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SPRINTING SPEED OF PREPUBERTAL GIRLS AND BOYS

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Abstract

The research problem was to analyze manifestation of sprinting speed and to compare the results obtained in prepubertal children in relation to gender. The aim of this study was to analyze the basic motor ability related to velocity in children before puberty. The study was conducted on the sample of 71 subjects who were divided into two subgroups: 37 boys and 34 girls, aged 9 years +/- 6 months. Three tests were applied for measurement of sprinting speed: time running 10 meters, high start time running 20 meters, high and start time running 20 meters flying start. The results showed that there was no statistically significant difference between subjects with respect to gender, in all three tests applied to estimate sprint speed at the level of $p < 0.05$. On this basis, it was concluded that prepubertal period of half of the respondents in the prepubertal period, as a criterion, does not constitute a basis for a statistically significant difference in the exercise of sprint speed.
Keywords: basic motor skills, boys, girls, age 9 years

Introduction

Analysis of gender-related sprinting speed of prepuberty girls and boys

When we talk about speed, it should be taken into account that the speed is actually a multidimensional motor ability and that, in its essence, there are four forms of expression. The manifestation of speed can be seen through the latent time of chain reaction, single-speed movement, movement frequency and sprint speed (Nićin, 2000). Although these elements are in inseparable mutual synergy, this research is focused on the analysis of sprinting speed. When we discuss speed, it is commonly understood that speed manifests in frequent cyclical movements (sprinting). Speed of frequency movement is different in individual sprint sections, so that it is not the question of the same frequency trends, but the question of somewhat different ones, from step to step (Nićin, 2000). It is believed that the maximum efficiency of speed is defined by frequency and length of stride (Čoh & Žvan, 2011). Both parameters are interdependent, and they also depend on the process regulation in the center of motor stereotypes. From the biomechanical point of view, step, as the basic structural unit, depends on the eccentric-concentric muscle action cycles at the action of movement. They further state that the relation between frequency and stride length is individually defined and automated. Changing one of these parameters results in a change of another. When the stride length increases, the frequency decreases, and vice versa.

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Research results of Blazević, Babić & Antekolović, (2011) indicated that prepubertal boys have a rational running technique, while girls on average predominantly set foot on the surface over heels. Based on the method of execution of running techniques, the boys achieved better results in the 50 m. The differences could be interpreted as the shape and organization of the game, i.e. as the manner of spending leisure time. Girls of younger school age are still in the game, which is predominantly static type, while boys are more physically active, which is reflected in the quality of their musculature. From the above, one might recommend learning proper running technique as one of the priorities in teaching physical education to children in elementary schools Also, in previous research, based on meta-analysis, which assessed the differences in motor skills of children aged 6 and 7, Janković (2014.) came to certain conclusions. Concerning the variable that was evaluated by the speed of running (20 m high start), there were statistically significant differences between boys and girls. The boys achieved better results, and they were faster at the given distance. Using multivariate analysis in their research, Sabolč & Lepeš (2012) analyzed the differences in some of the motor skills of children aged 7. Among other things, they analyzed sprinting speed by a test run at 20 m from the high start. Based on the results they concluded that gender differences of respondents occurred in terms of a statistically significant difference in favor of boys. In further research related to determining the difference in speed between sprinting of girls and boys aged 3 – 10, Babić, Blazević and Vlasić (2010) came to the following conclusions. The results of univariate analysis of variance showed that there was no statistically significant difference in the parameters of sprinting between boys and girls of preschool and younger school age. This research confirmed the results of previous research according to which a significant difference in these parameters occurs during puberty, when there are significant changes in the body. Nićin (2000.) points out that the frequency movements can basically be divided into movements of the same amplitude and the movements of different amplitudes. The interesting issues for this study were the movements of different amplitudes which are characteristic of sprinting. Factors that are responsible for expression of speed frequency movements can be grouped into those that relate to the structure of the CNS and the locomotor system, the state of other motor skills and the techniques involved in the movement. One of the main factors that allows full expression rate is the level of sports technique, which is characterized by perfect innervation and coordination of movement at the maximum intensity neuromuscular effort (Željaskov, 2004.). Petrović and Kukrić (2006.) argue that sprint running speed can improve by strength training, because stronger muscles give greater force at every turn. They also point out that sprint running speed can be improved, and that its manifestation depends on techniques of running, specifically stride length. They point out that the frequency step also affects the expression of sprint speed, but that its impact is determined by genetic inheritance. This is confirmed by earlier research (Kurelić, Momirović, Stojanović, Radojević and Viskić-Štallec, 1975; Zaciorski, 1975; Pistotnik, 2003.) which indicated the same conclusion that the inherent speed ratio is 0.90 to 0.95. In a study of kinematic parameters of maximal running speed, it was concluded that the maximum running speed is defined as the product of stride length and step frequency (Petrović, Kukrić and Guzina, 2007.). Also, these authors point out that the increase in maximal running speed required one or both components increase, but without an adverse effect one to another. In accordance with this previous research, one common conclusion can be drawn that sprinting speed is significantly genetically predetermined. Its manifestation is affected by a lot of factors, the most important of which are the stride frequency and stride length, and also the condition of other motor abilities, CNS and the running technique. As previously noted in this study, evaluation was performed in terms of the occurrence of sprint speed in subjects aged 9 in both genders. The reason for doing research just on this sample is that previous studies find that it is the greatest period of growth development of motor abilities, and it is one of the key sensitive periods for its development (Zaciorski, 1975, Nićin, 2000, Mikić, B., Biberović, A. Macković, S., 2001, Željaskov 2004, Bijelić and Simović, 2005, Bala, G., Stojanović, M. Stojanović, M., 2007, Caput-Jogunica, 2009). Nićin (2000) believes that the largest increase

frequency movements occurs between 8 and 12. While (Gužalovski, 1977.) points out that the typical sensitive periods for the development speed frequency movements and sprint speed range in both genders occur at the age 7 - 9. Caput-Jogunica (2009.) points out that the development speed according to the results of previous studies may be most affected at a younger age (especially from 10 to 14 years) and by means of carefully selected exercises. The findings of previous studies outlined the framework of this research including the analysis of motor skills, speed in relation to gender and age of the respondents. The results of this research (Babićet al., 2010, Blazević et all., 2011, Sabolč and Lepeš, 2012, Janković, 2014.), one of which showed differences in the results of tests applied to analyze sprinting speed of early school-age respondents in relation to gender, while the others did not show it, provided the basis for defining problem of this research. On this basis, the problem of this research was to analyze patterns of sprint speed and to compare the results obtained in patients aged 9 in relation to gender. The research topic is sprinting speed as a kind of manifestation of basic motor abilities of speed. With regard to the issue dealt with in the, the aim is to analyze the basic motor abilities related to speed in children at the age of 9.

Method

This research is based on the method of theoretical analysis, which is applied to analyze speed and its forms of occurrence, as well on the interpretation of the results of evaluation of basic speed-related motor abilities in children at the age of 9. Research is also based on descriptive and causal methods that are aimed to describe and explain the connection between the results obtained, as well as their interrelations. The study was conducted on a sample of 71 children aged 9 years +/- 6 months, which included 37 males and 34 female subjects. Respondents were involved in some form of physical activity, in various school sports. All respondents attended sport schools of the same duration, about a year ago. The work program in sport schools was almost the same, which means that its purpose was a comprehensive development of children. In doing so, special emphasis was put on the development of motor abilities through programs that have been adapted to the given age. Maturity of respondents was not evaluated in any way, except on the basis of the chronological age. This was done because most foreign and domestic anthropologists refer to this period as the age of puberty or early school age. They also state that these years of age ranges 6 to 10.5 years in girls, and 6 to 12.5 years of age in boys (Bijelićand Simović, 2005.). The variables in this study are divided into criterion and predictor ones: Criterion variable: POL- gender of respondents,
Predictor variables: SP10MHS-time running 10 meters high start, SP20MHS-time running 20 meters high start, SP20MFS-time running 20 meters flying start (Balaet al., 2007.). Tests were performed on a hard, flat surface in a hall measuring 20x50 meters. The distance of 10 and 20 meters was measured in such a way that the starting line width was included in the distance of 10 and 20 meters, whereas the width of ribbon colored finishing line was not included. Both lines were 2 meters in length and parallel to each other. Two racks were placed at each end of the line. The examiner, who measured the result, was sitting exactly on the extended line of finish and rack. Behind the finish line, there was an area long enough to enable running away of participants after the test. Respondents began running from a standing start and at the command "now", after which they ran at maximum speed into the area between the two lines. The stopwatch switched on at the buzzer sound of "now", and switched off when the subject chest crossed the finish line. In test runs at 20 meters with flying start, behind the starting line, at a distance of 10 meters, there was a mark by lines that represented the start-up line. In the speed-up zone, the respondent speeded up progressively, so that he achieved maximum running speed at the start line. Respondents started from a standing start from the line where speed-up zone starts. An assistant timekeeper, who was standing in the extension of the starting line with racks placed

at each end, gave the signal to the timekeeper to start measuring when the respondent's breast cut off the starting line. The stopwatch is stopped when the respondent's breast cut off the finishing line. The running time was measured manually and rounded off at the tenths of a second. Respondents wore sports equipment (shorts, T-shirts, sneakers). In order to formulate valid conclusions, calculatation included the following:

Basic descriptive parameters: the arithmetic mean, variational width, standard deviation, variance, measures the asymmetry – skewness and kurtosis, the Kolmogorov-Smirnov's test. Parametric statistics: the difference between subjects was analyzed by multivariate analysis of variance (MANOVA).

Statistical analysis was performed on a personal computer Pentium IV with the statistical program SPSS (version 11.0).

In relation to the problem, the subject and aim of the research, the following hypothesis was put forward.

H_1- statistically significant difference in the results of developing sprinting speed between male and female respondents is expected.

Results

Table 1. *Descriptive statistics results of tests for the assessment of sprint speed in subjects of both genders*

boys	N	l	Min	Max	M	SD	s	Skew	Kurt	KS
SP10MHS	37	0.9	2.8	3.7	3.13	0.24	0.05	0.42	-0.54	0.72
SP20MHS	37	1.1	5.4	6.5	5.93	0.29	0.08	0.02	0.35	0.39
SP20MFS	37	1.8	3.9	5.7	4.57	0.38	0.14	0.64	1.32	0.70
girls	N	l	Min	Max	M	S. D.	s	Skew	Kurt	KS
SP10MHS	34	1.3	2.4	3.7	3.11	0.29	0.08	0.28	0.00	0.72
SP20MHS	34	1.0	5.5	6.5	5.94	0.26	0.07	0.04	-0.32	0.54
SP20MFS	34	1.2	3.9	5.1	4.67	0.31	0.09	-0.50	-0.75	0.29

Legend: N – sample of respondents, l – ranking, Min – minimum score, Max – maximum result, M – mean, SD – standard deviation, s – variance, Skew – - skjunis, Kurt – kurtosis, KS – Komogorov-Smirnov test.

Table 1. presents the results of descriptive statistics results of tests for the assessment of sprinting speed in both genders. Before analyzing results, the normality of distribution of all results on the basis of Komogorov-Smirnov's test (KS) was tested, the results of which were significantly above 0.05, which indicates that the results have normality schedule. During the analysis of differences between the maximum and minimum results, i.e. rank values with male participants, the results of the test of the 10 meter running time from high start (SP10MHS) showed the lowest dispersion of results, while the test 20 meter running time on a 20 meter flying start (SP20MFS) indicated the largest dispersion results. During the analysis of differences between the maximum and minimum results, i.e. rank values in female subjects, the results of the test 20 meter test running time high start (SP20MHS) showed the lowest dispersion of results, whereas testing 10 meter running time high start (SP10MHS) indicated the largest dispersion of results. Male respondents showed a lower average value, and thus better results on tests 20 meter running high start (SP20MHS) and 20 meters running flying start (SP20MFS), while the female respondents showed better average scores on a test run on 10 meters high start (SP10MHS). Measures of asymmetry Skewness (tilt curve) and Kurtosis (curvature of the curve) did not show significant deviations from the mean.

Table 2. The difference between respondents in the results of tests for assessing sprinting speed in relation to gender (MANOVA)

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	0.99	12534.20	3.00	67.00	0.00
	Wilks' Lambda	0.00	12534.20	3.00	67.00	0.00
	Hotelling's Trace	561.23	12534.20	3.00	67.00	0.00
	Roy's Largest Root	561.23	12534.20	3.00	67.00	0.00
GENDER	Pillai's Trace	0.00	0.03	3.00	67.00	0.99
	Wilks' Lambda	0.99	0.03	3.00	67.00	0.99
	Hotelling's Trace	0.00	0.03	3.00	67.00	0.99
	Roy's Largest Root	0.00	0.03	3.00	67.00	0.99

Table 2 shows the analysis of differences between the results of all three tests for assessment of sprinting speed with reference to gender of respondents by means of multivariate analysis of variance. The values of significance showed that there was no statistically significant difference between the respondents in all three tests applied.

Discussion

Greater dispersion of results in individual tests used in this study, that are presented in Table 1., can be explained by the fact that reduced multilateral development leads to absence of mutual coordination of legs and arms. Since hand movements directly affect the frequency of leg movements, low level of arm coordination and strength of shoulder girdle prevents the child's ability to run faster (Mikićet al., 2001.). Also, the confirmation can be found in the research of Blazević et al. (2011.), where they point out that boys have more rational running technique than girls, the main reason of which are the games that boys and girls used in their free time. The absence of differences in tests for assessing sprinting speed among respondents in relation to gender, Table 2., can be explained by the fact that the child's ability to perform rapid movements in prepubertal age progressively increasesirrespective of whether these children have any training or not. It is the same for boys and girls. The increase in speed is usually the result of the development of better muscular coordination. This is reflected in the coordination of the hands and feet, and the difference has been observed between children who had comprehensive development and those that did not have it. Gender differences in this period are not visible (Bijelić and Simović, 2005.). Bala et al., (2007.) came to certain conclusions regarding the assessment of motor abilities of speed. Based on research on a large number of respondents, he concluded that boys and girls before puberty do not show difference in manifestation of sprinting speed. Rađo (2000.) also analyzed the differences of speed manifestation between the males and females. He concluded that the speed of movement in relation to gender differences is evident. So in running, women lag far behind men, in terms of speed. This difference is certainly conditioned by differences in the strength of the movement between women and men. However, as the respondents in this study were at the age where the difference in strength of movement performance between genders is still not evident, this statement may be accepted only at a later age, when the difference in strength between geneders is evident. Mikićet al., (2001.) suggest that during early prepubertal age, at the running speed, gender differences among children are not visible. The difference becomes visible only at the time when children approach puberty, when boys perform better activities related to speed than the girls. Frequency of movement is characterized by unevenness in its development, thus it develops faster in those who train, than those who do not train this kind of activity. Similar conclusions have been drawn by the research of Babić et al. (2010.), who state that the maximum running speed increases with chronological age. According to Malina, R.M., Bouchard, C. and Bar-Or, O. (2004.), the maximum running speed (and without the effects of training) in children aged 5 to 8, biologically develops very

rapidly and after this period, the progress a little slower. Gender differences are small and not significant, but they are more significant after adolescence. The lack of differences between the results of tests for the assessment of sprinting speed in subjects of both genders may also be explained on the basis of the sensitive period of the development of motor abilities. Sensitive periods coincide with both genders, especially during prepuberty (Zaciorski, 1975, Gužalovski, 1977, Nićin, 2000, Mikić, B., Biberović, A. Mačković, S., 2001, Željaskov 2004, Bijelić and Simović, 2005, Balaet al, 2007, Caput-Jogunica, 2009). Maximum development of a certain ability is possible when all the processes of growth and development completed and, of course, when all motor and functional abilities and morphological characteristics reach optimal development. However, in the period of growth and development, there are phases which could be qualified as susceptible (sensitive) periods during which we can develop a maximum capacity for the maximum development of certain motor abilities. It is determined according to the stages of biological growth and the development and natural trends in the development of the motor system (Šalaj, 2010.). Based on a meta-analysis, Viru, A., Loko, J., Volver, A. Laaneots, L., Karelson, K., Viru, M. (1998.) found that there is a period in which motor skills develop rapidly, and that speed is one of those skills, but that it is being developed in the same period in boys and girls. Based on an analysis of the data and their interpretation complying with previous research, it can be concluded that there was no statistically significant difference in manifestation of sprint speed between males and females. In accordance with the results, H_1 hypothesis in which a statistically significant difference was expected in the results of developing sprinting speed related to gender of respondents - is rejected. The obtained results confirmed the earlier observations of similar problems (Zaciorski, 1975, Nićin, 2000, Mikićet al., 2001, Željaskov 2004, Bijelić and Simović, 2005, Balaet al., 2007, Babićet al., 2010). It can be concluded that the gender of respondents in the prepubertal period, as the criterion variable does not constitute a basis for a statistically significant difference in the manifestation of sprinting speed. Girls and boys at that age go through the same dynamics of maturation of biomotoric system that affects the manifestation of sprinting speed, owing to which motor abilities (development of intra and inter muscular coordination), functional ones (development of cardio-respiratory system) and the development of central regulatory mechanisms of internal organs (CNS) does not show any significant difference. The obtained results justify the use of similar or identical training operators for speed development in prepubertal period for both genders.

Conclusion

According to the results of multivariate analysis of variance with appropriate statistical procedure, there is no statistically significant difference in the manifestation of sprinting speed of the respondents in relation to gender. The results of this study are confirmed by some previous studies of similar problems (Zaciorski, 1975, Nićin, 2000, Mikićet al., 2001, Željaskov 2004, Bijelić and Simović, 2005, Balaet al., 2007, Babić et all., 2010.). However, the results are not in agreement with some studies (Blaževićet al., 2011, Janković, 2014, Sabolčand Lepeš, 2012.), which found statistically significant differences of sprinting speed in children of junior school age in relation to gender. It is also concluded that the respondent gender at the age of puberty or early school age, as a criterion, does not constitute a basis for a statistically significant difference in the manifestation of sprinting speed. Girls and boys of that age go through the same dynamics of maturation of bio-motor system that affects manifestation of sprinting speed, so that motor development (development of intra and inter muscular coordination), functional development (development of cardio-respiratory system) and the development of central regulatory mechanisms of internal organs (CNS alpha) do not show any significant difference.

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