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LEVEL OF FLEXIBILITY IN TAEKWONDO ATHLETES 7-9 AND 10-11 YEARS OLD

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ABSTRACT

Flexibility is one of the key components of success in Taekwondo, and, due to the demands of human anatomy, should be developed appropriately. The aim of this study was to determine the level of flexibility in male and female Taekwondo athletes and to identify any significant difference between the two genders in this physical quality. A total of a hundred and forty-one Taekwondo athletes took part in the research. Thirty-nine males and forty-three females aged 7 to 9 years old and forty-one male and 18 female athletes aged 10 – 11 years old. All of them had at least 2 years of Taekwondo training. The acquired data showed that the female participants in both age groups outperformed males in both tests. The average results were $\overline{X}_{1\ males\ 7\text{-}9} = 12.94$ *cm and* $\overline{X}_{2\ females\ 7\text{-}9} = 6.26$ *cm and* $\overline{X}_{1\ males\ 10\text{-}11} = 14.41$ *cm and* $\overline{X}_{2\ females\ 10\text{-}11} = 6.11$ *cm on the "Side Split" test. For the "Stand and Reach" test, the average results indicated values of* $\overline{X}_{1\ males\ 7\text{-}9} = 1.48$ *cm,* $\overline{X}_{2\ females\ 7\text{-}9} = 7.70$ *cm and* $\overline{X}_{1\ males\ 10\text{-}11} = 4.6$ *cm, and* $\overline{X}_{2\ females\ 10\text{-}11} = 8.5$ *cm. The differences were statistically significant for the 7-9 years old group, with Cohen's d = 1.01 and P(t)= 99.94 on the "Stand and Reach" test, Cohen's d = .74 and P(t)= 99.99 on the "Side split" test. The 10 – 11 years old group also showed a significant difference with Cohen's d = 0.71, P(t)= 98.89 on the "Stand and Reach" test, and Cohen's d = 0.91 and P(t)=99.89 on the "Side Split" test. These results could serve as a starting point for creating an evaluation system for flexibility in Taekwondo athletes.*

Keywords: *taekwondo, flexibility, training, level*

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INTRODUCTION

Taekwondo, one of the best cultural content brands in the Republic of Korea, has undergone significant changes over the past 20 years (Capener, 2016; Kim, 1986; Lee et al., 2024). World Taekwondo, a martial art system, has evolved into an Olympic combat sport, which brings its own specifics (Dimitrov, 2022), such as fast high and spinning kicks (Markovic, 2015). Success in Taekwondo, as in any other sporting discipline, is a function of the development of the athlete's motor skills, which are directly related to the motor qualities that are developed in the process of sports training.

According to Hadjiev et al. (2011), sports training is a highly effective tool for developing, improving, and manifesting taekwondo players' motor and intellectual capabilities. Jelyazkov et al. (2020) describe five primary physical abilities that are primarily developed in accordance with the specifics of the sport, the age of the athlete, and the training periodization.

Physical training is a complex pedagogical process that aims to develop and improve various physical qualities as a basis for high sports achievements in Taekwondo (Hadjiev et al., 2011). Success in Taekwondo relies on athletes' ability to execute kicks and defense techniques quickly and accurately, requiring a unique combination of muscular power and agility (Vargas et al., 2010; Bridge et al., 2014; Pieter, 2009). According to Yilmaz (2021), due to its structure, Taekwondo involves versatile movements such as mid-level and high-level kicks and rotary kicks. In Taekwondo, where technical diversity is high, long-term training

is required for making technical combinations and applying these techniques in the form of attacks and counterattacks.

The ability of a Taekwondo player to perform movements with a large amplitude is called flexibility (Hadjiev et al., 2011).

Additional factors influencing flexibility include external conditions such as temperature, warming up, round-the-clock periodicity of work, recreation, limitations of clothing or appliances, and recovery after overwork and injury (Hadjiev et al., 2011).

The main tools for developing flexibility are physical exercises with maximum possible amplitude. These exercises aim to ensure optimal amplitude in specific movements and create the necessary flexibility reserve for performing competitive exercises. Depending on the resistance overcome, they are divided into two main groups: passive and active flexibility exercises. Recently, Proprioceptive Neuromuscular Facilitation (PNF) Stretching during the warm-up has found its place in Taekwondo training. Typical PNF stretching involves a shortening contraction of the antagonist (opposite) muscle to place the target muscle on stretch. The stretch is followed by an isometric contraction of the target muscle (Frederick & Frederick, 2006). According to Behm & Haddad (2013), short durations of static and PNF stretching can improve flexibility without decreasing performance, while prolonged static stretching and proprioceptive neuromuscular facilitation stretching have been shown to impair subsequent strength, power, sprint time, reaction, and movement time, and balance among other attributes.

Since most Taekwondo injuries occur in the lower extremities (Gilsamaei et al., Shojaedin, Sadeghi, 2023), it is imperative to develop flexibility in order to minimize injuries to muscles, ligaments, and tendons. Sufficient muscle flexibility is critical as insufficient flexibility can predispose an athlete to injury and even delay recovery (Hill et al., 2017; Mendonca et al., 2007; Nuri et al., 2013). Taekwondo movements do not provide the necessary amplitude to improve flexibility after a certain point. Khazaei (2023) found no significant improvement in flexibility after 8 weeks of functional training in elite female Taekwondo athletes. Taekwondo athletes need to have excellent bio-motor capabilities, including aerobic and anaerobic fitness, muscle strength, speed, reaction time, agility, lactate production and clearance, body balance, and flexibility (Bridge et al., 2014; Tayech et al., 2020; Haddad et al., 2011; Bouhlel et al., 2006). From the above mentioned, flexibility can be developed systematically from an early age (Jelyazkov et al., 2020). Mineva (1985) discovers that flexibility should be best developed from the age of 11 to 14.

Many authors summarize different martial arts in terms of physiology, but given the different sets of rules, the different types of martial sports require different types of physical abilities. Gunawan (2021) compared Taekwondo and karate practitioners and discovered that Taekwondo athletes possess a higher level of flexibility. This is not surprising since competitive Taekwondo focuses mainly on kicking techniques. However, it is difficult to compare the level of flexibility as a determining factor of success in a Taekwondo match and to conclude the required level that a Taekwondo practitioner should possess.

This study aimed to determine the level of flexibility of male and female Taekwondo athletes and discover whether there is a significant difference between the two genders in this physical quality.

METHODOLOGY

Methods

We used the following research methods:

– Analysis and synthesis of the movements.

– Sports-pedagogical testing.

– Math statistical methods.
– Variation analysis – Mean, Standard deviation, Variation, Minimum, Maximum, Asymmetry, Excess),
– *t*-test for independent variables

Statistical analysis

All data were analyzed using SPSS, version 23.0 for Windows (IBM Corp. Inc., Chicago, IL, USA, 2015.

Test 1 -"Side Split"

The split is performed in a straight line (the pelvis and ankles are on the same line). The pelvis should be against the wall. The distance between the floor and the lowest part of the pelvis is measured using a tape measure. We took a photo of the athlete from a distance of 2 m so that we could later, by using the zoom option, record the result on the evaluation scale on the wall (Figure 1) using a setup by Sergiev (2019).

We performed that test on an elevated surface for the feet, 11 cm high, so we could measure the result even if the tested participant could perform beyond the full split.

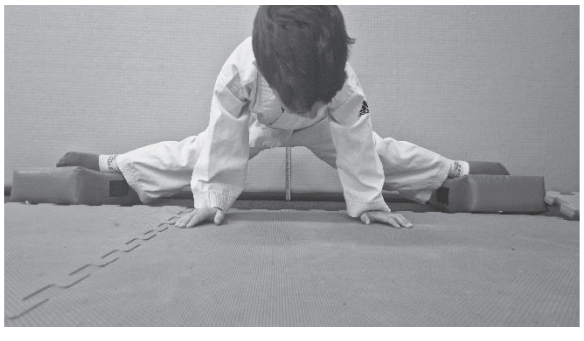

Figure 1. *Test "Side Split"*

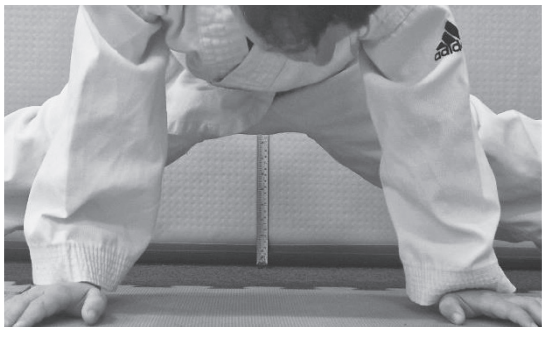

Figure 2. *"Side Split" using the zoom function*

Test 2 - "Stand and Reach"

The participant gets on a bench with the legs together and toes on the edge of the bench. A bend forward is performed with extended knees. The participant must hold the bend for 2 seconds, and the distance between the upper edge of the bench and the tips of the fingers must be measured. The test is a modified version of the "Sit and Reach" (Sergiev, 2019).

Participants

A total of 141 Taekwondo athletes voluntarily participated in the research as part of their annual testing - thirty-nine males and forty-three females from the age of 7 to 9 years old and forty-one males and eighteen females from the age of 10 – 11 years old. Each athlete's parent signed an informed consent form before the children participated in the study. All of the athletes had at least 2 years of Taekwondo training. The age group was determined according to the competition age groups "Children I" – 7 – 9 years old and "Children II" – 10 – 11 years old.

Testing procedures

The athletes were tested in two days. Children 7 – 9 years old were tested on the first day, and children 10 – 11 years old were tested on the second day. All of the athletes performed a 20-minute warm-up, including a 5-minute run and standard stretching exercises. Following that, each participant performed every test three times without being measured. Afterwards, they were invited to perform the tests. The participants were divided into two groups - while Group 1 was performing Test 1, Group 2 was performing Test 2. Once the tests were completed, the two groups exchanged places and performed the second test.

RESULTS

As shown in Figure 3 and Table 1, the average values for both male and female athletes derived from the results from the "Side Split" test show that female Taekwondo athletes in both tests possessed a higher level of flexibility than the males.

Table 1. *Variation analysis of the "Side Split" test*

	7 - 9 yrs old		10 - 11 yrs old	
	Males	**Females**	**Males**	**Females**
n	39	43	41	18
X_{min}	1	1	1	1
X_{max}	40	19	35	20
R	39	18	34	19
$\bar{X}$	13.21	6.91	14.41	6.11
S	9.50	6.16	8.93	6.93
V	71.91	89.13	61.99	113.36
As	0.578	0.572	0.145	1.214*
Ex	0.082	-1.136	-0.796	-0.047

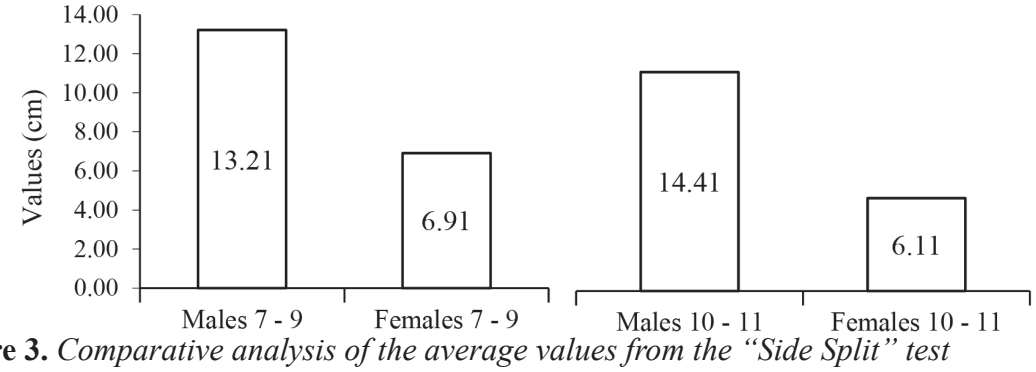

Figure 3. *Comparative analysis of the average values from the "Side Split" test*

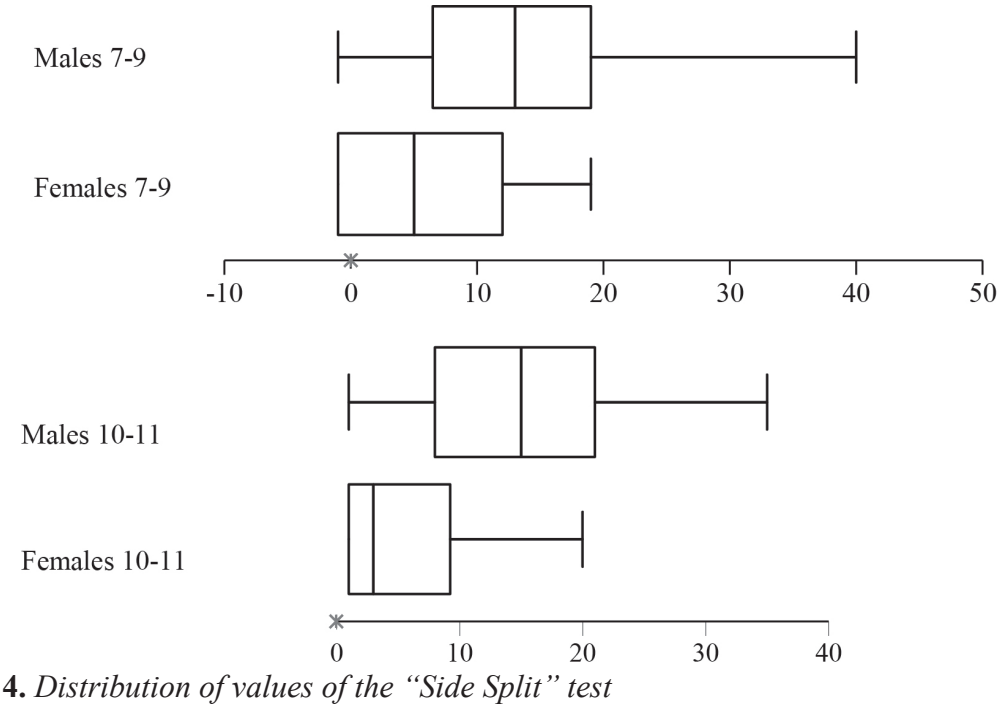

Figure 4. *Distribution of values of the "Side Split" test*

The distribution of values also favors female athletes, who demonstrated a better level of flexibility in the higher age group than the boys (Figure 4, Table 2).

Table 2. *Statistical significance of the data from the "Split" test of 7-9 years old*

Indicator	Males			Females			Differences		Significance		r_{bs}
	n	$\bar{X}_1$	S_1	n	$\bar{X}_2$	S	d	Cohen's *d*	*t*	*P*(*t*)	
Split	39	12.94872	9.851392	43	6.26	6.83	6.69	0.74	3.60	**99.94539**	0.37358

There was a statistically significant difference between the sexes in the 7 – 9 yrs old *P*(*t*)=99.94 and Cohen's *d* =0.74.

Table 3. *Statistical significance of the data from the "Split" test of 10-11 years old*

Indicator	Males			Females			Differences		Significance		r_{bs}
	n	$\bar{X}_1$	S_1	n	$\bar{X}_2$	S	d	Cohen's *d*	*t*	*P*(*t*)	
Split	41	14.4054	8.93016	18	6.11	6.93	8.29	0.91	3.46	99.892735	0.42931713

The same result was observed for the higher age group, 10–11 years old. The higher level of flexibility in the female athletes than that of their male counterparsts was statistically significant, with *P*(*t*)=99.89 and Cohen's *d* =0.91. (Table 3).

Table 4. *Variation analysis of the "Stand and Reach" test*

	7 - 9 yrs old		10 - 11 yrs old	
	Males	Females	Males	Females
n	39	43	41	18
X_{min}	-12	-5	-10.5	1
X_{max}	16	18	17	18
R	28	23	27.5	17
$\bar{X}$	1.48718	7.69767	4.60976	8.5
S	5.54347	5.14219	5.25299	5.20464
V	372.751	66.8019	113.954	61.231
As	-0.52	0.009	-0.587	0.214
Ex	2.416*	-0.063	1.856*	-0.411

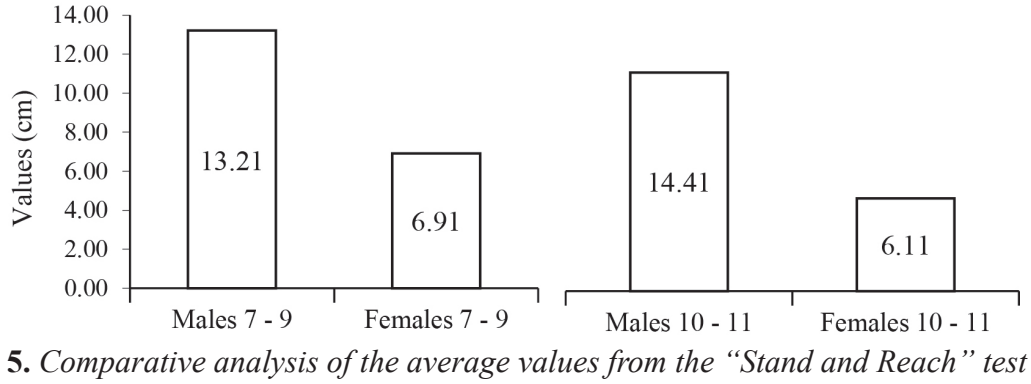

Figure 5. *Comparative analysis of the average values from the "Stand and Reach" test*

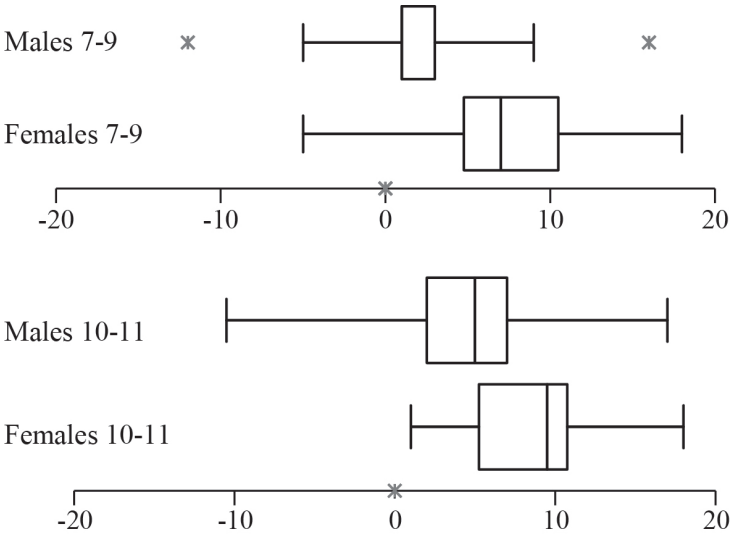

Figure 6. *Distribution of values of the "Stand and Reach" test*

The female athletes in both age groups also demonstrated a superior average level than the males on the "Stand and Reach" test. Unlike the "Side Split" test, the senior age groups in both sexes demonstrated better results than the younger athletes. (Table 4, Figures 5 and 6).

Table 5. *Statistical significance of the data from the "Stand and Reach test" test 7-9 yrs. old*

Indicator	Males			Females			Differences		Significance		r_{bs}
	n	$\bar{X}_1$	S_1	n	$\bar{X}_2$	S	d	Cohen's *d*	*t*	*P*(*t*)	
Stand and reach	39	1.48718	5.54347	43	7.70	5.14	-6.21	1.01	5.26	**99.9998838**	0.50713116

There was a statistically significant difference between the sexes in the 7-9 yrs. old $P(t)$=99.99 and Cohen's d =1.01 (Table 5). The same applied to the older group with $P(t)$=99.89 and Cohen's d =0.71 (Table 6).

Table 6. *Statistical significance of the data from the "Stand and Reach test" test 10-11 yrs old*

Indicator	Males			Females			Differences		Significance		r_{bs}
	n	$\bar{X}_1$	S_1	n	$\bar{X}_2$	S	d	Cohen's *d*	*t*	*P*(*t*)	
Stand and reach	41	4.60976	5.25299	18	8.50	5.20	-3.89	0.71	2.63	**98.8937195**	0.32856309

DISCUSSION

Since the acceptance of Taekwondo in the Olympic family, the sport has enjoyed even greater popularity than before. This is another factor that has prompted further dynamics in the development of Taekwondo as a sport. Though many debate that mainstream Taekwondo nowadays has little to do with the original martial art, it is unquestionable that its evolution and vast popularity as a sport have put greater physical demands upon athletes. This, on the other hand, has prompted even earlier sports specialization. Taekwondo competitions now involve children from the age of five and six years old. This means that training programs in sports clubs should be developed according to the age of the athletes. These programs must be compatible with the physiological development of the according age. Many coaches, pursuing "instant glory", try to intensify the

training programs and increase the number of sessions for young athletes, not considering the long-term damage and psychological burnout that can cause. Instead of focusing on the athlete's development and peaking in the senior age group, coaches go after fast results without concern for the athlete's physical and mental health in the long term. Bompa (2016) describes a 14-year study conducted in former East Germany in 1982, which results "support the contention that a strong foundation, which is established by using a multilateral approach, leads to a greater athletic success." On the other hand, flexibility is a physical quality that can be developed systematically from a young age. In an Olympic Taekwondo match, winning and having good results is possible even without a significant degree of flexibility. However, relying only on speed, power, and endurance without flexibility limits the athlete's technical and tactical abilities. Many of the Taekwondo techniques require head-level execution. Those techniques score more points (World Taekwondo, 2023) and are a powerful weapon. Under the current rules and regulations of the Taekwondo competition, athletes are allowed to perform up to three kicks without dropping the leg to the ground. Those types of kicks require a good level of flexibility from the executioner. This type of flexibility is evident at the top-level competitions both in male and female categories. That is why we believe that this type of flexibility should be developed from an early stage. Our investigation could be a starting point for developing a ranking system for evaluating young Taekwondo athletes. It should be updated periodically for better control over the training process. The only relevant research on this type of flexibility is found in rhythmic gymnastics research, which has tested only female participants for apparent reasons. The required level of flexibility in gymnastics is much greater than that in Taekwondo due to the specifics of the sport, and that is why we deemed it inappropriate to compare the flexibility required in the two sports. The relationship between such a great degree of flexibility and explosive power remains yet to be discovered.

CONCLUSION

The results are conclusive in terms of female advantage in hip joint and lower back flexibility. They are in accordance with the general perception that female athletes possess better flexibility than male athletes. The tests are useful in determining the level of flexibility in Taekwondo. However, more research is needed to determine the average level of flexibility a Taekwondo athlete should possess according to age group and level. More data should be gathered for the next age groups in competitive Taekwondo to create a ranking system for evaluation.

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