control anxiety well if they continue to exercise and train.

**Table 3.** Analyze differences in sports confidence and exercise persistence according to the gender of high school taekwondo players.

Area	Gender	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Sports confidence	Ability proof	Male	278	4.0791	.353	.091
		Female	86	4.0436		
	Social support	Male	278	4.2842	1.341	.605
		Female	86	4.1705		

Movement	Coach leadership	Male	278	4.3399	.73772	2.441*	.019
		Female	86	4.1250	.62867		
	Physical and mental preparation	Male	278	4.4245	.64828	2.519*	.020
		Female	86	4.2297	.55069		
	Athletic ability	Male	278	3.9523	.70725	5.322	.136
		Female	86	3.4738	.79431		
	Exercise habits	Male	278	4.2746	.79063	1.853	.838
		Female	86	4.0930	.80465		
	Exercise environment	Male	278	3.9658	.72830	4.317	.154
		Female	86	3.5698	.79117		
	Exercise interest	Male	278	3.8837	.74378	2.581	.108
		Female	86	3.6512	.68391		
	Exercise friend	Male	278	4.0899	.76390	2.648*	.018
		Female	86	3.8488	.64607		

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

### 3.3. Differences in sports confidence and exercise continuation by grade of high school breaking athletes

One-way ANOVA was conducted to analyze the difference in sports confidence and exercise continuation according to grades of high school Taekwondo breaking athletes, and the results are as shown in <Table 4>. As a result, there was no statistically significant difference in all factors of sports confidence. It was found that there was a statistically significant difference in the factors of exercise interest( $t=3.602$ ,  $p=.028$ ) in exercise continuation. On the other hand, there was no statistically significant difference in exercise ability( $t=5.322$ ,  $p=.136$ ), exercise habit( $t=1.853$ ,  $p=.838$ ), exercise environment( $t=4.317$ ,  $p=.154$ ), exercise friend( $t=2.581$ ,  $p=.108$ ). This is supported by the results of the study by Han[25] that there was no difference in sports self-esteem according to the careers of adult Form athletes and that there was a difference in exercise interest among the factors of exercise continuation.

**Table 4.** Analyze the difference in sports confidence and exercise continuation according to grades of high school taekwondo breaking athletes.

Area	Grade	<i>n</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>	<i>post-hoc</i>
Sports confidence	Ability proof	1	90	4.1056	1.101	.334	
		2	131	4.1317			
		3	143	3.9930			
	Social support	1	90	4.2926	.255	.775	
		2	131	4.2265			
		3	143	4.2634			
	Coach leadership	1	90	4.3250	.149	.862	
		2	131	4.2786			
		3	143	4.2762			
	Physical and mental preparation	1	90	4.3667	.541	.583	
		2	131	4.3416			
		3	143	4.4196			
Movement	Athletic ability	1	90	3.8167	1.658	.192	
		2	131	3.7615			
		3	143	3.9248			
	Exercise habits	1	90	4.1185	2.326	.099	



Exercise environment	2	131	4.3435	.71485	.423	.655	
	3	143	4.2005	.81950			
	1	90	3.8278	.79909			
	2	131	3.8550	.68637			
	3	143	3.9161	.80434			
	1	90	3.8926	.76409			
Exercise interest	2	131	3.6921	.71327	3.602*	.028	a>b, b<c
	3	143	3.9138	.72483			
	1	90	4.0074	.78846			
Exercise friend	2	131	4.0433	.69479	.071	.931	
	3	143	4.0396	.76350			
	1	90	3.8278	.79909			

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

### 3.4. Differences in sports confidence and exercise continuation according to winning experience of high school breaking athletes

A t-test was conducted to analyze the difference in sports confidence and exercise continuation according to the winning experience of high school Taekwondo breaking athletes, and the results are shown in <Table 5>. As a result, there was no statistically significant difference in all factors of sports confidence and all factors of exercise continuation.

These results are different from those of a study that showed differences in sports image abilities according to the winning results of high school breaking athletes[17]. It is thought that the winning experience in the Taekwondo breaking contest does not significantly affect sports confidence or exercise continuation.

**Table 5.** Analyze the difference in sports confidence and exercise continuation according to the winning experience of high school Taekwondo breaking athletes.

Area	Winning experience	n	M	SD	t	p
Sports confidence	Ability proof	Yes	165	4.1530	1.761	.392
		No	199	4.0025		
	Social support	Yes	165	4.3192	1.566	.077
		No	199	4.2060		
	Coach leadership	Yes	165	4.3227	.812	.580
		No	199	4.2613		
	Physical and mental preparation	Yes	165	4.3788	.010	.679
		No	199	4.3781		
Movement	Athletic ability	Yes	165	3.9470	2.494	.432
		No	199	3.7500		
	Exercise habits	Yes	165	4.1636	-1.487	.218
		No	199	4.2881		

Exercise environment	Yes	165	3.8788	.74980	.149	.721
	No	199	3.8668	.77271		
Exercise interest	Yes	165	3.8626	.69648	.799	.735
	No	199	3.8007	.76755		
Exercise friend	Yes	165	4.1172	.72863	1.974	.673
	No	199	3.9631	.75119		

### 3.5. The influence of sports confidence of high school breaking athletes on exercise continuation

A multi-session analysis was conducted on the effect of sports confidence of high school Taekwondo-breaking athletes on exercise continuation, and the results are shown in <Table 6>.

First, as a result of Regression analysis on the effect of sports confidence in high school Taekwondo breaking athletes on exercise continuation, social support and mental and physical preparation factors had a positive(+) effect on athletic ability under statistically significant levels. In addition, the regression model shows a value of 52.408 in the F value of  $p<.001$ , and  $R^2=.369$  for the regression equation, which explains 36.9% of the explanatory power of the total variance. However, among the sub-factors of sports confidence, there was no statistically significant effect on the factors of ability proof and coach leadership.

Second, as a result of regression analysis on the effect of sports confidence in high school Taekwondo breaking athletes on exercise continuation, it was found that mental and physical preparation factors had a positive(+) effect on exercise habits under a statistically significant level. Also, in the regression model, the F value shows a value of 9.852 at  $p<.001$ , and for the regression equation,  $R^2=.099$ , which shows 9.9% of the explanatory power of the total variance. However, among the sub-factors of sports confidence, there was no statistically significant effect on the factors of ability proof, social support, and coach leadership.

Third, as a result of regression analysis on the effect of sports confidence of high school Taekwondo breaking athletes on exercise continuation, it was found that ability proof and social support factors had a positive(+) effect on the exercise environment under statistically significant levels. Also, in the regression model, the F value is  $p<.001$  to 18.384, and for the regression equation,  $R^2=.170$ , which shows 17.0% of the explanatory power of the total variance. However, among the sub-factors of sports confidence, coach leadership and physical and mental preparation were found to have no statistically significant effect.

Fourth, as a result of regression analysis on the effect of sports confidence in high school Taekwondo breaking athletes on exercise continuation, it was found that mental and physical preparation factors had a positive(+) effect on exercise interest under a statistically significant level. In addition, in the regression model, the F value is  $p<.001$  to 30.746, and for the regression equation,  $R^2=.255$ , which shows 22.5% of the explanatory power of the total variance. However, among the sub-factors of sports confidence, there was no statistically significant effect on the factors of ability proof, social support, and coach leadership.

Fifth, as a result of regression analysis on the effect of sports confidence in high school Taekwondo breaking athletes on exercise continuation, social support and mental and physical preparation factors had a positive(+) effect on exercise friends under statistically significant levels. Also, in the regression model, the F value is  $p<.001$  to 21.451, and for the regression equation,  $R^2=.270$ , which shows 27.0% of the explanatory power of the total variance.

riance. However, among the sub-factors of sports confidence, there was no statistically significant effect on the factors of ability proof and coach leadership.

These results are consistent with the results of the study of Shin & Kim[26] that the self-management of college students' Taekwondo demonstrators had a positive effect on exercise continuation. This study supports the findings that sports confidence has a positive effect on exercise continuation.

**Table 6.** The effect of sports confidence of high school taekwondo breaking athletes on exercise continuation.

Dependent variable	Independent variable	<i>B</i>	<i>Beta</i>	<i>t</i>	
Athletic ability	(a constant)	.569		2.481	$R^2=.369$ , $F=52.408^{***}$
	Ability proof	-.036	-.039	-.566	
	Social support	.312	.284	3.300**	
	Coach leadership	.045	.043	.614	
	Physical and mental preparation	.432	.361	5.106***	
Exercise habits	(a constant)	2.488		8.618	$R^2=.099$ , $F=9.852^{***}$
	Ability proof	.077	.078	.954	
	Social support	.126	.108	1.053	
	Coach leadership	-.057	-.051	-.610	
	Physical and mental preparation	.260	.206	2.440*	
Exercise environment	(a constant)	1.947		7.352	$R^2=.170$ , $F=18.384^{***}$
	Ability proof	-.230	-.245	-3.111**	
	Social support	.482	.435	4.404***	
	Coach leadership	.147	.138	1.722	
	Physical and mental preparation	.041	.034	.419	
Exercise interest	(a constant)	1.223		5.045	$R^2=.255$ , $F=30.746^{***}$
	Ability proof	.007	.008	.102	
	Social support	.019	.018	.190	
	Coach leadership	.019	.018	.241	
	Physical and mental preparation	.552	.473	6.159***	
Exercise friend	(a constant)	1.409		5.726	$R^2=.270$ , $F=21.451^{***}$
	Ability proof	-.083	-.091	-1.207	
	Social support	.300	.277	2.953**	
	Coach leadership	.081	.078	1.020	
	Physical and mental preparation	.305	.259	3.359**	

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

## 4. Conclusion and Suggestions

This study was conducted to verify how sports confidence affects the continuation of exercise for high school students who participated in the national-scale Taekwondo breaking contest. In order to achieve the purpose of the study, a questionnaire was conducted on 364 youth breaking athletes who have participated in the national breaking competition and analyzed the collected data. The conclusion through the analysis is as follows.

First, as a result of verifying the difference between sports confidence and exercise continuation according to the gender of high school breaking athletes participating in the Taekwondo breaking contest, statistically significant differences were found in coach leadership

of sports confidence, physical and mental preparation factor, and exercise friend factor of exercise continuation.

Second, as a result of verifying the difference between sports confidence and exercise continuation according to grades of high school breaking athletes participating in the Taekwondo breaking contest, statistically significant differences were found in the factors of exercise interest in exercise continuation. On the contrary, there was no statistically significant difference in all factors of sports confidence.

Third, as a result of verifying the difference between sports confidence and exercise persistence according to the winning experience of high school breaking athletes participating in the Taekwondo breaking contest, there were no statistically significant differences in all factors of sports confidence and exercise persistence.

As a result of this study, the recent increasing status of the sports confidence of Taekwondo-breaking athletes was identified, and the conclusion that the sports confidence of high-school Taekwondo-breaking athletes could influence the continuation of the exercise was drawn. Based on this, if Taekwondo practitioners of various age groups, from adults to adolescents and adolescents to youths, participate in the breaking contest and find a way to continue their Taekwondo training, it is thought that it could be a meaningful study not only for the Taekwondo demonstration field but also for the overall development of Taekwondo.

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## 6. Appendix

### 6.1. Authors contribution

	Initial name	Contribution
Lead Author	JK	<ul style="list-style-type: none"> <li>-Set of concepts <input checked="" type="checkbox"/></li> <li>-Design <input checked="" type="checkbox"/></li> <li>-Getting results <input checked="" type="checkbox"/></li> <li>-Analysis <input checked="" type="checkbox"/></li> </ul>
Corresponding Author*	JP	<ul style="list-style-type: none"> <li>-Make a significant contribution to collection <input checked="" type="checkbox"/></li> <li>-Final approval of the paper <input checked="" type="checkbox"/></li> <li>-Corresponding <input checked="" type="checkbox"/></li> <li>-Play a decisive role in modification <input checked="" type="checkbox"/></li> </ul>
Co-Author	SL	<ul style="list-style-type: none"> <li>-Significant contributions to concepts, designs, practices, analysis and interpretation of data <input checked="" type="checkbox"/></li> <li>-Participants in Drafting and Revising Papers <input checked="" type="checkbox"/></li> <li>-Someone who can explain all aspects of the paper <input checked="" type="checkbox"/></li> </ul>



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Corresponding author  
E-mail: [knupe-j@hanmail.net](mailto:knupe-j@hanmail.net)

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## Comparative Analysis of TAEKWONDO Poomsae Professional Gym and High School Team Performance Factors

Seungjin Lee<sup>1</sup>

*Sangji University, Wonju, Republic of Korea*

Jaehwan Jeoung<sup>2\*</sup>

*Chosun University, Gwangju, Republic of Korea*

### Abstract

**Purpose:** The purpose of this study is to analyze the performance factors of Poomsae High School Team, which is destroying Poomsae specialized gym's stronghold by comparing the training place, training time, training method, various support, and leader's career and to find out the reason how they broke the stronghold of specialized gyms who have dominated the competition for a long time and performing well to provide guidance for Poomsae leaders.

**Method:** In order to achieve the purpose of this study, 5 Taekwondo Poomsae specialized gyms and 2 professional school teams were conducted, and data were collected through literature surveys and in-depth interviews on-site visits. Based on this, a comparative analysis of the performance factors of the Taekwondo Poomsae specialized gym and the high school team resulted in the following conclusions.

**Results:** Overall, differences in scholarships, food expenses, support and training time and leaders' training concentration were shown. However, both groups focused on personality and sincere training when it came to guidance philosophy, and for the gyms, supply and demand of athletes and counseling with parents, and for high school teams, maintaining relationships with school teachers, and managing athletes in the camp were found to be difficulties.

**Conclusion:** The reason why Poomsae specialized gym's performance factor is significantly lower than that of the professional high school team is that the number of camp and field training depends on the parents' economic factors, and because the performance is proportional to the training volume, the school team's training is relatively higher than the professional gym, which is analyzed as a factor that can produce good results..

**[Keywords]** Taekwondo, Poomsae, Athletic Performance, High School Team, Gymnastics

## 1. Introduction

Taekwondo competitions began in 1962 when the Korean Taekwondo Association joined the Korean Sports Association, international competitions began by establishing the World Taekwondo Federation in 1972, and was officially approved by the IOC in 1980. After the 1988 Seoul Olympics, it was selected as a demonstration event at the 1992 Barcelona Olympics, attracting many people's attention.

Due to the development of Taekwondo competitions, Taekwondo was selected as one of the top three intangible cultural brands representing Korea along with Hangeul and Arirang in 2014[1], and was selected as one of the 25 key events at the 2020 Tokyo Olympics, starting with the 2000 Sydney Olympics to the 2016 Rio de Janeiro Olympics being selected as an official Olympic event for 5 times in a row[2]. In this context, Taekwondo has greatly contributed to establishing Korea's status as an advanced country in sports[3].

As such, Taekwondo became a sports competition, and Taekwondo was able to achieve rapid development and global distribution. However, as Taekwondo was focused on the development of competition, the proportion of Poomsae which is the basis of Taekwondo, and which can be called the mother of competition, was reduced.

However, the importance of Poomsae has been gradually recognized in recent years. The Korea Taekwondo Association hosted the first Poomsae competition, Taekwondo Hanmadang in 1992, and is held every year by playing the overall sport of Taekwondo (Poomsae, Breaking, Taekwondo Gymnastics, Self-defense, etc.) except for the sparring[4].

Among them, the frequency of adoption of international competitions in which national athletes are selected and dispatched is increasing for Poomsae competitions including international competitions such as the World Championships, Universiade, World University Championships, Asian Championships, and Asian Games, and junior players can enter universities through winning the Poomsae competition. So Poomsae specialized gyms began to emerge for the college entrance examination through Poomsae at Yongin University, and Kyung Hee University presidential Poomsae competitions and to make national athletes[4][5].

With the emergence of the first generation of Poomsae masters such as Namchang gym, Gilajabi, Cheongjihoe, Gosuhoe, Jisungkyunghoe, and Jung's Taekwondo, the second generation of Poomsae masters such as Hodori, Araham, Dowongyeol, and Busan Academy began to emerge and for several years, Poomsae competition has been strong enough to be said to be the exclusive property of specialized gyms[6][7]. However, with the creation of the Poomsae team at Lila Art High School in Seoul, the stronghold of gym is collapsing along with the creation of the Poomsae team at Gwanak High School and I.T High School in Seoul.

The prize-winning performance, which was considered an exclusive property of Poomsae specialized gyms, is gradually performing as well as specialized gyms with the creation of professional high school teams, why?

Previous studies of Taekwondo Poomsae were conducted on ways to develop and revitalize Poomsae Competition[8][9][10], the process of change in the rules of the competition and the evaluation standards[11][12][13] ways to train athletes and ways to develop leaders[14][15], overall research regarding Poomsae[16][17], but the research analyzed on the direct performance factors for Poomsae athletes' performance improvement is insufficient.

Through this study, we will compare and analyze the training place, training time, training method, and leadership experience of the professional high school team that is destroying the stronghold of Poomsae specialized gym to find out the reason how they broke the stronghold of specialized gyms who have dominated the competition for a long time and performing well. Through this, we intend to provide basic data for Poomsae athletes to improve their performance.

## 2. Research Method

### 2.1. Research target

In this study, purposeful sampling was used among qualitative research methods to collect in-depth data in terms of truthfulness and reliability. Poomsae specialized gym and high school team, which are subject to research, were limited to the ones that have won the national competition and the gym and school team that recently produced national athletes. In addition, for Poomsae specialized gyms, gyms that had multiple winning of recent national championships and produced national athletes in the past 3 years were selected, and for the Poomsae High School team, highschools that had multiple winning of the recent

A number of national teams were selected from the Poomsae High School team. Based on this, five Poomsae specialized stamps and two Poomsae specialized high school teams were finally selected for the study and conducted research.

## 2.2. Collecting data

In this study, data were collected through literature surveys and in-depth interviews. In addition, experimental statements expressed verbally or in letters rather than quantified data were used as the main data needed for this study. Therefore, Poomsae specialized gyms and high school teams were visited directly to conduct field trips and surveys, and each team was trained to collect data and research and analysis.

## 2.3. Data analysis

In qualitative research, data analysis needs to be conducted in parallel with data collection. This is because data collection methods can be modified according to the analysis results, and insufficient data must be supplemented.

The data analysis of this study was confirmed by listening to and reading the recordings and transcripts more than twice after the recording was completed to ensure the objectivity and validity of the study, as the results could vary depending on how the researchers understand and interpret raw data. Even in this systematization process, researchers went through a reconfirmation process through a review with their guidance professors and Donghak researchers to understand the research participants correctly and to prevent researchers from falling into prejudice.

The data compiled in this way were modified and supplemented and reconstructed through discussion with experts, and the final reconstructed data were classified and documented to suit the analytical purpose and data content of this study.

## 3. Result and Discussion

### 3.1. Analysis of performance factors of poomsae specialized gym

#### 3.1.1. Analysis according to field visit investigation

**Table 1.** Field visit investigation analysis of poomsae specialized gym.

	Year of foundation	Size of training field	Number of leaders	Parent support and accommodation
Gyeonggi-do JP gym	2005	6m×20m	1 director, 1 coach	No support Stay together once a month
Gyeonggi-do CE gym	2008	6m×11m	1 director, 2 coach	Preparation of snacks during training and competition No Accommodation
Daegu YG gym	1997	About 214.88m <sup>2</sup>	1 director, 2 coach	Support for competition meals, snacks, and vehicles No Accommodation
Ulsan MC gym	2005	10m×12m	1 director, 1 coach	Support for training and competition snack No Accommodation
Busan AS gym	2009	10m×10m	1 director, 1 coach	Support for snacks and vehicles for training and competitions Camp once in the summer and once in the winter

According to the on-site survey analysis of Poomsae specialized gyms, the YG gym in Daegu, which was founded in 1997, was the earliest, and the AS gym in Busan was the latest in 2009.

The size of the training ground is the size of a one usual stadium(10m×10m), which was small for many athletes to train. In addition, the number of leaders was average with 1 di-

rector and 1 coach, and the number of leaders and the size of the training ground were not proportional to the winning performance.

Most of the support from parents is provided with snacks and vehicles, and accommodation was rarely done once a month or once during the vacation due to students' school life and family circumstances.

**Table 2.** Analysis of training program of poomsae specialized gym.

Training program	
Gyeonggi-do JP gym	Monday to Saturday - about 3 hours, Sunday - about 5 hours Flow training of Poomsae based on basic exercise such as physical training, flexibility, and kick intensive training
Gyeonggi-do CE gym	Training 3 hours on weekdays and 5 hours on weekends Warm-up 30 minutes basic Movement 30 minutes kick 30 minutes main exercise 1 to 2 hours
Daegu YG gym	Weekdays four hours, weekends seven hours of training Training in order of 30 minutes jump rope, 30 minutes stretching, 30 minutes basic movement, and 2 and a half hour kicking and Poomsae
Ulsan MC gym	Weekdays 4 hours, Saturdays 7 hours, Sundays 5 hours 30 minutes of stretching and warming up, basic kicks, basic movements, walking steps, and personal training for 2 to 3 hours
Busan AS gym	3 hours of training from Monday to Sunday 20 minutes of warm-up exercise, 1 hour of basic physical training, 30 minutes of basic kick After one hour of intensive training, he/she begins personal training and focuses on the individual vulnerable part of the training

According to the analysis of the training program of Poomsae specialized gym, specialized gyms were training for an average of 3 hours on weekdays and 5 hours on weekends, and they seemed to focus on flexibility and kick practice.

### 3.1.2. Analysis based on leader's interview

**Table 3.** Interview analysis of leader of poomsae specialized gym.

	Personal experience and educational background	Prize winning experience of leader	Leadership philosophy	Difficulties in coaching
Gyeonggi-do JP gym	Grand prize at the Korean taekwondo association gym competition, grand taehyup instructor graduate school completion	Leader award at Yongin university, Keimyung university	Let's be a person who pursues personality	Coaching of adolescents
Gyeonggi-do CE gym	Won award at world taekwondo hanmadang and title of the power breaking at Korea taekwondo association, graduate school completion	None	Be an active person	When the athletes don't follow instructions
Daegu YG gym	Won multiple poomsae competitions, university lectures, Master's degree completion	Won awards at Korea taekwondo association, poomsae competition at Gyeongju Korea open	Let's be polite rather than having good skills	When athletes don't show enthusiasm for the sport
Ulsan MC gym	Grand prize of the Korea taekwondo association gym competition and instructor of gym activation, completion of a doctorate	Leader award at Kyung Hee university, etc.	Be a changing human being, a developing human being	When I see him/her struggling in a slump

Busan AS gym	Poomsae national athlete coach, graduate school completion	Won leader award at Seoul National university of education, Keimyung university, Yongin university, minister of culture, sports and tourism, and minister of Korea taekwondo association	A genius can't beat those who try, and those who try can't beat those who enjoy	The sensitivity of adolescents
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According to the analysis of the leaders of Poomsae specialized gyms, the leaders were recognized for their gym management at the Korea Taekwondo Association Gym Competition or won the Poomsae Competition and the Breaking Competition and the leader's award in recognition of their leadership skills. In addition, the leader of the Busan AS gym was coaching students based on his leadership, including serving as a coach for the national Poomsae team.

The guiding philosophy of the leaders of Poomsae specialized gyms had a guiding philosophy focusing on the personality of the adolescent athletes, such as being human beings who pursue personality, active person, manners rather than ability, being a changing person, and a developing person.

The difficulty of the guidance in each leader's own hardships could be felt. The leader of JP gym in Gyeonggi-do had difficulty in guiding adolescent students, and the leader of CE gym in Gyeonggi-do said he felt difficulties when athletes did not follow the leader's instructions properly. The leader of YG gym in Daegu said it was difficult to see the athletes when they do not show enthusiasm and do them roughly, while the leader of Ulsan's MC gym said it was difficult to look at the athletes who were in a slump. Lastly, the leader of the AS gym in Busan said that he finds it difficult to deal with athletes due to the sensitivity of adolescents.

## 3.2. Analysis of performance factors of poomsae high school team

### 3.2.1. Analysis according to field visit investigation

**Table 4.** Field visit investigation analysis of poomsae specialized high school team.

	Year of foundation	Size of training field	Number of leaders	Support and accommodation
AA high school in Seoul	2011	2 10m×10m court	1 director	School self-support(free dormitory) Accommodation within a year(free) Providing various scholarships, food expenses, and vehicles for athletes
BB high school in Seoul	2006	1 10m×10m court	1 director, 1 coach	Preparation of training and competition meals and snacks Accommodation conducted during winter training period

According to the field visit survey conducted by Poomsae professional high school team, the Poomsae Team of BB High School in Seoul was founded in 2006, and the Poomsae Team of AA High School in Seoul was founded a little later in 2011.

The size of the training ground of AA High School in Seoul had 2 10m×10m courts, and BB High School in Seoul had 1 10m×10m court, creating an environment like a stadium where athletes compete, allowing them to focus on training and competition.

AA High School in Seoul had 1 director as the leader and BB High School in Seoul had 1 director and 1 coach as the leader.

For the support of professional high school teams, the Poomsae team at AA High School in Seoul was supported by the school itself, not by the parents' association and by the support

of the school itself, there were no restrictions on meals and accommodations. The Poomsae team at BB High School in Seoul was provided with meals and snacks by the parents' association and accommodation happened during the winter training period.

**Table 5.** Analysis of poomsae specialized high school team's training program.

Training program	
AA high school in Seoul	Full support from the school itself gives athletes a lot of training time by using the dormitory More training time, more practice, more practice moves to practice Winter training & Field training - Training focusing on basic skills, such as basic movements, kicks, and walking steps Competition Season - Focus on Poomsae Mastery Training so that they can focus on upcoming competitions
BB high school in Seoul	First and second graders train 3 hours on weekdays, third graders train 4 hours, and first, second and third graders train 5 hours on weekends Personal exercise and personal guidance after 30 minutes of warm-up Winter training - Basic movements 1 hour, Poomsae 1 hour, muscular exercise and weight 1 hour after running mountains, running stairs Competition Season - 3 hours or more of the main exercise

According to the analysis of the training program of Poomsae Specialized High School team, the training program of AA High School in Seoul had a lot of training time due to the use of dormitories. They had an average of 5 hours of training on weekdays and an average of 7 hours on weekends, and as they have a lot of training time, they can have a lot of practice and moves to practice. It is said that basic skills will be learned through winter training and field training, and that Poomsae will be cleaned up through Poomsae mastery practice during the competition season[18].

In the case of training programs at BB High School in Seoul, it is said to train for an average of 3 hours on weekdays and 5 hours on weekends, while winter training programs, after focusing on basic physical strength such as running mountains and running stairs, training with a keen interest in learning movements. It is said that Poomsae will be cleaned up through Poomsae mastery training, just like AA High School during the competition season.

### 3.2.2. Analysis based on leader's interview

**Table 6.** Interview analysis of the leader of poomsae high school team.

	Career and educational background	Prize winning experience of leader	Leadership philosophy	Difficulties in coaching
AA high school in Seoul	International judging activities, instructor activities at the kukkiwon leadership training institute, taekwondo poomsae instructor activities at the Korea military academy and the Korea national sport university, and the current head of the national athlete demonstration team;	Dispatched overseas taekwondo instructors, served as national athlete coach of poomsae, received the order of sports gilinjang, and the Korea sports council award	Creating the right human being	Concerns regarding adolescent athletes
BB high school in Seoul	Graduated from a four-year university majoring in taekwondo	Steadily coaching for 9 years	If it doesn't work, do it till it does	Exercise environment

As a result of the interview with the leaders of Poomsae High School Team, the leader of AA High School in Seoul was teaching Poomsae at the Korea Military Academy and four-year university Taekwondo Department, leading Poomsae and national athlete demonstration team at the front line. In addition, received the Order of Sports Merit and the Korean Sports President Award for his contribution to the development of the Korean sports community by dispatching taekwondo instructors and coaching the national Poomsae team.



In the case of the leader of BB High School in Seoul, graduated from the four-year university's Taekwondo department and has been teaching steadily the Poomsae team for nine years.

The leaders' guiding philosophy was concerned with the right creation of human beings and the right personality of adolescent athletes until it was not possible.

The leader of AA High School in Seoul answered that there was nothing difficult in coaching but worrying about adolescent athletes, and the leader of BB High School in Seoul said that the athletic environment needs to be improved[19][20].

#### 4. Conclusion and Suggestions

The purpose of this study is to analyze the performance factors of Poomsae High School Team, which is destroying Poomsae specialized gym's stronghold by comparing the training place, training time, training method, various support, and leader's career and to find out the reason how they broke the stronghold of specialized gyms who have dominated the competition for a long time and performing well to provide guidance for Poomsae leaders. In order to achieve the purpose of this study, five Taekwondo Poomsae specialized gyms and two professional school teams were conducted, and data were collected through literature surveys and in-depth interviews on-site visits. Based on this, a comparative analysis of Taekwondo Poomsae specialized gym and the performance factors of the high school team resulted in the following conclusions.

First, the team of Poomsae specialized gym was maintained by the support of parents, while the professional high school team was given various benefits such as providing dormitories, various scholarship systems, food support, and vehicle provision for the team given by the school. This affected the acquisition of outstanding players, the morale of players, the acquisition of training time, and the concentration of training. Second, most of the Poomsae specialized gym leaders were engaged in the athlete team and gym operation, while the professional high school team leaders devoted themselves to fostering the team, making positive efforts to develop the team through external activities such as taekwondo lectures and taekwondo officials. Third, the guidance philosophy of Poomsae specialized gym and high school team leaders were focused on identity and sincere training such as to become a changing human being and a developing human being. A genius can't beat those who try, and those who try can't beat those who enjoy. As such, the philosophy of guidance of specialized gym and high school team leaders mostly were interested in true personality education of the athletes. Fourth, Poomsae specialized gyms had great difficulties in supplying and managing players every year, consulting parents, and management, and high school team leaders had difficulties in human relationship with the school principal and the vice principal in charge and also had difficulties in managing players when having an accommodation. Fifth, the Poomsae Specialized High School team had more training and accommodation than Poomsae Specialized gyms[19].

The reason why Poomsae specialized gym's performance factor is significantly lower than that of the professional high school team is that for the specialized gyms, the number of camp and field training depends on the parents' economic factors, and the performance is relative to the training volume. Therefore, the school team's training volume was relatively higher than the specialized gym, which was analyzed as a factor that could produce good results.

The systematic and diverse support of the Poomsae High School team played a role as a factor in the performance increase, which seems to have helped break down the long-standing stronghold of the Poomsae specialized gyms. In a follow-up study, first, it is expected that parents' active participation in the operation of the team will be followed up on the correlation between the players' morale and the competition performance. Second,



through many national Poomsae competitions, follow-up research on the activation of middle and high school Poomsae trainees will be conducted. Third, there is a need for continuous research on effective training programs to develop a lot of the guidance methodology of Poomsae national athletes.

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## 6. Appendix

### 6.1. Authors contribution

	Initial name	Contribution
Lead Author	SL	<ul style="list-style-type: none"> <li>-Set of concepts <input checked="" type="checkbox"/></li> <li>-Design <input checked="" type="checkbox"/></li> <li>-Getting results <input checked="" type="checkbox"/></li> <li>-Analysis <input checked="" type="checkbox"/></li> <li>-Make a significant contribution to collection <input checked="" type="checkbox"/></li> <li>-Final approval of the paper <input checked="" type="checkbox"/></li> <li>-Corresponding <input checked="" type="checkbox"/></li> </ul>
Corresponding Author*	JJ	<ul style="list-style-type: none"> <li>-Play a decisive role in modification <input checked="" type="checkbox"/></li> <li>-Significant contributions to concepts, designs, practices, analysis and interpretation of data <input checked="" type="checkbox"/></li> <li>-Participants in Drafting and Revising Papers <input checked="" type="checkbox"/></li> <li>-Someone who can explain all aspects of the paper <input checked="" type="checkbox"/></li> </ul>

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Corresponding author  
E-mail: [jk7319@hanmail.net](mailto:jk7319@hanmail.net)

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## Research Regarding the Job Satisfaction of TAEKWONDO Instructors and the Revitalization of Taekwondo Center

Jinhwan Mok<sup>1</sup>

*Korea National Sport University, Seoul, Republic of Korea*

Jang Kwon<sup>2\*</sup>

*Korea National Sport University, Seoul, Republic of Korea*

### Abstract

**Purpose:** This study was analyzed by conducting a survey of 170 leaders working at taekwondo gyms in Seoul and Gyeonggi Province to find out the impact of the Taekwondo master's job satisfaction on the revitalization of the Taekwondo gym.

**Method:** Descriptive Statistics, Frequencies, t-test, One-way ANOVA, and Multiple regression Analysis was used on the data collected through the surveys by using the SPSS 22.0 to determine the effect between factors. The significance level for all statistics was set to 0.05.

**Results:** First, the sub-variant analysis of the job satisfaction for Taekwondo masters, showed no statistically significant difference in gender. In addition, there were statistically significant differences in all factors depending on their educational background. Also, the guidance experience showed statistically significant differences in the factors relating to the task itself.

Second, the sub-variant analysis of the Taekwondo master's gym activation (personal performance) showed no statistically significant difference in gender, but statistically significant differences showed in all factors depending on educational background. In addition, there have been statistically significant differences in the factors of individual performance over the course of the guidance career.

Third, an analysis of the impact of job satisfaction of Taekwondo masters on the revitalization of Taekwondo gyms (management performance) showed that all factors in job satisfaction have a statistically significant impact on individual performance and painting performance related to the revitalization of Taekwondo gyms.

**Conclusion:** The study found that the job satisfaction of Taekwondo masters has a positive impact on the revitalization of taekwondo gyms (management performance). We hope that the results of this study will be provided as basic data for how to revitalize the Taekwondo gym, and we hope that it will help revitalize the Taekwondo gym.

**[Keywords]** Taekwondo Master's, Job Satisfaction, Activation of Taekwondo Gym, Taekwondo, Management Performance

## 1. Introduction

The quality and importance of education of the Taekwondo gym, which is the root of Taekwondo education, should be more important than any other factors. The role of the leader, such as the personality of the leader and the idea of education, is most important in the education of the Taekwondo gym. However, the current status of taekwondo training is that many seals lack excellent educational guidance due to lack of professional manpower.

As of 2018, 13,946 sports facilities were registered with the Ministry of Culture, Sports and Tourism, an increase of more than 900 from 13,026 in 2008 a decade ago [1]. Although it

is hard to think of a large increase in figures, there is a big difference between the training population in 2011 and the training population in 2018. In 2011, the number of elementary school students nationwide was 3,132,477, and in 2017, the number of elementary school students was 2,674,227[2], you can see that it decreased significantly within 6 years and it shows that the management of Taekwondo gym became very difficult if you take into account that more than 80% of the current taekwondo training population is elementary school students.

Despite the increase in sports facilities and changes in the training population and the increase in consumers of sports facilities in the environment and consciousness, the current treatment of leaders directly engaged in sports facilities hasn't changed almost at all from the past. Most Taekwondo masters also show a high turnover rate due to poor working conditions, such as low wages, low social status, incomplete living security, and excessive physical exhaustion[3]. In fact, Taekwondo masters have many problems with their working conditions, such as lower wage levels compared to other jobs, insufficient welfare systems, and personnel evaluation systems, and poor working conditions for Taekwondo masters lead to job dissatisfaction due to psychological anxiety and conflict over roles at work[4]. The job dissatisfaction of Taekwondo masters can lead to turnover, and it will have a negative impact on the management of Taekwondo gyms, while the job satisfaction of Taekwondo masters will have a positive impact on the revitalization of Taekwondo gyms.

Job satisfaction is an emotional response to job conditions, such as wages or management and job content, generally referred to as fraud or quality of work life[5], and refers to the psychological state of the workplace[6]. It is reported that the job in the workplace has a direct impact on the performance of the job of organizational members with negative or positive feelings[7]. This means that job satisfaction or dissatisfaction with the job affects individual and organizational development because job satisfaction consequently affects organizational development and performance[8]. As such, the job satisfaction of the masters who directly guide the trainees at the Taekwondo gym can be said to affect the management performance to revitalize the Taekwondo gym.

As the business environment changes, Taekwondo gyms need to develop new and diverse management revitalization strategies and education programs to meet the needs of parents and students and suppliers of Taekwondo masters[9]. In the successful management of Taekwondo gyms, masters with the right personality and educational concepts are essential. However, many taekwondo gyms now often are seen hiring part-time workers or care teachers and car drivers who are not qualified due to the absence of a master. In the end, the revitalization of Taekwondo gym requires scientific and systematic research on management, and systematic management laws and promotional strategies need to be introduced and applied to the management of Taekwondo gym[10]. Furthermore, during this continuous social changes, the training of Taekwondo gym requires practical elements and mental quality aspects of Taekwondo with joy without losing its original spirit[11].

Therefore, the purpose of this study is to find out how the job satisfaction of a Taekwondo master at a Taekwondo gym affects the revitalization of the Taekwondo gym, and to provide basic data for the revitalization of the Taekwondo gym. We hope that the results of this study will help revitalize the Taekwondo gym.

## **2. Research Method**

### **2.1. Research participants**

A survey was conducted targeting the participants of 170 leaders working at taekwondo gyms in Seoul and Gyeonggi Province using purposive sampling, a method of selecting candidates according to the characteristics of the study. Taekwondo masters established re-

search indicators classified as gender, educational background, and guidance experience. The demographic characteristics of the research participants are shown in <Table 1>.

**Table 1.** Demographic characteristics of research participants.

Sortation	Characteristic	Sortation	Personnel	Percentage%
Taekwondo master	Gender	Male	123	72.4
		Female	47	27.6
	Academic background	Graduated high school	53	31.2
		Graduated university	93	54.7
		Graduated graduate school	24	14.1
	Guidance experience	Less than a year	18	10.6
		More than 1 year and less than 3 years	45	26.5
		More than 3 years and less than 5 years	23	13.5
		Over 5 years	84	49.4
Total		170	100.0	

## 2.2. Date collection

### 2.2.1. Job satisfaction

Job satisfaction was used after partially modified and supplemented to fit this study by three sub-factors of the nine questions which were job itself, working conditions, and guidance used by Oh[12]. The scale level of the survey was 5 points Likert, consisting of 1 point for 'not at all', 3 points for 'normal' and 5 points for 'very so'. As a result of calculating the cronbach's  $\alpha$  value, as job itself( $\alpha=.755$ ), working conditions( $\alpha=.690$ ), and guidance( $\alpha=.832$ ), the reliability of job satisfaction was shown to be problem-free.

### 2.2.2. Activation of taekwondo gym(management performance)

The management performance of the Taekwondo gym partially modified and supplemented the survey used by Jin[13] which can measure two factors: personal performance and corporate performance, to fit this study. The survey scale level is 5 points Likert, consisting of 1 point for "not at all", 3 points for "normal" and 5 points for "very so". The result of calculating the cronbach's  $\alpha$  value was a reliable level of .781.

## 2.3. Data analysis

In this study, the data collected from the survey were used with SPSS 22.0 for Descriptive Statistics, Frequencies, t-test, One-way ANOVA, and Multiple regression analysis to determine the influence between the factors.

## 3. Result

### 3.1. Differences in job satisfaction by personal characteristics of taekwondo masters

#### 3.1.1. Verification of differences in job satisfaction of taekwondo teachers according to gender

<Table 2> is the result of analyzing the difference in job satisfaction according to the gender of Taekwondo masters. As a result,  $t=.525$ ,  $p=.055$  in the job itself,  $t=-.378$ ,  $p=.286$  in working conditions,  $t=-.775$ ,  $p=.304$  in the guidance, shows no statistically significant difference in all factors.

**Table 2.** Comparison of job satisfaction differences by gender.

Area	Gender	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Job itself	Male	123	4.19	.90	.525	.055
	Female	47	4.11	.79		
Working conditions	Male	123	3.63	.97	-.378	.286
	Female	47	3.70	.92		
Leadership	Male	123	3.88	1.05	-.775	.304
	Female	47	4.02	.98		

### 3.1.2. Verification of differences in job satisfaction of taekwondo masters according to their educational background

<Table 3> is a result of analyzing the difference in job satisfaction according to the educational background of Taekwondo masters. The result is  $F=8.300$ ,  $p=.001$  in the job itself,  $F=5.324$ ,  $p=.006$  in working conditions,  $F=4.733$ ,  $p=.010$  in the guidance, showed a statistically significant difference in all factors. Postmortem analysis showed that there was a difference between graduation from graduate school( $M=4.79$ ), graduation from high school( $M=3.96$ ), graduation from graduate school and graduation from university( $M=4.12$ ).

**Table 3.** Comparison of job satisfaction differences by academic background.

Area	Academic background	<i>n</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>	<i>post-hoc</i>
Job itself	Graduated high school	53	3.96	.85	8.300***	.001	A<C, B<C
	Graduated university	93	4.12	.91			
	Graduated graduate school	24	4.79	.35			
Working conditions	Graduated high school	53	3.55	.80	5.324**	.006	A<C, B<C
	Graduated university	93	3.56	1.03			
	Graduated graduate school	24	4.23	.83			
Leadership	Graduated high school	53	3.65	1.19	4.733*	.010	A<C, B<C
	Graduated university	93	3.94	.95			
	Graduated graduate school	24	4.41	.73			

Note: A: Graduated Highschool, B: Graduated University, C: Graduated Graduate school

\* $p<0.05$ , \*\* $p<0.01$ , \*\*\* $p<0.001$ .

### 3.1.3. Verification of differences in job satisfaction of taekwondo masters according to their guidance experience

<Table 4> is the result of analyzing the difference in job satisfaction according to the guidance experience of Taekwondo masters. As a result, there was a statistically significant difference as  $F=4.904$ ,  $p=.003$  in the job itself. As a result of the post-analysis, there is a difference between more than 5 years( $M=4.39$ ) and less than 1 year( $M=3.81$ ), 5 years or more and more than 3 years and less than 5 years( $M=3.76$ ). On the other hand, working conditions( $F=.800$ ,  $p=.496$ ), guidance( $F=.403$ ,  $p=.751$ ) showed no statistically significant differences.

**Table 4.** Comparison of job satisfaction differences by guidance experience.

Area	Guidance experience	<i>n</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>	<i>post-hoc</i>
Job itself	Less than a year	18	3.81	.85	4.904**	.003	A<D, C<D
	1 to 3 years	45	4.09	.83			
	3 to 5 years	23	3.76	.91			

Working conditions	Over 5 years	84	4.39	.83	.800	.496
	Less than a year	18	3.42	.75		
	1 to 3 years	45	3.71	.99		
	3 to 5 years	23	3.47	.64		
	Over 5 years	84	3.72	1.05		
Leadership	Less than a year	18	3.70	1.07	.403	.751
	1 to 3 years	45	3.99	1.14		
	3 to 5 years	23	3.84	.90		
	Over 5 years	84	3.95	1.00		

Note: A: Less than a year, B: More than 1 year and less than 3 years, C: More than 3 years and less than 5 years, D: Over 5 years

\* $p < 0.05$ , \*\* $p < 0.01$ .

## 3.2. Differences in the management performance of taekwondo gyms by personal characteristics of taekwondo masters

### 3.2.1. Verification of differences in the taekwondo gym management performance of taekwondo masters according to gender

<Table 5> is a result of analyzing the difference between the management performance of Taekwondo gyms according to the gender of Taekwondo masters. As a result,  $t = .853$ ,  $p = .395$  in personal performance,  $t = .018$ ,  $p = .986$  in Taekwondo gym(enterprise) performance, showed no statistically significant difference in all factors.

**Table 5.** Comparison of differences in management performance of taekwondo gyms by gender.

Area	Gender	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Individual performance	Male	123	3.85	.76	.853	.395
	Female	47	3.74	.76		
Center(enterprise) performance	Male	123	3.57	.68	.018	.986
	Female	47	3.57	.63		

### 3.2.2. Verification of differences in the taekwondo gym management performance of taekwondo masters according to their academic background

<Table 6> is a result of analyzing the difference between Taekwondo master's management performance and Taekwondo master's educational background. The result is  $F = 15.283$ ,  $p = .001$  in individual performance,  $F = 8.062$ ,  $p = .001$  in Taekwondo gym(enterprise) performance, showed statistically significant differences in all factors. Post-analysis shows that there is a difference between graduated college( $M = 3.82$ ) and graduated high school( $M = 3.52$ ), graduated graduate school( $M = 4.48$ ), graduated high school, and graduated college. There is a difference in Taekwondo gym(enterprise) performance between graduated graduate school( $M = 3.40$ ) and graduated high school( $M = 3.56$ ), graduated graduate school and college( $M = 4.03$ ).

**Table 6.** Comparison of differences in management performance of taekwondo gym according to educational background.

Area	Academic background	<i>n</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>	<i>post-hoc</i>
Individual performance	Graduated high school	53	3.52	.72	15.283***	.001	A<B, A,B<C
	Graduated university	93	3.82	.73			
	Graduated graduate school	24	4.48	.52			
Center (enterprise)	Graduated high school	53	3.40	.56	8.062***	.001	A<C, B<C
	Graduated university	93	3.56	.67			



performance	Graduated graduate school	24	4.03	.67
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Note: A: Graduated Highschool, B: Graduated University, C: Graduated Graduate school

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

### 3.2.3. Verification of differences in the taekwondo gym management performance of taekwondo masters according to their guidance experience

<Table 7> is a result of analyzing the difference between Taekwondo gym management performance based on Taekwondo master's guidance experience. As a result, the individual performance showed a statistically significant difference by  $F=3.647$ ,  $p=.014$ . Post-analysis showed that there was a difference between more than five years ( $M=3.99$ ) and less than one year ( $M=3.45$ ), more than three years and more than five years ( $M=3.62$ ). On the other hand, Taekwondo gym (corporate) performance ( $F=.321$ ,  $p=.810$ ) showed no statistically significant differences.

**Table 7.** Comparison of differences in management performance of taekwondo gym according to guidance experience.

Area	Guidance experience	<i>n</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>	<i>post-hoc</i>
Individual performance	Less than a year	18	3.45	.67	3.647	.014	A,C<D
	1 to 3 years	45	3.75	.78			
	3 to 5 years	23	3.62	.65			
	Over 5 years	84	3.99	.76			
Center (enterprise) performance	Less than a year	18	3.47	.50	.321	.810	
	1 to 3 years	45	3.62	.65			
	3 to 5 years	23	3.50	.61			
	Over 5 years	84	3.59	.72			

Note: A: Less than a year, B: More than 1 year and less than 3 years, C: More than 3 years and less than 5 years, D: Over 5 years

\*p<.05

### 3.3. Effect of job satisfaction of taekwondo masters on the management performance of taekwondo gym

The results of a multiple regression analysis on the effect of job satisfaction of Taekwondo masters on personal performance and Taekwondo gym (corporate) performance are as shown in <Table 8>. An analysis of the effects of job satisfaction of Taekwondo masters on personal performance showed that the level of attention  $p<.001$  ( $F=75.784$ ), the job satisfaction level of taekwondo instructors was shown to affect individual performance. In addition, in the regression analysis, three independent variables account for 57.0% of the individuality and overall variability. Job satisfaction factors affecting individual performance are the job itself ( $\beta=.404$ ), working conditions ( $\beta=.212$ ) and guidance ( $\beta=-.286$ ), all factors have been shown to have a static(+) effect on individual performance. In addition, after analyzing the effect of job satisfaction of Taekwondo masters on corporate performance, the level of significance  $p<.001$  ( $F=42.522$ ), the job satisfaction level of taekwondo masters was found to affect the performance of Taekwondo gym (corporate). And in the regression analysis, three independent variables account for 42.4% of the individuality and overall variability. Job satisfaction factors affecting Taekwondo gym (corporate) performance are the job itself ( $\beta=.301$ ), working conditions ( $\beta=.258$ ), guidance ( $\beta=.221$ ) showed that all factors had a static(+) effect on painting (corporate) performance.

**Table 8.** Effect of job satisfaction on personal performance and enterprise performance.

Individual performance	Enterprise performance
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	<i>b</i>	<i>SE</i>	<i>β</i>	<i>t</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>β</i>	<i>t</i>	<i>p</i>
Job itself	.353	.055	.404	6.452	.001	.231	.055	.301	4.163	.001
Working conditions	.169	.057	.212	2.945	.004	.180	.058	.258	3.093	.002
Leadership	.211	.050	.286	4.243	.001	.143	.050	.221	2.841	.005
<i>r</i> <sup>2</sup> =.570, F=75.784, p=.001					<i>r</i> <sup>2</sup> =.424, F=42.522, p=.001					

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

## 4. Discussion

### 4.1. Differences in job satisfaction by personal characteristics of taekwondo masters

This study was conducted to find out how the job satisfaction of a Taekwondo master at a Taekwondo gym affects the revitalization of the Taekwondo gym. In order to achieve the purpose of this study, a survey was conducted and analyzed on 170 leaders working at taekwondo gyms located in Seoul and Gyeonggi Province. In response, we will discuss the impact of job satisfaction of taekwondo masters on the revitalization of taekwondo gyms(management performance) as follows, focusing on the results of the study.

In this study, the individual characteristics of taekwondo masters were modified to verify differences in job satisfaction according to gender, academic background, and guidance experience, and some variables showed statistically significant differences in individual characteristics. First, t-verification was conducted to find out the difference in job satisfaction of Taekwondo masters by gender, and there were no significant differences in all sub-factors in gender. A study by Kim[14] showed statistically significant differences in job satisfaction depending on the gender of taekwondo masters, but this study showed no significant difference. These results show that there may be differences in tools to measure job satisfaction, and that there may be no difference in job satisfaction depending on gender.

Second, a one-way random analysis was conducted to find out the difference in job satisfaction of Taekwondo masters depending on their educational background, and statistically significant differences were found in all factors of job satisfaction. The results of the study showed that the higher the educational background, the higher the job satisfaction, but the results showed that the sports leaders with lower education level, the higher the job satisfaction level than the leaders with higher education level, in a study by Sang-chul Lee and Kim[15]. A study by Kwon[3](2013) shows that the higher the level of education, the higher the awareness of occupation, and supports the results of this study. The result can be inferred that the higher the educational background of Taekwondo master, the more they consider the job of a taekwondo master as their lifelong career.

Third, a one-way random analysis was conducted to find out the difference in job satisfaction of taekwondo instructors according to their guidance experience, and statistically significant differences were found in the factors of the job itself. Seung-haeng Lee's[16] study showed no difference in job satisfaction depending on the experience of Taekwondo masters. In this study, the results of the prior study partially support the difference in job satisfaction based on experience only appeared in the job itself. These results show that Taekwondo masters do not change much in their working conditions and leadership as their guidance experience goes up, and that they will need to make efforts to improve their working conditions and leadership.

### 4.2. Differences in the activation(management performance) of taekwondo gyms by personal characteristics of taekwondo masters

In this study, the individual characteristics of taekwondo masters were modified to verify differences in the activation(management performance) of taekwondo gyms according to gender, academic background, and guidance experience, and some variables showed statistically significant personal characteristics.

First, t-verification was conducted to find out the difference in the Taekwondo gym activation(management performance) of taekwondo instructors by gender, and there was no significant difference in all sub-factors in gender. Director and feedback, downward/horizontal communication, mood and quality of communication, organizational information, and job satisfaction were high for the male. As a result of consulting with a prior study[14] that shows that there are differences in the activation of taekwondo gyms depending on gender, the study did not show any differences. This shows that the actual activation of the Taekwondo gym will not affect much depending on gender. It is believed that the activation of the Taekwondo gym will change depending on how satisfied you are with your job rather than your gender.

Second, a one-way random analysis was conducted to find out the difference in Taekwondo master's Taekwondo gym activation(management performance) according to their academic background, and statistically significant differences were found in all factors of Taekwondo master's Taekwondo gym activation(management performance). The professionalism of taekwondo masters with high educational backgrounds is believed to have a positive impact on the revitalization of taekwondo centers. Bae's[17] study reported that there was no difference in professionalism depending on the educational background, but the result of this study means that the educational background of the Taekwondo master who teach the trainees at the Taekwondo gym affects the activation of Taekwondo gyms and as the educational background becomes higher, there is a difference in the effort for the individual performance and corporate performance for the activation of Taekwondo gyms.

Third, a one-way random analysis was conducted to find out the difference in Taekwondo master's Taekwondo gym activation(management performance) according to the guidance experience, and statistically significant differences were found in the factors of individual performance. This means that as the leadership experience increases, they are making a lot of efforts for individual performance, and it is believed that if the individual's bonus goes up, it will naturally lead to the achievement of the gym.

#### **4.3. Effect of job satisfaction level of taekwondo masters on the revitalization(management performance) of taekwondo gym**

In this study, the job satisfaction of Taekwondo masters influences the factors of the revitalization of Taekwondo gym(management performance). Based on the results of this study, we would like to discuss specifically compared to prior studies.

First, a multi-session analysis was conducted to find out the impact of job satisfaction of Taekwondo masters on the individuality and factors of Taekwondo gym activation(management performance) and found that all factors of job itself, working conditions, and leadership had a significant impact on personal performance. As a result of a multi-term analysis to determine the impact of job satisfaction of Taekwondo masters on the individuality and factors of Taekwondo gym activation(management performance), all factors of job itself, working conditions, and leadership have a significant impact on personal performance. As a result of a study that reported that Taekwondo masters' dedication and pride in their jobs directly affect job satisfaction, the higher their job satisfaction, the higher their personal performance, and their personal performance has a positive impact on the activation of the Taekwondo gym.

Second, a multiple session analysis was conducted to determine the effect of job satisfaction of Taekwondo masters on the performance factors of Taekwondo gym activation(management performance), and found that all factors of job itself, working conditions,

and leadership had a significant impact on the performance of the school. This is in line with a prior study[18][19], that showed that the professionalism of taekwondo masters had a positive impact on job satisfaction, and the higher the job satisfaction level of taekwondo masters, the more positive it is.

## 5. Conclusion and Suggestions

This study conducted a survey of 170 leaders working at taekwondo gyms in Seoul and Gyeonggi Province to find out the impact of Taekwondo master's job satisfaction on the revitalization of the gym.

In this study, Descriptive Statistics, Frequencies, t-test, One-way ANOVA, and Multiple regression Analysis was used on the data collected through the surveys by using the SPSS 22.0 to determine the impact between factors. The significance level for all statistics was set to 0.05, and the conclusions obtained from the analysis were as follows.

First, the analysis, which is a sub-variant of job satisfaction for Taekwondo masters, showed no statistically significant differences in gender, and showed statistically significant differences in all factors depending on their educational background. In addition, the guidance experience showed statistically significant differences in the factors related to the task itself.

Second, the analysis of the sub-variance of Taekwondo master's Taekwondo gym activation(management performance) showed no statistically significant difference in gender, but showed statistically significant differences in all factors depending on educational background. In addition, there have been statistically significant differences in the factors of individual performance over the course of the guidance career.

Third, an analysis of the impact of job satisfaction of Taekwondo masters on the revitalization of Taekwondo gyms(management performance) showed that all factors in job satisfaction have a statistically significant impact on individual performance and painting performance related to the revitalization of Taekwondo gyms.

Based on the results produced in this study, the following suggestions are made for subsequent research.

First, for the Taekwondo masters, the study derived results by selecting Taekwondo masters in Seoul and Gyeonggi-do as participants. The results of this study will not be generalized to Taekwondo masters across the country. In order to compensate for the limitations of these studies, studies on taekwondo masters across the country are expected to produce more persuasive results.

Second, the study only conducted statistical verification through a survey on how the job satisfaction of Taekwondo masters influenced the revitalization of the Taekwondo gym. Statistical figures are limited to look into the inner details of Taekwondo masters, so if a qualitative analysis is made for a deeper analysis of Taekwondo masters' thoughts, it will be a meaningful study to draw out the grievances of Taekwondo masters.

Third, this study produced results using tools to measure personal and enterprise performance to evaluate the activation of Taekwondo gyms. In the future, if a clear measure is developed to evaluate the activation of the Taekwondo gym, more effective ways to activate the painting can be discussed.

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## 7. Appendix

### 7.1. Authors contribution

	Initial name	Contribution
Lead Author	JM	<ul style="list-style-type: none"><li>-Set of concepts <input checked="" type="checkbox"/></li><li>-Design <input checked="" type="checkbox"/></li><li>-Getting results <input checked="" type="checkbox"/></li><li>-Analysis <input checked="" type="checkbox"/></li><li>-Make a significant contribution to collection <input checked="" type="checkbox"/></li><li>-Final approval of the paper <input checked="" type="checkbox"/></li><li>-Corresponding <input checked="" type="checkbox"/></li><li>-Play a decisive role in modification <input checked="" type="checkbox"/></li></ul>
Corresponding Author*	JK	<ul style="list-style-type: none"><li>-Significant contributions to concepts, designs, practices, analysis and interpretation of data <input checked="" type="checkbox"/></li><li>-Participants in Drafting and Revising Papers <input checked="" type="checkbox"/></li><li>-Someone who can explain all aspects of the paper <input checked="" type="checkbox"/></li></ul>

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Corresponding author  
E-mail: [hope222ysh@knsu.ac.kr](mailto:hope222ysh@knsu.ac.kr)

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## Biomechanical Analysis of SPIN KICKS for Establishing the Technical Difficulty of Free style Poomsae in Taekwondo

Sihyun Ryu

Korea National Sport University, Seoul, Republic of Korea

### Abstract

**Purpose:** Quantitative grounds for the difficulty distinction and clear evaluation criteria of Taekwondo free style Poomsae spin kick are required. The purpose of this research is to conduct a kinematic analysis of 540°Dwihuryochagi(540D), 720°Dollyochagi(720D) and 900°Dwihuryochagi(900D) and provide a quantitative basis for spin kick difficulty classification.

**Method:** 13 athletes(age: 20.6±0.7 years, height: 171.3±4.2 cm, weight: 65.4±6.2 kg, experience: 8.3±4.5 years) were selected for this study. The analysis variables were the interval-specific time required for the spin kick, the displacement and velocity of the center of mass(COM), and the rotation angle and rotation angular velocity of the trunk.

**Results:** First, as the rotation angle increased, the time to kick(E2-E4) increased and the height of kick-off(E4) COM decreased( $p<.05$ ). Second, it has been shown that the time to land(E4-E5) is shortened( $p<.05$ ). The 900D was followed by kick after the landing was completed. Third, for the rotational angular velocity of the torso, rapid angular velocity was shown in the order of 900D > 720D > 540D in the air rotation interval(Phase 2-5).

**Conclusion:** Based on the results of this study, the difficulty of 900D should be allocated higher than that of 540D and 720D. In addition, Video Assistant Referee(VAR) techniques need to be applied to evaluate the success of 900D.

**[Keywords]** Free Style Poomsae, Spin Kick Difficulty, 540° Dwihuryochagi, 720° Dollyochagi, 900° Dwihuryochagi

## 1. Introduction

In order to overcome the lack of difficulty, lack of discrimination, fairness, etc due to the lack of technical difficulty of the Taekwondo official Poomsae[1][2][3][4][5], the World Taekwondo Federation established the free style Poomsae event in 2011 and developed into an official event from the World Taekwondo Poomsae Championship in 2012[6][7][8]. In particular, free style poomsae was introduced in the Taekwondo poomsae event at the 2018 Jakarta-Palembang Asian Games. Free style Poomsae refers to Poomsae, which is freely composed of dance moves and choreography based on the skills of Taekwondo[9][10][11]. At this time, other skills, not Taekwondo skills, are subject to deduction, and the Poomsae competition will be held based on the Taekwondo skills recognized by the Poomsae Committee by submitting a free style Poomsae plan in advance[12][13]. Thus, free style poomsae is likely to develop in terms of being able to solve boredom and athlete discrimination problems caused by monotonous techniques of authorized Poomsae, and express the dynamics of Taekwondo.



However, the criteria, technical difficulty, and the deduction for the 5 essential skills of free style Poomsae are not yet presented as in <Table 1>[13]. A study on improving the free style Poomsae evaluation method[7] noted that the scoring items for essential technologies are not clear, so there is a limit to developing into international competition events such as the World Poomsae Championship, Universiade, and Asian Competition. In particular, the study for difficulty classification of spin kicks[14] also emphasized that the evaluation criteria of the existing spin kick consisted of only rotation angle and accuracy, resulting in insufficient consideration of kick height, deduction, and aerial motion. Thus, in order to establish specific difficulty classification and clear evaluation criteria for free style Poomsae essential techniques, scientific and quantitative grounds need to be presented through kinetic analysis of essential technologies.

**Table 1.** Allotted scoring chart for free-style poomsae.

Scoring criteria	Details of scoring criteria	Point
Technical skills(6.0)	Jumping side Kick	5.0
	Multiple kicks in a jump	
	Gradient of spins in a spin kick	
	Kyorugi style consecutive kicks	
	Acrobatic kicking technique	
	Basic movements & practicability	1.0
Presentation(4.0)	Creativeness	4.0
	Harmony	
	Expression of energy	
	Music & choreography	
	Maximum points	10.0

In the meantime, kinematic studies of high-level spin kicks have been mainly limited to 540D[6][15][16][17][18][19], and further kinematic analysis for difficulty classification is urgently needed as the rotation angle of rotational kicks in free style poomsae competitions is 720° and 900°. Recently, a kinematic study[20] has been reported to present effective training methods for 720D and 900D, but there is no comparison between the two high-level techniques, which limits suggesting spin kick difficulty distinction. Therefore, in this study, we conducted a kinematic analysis of the spin kick(540D, 720D, 900D) performed in free style Poomsae and provide a quantitative basis for separating the difficulty of the spin kick.

## 2. Method

### 2.1. Participants

The subjects of the study recruited 13 athletes(age: 20.6±0.7 years, height: 171.3±4.2 cm, weight: 65.4±6.2 kg, and experience: 8.3±4.5 years) and a spin direction of the spin kick of all subjects was counterclockwise. At this time, this study was approved by K University(IRB task management number: 1263-20200002-HR-085-01, approval number 20200210-106, approval date 2020.03.03.) and all subjects participated voluntarily.

### 2.2. Experimental procedure

In this study, 8 infrared cameras(Oqus 300, Qualis, Sweden) were used to photograph Taekwondo spin kicks(540D, 720D, and 900D), and the sampling rate was set at 200 Hz. In addition, a total of 18 reflection markers made of 2 cm diameter were attached to the upper and lower extremity joint points to obtain three-dimensional coordinates[21]. Sufficient

guidance and practice were induced in advance and participated in the experiment, and the height of the target of the spin kick was carried out at the preferred height of the target. Spin kick was performed 3 times for each technique, and sufficient rest time was given during the attempt to avoid affecting the operation. In this case, enough space was provided to perform the spin kick, and it was induced to carry out the same conditions as the breaking stadium. To ensure the stability of the experiment process, a Taekwondo mat was installed, and safety personnel were placed around the area where the spin kick was performed to prevent injuries that could occur in advance.

### 2.3. Data processing

The three-dimensional position coordinate values of the reflective markers attached to the joints of the human body were obtained from Qualisys Track Manager software (Qualisys, Sweden) via the non-linear transformation (NLT) method. Matlab R2009a software (The Mathworks, USA) calculates the interval-specific time required for spin kick difficulty classification, the displacement and velocity of COM, and the rotation angle and angular velocity of the trunk segment. In order to eliminate the noise generated during the acquisition of data, the Butterworth 4th order low-pass filter was smoothed, and the cut-off frequency was set to 12 Hz. The cut-off frequency decision was determined by conducting a fast Fourier transform (FFT) analysis and calculating the power spectral density (PSD) for signals switched to frequency, considering the accumulated level of 99.9% of PSD as representative of each signal characteristic [22].

### 2.4. Analysis phase

An analysis phase was divided into rotation on the ground (Event1), take off (Event2), maximum height of COM (Event3), kicking (Event 4) and landing (Event 5) as shown in Figure 1 [6][16]. At this time, 900D was analyzed until the moment of kick as all subjects were kicked at the moment of landing or after landing.

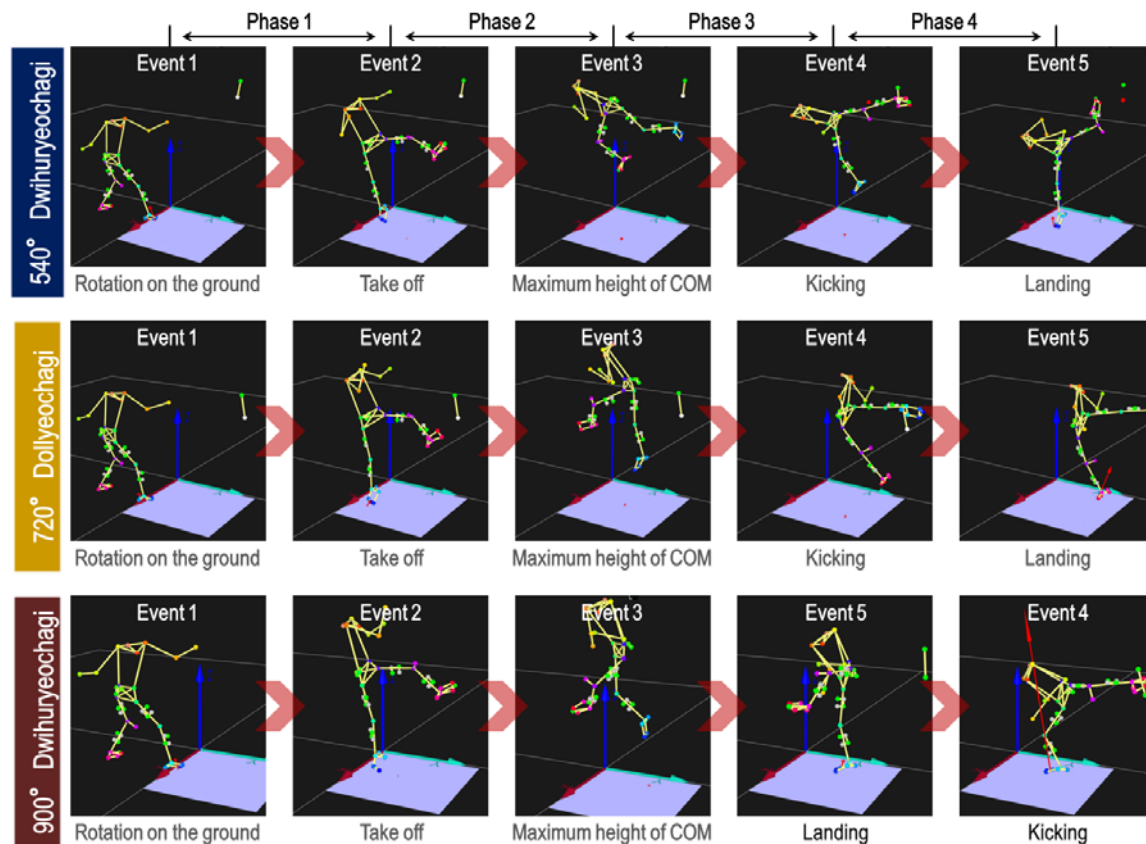
### 2.5. Analysis variables

The variables produced in this study were the time required for each spin kick phase, the displacement and velocity of COM, the rotation angle and angular velocity of the trunk segment. COM was then calculated using the coordinate values of each joint of the human body and calculated the displacement and velocity of the interval COM [22]. In addition, the rotation angle and angular velocity of the trunk segment were calculated by Cardan's Xyz rotation method to utilize the rotation angle of the trunk in the horizontal plane [23][24]. The direction of the rotation angle is defined as the counterclockwise rotation (+), and the clockwise rotation (-) is defined.

### 2.6. Statistical processing

In this study, One-way repeated measure ANOVA was conducted to compare the variables according to the Taekwondo spin kick type. The post-hoc was set to Bonferroni. Effect size ( $\eta_p^2$ ) and statistical power were presented, and all statistical significance levels were set at .05.

**Figure 1.** Analysis phase.



### 3. Result

#### 3.1. Time

**Table 2.** Differences in time between three rotation kicks(unit: sec).

Variables	540D <sup>a</sup>	720D <sup>b</sup>	900D <sup>c</sup>	F	p	Post-hoc	$\eta_p^2$	Power
Rotation phase on the ground(P1)	0.39±0.05	0.40±0.03	0.40±0.04	.441	.648	-	.035	.113
Rotation phase on the air(E2-E5)	0.57±0.03	0.55±0.02	0.57±0.02	10.042	.001	a, c > b	.456	.972
Jumping phase(P2)	0.25±0.02	0.26±0.01	0.26±0.01	6.171	.007	b, c > a	.340	.848
Kicking phase(P3)	0.20±0.03	0.23±0.04	0.39±0.05	189.447	.000	c > b > a	.940	1.000
Landing phase(P4)	0.13±0.04	0.05±0.04	-0.08±0.05	124.008	.000	a > b > c	.912	1.000

Note: 540D: 540°Dwiuryeochoagi, 720D: 720°Dollyeochoagi, 900D: 900°Dwiuryeochoagi, E1: rotation on the ground, E2: take off, E3: maximum height of COM, E4: kicking, E5: landing. P1: E1-E2, P2: E2-E3, P3: E3-E4, P4: E4-E5

\*means  $p < .05$ .

The time for each phase of the spin kick was as shown in <Table 2>. The total rotation phase on the air is  $F=10.042(p=.001)$ , Effect size( $\eta_p^2$ )=.456, Statistical power=.922, showed a statistically significant difference between spin kicks, and post-hoc results showed that 540D and 900D were longer than 720D. The jumping phase was  $F=6.171(p=.007)$ , Effect size( $\eta_p^2$ )=.340, Statistical power=.848, which resulted in statistically significant differences between spin kicks, and post-hoc results showed that 720D and 900D were longer than 540D.

From the maximum height of COM to the kicking phase takes  $F=189.447(p=.000)$ , Effect size( $\eta^2_p$ )=.940, Statistical power=1.000 showed statistical differences between spin kicks, and post-hoc results showed that it was long in order of 900D > 720D > 540D. The landing phase after the kicking takes  $F=124.008(p=.000)$ , Effect size( $\eta^2_p$ )=.912, Statistical power=1.000 showed statistical differences between spin kicks, and post-hoc results showed that it was long in order of 540D > 720D > 900D. In the case of 900D, the kick was found to have taken place after landing.

### 3.2. COM displacement

**Table 3.** Differences in displacement of COM between three rotation kicks(unit: cm).

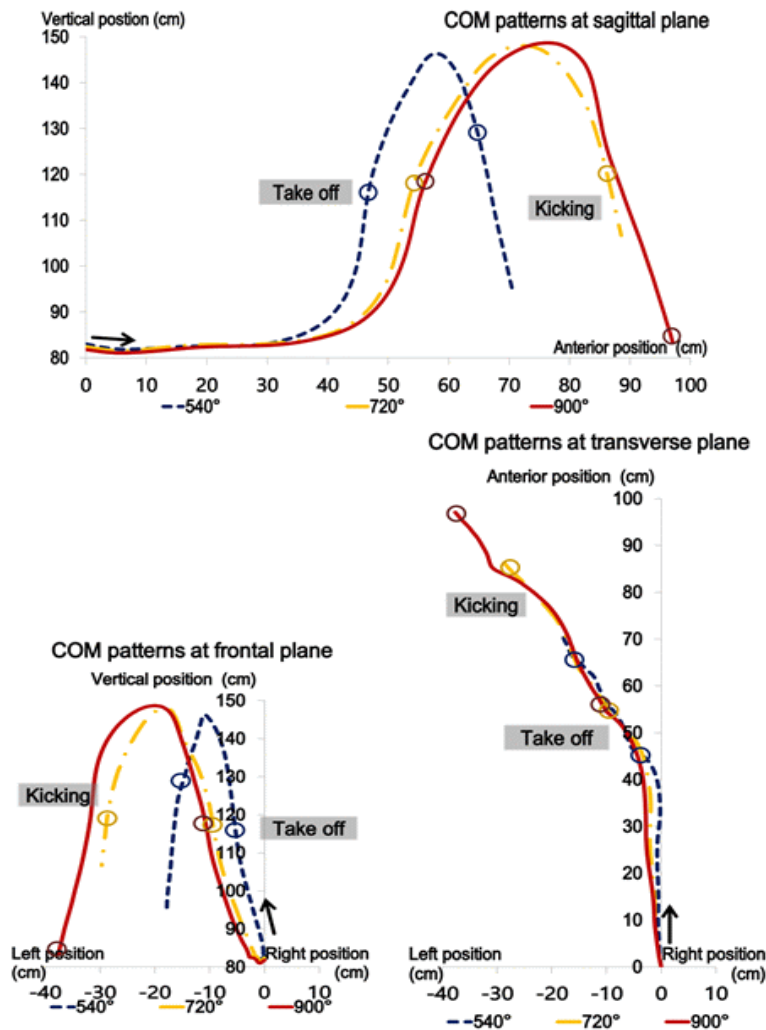
Variables	540D <sup>a</sup>	720D <sup>b</sup>	900D <sup>c</sup>	<i>F</i>	<i>p</i>	Post-hoc	$\eta^2_p$	Power
M/L COM Dis. at P1	-5.4±4.5	-9.3±5.0	-11.0±5.9	6.945	.004	<i>a</i> > <i>c</i>	.367	.889
A/P COM Dis. at P1	46.9±8.1	54.4±5.6	56.2±4.9	19.669	.000	<i>b, c</i> > <i>a</i>	.621	1.000
S/I COM Dis. at P1	32.7±3.3	34.9±3.7	35.8±3.6	13.795	.000	<i>b, c</i> > <i>a</i>	.535	.996
M/L COM Dis. at P2	-5.7±6.4	-9.1±8.9	-9.5±5.9	1.496	.244	-	.111	.287
A/P COM Dis. at P2	11.6±4.3	18.6±5.6	21.1±3.7	22.483	.000	<i>b, c</i> > <i>a</i>	.652	1.000
S/I COM Dis. at P2	30.6±3.8	30.7±3.8	31.7±3.7	2.153	.138	-	.152	.397
M/L COM Dis. at P3	-4.0±5.5	-9.7±7.6	-17.4±10.7	9.426	.001	<i>a, b</i> > <i>c</i>	.440	.963
A/P COM Dis. at P3	6.7±3.2	13.6±4.6	20.7±7.8	23.909	.000	<i>c</i> > <i>b</i> > <i>a</i>	.666	1.000
S/I COM Dis. at P3	-17.8±5.1	-27.6±8.8	-66.2±9.1	223.868	.000	<i>a</i> > <i>b</i> > <i>c</i>	.949	1.000
M/L COM Dis. at P4	-2.9±2.9	-1.8±2.2	-	1.357	.267	-	.102	.189
A/P COM Dis. at P4	5.9±4.2	2.6±2.7	-	7.981	.015	<i>a</i> > <i>b</i>	.399	.737
S/I COM Dis. at P4	-33.3±11.2	-13.7±10.2	-	37.284	.000	<i>b</i> > <i>a</i>	.757	1.000

Note: 540D: 540°Dwihuryochagi, 720D: 720°Dollyochagi, 900D: 900°Dwihuryochagi, COM: center of mass, Dis: displacement, M/L: medial(left, -) / lateral(right, +), A/P: anterior(+)/posterior(-), S/I: superior(+)/inferior(-)

\*means  $p < .05$ .

The COM displacement for each phase of the spin kick was as shown in <Table 3> and <Figure 2>. First of all, statistical differences between spin kicks of the medial/lateral(M/L) COM displacements for P1 and P2 were showed  $F=6.945(p=.004)$ , Effect size( $\eta^2_p$ )=.367, Statistical power=.889 and  $F=9.426(p=.001)$ , Effect size( $\eta^2_p$ )=.440, Statistical power=.963, respectively. At this time, 900D was found to move more to the left compared to 540D and 720D. Next, the anterior/posterior (A/P) COM for P1, P2 and p3 showed statistical differences between spin kicks as  $F=19.669(p=.000)$ , Effect size( $\eta^2_p$ )=.621, Statistical power=1.000,  $F=22.483(p=.000)$ , Effect size( $\eta^2_p$ )=.652, Statistical power=1.000 and  $F=23.909(p=.000)$ , Effect size( $\eta^2_p$ )=.666, Statistical power=1.000, respectively. At this time, 720D and 900D were found to move forward more than 540D. In the P4,  $F=7.981(p=.015)$ , Effect size( $\eta^2_p$ )=.399, Statistical power=.737, showed statistical differences between spin kicks, with 540D moving more forward compared to 720D. Finally, the superior/inferior(S/I) COM of P1 was  $F=7.981(p=.015)$ , Effect size( $\eta^2_p$ )=.399, Statistical power=.73, which showed statistical differences between spin kicks. At this time, 720D and 900D were found to move up more than 540D. In the P3,  $F=223.868(p=.000)$ , Effect size( $\eta^2_p$ )=.666, Statistical power=1.000, showed statistical differences between spin kicks, and it moved down a lot in the order of 900D > 720D > 540D. In the P4,  $F=37.284(p=.000)$ , Effect size( $\eta^2_p$ )=.757, Statistical power=1.000 showed statistical differences between spin kicks, with 540D moving downward a lot compared to 720D.

**Figure 2.** COM patterns of spin kick at frontal, transverse and sagittal plane. blue line: 540° Dwiuryochagi, yellow line: 720° Dollyeochagi, red line: 900° Dwiuryochagi, first cycle: take off, second cycle: kicking.



### 3.3. COM velocity

The COM velocity for each phase of the spin kick was as shown in <Table 4> and <Figure 3>. First of all, the statistical differences between spin kicks of the M/L COM velocity in the P1 was showed  $F=6.197(p=007)$ , Effect size=.341 and Statistical power=.849. The 900D was faster to the left than the 540D. Next, the statistical differences between spin kicks of A/P COM velocities in the P1, P2 and P3 were showed  $F=28.027(p=000)$ , Effect size=.700, Statistical power=1.000,  $F=15.567(p=.000)$ , Effect size=.565, Statistical power=.998,  $F=7.285(p=.003)$ , Effect size=.378, and Statistical power=.904, respectively. The 720D and 900D were faster forward than the 540D. And the statistical differences between spin kicks of S/I COM velocity in the P2 was showed  $F=4.097(p=029)$ , Effect size=.255, and Statistical power=.670. The 540D was vertically faster than the 720D. Conversely, in the P3,  $F=66.930(p=.000)$ , Effect size=.848, and Statistical power=1.000 showed statistical differences between spin kicks. At this time,  $900D > 720D > 540D$  followed by a fast velocity in the downward direction.

**Table 4.** Differences in mean velocity of COM between three rotation kicks(unit: cm/s).

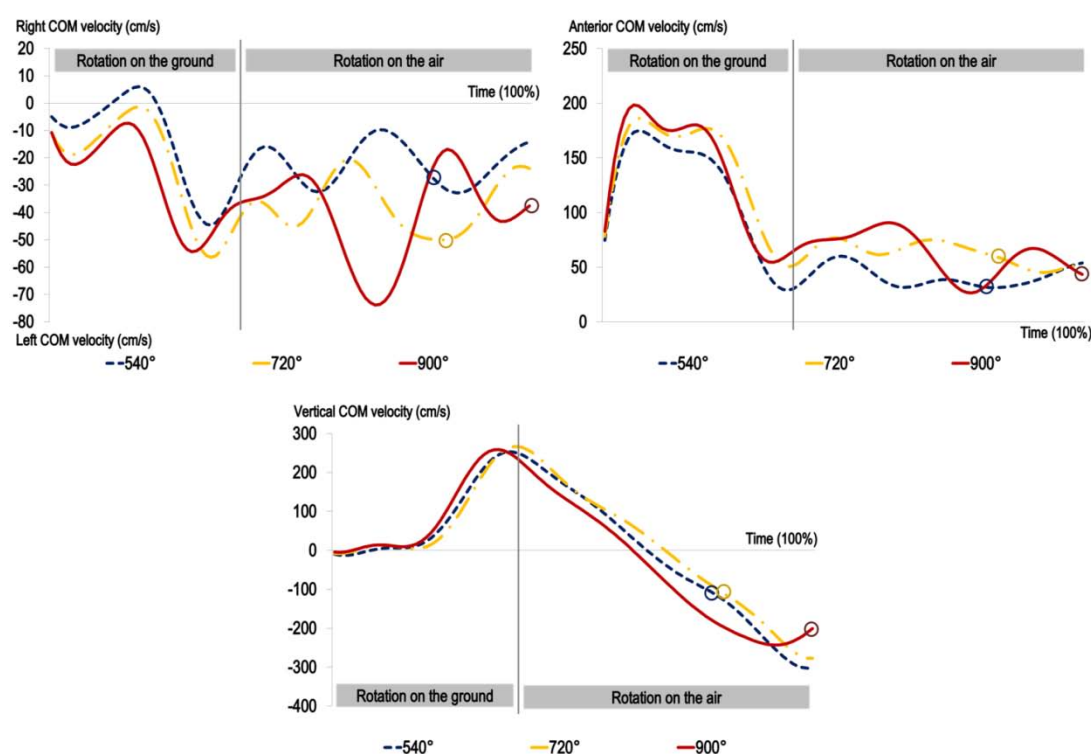
Variables	540D <sup>a</sup>	720D <sup>b</sup>	900D <sup>c</sup>	F	p	Post-hoc	$\eta_p^2$	Power
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M/L COM Vel. at P1	-14.7±13.2	-23.7±13.6	-27.5±13.7	6.197	.007	a > c	.341	.849
A/P COM Vel. at P1	119.0±13.0	136.1±12.8	140.9±14.1	28.027	.000*	b, c > a	.700	1.000
S/I COM Vel. at P1	86.4±12.3	89.1±10.2	92.0±11.9	2.956	.071	-	.198	.521
M/L COM Vel. at P2	-22.3±25.8	-33.5±33.7	-36.0±23.2	1.143	.335	-	.087	.227
A/P COM Vel. at P2	45.0±17.6	69.5±21.7	79.0±13.7	15.567	.000*	b, c > a	.565	.998
S/I COM Vel. at P2	123.8±9.7	116.8±9.5	121.4±9.9	4.097	.029*	a > b	.255	.670
M/L COM Vel. at P3	-21.3±27.2	-44.6±33.5	-43.9±23.8	3.033	.067	-	.202	.533
A/P COM Vel. at P3	35.5±18.4	59.3±18.7	52.3±15.6	7.285	.003*	b, c > a	.378	.904
S/I COM Vel. at P3	-90.2±15.8	-116.1±19.6	-168.0±16.1	66.930	.000*	a > b > c	.848	1.000
M/L COM Vel. at P4	-23.8±26.0	-29.9±28.0	-	.217	.650	-	.018	.071
A/P COM Vel. at P4	41.6±21.3	46.7±16.8	-	.462	.510	-	.037	.096
S/I COM Vel. at P4	-258.0±10.8	-260.7±9.7	-	.472	.505	-	.038	.097

Note: 540D: 540°Dwihuryochagi, 720D: 720°Dollyochagi, 900D: 900°Dwihuryochagi, COM: center of mass, Dis.: displacement, M/L: medial(left, -) / lateral(right, +), A/P: anterior(+)/posterior(-), S/I: superior(+)/inferior(-)

\*means  $p < .05$ .

**Figure 3.** COM mean velocity patterns of spin kick. blue line: 540° Dwihuryochagi, yellow line: 720° Dollyeochagi, red line: 900° Dwihuryochagi, cycle: kicking.



### 3.4. Trunk angle

The trunk rotation angle of the spin kick was as shown in <Table 5> and <Figure 4(Left)>. The trunk rotation angles in P2-P5 were showed statistical differences between spin kicks except for the ground rotation Phase(P1). At this time, the rotation angles were large in order of 900D > 720D > 540D.

**Table 5.** Differences in trunk rotation angle between three rotation kicks(unit: deg).

Variables	540D <sup>a</sup>	720D <sup>b</sup>	900D <sup>c</sup>	F	p	Post-hoc	$\eta_p^2$	Power
E1	64.7±37.1	62.5±20.5	64.3±21.6	.085	.919	-	.007	.061
E2	348.3±10.1	365.0±21.2	370.8±24.3	9.978	.001*	c > b > a	.454	.971



E3	542.8±31.0	614.3±24.3	648.9±34.0	87.415	.000*	c > b > a	.879	1.000
E4	604.4±28.8	758.1±14.9	933.1±56.2	384.218	.000*	c > b > a	.970	1.000
E5	587.2±23.1	775.8±25.0	944.8±54.5	566.399	.000*	c > b > a	.979	1.000
P1	283.6±39.5	302.5±19.9	306.5±25.7	2.779	.082	-	.188	.495
P2	194.6±25.8	249.4±25.3	278.1±19.5	110.746	.000*	c > b > a	.902	1.000
P3	61.6±44.1	143.7±22.6	284.2±40.9	147.748	.000*	c > b > a	.925	1.000
P4	-17.2±20.4	17.8±17.8	-	30.003	.000*	b > a	.714	.999

Note: 540D: 540°Dwihuryochagi, 720D: 720°Dollyochagi, 900D: 900°Dwihuryochagi, rotation direction: counterclockwise(+), clockwise(-)

\*means p<.05.

### 3.5. Trunk angular velocity

The trunk rotation angular velocity of the spin kick was as shown in <Table 6> and <Figure 4(Right)>. The trunk rotation angular velocities were showed statistical differences between the spin kicks at all intervals. At this time, the trunk rotation angular velocities were large in the order of 900D > 720D > 540D.

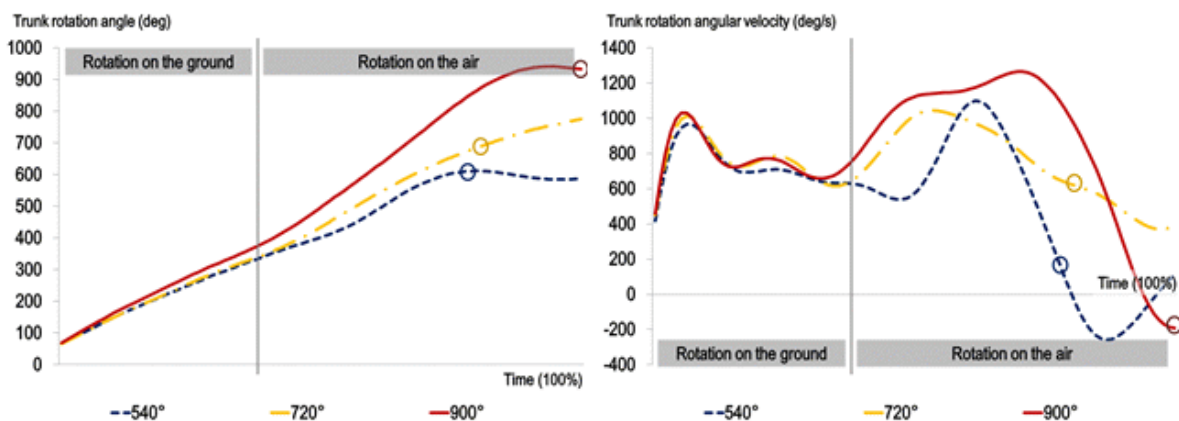
**Table 6.** Differences in trunk rotation angular velocity between three rotation kicks(unit: deg/s).

Variables	540D <sup>a</sup>	720D <sup>b</sup>	900D <sup>c</sup>	F	p	Post-hoc	$\eta^2_{\text{av}}$	Power
P1	721.3±56.8	755.6±50.6	764.9±61.1	7.809	.002*	c > a	.394	.923
P2	784.2±80.2	942.4±66.2	1062.3±72.5	54.278	.000*	c > b > a	.819	1.000
P3	301.2±215.7	619.7±68.5	739.6±175.8	38.664	.000*	c, b > a	.763	1.000
P4	-142.8±130.2	339.3±152.1	-	104.918	.000*	b > a	.897	1.000

Note: 540D: 540°Dwihuryochagi, 720D: 720°Dollyochagi, 900D: 900°Dwihuryochagi, rotation direction: counterclockwise(+), clockwise(-)

\*means p<.05

**Figure 4.** (Left) trunk rotation angle patterns. (Right) angular velocity patterns. blue line: 540° Dwihuryochagi, yellow line: 720° Dollyeochagi, red line: 900° Dwihuryochagi, cycle: kicking.



## 4. Discussion

This study was conducted the biomechanical analysis of the spin kick(540D, 720D, 900D) performed in Taekwondo free style poomsae and provide a quantitative basis for distinguishing the difficulty of the spin kick. To this end, the interval time of each phase for spin kicks, the displacement and velocity of the COM, the rotation angle and angular velocity of the trunk were examined.

First of all, the duration of the rotation in the ground(P1) was shown to be about 0.4 sec for all spin kicks, and the duration of the rotation in the air(P2-P5) was about 0.57 sec. This



results similar to the studies[6][20], and it was judged that the ground rotation time and flight time were almost the same, even with increasing rotation angles.

The part that you have to pay attention here is that as the rotation angle increases, the time it takes to kick increases, and the height of the center of mass decreases at the moment of kick, which decreases the time it takes to land. This means that as the rotation increases, the COM reaches the maximum height and then comes down to the ground as much as possible, as indicated by the study[6], which states that it is an important success factor for 540D to perform at the highest COM height. It was mentioned that it was important to perform the kick at the maximum height of COM when performing reverse rotation Dolgae-chagi[25]. In particular, the 900D was followed by Dwihuryochagi after the landing was completed, and the same results were reported in the study[20]. As can be inferred from the free style Poomsae scoring regulation[13], which states that the points are awarded according to the angle of rotation of the jump kick, the spin kick must be performed in the midair. In this respect, the 900D of the subjects in study[20] and this study can be defined as a failed motion. In addition, the kicking after landing can cause lower extremity injuries, and detailed monitoring is required to prevent injuries[26]. Nevertheless, completion of the pre-landing spin kick has not been a scoring consideration to date, given that it is difficult to visually determine the success of the 900D in the actual competition. To overcome the errors and limitations of these scoring, the application of the Video Assistant Revere(VAR) system being applied in football matches is imperative[27]. VARs are considered suitable for Taekwondo free style Poomsae events in that they can improve the professional and moral standards of sport, fair play[28].

After the take off to the highest height, with 540D at 0.2 sec and 720D at 0.23 sec, while the 900D at 0.47 sec took about twice as long. In addition, there was a 0.03 sec difference between 540D and 720D, but a 0.24 second difference between 720D and 900D. This implies a time difference of about 8 times, despite the increase in rotation angle by half(i.e., 180°), which is considered to mean the degree to which 900D is difficult to perform. In the study proposed difficulty of the free style Poomsae spin kick[14], 540D was 0.6 points, 720D was 0.9 points, 900D was 1.3 points, and 1080D was 2.0 points, but based on this study, it is considered desirable assigning a higher difficulty point for 900D.

Finally, the rapid rotation velocities were found in the order of 900D > 720D > 540D in line with the results of the studies[6][20]. In order to succeed before landing the 900D, it is believed that the rotational velocities of about 950 deg/s must be maintained continuously from the take off(Event 2) to the kicking(Event 4) where the trunk should be at least over 540° rotated.

The results of this study suggest that the spin kick difficulty is problematic to simply determine the angle of rotation, and that it is desirable to distinguish the difficulty between 540D and 720D is small, and the difficulty between 720D and 900D is big. In addition, it is believed that applying VAR techniques to free style Poomsae to determine the success of high-level techniques such as 900D would help determine the correct decision.

## 5. Conclusion

In this work, the biomechanical analysis of spin kick(540D, 720D, 900D) was conducted to provide a quantitative basis for distinguishing the difficulty of the Taekwondo free style Poomsae spin kick. The results are as follows. First, as the rotation angle increased, the time to kick(E2-E4) was longer and the height of kick(E4) COM was lowered( $p<.05$ ). Second, it has been shown that the time to land(E4-E5) is shortened( $p<.05$ ). The 900D was followed by Dwihuryochagi after the landing was completed. Third, for the rotational angular velocity of the trunk, rapid angular velocity was shown in the order of 900D > 720D > 540D in the air(Phase 2-5). It is not appropriate to distinguish the difficulty of the spin kick only by the

angle of rotation, and a high difficulty of 900D should be assigned based on the results of this study. Furthermore, it is appropriate to evaluate the success of high-level techniques such as 900D using VAR techniques. In future studies, biomechanical studies are expected to distinguish difficulty levels of other essential techniques.

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# 7. Appendix

## 7.1. Authors contribution

Initial name		Contribution
Lead Author & Corresponding Author*	SR	-Set of concepts <input checked="" type="checkbox"/>
		-Design <input checked="" type="checkbox"/>
		-Getting results <input checked="" type="checkbox"/>
		-Analysis <input checked="" type="checkbox"/>
		-Make a significant contribution to collection <input checked="" type="checkbox"/>
		-Final approval of the paper <input checked="" type="checkbox"/>
		-Corresponding <input checked="" type="checkbox"/>
		-Play a decisive role in modification <input checked="" type="checkbox"/>
		-Significant contributions to concepts, designs, practices, analysis and interpretation of data <input checked="" type="checkbox"/>
		-Participants in Drafting and Revising Papers <input checked="" type="checkbox"/>
		-Someone who can explain all aspects of the paper <input checked="" type="checkbox"/>

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