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ORIGINAL ARTICLE

Age-related differences in the specific test on taekwondo players

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ABSTRACT

In studies on agility in sports, changes in agility with age have been frequently investigated. It is not precisely known how the taekwondo-specific agility test will changes according to age. This study aimed to identify and compare the specific taekwondo agility abilities of elite taekwondo players in different age groups. Twenty-seven taekwondo players (14 males-13 females) between the ages of 11-15 participated in the study. The players were divided into 2 age groups: 11-12 and 13-15 years old. Each participant completed three tests: The taekwondo-specific agility test (TSAT), Zigzag agility test (ZT) and standing long jump test (SLJ). The anthropometric characteristics were also evaluated. Then, TSAT, ZT, and SLJ tests were performed on the other day. The results indicated that there were significant differences in TSAT, ZT, and SLJ among the age groups. In addition, significant differences in BMI, height, and weight were observed between groups ($p < .05$). The athletes in the 13-15 age group performed considerably better in the TSAT, ZT, and SLJ tests. The results also indicate that taekwondo players aged 11-12 years can improve their performance more with ZT and TSAT exercises than SLJ exercises.

Keywords: Performance analysis of sport, Physical conditioning, Change of direction, Specific testing, Physical fitness, Growth, Development, Children.

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INTRODUCTION

Taekwondo is a combat sport that has been in the Olympics since the year 2000. Taekwondo moves include kicks and punches to the opponent's torso and head on a 12mx12m square area. In taekwondo tournaments, players are categorized according to their weight and age.

Taekwondo actions involve high-intensity bouts of short duration (1-3 seconds), performed in a limited area with rapid changes of direction (Hausen, 2017; Santos, 2011). The matches consisted of three rounds (2-minutes each with one minute of rest). Campos et al. (2012) demonstrated that Taekwondo is predominantly aerobic (66%). However, high-intensity movements (i.e., a moment of attack or defence) were maintained by the ATP-PCr system (30%), with a low contribution from the glycolytic system (4%). Agility has special importance in taekwondo because of the large number of atypical situations that demand multiple rapid changes of direction in the relatively small space of the court. The physiological profile of taekwondo athletes, as well as their acute and chronic adaptations to taekwondo, have been extensively studied recently (Tasiopoulos, 2015; Nikolaidis and Tasiopoulos, 2015; Tasiopoulos, 2014); however, the relationship between kicking performance and agility in taekwondo athletes has not been clearly established. In addition, most studies measured agility, but not taekwondo-specific agility (Singh, 2015; Singh and Sathe, 2017). In addition, studies in the literature are limited to specific agility related to taekwondo. The Illinois Agility Test (IAT), zigzag agility test, and agility T- test are commonly used in studies to assess agility. According to Hachana (2013), these tests are the most effective for measuring agility. Motoric characteristics, such as agility, strength, and speed of change of direction, are crucial in Taekwondo to achieve high performance during the game. These characteristics change with age during childhood and adolescence (Malina, 2004). Studies have stated that agility performance time decreases until early middle age. This decrease in agility was divided into three phases. The first group (7–10 years old) had a 27.1% decrease in agility time. In the second group (10–14 years old), the decrease was 26.5%, and in the third group (14–18 years of age), there was a 16.5% decrease (Henrieta and Hornikova, 2019). Agility performance mostly improves between 5 and 8 years of age, and then continually improves up to 18 years (Malina, 2014). Another study showed that agility time was significantly different between 13 and 14 years old but not between 12 and 13 years old (Horicka, 2018). In addition to the importance of agility in taekwondo, explosive strength and specific taekwondo agility are important. Taekwondo-specific agility is required to quickly perform all-out technical-tactical movements in multidirectional planes by maintaining dynamic balance, speed, and precision, maintaining and controlling correct body positions while quickly changing direction through a series of movements. Taekwondo exercises and repetitions of specific taekwondo movements improve these features. Also, valid tests involving these techniques are used to measure taekwondo-specific agility (Chaabene, 2018; Tasiopoulos, 2015).

Taekwondo includes many specific kicks, punches, and self-defence performances. During the game, it is necessary to create a specific kick or punch technique for some body parts to earn points. Moreover, knowing taekwondo requirements according to age will benefit trainers. Therefore, taekwondo training requires a specific and different approach to designing physical preparation practice. The aim of this study was to identify the specific taekwondo agility abilities and compare the different agility abilities of different age groups of elite male and female taekwondo players.

MATERIALS AND METHODS

Participants

Twenty-seven (14 males-13 females) elite-level junior taekwondo athletes (mean ± SD: age:12.81 ± 1.6 years; height:158.3 ± 11.1 cm; Weight:49.2 ± 9.2; body mass index:19.48 ± 2.13) participated in the study. Athletes consisted in national and international taekwondo events of different weight categories. Athletes have at least 4 years of taekwondo training and competition experience. None of them was involved in any weight loss procedures during the experimental period, which was conducted during the in-season period of the competitive year. All the athletes completed the study. Groups are divided into 2 groups:11-12 years old (Mean ± SD: age:11.9 ± 0.7 years; Height:149.1 ± 8.07 cm; Weight:40.1 ± 5.94 kg; body mass index:17.98 ± 1.83; Experience; 4.91 ± 1.04 years), and 13-15 years old (Mean ± SD: Age: 14 ± 0.8 years; Height: 164.5 ± 8.32 cm; Weight: 55.44 ± 4.70 kg; Body mass index: 20.51 ± 1.68; Experience: 5.75 ± 1.06 years). Athletes were verbally informed about research protocols prior to participation in the study. A comprehensive verbal description of the nature and purpose of the study, as well as of the experimental risks, was provided to the children, adolescents, their parents/guardians, and teachers. This information was also sent to parents and guardians by regular mail, and written informed consent was obtained from parents and children before participation. The study was conducted according to the Declaration of Helsinki and was approved by the Institutional Review Committee for the Ethical Use of Human Subjects at Dokuz Eylül University, Turkey(The approval number: 2021/26-37- 22.09.2021).

Procedures

Each participant completed three tests: the TSAT, zigzag agility test, and Standing Long Jump test. The time in seconds and hundreds of seconds were determined using an electronic timing system (Microgate, Bolzano-Bozen, Italy).

Anthropometric characteristics of the athletes were measured at the beginning of the testing session. The TSAT, ZT, and SLJ tests were performed on the second day. Before the tests, the athletes were asked to wear clothes and shoes that did not restrict their movements. Athletes were informed that they should not perform any intensive activities 48 hours before the measurements. After anthropometric variables were measured and recorded for each athlete, a standard warm-up was performed by the researcher. Tests were conducted indoors on the taekwondo tatami from 16:00–18:00 in a randomized, counterbalanced order, with breaks between tests ranging from 5 to 10 min. Tests were preceded by a 10-minute warm-up, including 5 minutes of running with the remaining time dedicated to static and ballistic stretching, as well as specific submaximal exercises such as kicking, squatting, and jumping. Subsequently, participants were allowed to perform two submaximal trials for each test. First, the zigzag agility and Standing Long Jump tests were performed. After this measurement, the athletes performed a Taekwondo-specific agility test in the tatami field. For reliability purposes, the test was repeated twice for each participant and the best value was recorded. Each test was performed at the same place and time of the day (4-6 pm), and the tests were completed in September. All the instruments were calibrated to ensure acceptable accuracy.

Anthropometric measurements

Height was measured with a stadiometer (Seca 220, Birmingham, United Kingdom) to the nearest 0.1 cm, and body mass was recorded using a portable scale (Tanita BF683W, Munich, Germany) to the nearest 0.1 kg. Body mass index (BMI) was derived from the results of height and body mass, dividing body mass by height squared. During the measurements, participants were barefoot and dressed in shorts only.

Taekwondo-specific agility test (TSAT)

From a guard position with both feet behind the start/finish line, the performer had to: (a) move forward in guard position without crossing feet as quick as possible to the centre point, (b) turn toward partner 1 by adopting a lateral shift and perform a roundhouse kick with the left leg (i.e., leading-roundhouse kick; dollyo-chagi); (c) move toward partner 2 and perform a roundhouse kick with the right leg (i.e., leading-roundhouse kick; dollyo-chagi); (d) return to the centre; (e) move forward in the guard position and perform a double-roundhouse kick (i.e., narae-chagi) toward partner 3, and (f) move backward to the start/finish line in a guard position (Figure 1). Sparring partners 1 and 2 holds a kick-target, whereas partner 3 holds two kick targets. Sparring partners were instructed to maintain the kick-target at the torso height of the tested athlete. If a participant failed to follow these instructions (e.g., crossed 1 foot in front of the other during the various displacements or failed to touch the kick-target powerfully when kicking), the trial was terminated and restarted after a 3-minute recovery period. The time needed to complete the test was used as a performance outcome and was assessed using an electronic timing system (Brower Timing Systems, Salt Lake City, UT, USA). Two trials were given to each athlete and the best one was recorded. (Chaabene, 2018).

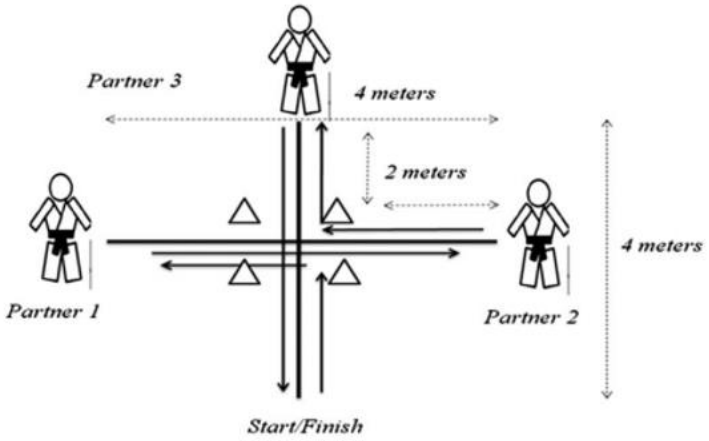

Figure 1. Taekwondo-specific agility test.

Zigzag Agility Test (ZT)

The participants ran one lap as fast as they could around a 3 m- 4.85 m zigzag path marked with tape on the floor and cones in every corner. The test was repeated twice, and the best score was retained(Ortiz, 2005). (ICC: 0.92)

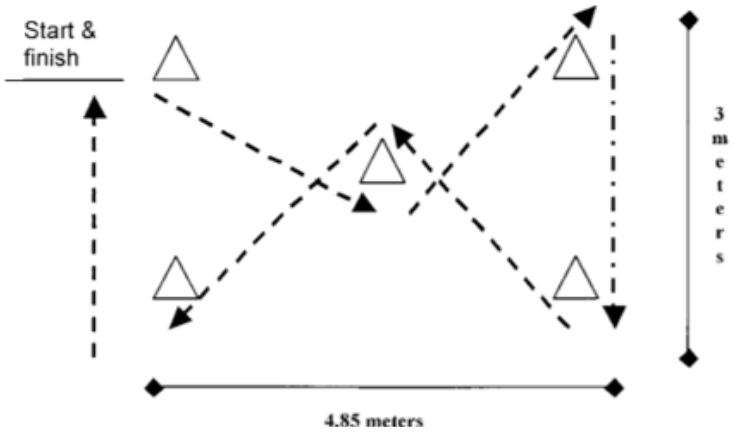

Figure 2. Zigzag Agility Test.

Standing Long Jump Test (SLJ)

The participants stood behind the starting line, with their feet together, pushed off vigorously, and jumped forward as far as possible. The distance is measured from the take-offline to the point where the back of the heel is nearest to the take-off line landing on the mat or non-slippery floor. The test was repeated twice, and the best score was retained (cm) (Castro, 2009).

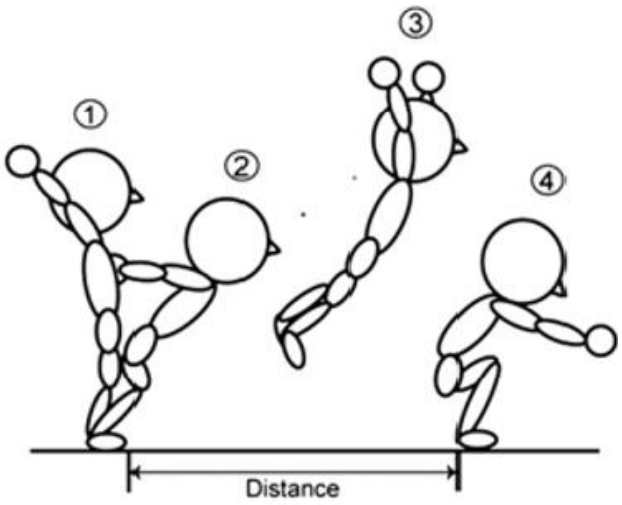

Figure 3. Standing Long Jump Test.

Statistical analyses

The collected data were statistically processed using SPSS statistical program for Windows (version 20.0; SPSS, Inc., Chicago, IL, USA). Elementary descriptive parameters (mean, SD, maximum, and minimum) were calculated. The normality assumption was checked using the Shapiro-Wilk test, and all variables showed a normal distribution. The T-test for independent samples was used to determine significant differences in TSAT, Zigzag agility test, and standing long jump between these groups. According to the descriptive characteristics of this study, the correlation between age and performance skill variables was checked using the elementary causal procedure (Pearson's correlation coefficient) for each group. The level of significance was set at $p \leq .05$.

RESULTS

Table 1. Characteristics of players.

	n	*Age*	*Height (cm)*	*Weight (kg)*	*BMI*	*Experience (years)*
11-12 yrs. of age	11	11.9 ± 0.7	149.1 ± 8.07	40.18 ± 5.94	17.98 ± 1.83	4.91 ± 1.04
13-15 yrs. of age	16	14 ± 0.8	164.5 ± 8.32	55.44 ± 4.70	20.51 ± 1.68	5.75 ± 1.06

Athletes were divided into two distinct age groups as 11-12 and 13-15 years old ahead of the study. Table 1 shows the physical qualities and body compositions of the two groups.

Table 2 illustrates the TSAT, ZT, and SLJ values of 11-12- and 13–15-year-old taekwondo players. Additionally, Table 2 shows the height, weight, and BMI of the athletes and the outcomes of the comparison between these two groups. There were significant differences in TSAT, ZT, and SLJ among the age groups. There were significant differences in BMI, height and weight between groups. ($p < .05$).

Table 2. Means, SD, maximum and minimum of all variables for the comparison between these 2 groups (results of t-test).

	11-12 yrs. of age			***13-15 yrs. of age***				
	Mean ± SD	Min	Max	Mean ± SD	Min	Max	t	*p*
TSAT (sn)	5.85 ± 0.3	5.38	6.28	5.37 ± 0.35	4.80	6.00	3.08	**.00****
Zigzag test(sn)	7.31 ± 0.4	6.76	8.13	6.82 ± 0.39	6.18	7.47	3.68	**.00****
Standing long jump (cm)	158.09 ± 19.38	137	201	175.13 ± 20.29	138	207	-2.18	**.03***
Height (cm)	149.1 ± 8.07	135	159	164.5 ± 8.32	152	181	-4.77	**.00****
Weight (kg)	40.18 ± 5.94	26	48	55.44 ± 4.70	49	65	-7.43	**.00****
BMI	17.98 ± 1.83	14.27	21.05	20.51 ± 1.68	17.24	22.96	-3.69	**.00****

*Note. **Sig. (p < .001), *Sig. (p < .05). t = T-statistic value.*

Table 3. Correlation coefficients between all variables in the 11-12-year-old group.

	TSAT	**Zigzag test**	**Standing long jump**
TSAT	1		
Zigzag test	.793**	1	
Standing long jump	-.605*	-.525	1

*Note. **. Correlation is significant at the .001 level (2-tailed). *. Correlation is significant at the .05 level (2-tailed).*

Table 3 shows the correlation between the variables in the group of 11–12-year-old players. The values demonstrate the relationship between the agility tests(zigzag test and TSAT) and SLJ. Although there was a positive correlation between ZT and TSAT, there was no correlation between ZT and SLJ. While the correlation between TSAT and SLJ was − -0.60, the correlation between TSAT and ZT was 0.79. This shows that the correlation between TSAT and ZT provides more accurate information for athletes aged 11-12. TSAT and ZT have a positive correlation; however, TSAT and Standing long jump have a negative correlation. According to post-hoc analysis of sample size [correlation TSAT-ZT = 0.79, correlation TSAT-SLJ = - 0.60, SLJ-ZT = -0.52 sample size= 11, type-1 error (α) = .05], values of this study was found.

Table 4. Correlation coefficients between all variables in the group 13-15-year-old players.

	TSAT	***Zigzag test***	***Standing long jump***
TSAT	1		
Zigzag test	.605*	1	
Standing long jump	-.538*	-.656**	1

*Note. **. Correlation is significant at the .001 level (2-tailed). *. Correlation is significant at the .05 level (2-tailed).*

The correlation between the parameters for players between the ages of 13-15 is shown in Table 4. For all tests of players aged 13-15, a correlation was discovered, as opposed to the correlation variables for children aged 11-12. The correlation between TSAT and ZT was 0.60, whereas the correlation between ZT and SLJ was − -.53. While TSAT and ZT have a negative correlation with SLJ, TSAT and ZT have a positive correlation with each other. According to post-hoc analysis of sample size [correlation TSAT-ZT = 0.60, correlation TSAT-SLJ = -0.53, SLJ-ZT = -0.65 sample size= 16, type-1 error (α) = .05], values of this study was found.

DISCUSSION

This study investigated and compared the TSAT and zigzag agility tests in taekwondo athletes between the ages of 11-12 and 13-15. Significant differences were observed between the two age groups. As expected, TSAT time, zigzag agility test time, and standing long jump results at 13–15-year-old were significantly better

than those of the other group. Our data support and expand on previous findings that indicate the performance of agility tests on taekwondo players during early childhood. Agility performance increases continuously until pre-adolescence, and studies have shown that specific agility test performance also increases with age (Vescosi, 2011; Tasiopoulos, 2015). Agility is considered a fundamental prerequisite in taekwondo for the execution of kicking techniques (Bridge, 2014; Casolino, 2012; Pieter, 2000). Tasiopoulos et al. found a significant difference in agility performance and leg acceleration in taekwondo players under 12 years old (U12) and under 15 years old (U15). The agility performance and leg acceleration test data for the U15 age group were better than those for the U12 age group (Tasiopoulos, 2015). Furthermore, Nikolaidis et al. (2016) compared six different taekwondo player groups (7–9, 10–11, 12–13, 14–17, 18–32, and 33+ years) and discovered differences in agility performance between groups. In addition, according to Jakovljevic et al.(2012), in their study on 12-14 year-old basketball players, the T-test and Basketball zigzag agility test of the 14-year-old group were found to be better than those of the 12-year-old group. These studies indicate that agility in general and sport-specific agility increases with age during preadolescence and adolescence. There were considerable differences in agility between the different age groups. The results of this study support these findings by showing that agility and TSAT performances of taekwondo players also increase with age, and that there are performance differences between ages.

Our results also support the findings in the literature that SLJ distance increases with age (Castro and Ortega, 2010). In this study, the SLJ values of the 13-15 age group athletes were found to be significantly higher than the 11-12 age group. Loursen et al. found that SLJ values increased more rapidly between the ages of 12-14 years, with the largest increase occurring between 10-13 years (Kelly, 2022). In another study, Ramirez et al. (2017) reported significant differences in long jump results between the ages of 9 and 18, with the greatest improvement observed between the ages of 9-13.

The results indicated that TSAT was positively and highly correlated with the zigzag test (r-value:0.79) among 11-12-year-old players. The correlation was moderately negative between TSAT and SLJ (r = -0.60) in 11-12 year-old players. In addition, no significant relationship was found between SLJ and zigzag test performance. On the other hand, TSAT was moderately correlated to ZT and SLJ (r-values:0.60 and -0.53, respectively) in the 13-15 years old players. Contrary to the 11-12 age group, there was a significant negative correlation between the SLJ and ZT (r = -0.65) in the 13-15 age group. The results indicate that the taekwondo-specific agility performance, zigzag agility performance, and explosive strength are interrelated. Explosive strength, acceleration, and deceleration over a short time are the main components of taekwondo. These tests evaluate the explosive strength and agility performances of 11-12 and 13-15-year-old players with varying complexities: acceleration, body movement control, and coordination. Although there was an age difference between the groups, a correlation was found between all the tests. Therefore, the values of the correlation coefficients between the tests indicate that all three tests compare similar qualities. Fiorilli et al. also found a high correlation between agility tests in players in each age group(U12-U14-U16-U18) between the ages of 12-18 (Fiorilli, 2017). Studies in the literature have compared general agility tests with specific agility tests. Jakovljevic et al.(2012) found a significant correlation between the agility t-test and the specific basketball test in basketball players aged 12 and 14. In addition, Jones et al.(2013) reported a significant correlation between SLJ and agility t-test for the 11-12 age group. Moreover, another study reported a moderate negative correlation between TSAT and SLJ and a positive high correlation between TSAT and agility t-test. These findings suggest that training the horizontal jump force in taekwondo athletes could increase their agility performance (Chaabene, 2018; Brughelli, 2008).

CONCLUSION

This study compared the agility performance of taekwondo athletes in the 11-12 and 13-15 age groups and evaluated the differences. The findings of this study are similar to those in the literature (Castro, 2010; Kelly, 2022; Fiorilli, 2017; Avcı, 2021). In addition, this study helps to better understand the development of taekwondo-specific agility with age. TSAT performance and zigzag agility test performance both increased with age among taekwondo players aged 11-12 and 13-15 years old taekwondo players. This may be due to the physical features of the 13-15 age group and the fact that the strength is more developed than the 11-12 age group. TSAT appears to be more sensitive and can better distinguish differences among players. Therefore, although there was not much difference in years of experience between the groups, a significant difference was found in their TSAT test performances. Due to the better correlation between zigzag agility and SLJ performance in the 13-15 age group, SLJ and agility training could improve taekwondo-specific agility. On the other hand, taekwondo players aged 11-12 can improve their performance more with ZT and TSAT agility exercises than SLJ exercises.

Limitations of the study

A limitation of this study was that the genders of the athletes in the sample group were not evaluated separately.

AUTHOR CONTRIBUTIONS

Conceptualization: Berk Avci and Aksel Celik. Data curation: Berk Avci. Formal analysis: Berk Avci and Aksel Celik. Investigation: Berk Avci. Methodology: Berk Avci and Aksel Celik. Project administration: Berk Avci. Resources: Berk Avci. Supervision: Berk Avci. Validation: Berk Avci. Visualization: Berk Avci. Writing – original draft: Berk Avci and Aksel Celik. Writing – review & editing: Berk Avci and Aksel Celik.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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