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The Examining Body Composition, Sprint and Coordination Characteristics of the Children Aged 7- 12 Years

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KEYWORDS Eight-run Test. 30m Sprint. Gender. Children. Body Mass Index

ABSTRACT The aim of the present paper is to examine body composition, sprint and coordination parameters of the children aged 7-12 years according to gender and age. Nine hundred forty-five children participated in the research study. To determine the values of body composition of children, Body mass index was calculated. In addition, to determine the sprint performance; 30 m sprint test, for coordination skills; the eight-run test, were used. Independent t-test, One Way ANOVA and Tukey HSD were used for statistical analysis. Significant differences were 30 m sprint and the eight-run test performance between boys and girls in favor of boys. No significant differences were observed in body mass index. It was observed that speed and coordination performance of girls and boys improved as age progressed. Body mass index of children increased due to increase in their body height and body weight resulted from their physical evolution. The reason to performances of boys to be better than girls in all ages may be attributed to differentiated endocrine system starting with the puberty. The differentiation in endocrine system may affect the body composition. It is thought that growth process might play an important role in children's performance.

INTRODUCTION

Anthropometric and motor characteristics that are leading skill criteria are seen as prerequisite for ability recognitions. Predetermining and following them is important for high efficiency potential. Defining anthropometric characteristics is important for performance of athletes. It's crucial to observe the changes in motor characteristics based on age and gender for determining which exercise program should be used and for choosing and directing skills (Deliceoglu et al. 2013). The speed over the first steps (first-step quickness) and the ability to rapidly increasevelo city (acceleration) would be considered of greater importance to successfulperformance (Cronin et al. 2005). Speed capability is an important motor characteristic determining the efficiency in many sports branches, (for example, speed racing, sports games and sports branches depending on binary struggle), so it should be developed from early ages as much as possible (Muratli 2007). There are numerous studies examining speed (sprint) that is one of the important features in childhood, affect performance in children (Papaiakovou et al. 2009; Milanese et al. 2010; Hammami et al. 2014; Manna et al. 2014; Van der Niet et al. 2014). Motor coordination was argued to contribute to adequate attainment, physical, cognitive and social development (Payne et al. 1998). Current and future benefits related to the attainment and maintenance of motor proficiency depends on the promotion of development and improvement of motor coordination at young ages (Lubans et al. 2010). There are some studies examining coordination which is more important for children and effects of children motor performance and motor skill proficiency (Quan et al. 2000; Kambas et al. 2003; Kokstejn et al. 2012; Samaras et al. 2012; Hiraga et al. 2014). Body composition profile is a fundamental component of physical fitness. Suitable body composition characteristics definitely contribute to achieve optimal level of physical fitness (Mayooran et al. 2014). For this reason, studying and examining physical characteristics and performance profiles that are important elements of selection of talent and sports orientation are accepted to be important (Celik et al. 2013). There are numerous studies which indicate the importance of the body composition in terms of health and performance in children (Cristi-Montero et al. 2014; Mayooran et al. 2014). Besides these, some studies indicated that there was inverse relationship between motor coordination and body mass index (Wrotniak et al. 2006; Lopes et al. 2011; D'Hondt et al.

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2013; Birch et al. 2014; D'Hondt et al. 2014; Ferguson et al. 2014), between sprint performance and body mass index (Podstawski and Borys-lawski 2012). Determination of physical characteristics of children is also important in terms of determination of their skills. Ability to achieve high level of success in sports branches shows a close relationship with early guidance to sports. Ability recognition is the selection and grouping of young athletes to be canalized to the right sports branch. The purpose of the presentpaper is to examine speed, body composition and coordination parameters of children aged 7 to 12 according to gender and age.

METHODOLOGY

Subjects

A total of 945 children (7 years; 62 girls, 61 boys, 8 years; 59 girls, 86 boys, 9 years; 66 girls, 72 boys, 10 years; 72 girls, 72 boys, 11 years; 72 girls, 72 boys, 12 years; 72 girls, 72 boys) aged 7-12 years, participated in this study voluntarily. For measurements, permission was obtained from the *Mugla* Province National Education Directorate. Measurements were held in the gym which belongs to *Mugla* Provincial Directorate of Youth Services and Sports. To determine the values of body composition of children's, Body mass index was calculated. In addition, to determine the sprint performance; 30 m sprint test, for coordination skills; the eight-run test, were used.

Height (cm) and Weight (kg) Measurements

Height was measured to the nearest 0.1 cm by using a stadiometer. Weight was measured to the nearest 0.1 kg on an electronic scale (Seca Corp, Birmingham, United Kingdom).

BMI (Body Mass Index)

BMI was calculated as body mass in kilograms divided by height in meters squared (kg/m^2) (WHO 2014).

30-meter Sprint

The 30-meter sprint test was used to determine speed. The sprint time for 30 m. was measured using photo cell (Newtest 300 Series Powertimer, Finland) positioned at the starting and finishing lines at a height of 1 m. Participants started from a standing position, placing their forward foot 0.5 m behind the sensor. The measurement of the time was performed twice. The faster time was selected for additional analysis (Imai et al. 2014).

Eight-run Test

After placing a cone into each corners of a rectangle with length of 5 meters and width of 3 meters and placing another cone into the point where diagonals of the rectangle intersect, the subject runs around each cone by drawing a large shape of eight and returns to the starting point and the time is recorded in seconds. The best of 3 runs is recorded by Photocell timer assembly and the running time is determined (Eurofit test battery).

Both 30-m sprint test and eight-run test performances of children were measured and determined by photocell (Newtest 300 Series Powertimer, Finland) as the time between the start and the end. Each test was applied to the child twice and the best value was recorded.

Statistical Analyses

For the analysis of the data obtained from the study, SPSS 16.0 program was used. To test whether there are any significant differences boys and girls, Independent t -test was used. To find out whether there are any significant differences between the age groups, One Way ANOVA and to find out which age group cause the difference, Tukey HSD test was used.

RESULTS

Mean and standard deviation values of the height, body weight and body mass index and t scores p-values of body mass index of boys and girls aged 7-12 years were displayed. There were no significant differences in body mass index in terms of gender in all age groups (Table 1).

When compared with boys and girls, significant differences were found in Eight run and 30 m sprint performance at ages of 7 years, 8 years, 9 years, 10 years, 11 years, 12 years ($p<0.001$). It was found that boys performed better performance than girls in 30 m sprint and Eight run test performance in all ages (Table 2).

Table 1: The values of mean and standard deviation of height, weight, body mass index of children and the results of body mass index according to independent t-test

Ages	*Gender*	*N*	*Weight (kg)* X±SD	*Height (cm)* X±SD	*BMI (kg/m²)* X±SD	*t*	*p*
7 years	Girls	58	23.13 ± 4.50	123.30 ± 5.40	15.13±2.29	-.424	.673*
	Boys	64	23.90 ± 4.77	124.61 ± 4.96	15.31±2.40		
8 years	Girls	54	26.52 ± 5.37	129.07 ± 3.85	15.84±2.64	-1.294	.198*
	Boys	82	27.41 ± 7.31	128.07 ± 4.60	16.58±3.56		
9 years	Girls	65	30.46 ± 6.00	132.82 ± 3.92	17.17±2.78	.316	.753*
	Boys	68	30.52 ± 6.06	133.33 ± 4.90	17.03±2.38		
10 years	Girls	71	35.35 ± 9.35	137.66 ± 5.67	18.44±3.71	1.772	.079*
	Boys	70	33.26 ± 7.57	137.43 ± 6.20	17.46±2.77		
11 years	Girls	93	38.17 ± 8.05	143.18 ± 7.82	18.46±2.72	-.443	.659*
	Boys	85	37.51 ± 8.63	141.19 ± 5.69	18.66±3.20		
12 years	Girls	97	44.76 ± 9.85	149.04 ± 6.39	20.09±4.04	-.845	.399*
	Boys	98	45.35 ±11.28	147.77 ± 7.02	20.57±3.89		

*N.S. **p<0.05, ***p<0.01, ****p<0.001

Table 2: The results of Eight- Run and 30 m sprint performance of children aged 7 years according to independent t-test

Ages	*Parameters*	*Gender*	*N*	*X*	*S.D.*	*t*	*p*
7 years	Eight-run (sec)	Girls	58	15.63	1.28	4.102	0.000***
		Boys	63	14.15	1.34		
	30 m sprint (sec)	Girls	58	8.30	.78	4.768	0.000***
		Boys	63	7.64	.75		
8 years	Eight-run (sec)	Girls	54	14.18	.99	2.323	0.022*
		Boys	82	13.72	1.21		
	30 m sprint (sec)	Girls	54	7.59	.80	3.275	0.001**
		Boys	82	7.18	.63		
9 years	Eight-run (sec)	Girls	65	13.69	.90	3.155	0.002***
		Boys	69	13.00	1.53		
	30 m sprint (sec)	Girls	65	7.17	.61	3.835	0.000***
		Boys	69	6.71	.74		
10 years	Eight-run (sec)	Girls	71	13.23	.98	6.609	0.000***
		Boys	69	12.04	1.13		
	30 m sprint (sec)	Girls	71	6.87	.60	7.040	0.000***
		Boys	70	6.21	.51		
11 years	Eight-run (sec)	Girls	93	13.14	1.15	6.451	0.000***
		Boys	84	11.99	1.20		
	30 m sprint (sec)	Girls	93	6.56	.48	7.751	0.000***
		Boys	83	6.04	.39		
12 years	Eight-run (sec)	Girls	97	12.69	1.08	5.767	0.000***
		Boys	97	11.83	.99		
	30 m sprint (sec)	Girls	97	6.58	.56	6.692	0.000***
		Boys	98	6.07	.49		
7-12 years (Total)	Eight-run (sec)	Girls	438	13.53	1.32	8.568	0.000***
		Boys	464	12.71	1.51		
	30 m sprint (sec)	Girls	438	7.06	.86	8.384	0.000***
		Boys	465	6.59	.83		

*p<0.05,**p<0.01,***p<0.001

The values of Eight run, 30 m sprint performance and body mass index of boys as compared with One-Way ANOVA test according to age, significant differences were found in three variables at p <0.001 level, The results of Tukey HSD test revealed that there are significant differences among all ages groups except ages of 7-8, 10-11 and 11-12 in terms of eight run test performance. Statistically significant differences were observed in all age groups in 30 m sprint performance except ages of 10- 11 and 11-12. Statistically significant differences were found in body mass index in all age group except ages of 7-8, 8-9, 8-10, 9-10, 10-11 (p<0.001). BMI val-

ues of boys increased as with advancing age due to increase in their body height and body weight resulted from their physical evolution The results indicate that 30 sprint and eight run (coordination) performance of boys improved as age progressed (Table 3).

The values of Eight run, 30 m sprint performance and body mass index of girls as compared with one-way ANOVA test according to age, significant differences were found in three variables at p <0.001 level, The results of Tukey HSD test revealed that there are significant differences among all ages groups except ages of 8-9, 9-10, 10-11 in terms of eight run test performance. Statistically significant differences were observed in all age groups in 30 m sprint performance except ages of 9-10, 11-12. Significant differences were noticed during statistical measurements in body mass index in all age groupsexcept for ages of 7-8, 8-9, 9-10, 9-11, 10-11 (p<0.001). It was found that BMI values of girlsincreases as agegoesupdue to increase in their body height and body weight resulted from their physical evolution. This research paper showed that improvements were observed in 30m sprint and eight run (coordination) performance of girls who participated in the study with increasing age (Table 4).

Table 3: The results of One Way ANOVA and Tukey HSD tests of ages 7-12 years boys

	Ages	*N*	*X*	*S.D*	*F*	*p*	*Tukey HSD*
Body Mass Index (kg/m^2)	7	64	15.31	2.40	27.542	0.000***	7-9*, 7-10**, 7-11***,
	8	82	16.58	3.56			7-12***, 8-11***,8-
	9	68	17.03	2.38			12***, 9-11*, 9-12***,
	10	70	17.46	2.77			10-12***, 11-12**
	11	85	18.66	3.20			
	12	98	20.57	3.89			
Eight-run (sec)	7	63	14.15	1.34	48.807	0.000***	7-9***, 7-10***, 7-
	8	82	13.72	1.21			11***, 7-12***, 8-9**, 8-
	9	69	13.00	1.53			10***, 8-11***, 8-12***,
	10	69	12.04	1.13			9-10,***, 9-1***,9-12***
	12	97	11.83	.99			
30 m sprint (sec)	7	63	7.64	.75	91.809	0.000***	7-8***, 7-9***, 7-10***,
	8	82	7.18	.63			7-11***, 7-12***, 8-9***,
	9	69	6.71	.74			
	10	70	6.21	.51			8-10***, 8-11***,
	11	83	6.04	.39			812***, 9-10***, 9-
	12	98	6.07	.49			11***, 9-12***

*p<0.05 **p<0.01 ***p<0.001

Table 4: The results of One Way ANOVA and Tukey HSD tests of ages 7-12 years girls

	Ages	*N*	*X*	*S.D*	*F*	*p*	*Tukey HSD*
Body Mass Index (kg/m^2)	7	58	15.13	.30	24.117	0.000***	7-9**, 7-10***, 7-
	8	54	15.84	.35			11***, 7-12***, 8-
	9	65	17.17	.34			10***, 8-11***,8-
	10	71	18.44	.44			12***, 9-12***
	11	93	18.46	.28			10-12*, 11-12***
	12	97	20.09	.41			
Eight- Run (sec)	7	58	15.13	1.28	45.333	0.000***	7-8***, 7-9***, 7-
	8	54	14.18	.99			10***, 7-11**,7-12***,
							8-10***, 8-
	9	65	13.69	.90			11***, 8-12*** ,9-
	10	71	13.23	.98			11*, 9-12***,10-
	11	93	13.14	1.15			12*, 11-12*
	12	97	12.69	1.08			
30 m Sprint (sec)	7	58	8.30	.10	78.279	0.000***	7-8***, 7-9***, 7-
	8	54	7.59	.10			10***, 7-11***, 7-
	9	65	7.17	.07			12***, 8-9**, 8-
	10	71	6.87	.07			10*** , 8-11***, 8-
	11	93	6.56	.04			12***, 9-11***, 9-
	12	97	6.58	.05			12***, 10-11*, 10-12*

*p<0.05 **p<0.01 ***p<0.001

DISCUSSION

Growth and maturation affect children to acquire skills and their motor performance. Therefore, the growth and maturation are required to be understood very well when conducting researches about children (Siner et al. 2000; Kosar and Demirel 2004). Gender differences stoodleastfor motor development and motor tests in early childhood (Malina et al. 2004). These differences begin to be more meaningful and significant after the beginning of the sexual maturation starting from the age of 10 (Davies and Rose 2000). The purpose of this paper is to examine speed, body composition and coordination parameters of children aged 7 to 12 according to gender and age. Findings of the paperhave been presented under three headlines.

Body Mass Index

In the paper, no significant difference in body mass index values in all ages according to gender (Table 1). The values of body mass index of boys and girls increases as age progress (Tables 3, 4). The results of body mass index of this paper are in accordance with the paper of Saygin (2014), studied on 2378 Turkish children, aged 6-12 years, stated that no significant difference was found in BMI values in terms of gender whereas there was significant difference in BMI values of boys and girls in terms of age. Body mass index of boys and girls increased as ages progressed. Ferguson et al. (2014) reported that body mass index were significantly higher for having Developmental Coordination Disorder as compared with typically developing children. Manna et al. (2014) found the body massindex of pre-pubertal boys as 17.3 ± 1.5(kg/m^2), pubertal boys as 18.0 ± 1.5(kg/m^2), post-puberalboys as 17.8 ± 1.2 (kg/m^2) aged 10-16 years. Deliceoglu et al. (2013) examined the anthropometric and motor characteristics of children aged 7-15. They observed that boys aged 7-11 participating to the paper were superior to girls in terms of motoric characteristics and the values close up to each other for the age of 12. They found that the values of boys steadily increase in the age of 13 and reach the highest value in the age of 15. According to the findings of the paper, the changes in body conditions of boys and girls during the adolescence affect the motoric characteristics. The values of boys were found better than girls in all age groups in terms of motoric characteristics. It was found as a result of this study that speed skills increase by age and boys have better speed values when compared to girls. Veligekas et al. (2012) found body mass index of 10-year-old boys as 18.1±2.6 and 10-year-old-girls as 18.6±2.4 and 11-year-old boys as 20.4±3.1 and 11-year-old-girls as 19.5±2.9 and 12-year-old boys as 20.3±3.8 and 12-year-old girls as 19.7±3.0. Sahin et al. (2011) found the body mass index of boys aged 7 doing taekwondo as 14.94 ±2.77(kg/m^2) and boys aged 8 as 17.64 ±2.75 (kg/m^2). According to the results of the paper conducted by Meckel et al. (2010), the average of age of 18 children was found 10.4±1.2 and their BMI was found 18.1±1.5(kg/m^2) and their 20-m sprint performances were found 4.10±0.34sec. Milanese et al. (2010) examined the motor skills and anthropometric characteristics of children aged 6-12 and overviewed the relationship between these features with their paper conducted on 152 children. As a result, motor performance of children aged 6-12 was found to increase with increasing age. This relationship was found higher for boys when it is partially associated with increasing age. It may result from least amount of fatness in boys. Subcutaneous fat measurements are better determinants of physical fitness when compared to BMI and waist circumference measurements. Skinfold measurement of girls was found higher when compared to boys. Any significant difference could not be found for BMI in terms of gender. Motor performance of boys with the age range of 8 and 12 were found better than girls. Boys are faster than girls in this age range. The results and findings of the paper of Azita et al. (2009) that had been conducted on 951 students aged 9-11, which had been resulted by finding a significant difference in Body mass index parameters of girl and boy volunteers aged 9, are not supporting our study.

Eight-run Test

In this paper, significant difference was found in terms of coordination performance between boys and girls. The values of boys werefound to be higher than girls in all ages (Table 2). It was observed that the values of coordination of boys and girls improved with increasing age (Tables 3, 4). A proper motor coordination level is essential for strong general development as

well as for health, psychosocial development, and well-being (Piek et al. 2006; Haga 2008). In their paper conducted on 539 British children aged 6-11, Birch et al. (2014) researched whether there was a difference between fundamental skill proficiency of the children grouped by school age. While the sprint performance of boys found better than the girls'; it was stated that an increased BMI has an adverse effect on sprint performance. D'Hondt et al. (2014) stated that children's weight status negatively influences future level of gross motor coordination. Hiraga et al. (2014) found that children with developmental coordination disorder had lower levels of physical fitness, even with normal BMI. Lopes et al. (2013) reported that boys had significantly higher levels of gross motor coordination compared with girls aged 9-12 years children. Demiral (2011) found the coordination values of the boys and girls aged 7-12 doing judo in experimental group as 15.60±2.23 and 16.38±1.14, respectively. Vandorpe et al. (2011) determined significant developments by age in all 4 subtests of Body Coordination Test that measures gross motor coordination skill and mentioned that each age group has better coordination skills than the 1 year younger ones. Ahnert et al. (2009) mentioned that stability of motor skills is important for skill selection and development, and early diagnosis of children with motor disabilities and motor disorders. Recent longitudinal studies show that motor skills measured by Classical Test Theory (CTT) have long-term medium to high stability beginning from elementary school years to early adolescence. Gross motor coordination showed a gradual increase during elementary school years. Kostic et al. (2009) found statistically significant differences in coordination skills of first grade boys and girls. Wrotniak et al. (2006) indicated that children with greater-standardized BMI were less physically active, moresedentary, and had poorer motor proficiency compared with children with a lower standardized BMI. On the other hand, Zurc et al. (2005) determined significant differences in coordination skills of the boys and girls aged 6.5. Kambas et al. (2003) studied the effect of age and gender on coordination performance tests for school-age and pre-school children. As a result; it was reported that age and gender of a child found not to effect the coordination performance. As linearity could not be found in coordination performance of children between ages of 8 and 10, it was stated that this does not apply to children between the ages of 4 and 7 years. Quan et al. (2000) stated as a result of their paper that the sensitive period for the development of coordination skill for people is the ages between 7 and 10 and added that this development slows down around the age of 11 and this age is a critical time for the development. It was stated that the development rate of girls is faster than boys before the age of 9. It was indicated in the study that the development rate of boys is significantly faster than girls after the age of 9. In terms of level of development, a significant difference could not be found between girls and boys before the age of 11. It was stated that the coordination of boys is better than girls between the ages of 11 and 12.

30m Sprint Performance

This paper revealed that significant difference was found in terms of 30m sprint performance between boys and girls. The values of boys werefound to be higher than girls in all ages (Table 2). Improvements were observed in coordination performance of boys and girls with increasing age (Tables 3, 4). Hammami et al. (2014) stated that for improving sprint performance as well as maximal speed coaches could ensure the explosive strength ratio as an index to calibrate sprint development program and also for enhancing sport speed in children. Manna et al. (2014) found the spint performance of prepubertal boys as 6.6 ± 0.3 sec.,pubertal boys as 5.7 ± 0.4sec., pos-puberal boys as 5.1 ± 0.5sec., aged 10-16 years. Meylan et al. (2014) found that boys performed better than girls in 20 and 30-m sprint and change of direction time trial regardless of maturity status. Wattie et al. (2014) examined the relative age's influence on physical and motor tests among fourth grade children (9 to 10 years) from Germany. It was found that older boys performing better than relatively younger boys and older and younger girls in 20 m sprint test. Sokolowski et al. (2012) found that early maturing boys ran 50-m distance faster than late maturing boys. Significant differences are rather seen between the ages of 11 and 16. The biggest difference was observed between the ages of 14 and 15. The speed performance was found better for early maturing girls when compared to late maturing girls for the girls between the ages of 8 and 13. The statistical difference was ob-

served for the age of 11. The performances of late maturing girls were found better for the ages 14-15-16. Veligekas et al. (2012) found 30-m sprint performances of 10-year-old boys as 5.82±0.5 and 10-year-old-girls as 5.92±0.3 and 11-year-old boys as 5.70±0.4 and 11-year-old-girls as 5.75±0.5 and 12-year-old boys as 5.46±0.5 and 12-year-old girls as 5.73±0.5. Bucheitt et al. (2010) found that a significant correlation between short sprint test results and pubertal stage. Papaiakovou et al. (2009) researched the effect of biological age and gender on sprint performance during different sprinting phases in children and adolescents of both genders. The sample consisted of 360 sedentary students aged between 7 and 18 years, with 15 students representing each age group. The 30-m sprint speed was measured with photocells every 10 m. Boys and girls showed a gradual improvement in running speed during each sprint phase. It was mentioned that the boys reached a plateau after the age of 15; whereas girls tended to reach a plateau between the ages 12 and 13. It was determined that significant differences between genders were observed after the age of 15 years. It's concluded that, from 7 to 18 years of age, biological age and gender are factors affecting running speed during the 30-m speed.

CONCLUSION

The significant differences were found in speed and coordination performances of children aged 7-12 when compared in terms of gender. Improvements were observed in speed and coordination performances of children who participated in the study with increasing age. Body Mass Index of children increased due to increase in their body height and body weight resulted from their physical evolution. The reason to performances of boys to be better than girls in all ages may be attributed to differentiated endocrine system starting with the puberty. The differentiation in endocrine system may affect the body composition (muscularity - fatness ratio). Those boys have better speed and coordination performances compared to girls, may be resulted from increasing muscularity due to secretion of testosterone hormone for boys and from increasing fatness due to secretion of estrogen hormone for girls. The fact that children are in the period of physical evolution and adolescence, is thought to play a role in their coordination and speed performances.

RECOMMENDATIONS

Determination of performance parameters of children is one of the important elements of talent selection. Children at the right time, according to the body profile to redirect a sport, is also important in terms of their future. Therefore, In future, more detailed studies should be performed on factors affecting children's performance. A training emphasis on sprinting and coordination at an earlyage in girls compared with boys is recommended because of their earlier onset of puberty. Somatotype, age, coordination, sprint, body mass index and parameters related to performance of children should be monitored during development of childhood comprehensively.

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