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ORIGINAL ARTICLE

Determining the Motor Skills Affecting the Distance to the Opponent in Taekwondo

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ABSTRACT

Background: Athletes should stay close enough to the opponent to score points in an attack, but at the same time, they must keep enough distance to avoid the opponent's attack. Therefore, determining the correct distance can be related to the athlete's speed, explosive power, agility, technical and tactical abilities.

Aim: This study aims to determine the motor skill factors that affect the kick distance of athletes in taekwondo.

Methods: The study was carried out with the voluntary participation of elite, active competitor male athletes (n = 44). Athletes' basic motor skills performance levels were determined using 20 m speed, vertical jump, and anaerobic power tests. Taekwondo Performance Protocol (TPP) was used to determine the speed and quickness levels specific to Taekwondo. The kick distances of the athletes were determined with the data obtained from TPP. Correlation between athletes' kick distance and motor skills performance levels were examined, and the factors affecting the kick distance were determined. Descriptive and comparative statistics at a 95% significance level were employed in the statistical analysis of the data gathered.

Results: It was determined that the correlations between the athletes' kick distances and their technical speed, velocity, and anaerobic power performances were significant at a moderate and high level (ICC: 0,623-0,854; p<0,05).

Conclusion: The study results showed that fast and strong athletes with high anaerobic power and capacity could kick from longer distances. Athletes with advanced speed and power characteristics can effectively attack their opponents from long and safe distances.

Keywords: taekwondo, performance, kyorugi, distance control, kick distance

INTRODUCTION

Taekwondo is an Olympic combat sport with millions of professionals around the world. Taekwondo, which has been in the process of continuous development and transformation for decades, has reached its present form with the effects of science and technology. Studies revealed that in parallel with the changes in taekwondo, the physical structure and competition character of the athletes also changed[1–4]. However, under all circumstances, athletes must be developed in motor skills, psychology, technique, and tactics[5,6].

Since the Kyorugi competitions consist of three rounds of 2 minutes each, the anaerobic energy systems are dominant[7]. Athletes compete with strong and coordinative techniques[8–13]. In Taekwondo kyorugi competitions, a considerable proportion of points are obtained by kicks. Studies show that champion athletes use more offensive kicks than losers[9,11,12]. To win the competition, the athletes must be superior to their opponents in motor skills, technical, and tactical terms and have to earn maximum points. Therefore, during the competitions, the opponents should constantly check each other, take advantage of the mistakes of opponents, and attack with the right technique from the most appropriate distance at the most appropriate time. In an attack, athletes must be able to defend at a controlled distance to prevail. Therefore, in kyorugi competitions, taekwondo athletes have to determine the correct distance to their opponent. It was observed that the athletes make an effort to determine the correct distance during the competition.

This is because being able to hit the target at the right time or avoid a possible attack is related to the distance between the opponents[14,15]. Athletes should stay close enough to the opponent to score points in an attack, but at the same time, they have to keep enough distance to avoid the opponent's attack. Therefore, determining the correct distance can be related to the athlete's speed, explosive power, agility, technical and tactical abilities.

It was determined that the factors determining the kick distance in taekwondo had not been studied yet. In this context, this study aims to determine the motor skill factors that affect the kick distance of athletes during taekwondo kyorugi performance.

MATERIAL & METHODS

Participants: The study was conducted with the voluntary participation of 44 male athletes at the elite level who actively participated in competitions. Descriptive information about the age, height, body weight and duration of experience of athletes was given in Table 1.

Ethical Suitability: For the study, the Ethics Committee License was obtained from the Scientific Studies and Publication Ethics Committee of Trabzon University Faculty of Social Studies and Humanities. All athletes and their legal guardians were informed in writing and verbally about the purpose, nature and process of the study, all questions were answered, they were reminded that they had the right to leave at any stage of the study. The participation form and parent permit documents were signed by all athletes and their parents. The study was conducted in accordance with the Declaration of Helsinki as revised in 2013.

Study Design Process: After obtaining descriptive information about athletes (Table 1), basic (20 m speed, vertical jump and anaerobic power) and taekwondo-specific (TPPspeed, TPPquickness) motor skills performance levels were determined. The kick distances of the athletes were

determined with the data obtained from Taekwondo Performance Protocol (TPP). After the data collection process, the data were analyzed to determine the motor characteristics that affect the athletes' kick distances (Table 2-6).

Determination of Basic Motoric Performance

20-meter sprint test: The 20-meter sprint test was used to evaluate the overall speed performance of the athletes. For the 20-meter sprint test, an indoor area was selected that was flat, incline, non-slippery and not affected by weather conditions. The same running course was used in sprint performance measurements before and after the study. Athletes were asked to run using their maximum speed in the designated running course of 20 meters. In line with the principle of full rest, all athletes repeated the test twice, and their best performance was recorded in seconds as the result of the test (Table 2).

Vertical jump and anaerobic power test: These tests are for detecting the athlete's jumping and anaerobic force. For the vertical jump test, a tape measure was glued to a flat, non-sloping and smooth wall so that the zero point was adjacent to the ground. During the test, athletes were first asked to reach the maximum distance while their feet touched the ground in front of the tape measure with their dominant hands. They were asked to reach the maximum distance by jumping with two feet. The distance between thee points the athlete could reach without jumping and the point he reached with jumping was measured and recorded in cm. In line with the principle of full rest, the test was repeated twice for all athletes, and the highest result was recorded.

In order to detect anaerobic power, the Lewis nomogram was used, in which vertical jump data was formulized. Anaerobic power was found with " P = [√4.9 (body weight kg)] x √vertical jump distance (m.) X 9.81 " formula and the result was recorded in watts[16].

Determination of Motoric Performance Specific to Taekwondo

Taekwondo performance protocol (TPP): The Taekwondo Performance Protocol (TPP) was used to detect speed and agility performance specific to taekwondo[17]. The speed and agility parameters require high-density loads over a short period of time. It is known that short-term and high-density loads are related to anaerobic processes[18,19]. For this reason, the test is designed to take 30 seconds to enable anaerobic processes to be active. In addition, it is examined in periods of 5 seconds in order to determine the maximal values (Figure 1).

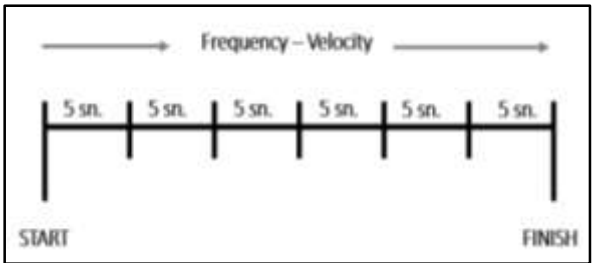

Figure 1. TPP start and end ranges

Implementation Phase of TPP: In order to make the necessary adjustments for the trial and test, the athlete was asked to apply the Palding - Chagi technique to the target fixed to the ground and wall in rhythm and series. Palding - chagi is a simple and low-level (applied to the body) technique that athletes often resort to at the time of competition. Palding-chagi is the most appropriate technique that requires a minimum of different variables, such as flexibility or balance. It is most suited for just evaluating the speed and agility of the athlete[20,21]. During the trial, the athlete's “point where the kicking foot (the foot executing the technique) touches the ground” and “point where the kicking foot contacts the target” were marked in a circle with a diameter of 25 cm. After the athlete's recovery was achieved in accordance with the principle of full rest, the athlete was put to the test. The athlete was reminded that he should not leave the marked area during the test, he should only hit the marked target, he should put his foot in the marked area on the ground after each technique is completed, and he should perform his maximum performance during the test period. If the athlete made a mistake during the test, he was allowed to try again after having a rest.

Measurement and data collection phase: During the measurement, athletes started the test as soon as they felt ready. The stopwatch was launched simultaneously as the athlete kicked the first kick and the performance was recorded on video. Every 5 seconds, the kicking frequency that the athlete was able to apply was recorded. Technical quickness (technical frequency) and speed performances of athletes were calculated with the obtained values.

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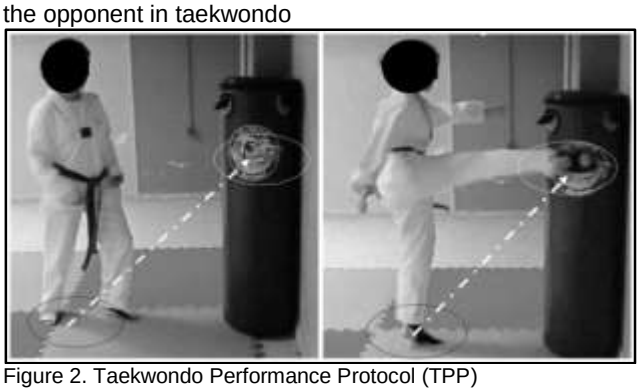
Figure 2. Taekwondo Performance Protocol (TPP)

Technical quickness test: During the test, the number of kicks that the athlete can apply was recorded as quickness performance. By examining the 5-second periods within the scope of the test, the total, maximum, minimum, and average quickness values of the athletes were determined (Figure 2). The results were recorded in numbers.

Technical speed test: The athletes ' technical speeds (Figure 2) were determined using the formula speed = distance / time. For this, the kicking frequency applied by the athlete throughout 30 seconds, and the distance covered by the foot between the ground and the target point were recorded and multiplied, and then divided into 30, which was the test duration. The measurement of the distance covered by the foot is shown in figure 3.

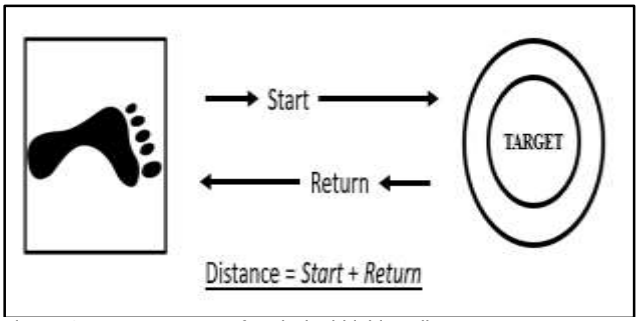

Figure 3. Measurement of technical kicking distance

By examining the 5-second periods within the scope of the test, the total, maximum, minimum, and average speed values of the athlete were determined. The results were recorded in cm/sn.

Statistical Analysis: Average ($\bar{x}$), standard deviation (Sd.), minimum and maximum values (range) of all variables were determined. First, all the data to be analyzed was checked with the Kolmogorov- Smirnov normality test. The relationships between the athletes ' kicking distances and their basic and taekwondo-specific motoric performance were determined by Pearson correlation analysis. For statistical analysis of the data, the SPSS 25.0 statistical software was used and the values $p<0.05$ and $p<0.01$ were taken as the level of significance.

RESULTS

Table 1. The athletes' descriptive features

n=44	$\bar{x}$ ± Sd.			Range		
Age (year)	13,34	±	1,18	11,00	-	15,00
Height (cm)	157,84	±	7,43	137,00	-	172,00
Weight (kg)	48,28	±	9,78	26,60	-	71,50
Experience (year)	4,16	±	1,16	3,00	-	6,00

The mean, standard deviation and minimum-maximum values of the age, height, weight, and the total years of taekwondo sport of the athletes were determined (Table 1).

Table 2. Descriptive data for motoric performance tests

n=44	$\bar{x}$ ± Sd.			Range		
20 m sprint (sec)	3,53	±	0,41	2,68	-	4,48
Vertical Jump (cm)	30,53	±	10,60	7,00	-	57,00
Anaerobic Power (Watts)	598,00	±	184,89	276,57	-	1058,70

Athletes' 20 m sprint and vertical jump performances were examined to determine their basic anaerobic motor skills properties. The anaerobic strength of the athletes was determined using the Lewis nomogram. Athletes' 20 m speed, vertical jump, and anaerobic power test scores were examined and the mean, standard deviation, minimum and maximum value ranges were determined (Table 2).

Table 3. Values regarding athletes' quickness performance parameters

n=44		$\bar{x}$ ± Sd.			Range		
KD (cm)		284,86	±	42,97	160,00	-	348,00
Kicking quickness (pcs)	0-5 (sec)	9,00	±	0,99	7,00	-	11,00
	5,1-10 (sec)	8,39	±	0,78	7,00	-	10,00
	10,1-15 (sec)	7,93	±	1,02	3,00	-	9,00
	15,1-20 (sec)	7,34	±	1,14	2,00	-	9,00
	20,1-25 (sec)	7,23	±	1,08	3,00	-	9,00
	25,1-30 (sec)	6,64	±	1,10	2,00	-	8,00
	Average quick. (pcs)	7,80	±	0,89	3,33	-	8,83
	Max. quick. (pcs)	9,16	±	0,94	7,00	-	11,00
	Min. quick. (pcs)	6,73	±	1,15	1,00	-	8,00
Kicking speed (cm/sec)	0-5 (sec)	511,68	±	92,68	320,00	-	668,80
	5,1-10 (sec)	477,85	±	85,37	274,40	-	620,00
	10,1-15 (sec)	451,41	±	89,07	184,80	-	594,00
	15,1-20 (sec)	416,24	±	82,71	123,20	-	537,60
	20,1-25 (sec)	412,70	±	90,35	184,80	-	556,80
	25,1-30 (sec)	379,63	±	90,21	123,20	-	537,60
	Average quick. (pcs)	444,22	±	80,68	206,67	-	550,00
	Max. quick. (pcs)	521,26	±	86,71	307,20	-	660,00
	Min. quick. (pcs)	383,81	±	86,94	62,00	-	537,60

KD: Kicking distance

TPP was used to determine the speed and quickness levels specific to Taekwondo. The kicking speed and kicking quickness performances of the athletes were determined using TPP. The speed and quickness performances of the athletes were examined at intervals of 5 seconds and the mean, standard deviation, minimum and maximum values were determined (Table 3).

Table 4. Relations between KD values of athletes and $TPP_{quickness}$ and TPP_{speed} performances

		0-5 sec	5,1-10 sec	10,1-15 sec	15,1-20 sec	20,1-25 sec	25,1-30 sec	x̄	Max.	Min.
$TPP_{quickness}$	KD	-0,129	0,009	-0,057	-0,208	0,104	0,166	-0,110	-0,236	0,014
TPP_{speed}		0,782**	0,854**	0,741**	0,623**	0,747**	0,720**	0,756**	0,785**	0,646**

**p<0,01; KD: kicking distance

The correlation between the athletes' kick distances (KD) and TPPspeed and TPPquickness performances was examined. It was found that there was no significant correlation between the KD of the athletes and any parameter of their technical quickness (TPPquickness) (p>0.05). On the other hand, positive and moderate-high level significant correlations were found between athletes' KD and kick speed (TPPspeed) performances in all parameters (ICC: 0.623-0.854; p <0.01) (Table 4).
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Table 5. Relations between KD values and basic anaerobic motoric performances of athletes

	20 m sprint	Vertical jump	Anaerobic power
KD (cm)	-,760**	,684**	,619**

**p<0,01; KD: kicking distance

The results of the KD and basic anaerobic motor skill performances correlation analysis showed that there was a high level of negative correlations between athletes' KD and 20 m speed performances, and there was a moderate level of positive correlation between athletes' vertical jump and anaerobic power performances (ICC: 0,684- 0.760; p<0.01) (Table 5).

DISCUSSION

This study aims to determine the motor skill factors affecting taekwondo athletes' KD. In the literature review, it was determined that the factors that can affect the taekwondo athletes' KD have not been examined and this study is the first.

The findings of the study revealed that the correlations between athletes' KD and kick speed, velocity, and anaerobic power performance were significant at a moderate and high level. The results revealed that the speed and strength characteristics dominated by anaerobic energy systems are effective in determining the distance while the athletes practice techniques. Speed and power characteristics distinguish elite athletes from others[22,23]. It is crucial for taekwondo athletes that the lower extremities show high anaerobic power characteristics, and this characteristic is considered to be essential for success in international competitions[7,24]. Kwon et al. (2019) found a significant correlation between the athletes' technical speed performance and their standing long jump and Wingate anaerobic strength test results[25]. Sant'Ana et al. (2014) found a significantly high correlation between athletes' roundhouse kick performances and vertical jump performances with the new protocol they developed to determine anaerobic power in taekwondo[26]. Ouergui et al. (2020) reported that high-intensity sprint and taekwondo-specific technical training, in which anaerobic processes are active, are effective in improving taekwondo performance and recommended to be included in training plans[27].

Previous studies support our results in terms of the positive effects of anaerobic power and capacity on taekwondo performance. Strong athletes with advanced anaerobic power systems can apply their techniques effectively from long distances as well as close distances, thanks to their speed. This characteristic provides a wider area for the athlete during the competition. Athletes who can use both close and long-distance techniques effectively are more offensive in competitions compared to opponents, and studies revealed that the champions in the Olympic games mostly used offensive techniques[9,11,12]. Athletes who aware that they can quickly reach the target from long distances, of course, will use these advantages and will demonstrate their technical skills both from short and long distances.

CONCLUSION

The study results showed that athletes who have improved motor skills associated with anaerobic power and capacity tend to apply their techniques from longer distances compared to other athletes. Athletes with advanced explosive power and speed can use their techniques effectively from longer distances. Strong and fast athletes can attack successfully and effectively from distances where their opponents cannot risk due to long distances. Being able to jump higher and farther and being able to hit fast and powerful kicks from a distance when the opponent does not expect, of course, provides a great advantage to the athletes. Therefore, the current findings will contribute to sports literature in terms of enhancing our understanding of the factors that determine distance control in athletes.

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