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Ramiz Arabacı[1] Recep Görgülü[2]
Fatih Çatıkkaş[3]
Uludag University[1] Bangor University[2]
Ege University[3]
ramizar@uludag.edu.tr
Bursa-Turkey

RELATIONSHIP BETWEEN AGILITY AND REACTION TIME, SPEED AND BODY MASS INDEX IN TAEKWONDO ATHLETES

ABSTRACT

The purpose of this study was to examine relationship between agility and reaction time, speed and body mass index of taekwondo athletes. Totally, thirty-one female (n=8, age 13.7±1.5 years) and male (n=23, age 14.7±3.9 years), taekwondo athletes volunteered to participate in this study. After 15 min warm-up subjects performed tests of reaction time (left and right hand reaction time), speed (30m sprint: 10m acceleration, flying 20 m sprint and 30m maximum speed) and agility (20m zigzag agility test), respectively. Body mass index was calculated by dividing the weight (kg) by the height squared (m^2). The mean (±SD), minimum and maximum values of performance tests were determined. The relationships between the performances on the agility and 10 m acceleration, flying 20 m sprint, 30 m maximum speed and left hand and right hand reaction time tests were determined by Pearson correlations. As a result, new tests of agility that include specific exercises of taekwondo are encouraged in further researches. Moreover agility test should be included cognitive properties such as anticipation and pattern recognition.

Keywords: Taekwondo, Agility, Speed, Reaction, Body Composition

TAEKWONDOCULARIN BECERİ İLE SÜRAT, REAKSİYON ZAMANI VE VÜCUT KİTLE İNDEKSİ ARASINDAKİ İLİŞKİ

ÖZET

Bu araştırmanın amacı taekwondocuların beceri ile reaksiyon zamanı, sürat ve vücut kitle indeksi özellikleri arasındaki ilişkinin incelenmesidir. Bu araştırmaya toplam otuz bir bayan (n=8, yaş 13.7±1.5 yıl) ve erkek (n=23, yaş 14.7±3.9 yıl) taekwondocu gönüllü olarak katıldı. Denekler 15 dakikalık ısınmadan sonra sırasıyla reaksiyon zamanı (sol ve sağ el reaksiyon), sürat (30 m sprint: 10 m hızlanma, 20 m hızlanarak sprint ve 30 m. maksimum hız)ve beceri(20m zigzag beceri testi) testlerini uyguladılar. Uygulanan performans testlerinin ortalama (±SS), minimum ve maksimum değerleri belirlendi. Vücut kitle indeksi, ağırlığın (kg), boyun karesine (m^2) bölünerek hesaplandı. Beceri ile 10 m hızlanma, 20 m hızlanarak sprint ve 30 m. maksimum hız, sol ve sağ el reaksiyon testleri arasındaki ilişki Pearson correlation testi ile belirlendi. Beceri ile 20 m hızlanarak sprint arasında ve beceri ile 30 m sprint arasında anlamlı pozitif ilişki olduğu tespit edildi ($p<0.05$). Sonuç olarak, taekwondo sporuna yönelik özel hareketler içeren yeni beceri testleri ileriki araştırmalarda değerlendirilmesi gerekir. Ayrıca, beceri testleri sezgi ve örnek tanıma gibi bilişsel özellikler de içermelidir.

Anahtar Kelimeler: Taekwondo, Beceri, Sürat, Reaksiyon, Vücut Kompozisyonu

1. INTRODUCTION (GİRİŞ)

Taekwondo is described as a way of fisting and kicking. However it is a branch of Olympic sports which is performed by speed, movements, and turning kick [1, 2, 3 and 4]. Taekwondo originates from various forms of ancient Korean martial arts. The system of martial techniques has been constituted since the late 1950s and has become an increasingly popular sport worldwide. All disciplines of the taekwon-do martial art are considered to be highly demanding for most muscle groups. Taekwon-do consists of the movements which are sudden and symmetrical in karate, and circular in kung-fu. For the techniques in taekwon-do to reach target, it should be performed by sudden change of direction. Thus, taekwon-do fighter's speed which requires performance, agility, skill and reaction time is of critical importance. In the researches peculiar to taekwon-do poomse, it is emphasized that it improves cardiorespiratory endurance, and general physical talents [3, 5 and 6]. One of the required biomotoric features in the sports branches like taekwon-do is speed, or taking the way as far as quick and moving quickly [7 ve 8]. Another feature of taekwon-do is reaction time. Reaction time is described as time period between the given stimulus and the beginning of the response that someone gives voluntarily [9 and 10]. And agility is a combination of speed and coordination. Speed which provides movements, the speed and coordination is an elementary technical demand for sportive performance in taekwon-do. Agility occurs by speed, coordination, flexibility, and power. When speed and flexibility are combined activity results: this is a talent of fast and coordinated movement in the game field [11]. In previous studies, it is stated that there is a weak relation between speed and technique [12, 13 and 14]. However, there are no taekwon-do players in the mentioned studies.

Especially, in weight-lifting and contact sports, anthropometrical features are very important. There are not adequate studies carried out on the relation between anthropometric features and technique [15]. In these studies, %fat analyzed as an anthropometric feature. In theory, anthropometric features may affect technique. However, this relation has not been approved yet explained whether there is a relation between technique and anthropometric features [16]. Currently, one of the evaluation ways of body structure is BMI.

Relatively little is known about the functional and physical demands of the event and physiological responses of taekwon-do athletes during competition, as the existing literature is limited. The capacity of taekwon-do athletes to produce varied high-speed actions and body composition are know to impact performance. High-speed actions can be categorized into actions requiring maximal speed, acceleration, reaction time and agility. Contradictory findings have been reported as to the extent of the relationship between the different speed components. For these reasons, the aim of this study was to examine relationship between agility and speed, reaction time and body mass index of taekwon-do athletes.

2. RESEARCH SIGNIFICANCE (ÇALIŞMANIN ÖNEMİ)

Agility, speed, reaction time and body composition are important components of sport, specially in taekwondo athletes [17 and 18]. Traditional definitions of agility have simply identified speed in directional changes as the defining component. Many strength and conditioning coaches believe agility and sprinting performance are strongly linked. However relationship between agility and straight sprinting speed not been fully explained by scientific studies. Very little research has attempted to correlate anthropometric variables and change of direction speed performance. To date have not research that investigate relationship between agility and reaction time. In our knowledge, present study is the first investigation demonstrated the importance of relationship between

agility and other physical components such as speed, reaction time and BMI of Turkish taekwondo athletes.

3. EXPERIMENTAL METHODS (DENEYSEL YÖNTEM)

- **Procedures and Subject Group:** Totally, thirty-one Caucasian female (n=8, age 13,7±1,5 years) and male (n=23, age 14,7±3,9 years), taekwon-do athletes volunteered to participate in this study. They were tested as part of their athletic training program during the first quarter of the season. All subjects gave their informed consent. Before carrying out performance tests, subjects performed warm-up. Warm-up session lasted 15min (running and stretching). Tests of left and right hand reaction time, 30m sprint (10 m acceleration, flying 20m sprint and 30m maximum speed) and agility (20m zigzag test) were conducted respectively on a single day for each test subject. All performance tests were performed on synthetic pitch indoors. The temperature of the sport facility was between 23-24°C during the testing day. Subjects were encouraged to achieve maximal performance during the tests. Two day before the intervention, subjects did not participate in competition or hard physical training to minimize the influence of fatigue on test performance. They recorded their normal dietary intake during the study and took no food or fluid (except water) 3 hours before intervention. Timeline during all data-collection session was showed in Figure 1.

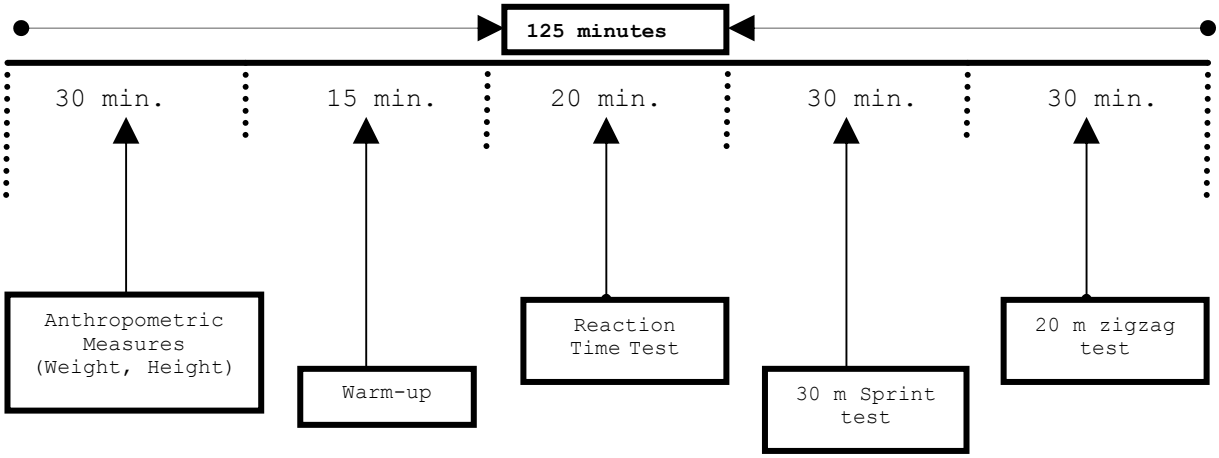

Figure 1. Timeline during all data-collection session
(Şekil 1. Test uygulamalarının süreleri)

- **Antropometric Measures:** Weight was measured to the nearest kilogram on a digital scale with the participant wearing lightweight clothing. Height was measured to the nearest 0.1 cm with a wall mounted measuring tape. Body mass index was calculated by dividing the weight in kilograms by the height in meters squared (kg/m^2).

Testing

- **Reaction time:** Audio reaction and movement times of the left and right hand were measured in the present study. The equipment used to measure reaction time was designed in a U shape and consisted of two sensors and one main apparatus. The main apparatus consisted of four digital counters. This equipment does not require calibration (Figure 2). Subjects first assumed a stationary standing position. After the hand was fixed in the U sensor system, a research assistant pressed a button for an audible signal. The subject was instructed to take

his/her backwards as quickly as possible on hearing the audible signal [19].

Figure 2. Reaction time test equipment
(Şekil 2. Reaksiyon zamanı test cihazı)

- **30 m sprint:** This test involves sprinting for 30 meters as fast as possible from a stationary standing start position, with no swinging movements. Since this is a very short distance to cover, subjects were expected to perform at 100% maximum efficiency. Sprint time was measured with an optoelectronic photocell (split time 10 meters). In addition to the 30 meter sprint time, this test also measured 10 meter acceleration and flying 20 meter sprint time. Time in this test was measured by photoelectric cells.
- **Agility:** The 20 m zigzag course included three 100° turns at 5 m intervals (Figure 3). Test-retest ratio limits of agreement data were 1.003·/1.022 (bias not significant), showing good reliability of the agility test [20]. Time in this test was measured by photoelectric cells. This zigzag test was chosen because it required the acceleration, deceleration, and balance control aspects of agility, and the familiarity of the subjects with the test and its relative simplicity also meant that learning effects would be minimal [21].

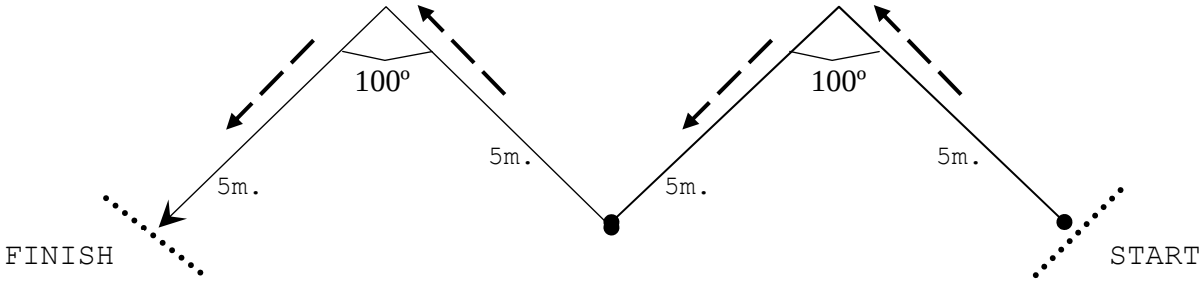

Figure 3. Diagram of the course used in the agility test
(Şekil 3. Beceri testinin şeması)

- **Statistical Analyses:** All statistical analyses were performed using SPSS version 16.0 (SPSS, SPSS Inc, Chicago, IL, USA) software. The mean (±SD), minimum and maximum values of performance tests were determined. The relationships between the performances on the agility and 10 m acceleration, flying 20 m sprint, 30 m maximum speed and left hand and right hand reaction time tests were determined by Pearson correlations test.

4. RESULTS (BULGULAR)

Descriptive characteristics of subjects are shown in Table 1.

Table 1. Descriptive characteristics of subjects
(Tablo 1. Deneklerin tanımlayıcı özellikleri)

Gender		Age (years)	Weight (kg)	Height (cm)	BMI(kg/m²)
Female (n=8)	Mean	13.7	54.7	161.1	20.9
	SD	1.5	8.5	8.6	1.4
Male (n=23)	Mean	14.7	51	161.1	19.2
	SD	3.9	15	12.6	2.8
Total (n=31)	Mean	14.4	51.9	161.1	19.6
	SD	3.4	13.6	11.6	2.6

As shown in Table 1, age, height, weight and BMI of female subjects (n=8) are, 13.7±1.5 years, 161.1±8.6 cm, 54.7±8.5 kg and 20.9±1.4 kg/m² respectively. Age, height, weight and BMI of male subjects (n=23) are 14.7±3.9 years, 161.1±12.6 cm, 51±15 kg and 19.2±2.8 kg/m^2, respectively.

Values of Mean (±SD), Minimum and Maximum for all tests are shown in Table 2.

Table 2. Values of Mean, Standard deviation, minimum and maximum for all tests
(Tablo 2. Tüm test sonuçlarının aritmetik ortalama, standart sapma, minimum ve maksimum değerleri)

Gender		Agility (sec)	10 m Acceleration (sec)	Flying 20m Sprint (sec)	30 m Sprint (sec)	Left HR (msec)	Right HR (msec)
Female (n=8)	Mean	7.35	1.79	3.80	5.59	21.31	22.21
	SD	.15	.10	.16	.20	4.86	4.46
	Min.	7.14	1.67	3.55	5.25	14.8	16.6
	Max.	7.60	1.98	3.98	5.85	29.9	29.6
Male (n=23)	Mean	7.01	1.76	3.63	5.39	21.79	21.93
	SD.	.60	.43	.32	.62	3.2	3.61
	Min.	6.15	1.33	3.25	4.6	15.6	13.5
	Max.	8.50	2.30	4.21	6.64	29.9	28.5
Total (n=31)	Mean	7.09	1.8	3.7	5.44	2.17	22
	SD.	.55	.37	.29	.55	36.20	3.77
	Min.	6.15	1.33	3.25	4.58	14.8	13.5
	Max.	8.50	2.30	4.21	6.64	29.9	29.6

Left HR: Left Hand Reaction. Right HR: Right Hand Reaction.

As shown in Table 2, female and male subjects agility determined as 7.35±.15 sec and 7.01, 10 m acceleration determined as 1.79±.10 sec and 1.76±.43 sec, flying 20 m sprint determined as 3.80±.16 sec and 3.63±.32 sec, 30 m sprint determined as 5.59±.20 sec and 5.39±.62, Left HR determined as 21.32±4.86 msec and 21.79±3.2 msec, Right HR determined as 22.21±4.46 msec and 21.93±3.61 msec, respectively.

The relation between agility and other physical fitness features of subjects are shown in Table 3.

Table 3. The relation between agility and other physical fitness features of subjects
(Tablo 3. Deneklerin beceri ve diğer fiziksel uygunluk özellikleri arasındaki ilişki)

	BMI (kg/m^2)	10 m acceleration (sec)	Flying 20 m sprint (sec)	30 m sprint (sec)	Left HR (msec)	Left HR (msec)
Agility	-.446*	.251	.826*	.613*	.220	.282

Left HR: Left hand reaction time. *:p<0.05
Right HR: Right hand reaction time.

As shown in Table 3, relationship between agility and flying 20 m sprint and between agility and 30 m sprint were significantly positive ($p<0.05$). In the other hand relationship between agility and BMI was negative ($p<0.05$). No significant relationship were determined between agility and 10 m sprint, Left Reaction Time and Right Reaction Time ($p>0.05$).

5. CONCLUSION (SONUÇ)

The aim of this to study was to investigate the relationship between agility and motor and anthropometric characteristics of taekwondo athletes. Many trainers and sportsmen are of the belief that there is a strong relationship between agility and speed. However proofs from studies up to date have shown that this is not the case. Studies carried out by [12, 13 and 14] have shown that there is a weak relationship between agility and speed. However, in present study it is observed that there is a statistically positive significant relationship between agility and flying 20 m sprint and 30-meter sprint results ($p<0,05$) and there is no significant relationship between agility and 10-meter sprint, Left Hand Reaction and Right Hand Reaction ($p>0.05$). The fact that some of findings of this study differ from the previous findings may be attributed to different skill tests used. Also present study shows that there is a negative significant relationship between agility and BMI ($p<0.05$). Although several studies examining the relationship between anthropometric characteristics (fat, height and weight percentage) and skills have been carried out no other study on the relationship between BMI and skill have been found. Depending on the findings of this study, BMI, the height and weight ratio of athletes, can be said to affect skill characteristics.

Based on correlations, it was concluded that agility was relatively unrelated to reaction time and 10-meter acceleration performance and agility were relatively related to flying 20-meter sprint, 30-meter sprint and BMI. Further research is required to establish a reliable and valid test of agility involving physical performance measures (speed) and perceptual factors. Agility testing is generally confined to tests of physical components such as change of direction speed, or cognitive components such as anticipation and pattern recognition. As a result, new tests of agility that include specific exercises of taekwondo are encouraged in further researches. Moreover agility test should be included cognitive properties such as anticipation and pattern recognition.

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