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The effects of the taekwondo training on children's strength-agility and body coordination levels

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Abstract

The present study investigated the effects of the taekwondo training given to the children on their strength-agility and body coordination levels. Participants were 42 school children who are 7 to 10 years old. They were divided into the girls' experimental (n = 9, X = 9.34±1.22 years, height = 134.44±12.77 cm, body weight = 34.16±12.04 kg, BMI [Body Mass Index] = 18.42±3.98 (kg/m^2) and control (n= 8, X= 8.60±1.17 years, height = 129.12±9.52 cm, body weight = 31.01±7.85 kg, BMI = 18.29±2.31 (kg/m^2) groups; and boys' experimental (n= 13, X= 9.05±0.78 years, height = 135.23±6.95 cm, body weight = 32.81±7.46 kg, BMI = 17.77±2.99 (kg/m^2) and control (n= 12, X= 9.06±1.03 years, height = 132.16±9.62 cm, body weight = 29.95±7.45 kg, BMI = 16.94±2.43 (kg/m^2)) groups. The experimental groups of both boys and girls took a standardised group exercise program led by the taekwondo coaches, which lasted for three times a week in 12 weeks, while control groups of both boys and girls did not take any trainig. The bilateral coordination, balance, running speed-agility and strength of sub-tests of the Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2) were employed before and after training. The results indicated that a statistically significant difference was found between strength & agility post-test values in girls. When the time interaction experimental and control groups of boys and girls were examined, a statistically significant difference was found between body coordination and strength-agility values. It was concluded that a 12-week taekwondo training given to the children in the 7-10 age group has increased the body coordination and strength-agility levels of the girls and boys.

Keywords: *Strength, Agility, Coordination, Child, BOT-2*

Introduction

The studies on the effects of sports throughout the growth period have not produced definitive results yet. In the sports science, studies are continuing to be conducted intensively in the fields of children and sports (Heller et al., 1998). The development of the basic motor skills can vary depending on the age. However, favorable environmental conditions need to be provided in order to ensure the development of the basic motoric features of children (Gallahue & Ozmun, 2006).

Previous studies have suggested that the sports programs initiated at early ages are effective in developing the fine and gross motor skills of children (Fisher et al., 2005; Wang, 2004; McKenzie et al., 1998). Regularly performed physical activities affect children not only physically, but also cognitively and affectively (Strong et al., 2005). When all these are considered, it is needed to encourage the participation in physical activity in the childhood period. Participation in physical activity is also considered to be the way for gaining the habit of activity the children can continue throughout their life, and the natural mechanism for a healthy life in older ages (Oliver et al., 2010). However, in order to be able to prepare programs for increasing the movement capacity of children, it is necessary to know about and follow up their motor development (Langendorfer & Roberton, 2002).

Taekwondo, an internationally well-known sport originated from Korea, requires perfection in kicks, punches, blocks and physical performance. The sport of taekwondo requires the ability to produce the maximum strength in a short time and a high level of sportive performance (Singh, 2012). Previous studies have showed that taekwondo has effects on physical fitness levels related to the health and sports (Pion et al., 2014), such as the anaerobic strength and capacity (Melhim, 2001), durability (Pieter et al., 1990), body composition (Toskovic et al., 2002), and strength (Falk & Mor, 1996). Since the upright position conditions need to be kept for a long time during the performance of the kicking techniques in taekwondo, motor skills are also instigated (Jlid et al., 2016). These values that can be gained by means of exercises play an important part in the development, growth and maturation of the child. From this point of view, determining what kind of effects taekwondo, which is primarily known as a contest sport, has on the motor development processes of children gains even more importance (Şahin et al., 2012). However, the development of basic motor skills also varies on gender. Suzana and Pieter (2006) revealed that taekwondo training promoted motor development, but boys had more explosive strength than girls. Another study striking differences between genders has also shown that boys showed higher aerobic endurance than girls after taekwondo training (Erie et al., 2007). These findings suggested that basic motor skills have changed between genders and separate evaluation is required.

The purpose of this study, therefore, was to examine the effects of taekwondo training practices at the basic level on strength-agility and body coordination among school children. It was hypothesized that the addition of a 12-week basic taekwondo training program would enhance strentgh-agility and body coordination in girls and boys.

Methods

Participants

The experimental and control group of the study consisted of the students who were studying in an elementary school. Students were asked whether they would like to participate in an afterschool teakwondo training by researchers. Students who wanted to participate in teakvondo training were included in the experimental group, but those who did not want to participate in taekwondo training were assigned as the control group. A voluntary consent form

and child assent form were obtained from students' parents and the students participating in the study. A total of 42 children of the 7-10 age group who took part in the study were divided into the groups of girls' experimental (n= 9), girls' control (n= 8), boys' experimental (n= 13) and boys' control (n= 12). The information about the anthropometric characteristics of the individuals taking part in the study is given in Table 1. The permission for the present study was obtained by the decision of the Health Sciences Scientific Research and Publications Ethics Council of Uşak University dated October 06, 2017. The participating children and their parents were informed about the tests to be applied.

Application of the Taekwondo Training

The students participating in the study were randomly assigned to the experimental and control groups. The experimental groups of both boys and girls took a standardised group exercise program led by the taekwondo coaches, which lasted for three times a week in 12 weeks, while control groups of both boys and girls did not take any trainig. Girls and boys in experimental groups were trained together. The training program was designed for the beginner level in taekwondo and comprised the basic taekwondo training. Each training session was composed of the 10-minute warming up exercises (joint rotations, muscle stretching and flexibility) performed before the drills, which was followed by 15 minutes of Poomsae (basic blocks, hits and hand techniques workouts), 15 minutes of basic taekwondo stepping drills, and 10 minutes of kicking at the target. At the end of each training session, cool down exercises (joint rotations, muscle stretching and flexibility) were performed for 10 minutes.

Measurements

The bilateral coordination, balance, running speed-agility and strength subtests of Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2) were used in order to determine the body coordination and strength-agility levels of the children (Bruininks & Bruininks, 2005). BOT-2 is a well-known measure of motor proficiency designed to provide clinicians, educators and researchers with useful information to assist them in evaluating the motor skills in students ranging from those who are normally developing to those with moderate motor skill deficits aged 4-21 years.

Bilateral coordination (7 items) subtest included touching nose with index fingers-eyes closed, jumping jacks, jumping in place-same sides synchronized, jumping in place-opposite sides synchronized, pivoting thumbs and index fingers, tapping feet and fingers-same sides synchronized, tapping feet and fingers-opposite sides synchronized. Balance (9 items) subtest included standing with feet apart on a line-eyes open, walking forward on a line, standing on one leg on a line-eyes open, standing with feet apart on a line-eyes closed, walking forward heel-to-toe on a line, standing on one leg on a line-eyes closed, standing on one leg on a balance beam-eyes open, standing heel-to-toe on a balance beam, standing on one leg on a balance beam-eyes closed. Running speed and agility (5 items) subtest included shuttle run, stepping sideways over a balance, one-legged stationary hop, one-legged side hop, and two-legged side hop. Strength (5 items) subtest included standing long jump, knee push-ups, sit-ups, wall sit, and V-up. Subtests of BOT-2 were used before and after the training. The total value for the body coordination was calculated by adding up the points obtained in the subtests of bilateral coordination and balance, and the total value for the strength and agility was calculated by adding up the points obtained in the subtests of running speed and agility and strength. The measurements were carried out in the order of bilateral coordination, balance, running speed and agility and strength. Due attention was paid to prevent the students being affected by each other during the tests and to give them adequate rest periods

between the tests. Tests were carried out by experts who have received training on applying and evaluating the BOT-2 test.

Data Analysis

The normality distributions of the motor performance values were evaluated by Shapiro-Wilk test ($n<50$) and found to have a normal distribution. Independent samples t-test was applied at $\alpha = 0.05$ significance level to determine whether there was a difference between the strength-agility and body coordination pre-test and post-test values of the girls and boys groups. Paired samples t-test statistical method was applied to evaluate time-dependent change in parameters.

Results

There were statistically no significant differences between the body coordination and the strength-agility pretest results of the girls and boys experimental and control groups ($p>0.05$; see Table 2). When the posttest results of the girls' experimental and control groups were examined, while no statistically significant difference was found between the body coordination values ($p>0.05$), a statistically significant difference was found between the strength and agility values of these two groups ($p<0.05$; see Table 3). No significant differences were found between the body coordination and strength-agility values of boys experimental and control groups ($p>0.05$; Table 3).

A statistically significant difference was found between body coordination and strength-agility values ($p<0.05$, see Table 4), when the time interaction experimental and control groups of boys and girls were examined. It was observed that there was a difference between the 1st and 2nd measurement values of body coordination and strength-agility of the experimental and control groups, and that the values of the individuals in the experimental group were higher than those of the control group in the both groups.

Discussion

Development of the basic motoric functions is of importance in terms of the attainment of the skills at early ages. Physical activities performed at early ages not only contribute to the development of the motor skills, but also help children gain social, reactional and academic skills, as well as self-esteem. Regular physical activities also protect them against the risks of chronic diseases at their older ages (Lucas et al., 2016). In individuals who are engaged in sports, determination of the performance at early ages paves the way for attaining the optimal success. Thus, the children at the primary school ages need to be applied many tests in order to obtain more information about their motor abilities, their general physical status and their physical development (Ayan & Mülazimoğlu, 2009).

When the posttest results of the girls experimental and control groups were examined, while no statistically significant difference was found between the body coordination values, a statistically significant difference was found between the strength and agility values of these two groups. There were no significant differences observed between the body coordination and strength-agility values of boys experimental and control groups. Similarly, Sheikh et al. (2003) found the game forms applied to the girls attending the 3rd grade-level in elementary school improve the features such as balance, coordination, speed, agility and movement sensitivity. These results suggest that the 12-week taekwondo training had an effect on the parameters of strength and agility both in girls.

It was observed that there was a difference between the 1st and 2nd measurement values of body coordination and strength-agility of the experimental and control groups, and that the values of the students in the experimental group were higher than those of the control group in the both groups. The findings indicated that the increase observed in both groups may be due to children taking part in the developmental period. In a similar way, it has been stated in the literature that, when the effect of the physical education program applied on the children of 9 years of age was investigated, it was found out that the experimental groups showed more improvement compared to the control group in a statistically significant way. In addition, it has been suggested that the improved motor skills result in even more improvement in the later ages (Pagona & Costas, 2008). Bakhtiari, Shafinia and Ziaee (2011) suggested that the exercise program applied on the children with an average age of 8.9 3 days a week for a period of 8 weeks improved their basic motor skills. Likewise et al., (2017) emphasized in their studies conducted on 406 boys and 553 girls that the physical training programs had positive effects on the motor skills. In addition, it was stated that the motor skills, running speed and agility skills levels of physically active children were higher compared to those of the children who were not physically active (Wrotniak, 2006). In a study conducted on the sport of taekwondo, the regular taekwondo training applied for a period of 10 weeks was suggested to increase the motor development values of the children of the 7-8 age group at a significant level (Şahin et al., 2012). Both locomotor and non-locomotor movements require the basic elements such as strength and agility. With increasing age, the need for the basic elements such as strength, balance, agility and coordination still increases. In the children of the 11-12 age group, the gross and fine motor skills are well-established. During that period, the motor skills of children can gradually excel (Haslofça et al., 2011).

In the development of children, besides the general motor development, the development of the sport-specific features is also of importance. Comparison of children performing different branches of sports is of importance in terms of the physical preconditions of the sports (Bressel et al., 2007). While soccer players display high performance in terms of their upper and lower body strength (Reilly et al., 2000), height and motor coordination seem to be more important in volleyball (Duncan et al., 2006). In martial arts such as taekwondo, flexibility, explosive power, balance, agility and motor coordination are among the features having an important role (Pion et al., 2014). Markoviç et al., (2005) stated in their study investigating the physical fitness and motor skills in taekwondo practitioners that the successful athletes were superior in terms of strength and agility. This suggests that the increase in the strength and agility attained at the end of the 12-week taekwondo training resulted from the features specific to that sport.

Conclusion

Consequently, the 12-week regular taekwondo training applied to the children of the 7-10 age group has been found out to increase the body coordination and strength-agility levels of the girls and boys. This increase may have resulted from the training program applied and the characteristics of taekwondo. Further studies are needed in order to establish the correlation between the motor performance variables and the taekwondo development level in a clear way.

Disclosure statement

No potential conflict of interest was reported by the authors

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Table 1. Anthropometric properties of groups (N = 42)

	Groups	*N*	*Age (Years)*	*Height (cm)*	*Body Weight (kg)*	*Body mass ındex (kg/m²)*
Girls	Experimental	9	9.34±1.22	134.44±12.77	34.16±12.04	18.42±3.98
	Control	8	8.60±1.17	129.12±9.52	31.01±7.85	18.29±2.31
Boys	Experimental	13	9.05±0.78	135.23±6.95	32.81±7.46	17.77±2.99
	Control	12	9.06±1.03	132.16±9.62	29.95±7.45	16.94±2.43

Table 2. Body coordination and strength & agility pre-test results for groups of girls and boys (N = 42)

		Groups	**N**	**x̄**	**Sd**	**t**	**p**
Girls	Body Coordination	Experimental	9	49.33	6.36	.323	.751
		Control	8	48.50	3.77		
	Strength & Agility	Experimental	9	58.33	6.87	.372	.715
		Control	8	57.12	6.44		
Boys	Body Coordination	Experimental	13	50.30	3.77	-.334	.741
		Control	12	50.75	2.70		
	Strength & Agility	Experimental	13	59.15	3.89	-1.026	.315
		Control	12	61.66	7.85		

Note: *p< 0.05

Table 3. Body coordination and strength & agility post-test results for groups of girls and boys (N = 42)

		Groups	**N**	**$\bar{X}$**	**Sd**	**t**	**p**
Girls	Body Coordination	Experimental	9	54.66	5.33	-.911	.377
		Control	8	56.62	3.06		
	Strength & Agility	Experimental	9	68.77	7.08	2.962	.010*
		Control	8	60.37	3.96		
Boys	Body Coordination	Experimental	13	56.00	3.91	.758	.456
		Control	12	54.91	3.14		
	Strength & Agility	Experimental	13	69.46	4.77	1.738	.096
		Control	12	65.16	7.40		

Note: *p< 0.05

Table 4. T-test Results for body coordination and strength & agility values of girls and boys groups (N = 42)

			Pretest		Posttest		95% CI for			
	Groups	n	M	SD	M	SD	Mean Difference	r	t	df
Body Coordination	Girls Experimental	9	49.33	6.36	54.66	5.33	-7.50, -3.15	.89*	-5.65*	8
	Girls Control	8	48.50	3.77	56.62	3.06	-12.27, -3.97	-.04	-4.62*	7
	Boys Experimental	13	50.30	3.77	56.00	3.91	-7.56, -3.82	.67*	-6.63*	12
	Boys Control	12	50.75	2.70	54.91	3.14	-6.64, -1.68	.11	-3.69*	11
Strength & Agility	Girls Experimental	9	58.33	6.87	68.77	7.08	-12.55, -8.33	.92*	-11.42*	8
	Girls Control	8	57.12	6.44	60.37	3.96	-6.37, -.12	.84*	-2.46*	7
	Boys Experimental	13	59.15	3.89	69.46	4.77	-12.64, -7.97	.62*	-9.62*	12
	Boys Control	12	61.66	7.85	65.16	7.40	-5.91, -1.08	.87*	-3.18*	11

Note: * p< 0.05