Electronic Body Protector for the Development of Taekwondo Athletes' Technical Skills: Reflections on Performance

Taekwondocuların Teknik Becerilerinin Geliştirilmesinde Elektronik Yelek: Performansa Yansımaları

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Abstract

This study aims to examine the change in taekwondo athletes' performances after training with an electronic body protector to develop their technical skills. This study comprised 14 licensed taekwondo athletes between 16 and 18 years of age who were training in a private gym. Six techniques were determined to develop the technical skills of the athletes, including three attacks and three counter-attacks using a combination of two techniques. A five-week taekwondo training program was held for two hours a day, three days per week.

Observation notes were taken to develop the training program while the participants were performing technical combinations during the first measurement, and the reasons for the athletes' low scores on the electronic body protector were determined. The qualitative data obtained from the observation notes were analyzed using the descriptive analysis method, while the quantitative data obtained from the electronic body protector system were analyzed using the descriptive statistics. In conclusion, the comparison of the values obtained from the first and last measurements showed that electronic body protector has a statistically significant impact on the athletes' performances in terms of score and time.

Keywords: electronic body protector, taekwondo techniques, performance

Özet

Bu çalışmada sporcuların teknik becerilerinin geliştirilmesi için elektronik yelekle yaptıkları antrenmanların sonucunda performanslarındaki değişimin incelenmesi amaçlanmıştır. Araştırmaya özel bir spor salonunda antrenman yapan, 16-18 yaş aralığında 14 lisanslı taekwondo sporcusu katılmıştır. Sporcuların teknik becerilerinin geliştirilmesi için, ikili teknik kombinasyonlarından üç atak, üç kontra atak olmak üzere toplam altı teknik belirlenmiş, haftada üç gün ikişer saat olmak üzere beş haftalık taekwondo antrenman programı uygulanmıştır.

Antrenman programını oluşturmak için, ilk ölçüm sırasında katılımcılar teknik kombinasyonları uygularken gözlem notları alınmış olup, sporcuların elektronik yelek sisteminden düşük puan alma sebepleri belirlenmiştir. Gözlem notlarından elde edilen nitel veriler betimsel analiz yöntemiyle çözümlenirken, elektronik yelek sisteminden elde edilen nicel veriler betimsel istatistiklerle analiz edilmiştir.

Sonuç olarak, ilk ve son ölçümlerden elde edilen değerler karşılaştırıldığında, elektronik yeleğin sporcuların performanslarına etkisi puan ve süre açısından istatiksel olarak anlamlı bulunmuştur.

Anahtar Kelimeler: elektronik yelek, taekwondo teknikleri, performans

Introduction

Taekwondo is a Korean martial art performed with bare feet and hands. It was developed by combining two separate systems – Foot Method and Fist Method (Lewis, 1996; Mark, 1984). Although it is described as a martial art, Taekwondo is also a fighting sport because Taekwondo athletes use both counter-attack and defense techniques against their opponents, depending on their positions changing during the match (Çatıkkaş, 2003; Yim, 1993; Yalçınkaya, 1986). The history of taekwondo dates back to the period before Common Era but it has become a modern sport branch today (Tel, 2008). It took approximately 40 years until Taekwondo is regarded as an international sport (Ramazanoğlu, 2000), and the level of participation has gradually increased since it became an Olympic sport. The increased interest in this sport in recent years has introduced new requirements for competition systems.

It is also highly important to receive immediate responses from the system (Cooper and Storer 2001) in order to objectively assess the performance of an athlete. A large number of analysis methods are available in all sports to reveal qualitative and quantitative data used to monitor performance, to determine training programs for athletes (Bayraktar and Kurtoğlu 2004), to determine their inadequacies and to improve them. Monitoring performance is considered to be easier for individual sports than for team sports (Özkara 2002). Physical performance tests are the best methods used to monitor the status of athletes and to verify the effectiveness of specific training activities (Ball et al. 2011, Kim et al. 2011). Data obtained from these tests can be used as an indicator of the minimum fitness standards necessary to determine appropriate physical characteristics for achievement in competitions and fighting at a particular level (Markovic et al. 2005; Heller et al. 1998).

Formerly, a referee used to assess the technical combinations performed by athletes in Taekwondo competitions and judge whether the technique was correctly and adequately performed, and award points to the athletes. This assessment method was observed to be biased and subjective. (Ko et al., 2013; Partridge et al., 2005). However, in 2004, World Taekwondo Federation decided that the athletes' performances during the matches should be assessed using an electronic system (Moenig, 2015) for a more reliable assessment and the elimination of cheating (Chi, 2005). This decision represents a new era of taking advantage of technological advances. This system, in which the intensity of strike is adjusted according to the categories and weights of the athletes, enables an objective assessment and obtaining fair results (Tasika, 2013; Song et al., 2010; Song, et al., 2010; Chi, 2008). Moreover, the scoring system adopted along with electronic body protectors made an important contribution to the use of accurate techniques and skills (Tornello et al.2014). Sensor-fitted electronic body protectors enable more accurate and reliable scoring and provide trainers and athletes with the opportunity to develop their attack and counter-attack strategies (Leveaux 2010, Tornello et al.2014). They can also determine the techniques to be used in competitions (İmamoğlu et al. 2010) and yield objective and fair results (WTF, Del Vecchio et al. 2011, Tornello et al. 2014).

This study aims to examine the change in the athletes' performance after training with an electronic body protector, both to enable adaptation to the new system and development of

technical skills. The study will contribute to the literature, which includes only a limited number of studies on the effectiveness of electronic systems since they are still so new.

Electronic Body Protector

Athletes have to wear arm and shin guards, mouth guards, gloves, groin guards, and instep protectors with sensors during the matches at Taekwondo competitions, along with sensor-fitted electronic body protectors. Sensor-fitted electronic body protectors and instep protectors are used for point evaluation (Figure 1). Sensors fitted to electronic body protectors and instep protectors automatically transfer the points to the scoreboard when the athletes apply adequate pressure using the correct technique. Otherwise, no point is given. (Del Vecchio et al., 2011; Partridge et al., 2005). Pressure (strike intensity) on the electronic body protector enables scores to be obtained by category and weight. This pressure applies to all countries in the World Taekwondo Federation, ensuring equality for all Taekwondo players across all criteria.

Figure 1. Electronic body protector and instep protector with sensors

Method

A mixed method research design including quantitative and qualitative approaches was employed in this study.

Athletes' consents were obtained using a voluntary participation form to collect technical data. The study was conducted with 14 licensed Taekwondo players between 16 and 18 years of age (young adult category) who were training Taekwondo in a private gym for three years.

Data Collection

Six techniques were determined to develop the technical skills of the athletes, including three attacks and three counter-attacks using a combination of two techniques. Points determined by the World Taekwondo Federation were taken as a basis for scoring the technical combinations (Table 1).

Table 1. Technical Combinations and Points Given for Them

	Techniques	Score
Attack Combinations	Palding-Chagi + Palding-Chagi by sliding forward	2 points
	Palding-Chagi + Double Palding-Chagi	3 points
	Palding-Chagi + Spinning Palding-Chagi	4 points
Counter-Attacks Combinations	Counter Palding-Chagi + Palding-Chagi	2 points
	Dwit-Chagi + Palding-Chagi	4 points
	Dwit-Chagi + Dwit-Chagi	6 points

Athletes were entitled to kick five times using both right and left feet for each technique. Considering the weight and categories of the participants, the average pressure value was determined to be 30 bar. Penalty points were not given because no points were registered by the electronic system when the athletes did not correctly kick. Although time limit was not regarded as a restriction, scores obtained by the participants for each technique and the completion times were collected from the electronic body protector system and assessed.

Measurements were taken to determine the status of the athletes and the scores each athlete obtained on the electronic body protector system were recorded on a performance table. Also, the athletes' mistakes or shortcomings in terms of technical kicks noticed during the first measurement were noted in the "observation note" section of the performance table.

The researcher, who is also a Taekwondo instructor, analyzed the data obtained from the observation notes and prepared a five-week training program held for two hours per day, three days per week. Athletes' mistakes for each technique were determined and added in the observation notes. Feedback was also noted regarding when they lost their balance while performing spinning techniques and when they should perform the technique after turning during the observation. The participants were told that in Dwit-Chagi technique, the sensor at the middle point under the foot should touch the electronic body protector; that they should pull their toes and the angle of their ankles toward themselves while kicking; and how they should adjust the angle of their hips. For the instep kicks, the parts of instep that should hit the electronic body protector were showed to the participants, and they were told that they should turn their hips fully in the direction of their kick. Corrections were made for all these techniques, and the participants were asked to perform them as two-technique combinations. It was observed that almost all the participants looked at the scoreboard, made mistakes and lost their concentration and balance before completing the two-technique combinations (after the first technique). This implied that the electronic body protectors had a negative effect on the athletes since it instantly showed their performance. To cope with this negative effect, the participants were told that they should not look at the scoreboard before the round is finished, and that they would eventually understand how much pressure they kick while training with the electronic body protector and be able to guess whether they score is high or not without looking at the scoreboard. All of the taekwondo-specific technical corrections and correct body positions and foot angles while performing the techniques were shown to the participants. In addition, the participants were also provided with feedback during the program to enable them to give up the habits they acquired before using electronic body protectors.

Having qualitative data offers trainers an enormous advantage while assessing the performance of athletes. It enables them to observe how many points the athletes receive for the techniques and the level of their technical control over the match during a competition. It also allows trainers to objectively evaluate themselves and their athletes without excuses for positive or negative results since the referee factor disappears (Ball et al. 2011, Kim et al. 2011).

At the end of five weeks, another measurement was taken from the athletes who performed technical exercises using electronic body protector. The development of athletes was assessed by comparing the first and the last measurements.

Data Collection Tools

Taekwondo practiced with an electronic bodyguard throughout the study to improve the technical skills of the athletes. The data were collected using a performance table prepared by the researcher. One performance table was used for each athlete. Scores obtained by the athletes for their right and left kicks in each two-technique combination, and the data obtained from the electronic body protector regarding the completion times for these techniques were added to the performance tables. The observation notes on what kind of mistakes the athletes made with regard to the kicks for which they could not score points were also added to performance tables.

Data Analysis

The qualitative data obtained from the observation notes were analyzed using the descriptive analysis method (Patton, 2014). The change in the athletes' performance was analyzed using the Wilcoxon test, a non- parametric statistical technique, on the qualitative data obtained from the electronic body protector system (Çokluk, Şekercioğlu and Büyüköztürk, 2010).

Result

During the first measurement, the data obtained from the observation notes were analyzed using descriptive analysis method. Table 2 shows the thematic codes related to the reasons why the athletes could not score points while performing technical combinations wearing the electronic body protector.

Table 2. Reasons why the athletes could not score points while performing technical combinations wearing the electronic body protector

Inability to reach adequate pressure value
Instep kicks which did not hit on the electronic body protector in Palding-Chagi
Inability to perform heel kick in Dwit-Chagi
Inability to perform correct and effective kick due to the inability to maintain their balance in Spinning Palding-Chagi
Inability to ensure footwork in techniques with spinning

The athletes were found to obtain low scores because they were unable to reach adequate pressure value, perform the heel kick effectively in the Dwit-Chagi technique, maintain balance, and ensure correct footwork in techniques involved with spinning, as well as because instep kicks did not hit properly on the electronic body protector (Table 2).

Table 3. Comparison of scores obtained by the athletes while performing technical combinations

	Techniques	N	Mean Score of First Measurement	Mean Score of Last Measurement	Z	p
Attack Combinations	Palding-Chagi + Palding-Chagi sliding forward	14	9.42	16	-3.306	0.001
	Palding-Chagi + Double Palding-Chagi	14	12.07	19.85	-3.316	0.001
	Palding-Chagi + Spinning Palding-Chagi	14	18	29.07	-3.299	0.001
Counter-Attacks Combinations	Counter Palding-Chagi + Palding-Chagi	14	12.64	16.85	-3.192	0.001
	Dwit-Chagi + Palding-Chagi	14	17.14	26.5	-3.298	0.001
	Dwit-Chagi + Dwit-Chagi	14	15.21	28.5	-3.330	0.001

Measurements were taken from the athletes before and after the five-week training program and compared in terms of the athletes' scores. Table 3 shows statistically significant differences between the first and last measurements for all techniques (at the $p<0.05$ significance level).

Table 4. Comparison of the athletes' technique combination completion times

	Techniques	N	First Measurement Time Average	Last Measurement Time Average	Z	p
Attack Combinations	Palding-Chagi + Palding-Chagi by sliding forward	14	52.50	36.35	-3.297	0.001
	Palding-Chagi + Double Palding-Chagi	14	52.79	33.50	-3.299	0.001
	Palding-Chagi + Spinning Palding-Chagi	14	52.00	38.57	-2.799	0.005
Counter-Attacks Combinations	Counter Palding-Chagi + Palding-Chagi	14	53.71	36.07	-3.297	0.001
	Dwit-Chagi + Palding-Chagi	14	53.71	40.00	-2.695	0.007
	Dwit-Chagi + Dwit-Chagi	14	58.10	38.21	-3.050	0.002

Table 4 show compares the completion times obtained in the first and last measurement and shows statistically significant differences between the first and last measurements (at the $p<0.05$ significance level).

Conclusion and Discussion

This study aimed to examine the change in taekwondo athletes' performances after training with an electronic body protector to develop their technical skills. The study was

conducted with 14 licensed Taekwondo players between 16 and 18 years of age, and the data were collected using a performance table prepared by the researcher.

The reasons for the low scores of the athletes on the electronic body protector system while performing technical combinations during the first measurement were found to be inability to reach adequate pressure values while kicking, perform the heel kick effectively in the Dwit-Chagi technique, maintain balance, and ensure correct footwork in techniques involved with spinning, as well as the instep kicks which did not hit properly on the electronic body protector in the Palding Chagi techniques.

A five-week training program was held for two hours, three days per week and the athletes were trained by the researcher, who is also a Taekwondo instructor. At the end of the program, a second measurement was performed on the athletes and the first and last scores were compared.

It was observed that before the training, the athletes generally scored a point from only one kick in the kicks determined as two-technique combinations. In other words, they could not completely perform techniques. However, the rate of completing two-technique combinations increased after the training. In their study conducted to examine wireless scoring and training systems with sensors, Partridge et al. (2005) emphasized that this system developed training techniques. Trainers and sports scientists not only obtain objective information about the physical skills of the athletes, but also find an opportunity to reorganize their training, to motivate their athletes and provide them with objective feedback (Ball et al. 2011, Kim et al. 2011). Song et al. (2010) stated that the electronic system used by Taekwondo instructors improved the training techniques of athletes and affected their performance.

It can be stated that training with electronic body protectors increased conditioning, improved technical skills, enabled the participants to learn the accurate use of technique and improved their footwork. A study by Song, Jeon (2010) analyzed the effectiveness of electronic body protectors and user satisfaction and found that, according to the responses obtained from 10 individuals, the users were generally satisfied with the system. Since the electronic body protector system is objective, scoring is equal and fair for all athletes, and athletes show a better performance when they are fairly compensated for their performance. This means that obtaining instant and objective performance results, which are showed in the electronic systems in which the intensity of strike is adjusted according to their categories and weights, is important for athletes (Tasika, 2013; Song et al., 2010; Song, Woo, Min, & Lee, 2010; Chi, 2008).

In the present study found that, compared to the first measurement, the athletes were able to apply the techniques in shorter times after the training program and their total scores increased for all techniques. In a study conducted by Moenig (2015) to examine the rules and equipment changes made by World Taekwondo Federation, it was emphasized that new rules shortened the duration of matches in competitions. Similarly, Partridge et al. (2005) reported that the electronic system helped athletes to score points in shorter times during their training. All of these results indicate that electronic body protector contributed to the development of

athletes' technical skills and trainers' ability to develop effective attack and counter-attack strategies (Tornello et al. 2014).

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