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THE RELATION BETWEEN THE KINEMATIC PARAMTRES OF RUNNING AT MAXIMUM SPEED AND THE 50 METRES RUNNING RESULTS

VESNA BABIĆ[1], IVA BLAŽEVIĆ[2]

Abstract
The aim of this research is to determine the relation between the kinematic parameters of running at maximum speed and the 50 metres running results for children of a younger school age, as well as between girls and boys.The obtained results indicates that the length of the step is the parameter which has the key role in 50 metre running. In the analysis of differences it has been determined that boys achieve a better time in 50 metre running, have a shorter duration of the contact between the foot and the ground and a shorter flying phase.
Key words: sprinter's running, kinematic parameters, maximal speed, children.

Introduction

Sprinting is a cyclic motor activity which consists of repetitive running steps, and it is determined by acceleration, achieving the maximum speed and by the capability of keeping the maximum speed on the track as long as possible. Metabolic and anthropometric components have a powerful impact on these factors. The horizontal speed of the sprinter's step is a product of the length and frequency of the step. From the biomechanical point of view of the sprinter's step, the components which determine the running speed are the frequency of the step, the length of the step, the time of the contact of the ground and the foot and the flight phase (P. Bellotti, 1991; G.P. Bruggemann, B. Glad, 1990; J. Hay, 1994; M.J. Harland, J.R. Steele, 1997; B. Gajer et al., 1999; A. Ferro et al., 2001; J. Hunter et al., 2004; V. Babić, 2005, 2007 and 2008; A. Ito, 2006). In previous researches about the relation between the length and the frequency of the step, papers can be found in which the opinion has been represented that the frequency of the step and its appertaining aspects can be suggested as limiting factors for speed. On the other hand, some researchers suggest that more importance should be given to increasing the length of the step. Other researchers support the need for increasing both the length and the frequency of the step. Despite different statements, the possibility of a negative interaction between the length and the frequency of the step should be seen through the sprinter's training process with the aim of increasing the length of the step, the frequency of the step or both (J. Hunter, R.N. Marshall, P. McNair, 2004). According to the previous accessible researches in which the phase of the running speed has been examined, it can be determined that the frequency of the step increases with the increase in running speed, while the length of the contact between the foot and the ground decreases with the increase in running speed (M. Čoh et al.,, 2001; M. Čoh, K. Tomažin, 2008; V. Babić, M. Čoh, D. Dizdar, 2008; I.N. Bezodis, D.G. Kerwin, A.I.T. Salo, 2008; G.P. Paradisis et al., 2009). Placing the foot on the ground should be as close as possible to the vertical projection of the centre of the body. Sprinters who achieve a better time in 100 metre running have a shorter length of contact between the foot and the ground in the phase of the start acceleration and the maximum running speed and a longer length of the step in the phase of maximum speed.Previous researches of the sprinter's running for children and the young in the phase of maximum running speed (U. Praprotnik, M. Čoh, 2001; R. Pišot, B. Šimunić, 2006; M. Bračić, M. Čoh, K. Tomažin, 2009; V. Babić, I. Blažević, J. Vlašić, 2010) have determined that the maximum running speed increases with the age of the examinees and that boys and girls differ in biomechanical parameters of running when age is taken into account. Boys and girls of a younger school age show a statistically significant difference in the frequency and length of the step while running at maximum speed. Boys achieve a higher frequency of steps, while girls make longer steps. The main aim of this research is to determine the relations between the kinematic parameters of running at maximum speed (the frequency of steps, the length of steps, the duration of the contact and the flight) and the results in 50 metre running for children of a younger school age, as well as the differences between boys and girls in the analyzed parameters.

Faculty of Kinesiology, University of Zagreb, CROATIA
Primary school Vidikovac in Pula, CROATIA
Email: vesna.babic@kif.hr
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Research methods and procedures

Sample of examinees

The sample of examinees is made of 150 male and female pupils from the first and second form of a primary school in Pula (70 male and 80 female pupils). The average male pupils' age is 8.12±0.63, their height is 133.56±7.66 centimetres, and their body mass is 31.42±8.05 kilogrammes. The average female pupils' age is 8.08±0.61, their height is 132.05±6.44 centimetres, and their body mass is 29.91±7.25 kilogrammes.

Sample of variables

The sample of variables is made of variables used for determining the kinematic parameters of the sprinter's running in the phase of the maximum speed (the frequency of steps, the length of steps, the duration of the contact and the flight) and the 50 metre running time (KT50).

Methods of data processing

Kinematic parameters of the sprinter's running in the phase of maximum speed in the segment from the 15th to the 35th metre on a 50 metre section and the running time on a 50 metre section have been collected for the needs of this research. The kinematic parameters of the sprinter's running in the phase of maximum speed have been collected by applying the Opto jump technology which was set on the segment between the 15th and the 35th metre, on a length of 20 metres. The computer programme Sprint comes along with the Opto jump technology. It makes notes about the speed and the running time, the length of the contact and of each step's flight and it works out the average running speed, the average frequency of the step and the length of the steps. The 50 metre running time has been measured by the system for electronic measuring and the supporting computer programme Brz.For further data processing the multiple regression analysis and the univariate analysis of the variance have been used.

Results

Table 1. The results of the regression analysis in the area of sprinter's running kinematic parameters for boys

R= 0,94; R^2=0,88; F(4,64)=115,96 p<0,000; SEE=0,28						
KT50	**β**	**β_e**	**B**	**B_e**	**t (64)**	**p**
Intercept			15,34	9,58	1,60	0,11
LENGTH OF CONTACT	0,48	0,38	24,01	18,80	1,28	0,21
LENGTH OF FLIGHT	0,43	0,30	26,16	18,35	1,43	0,16
FREQUENCY OF STEPS	-0,23	0,38	-0,71	1,20	-0,59	0,56
LENGTH OF STEPS	**-0,84**	**0,06**	**-0,06**	**0,00**	**-15,21**	**0,00**

Table 2. The results of the regression analysis in the area of sprinter's running kinematic parameters for girls

R= 0,94; R^2=0,89; F(4,72)=156,05 p<0,000; SEE=0,30						
KT50	**β**	**β_e**	**B**	**B_e**	**t (72)**	**p**
Intercept			19,18	6,76	2,84	**0,01**
LENGTH OF CONTACT	0,31	0,23	16,52	12,29	1,34	0,18
LENGTH OF FLIGHT	0,26	0,20	16,25	12,62	1,29	0,20
FREQUENCY OF STEPS	-0,32	0,28	-1,02	0,90	-1,14	0,26
LENGTH OF STEPS	**-0,78**	**0,05**	**-0,07**	**0,00**	**-15,58**	**0,00**

Table 3. Differences in anthropometric characteristics between girls and boys

VARIABLE	**MEAN BOYS**	**MEAN GIRLS**	**SD BOYS**	**SD GIRLS**	**SS**	**MS**	**df**	**F**	**p**
KT50	**10,09**	**10,58**	**0,80**	**0,92**	**8,76**	**8,76**	**1**	**11,60**	**0,00**
LENGTH OF CONTACT	**0,15**	**0,16**	**0,01**	**0,01**	**0,00**	**0,00**	**1**	**7,85**	**0,01**
LENGTH OF FLIGHT	**0,09**	**0,11**	**0,01**	**0,01**	**0,01**	**0,01**	**1**	**29,06**	**0,00**
FREQUENCY OF STEPS	**3,99**	**3,69**	**0,25**	**0,28**	**3,15**	**3,15**	**1**	**42,23**	**0,00**
LENGTH OF STEPS	135,29	138,27	10,46	10,68	325,79	325,79	1	2,91	0,09

Chart 1. The graphic representation of the running speed for girls and boys

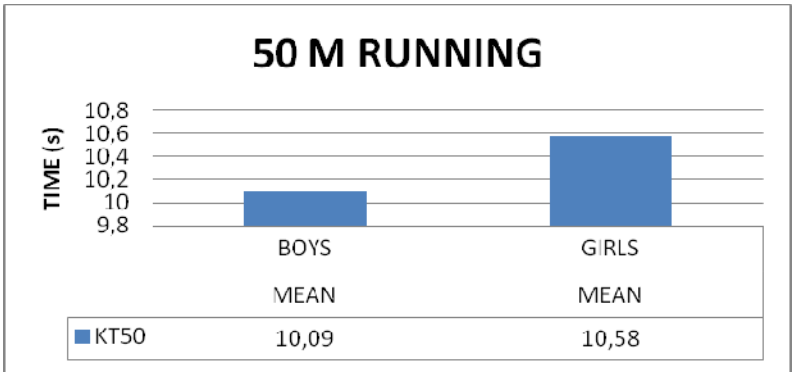
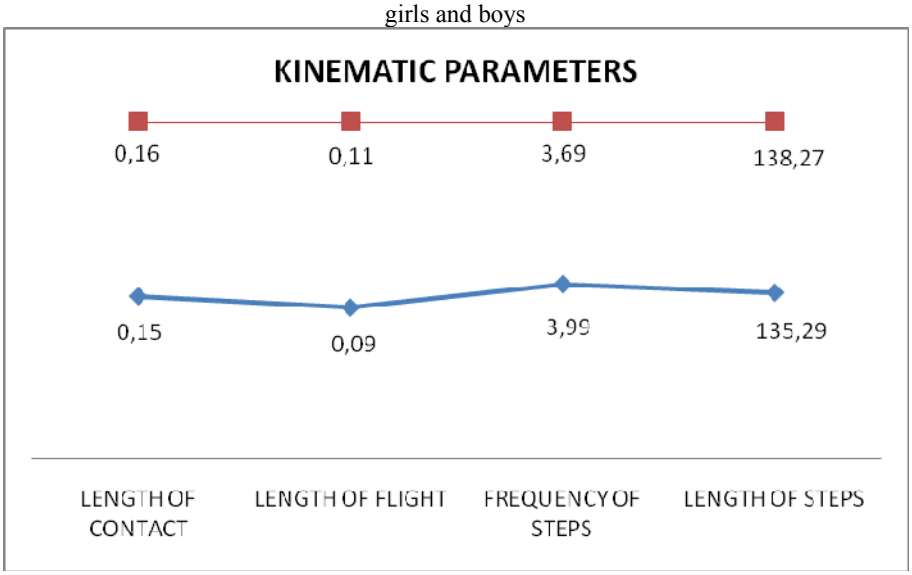


Chart 2. The graphic representation of the length of contact, length of flight, frequency of steps and length of steps for girls and boys



Discussion

The results obtained for the variable 50 metre running time (KT50) show that the average value for boys is 10.09 seconds and for girls 10.58 seconds.The relation between results of the 50 metres running and the kinematic parameters of the sprinter's running in the phase of maximum speed for both girls and boys of a younger school age has been determined by the standard procedure of the multiple regression analysis. It has been determined that the multiple correlation (R=0.94) is statistically significant for boys (*Table 1.)*. It is possible to explain 88 percent of the variance by the applied group of the sprinter's running kinematic parameters. In the group of four variables of the predictive group, only the variable *length of steps* has a statistically negative influence on the criteria variable. Since running time is an inversely scaled variable, boys who achieve a better 50 metre running time have averagely a higher length of steps in 50 metre running. It has been determined that the multiple correlation (R=0.94) is statistically significant for girls (*Table 2.*). It is possible to explain 89 percent of the variance by the applied group of the sprinter's running kinematic parameters. Of all the variables of the predictive group only the variable *length of steps* has a statistically negative influence on the criteria variable. This means that girls who achieve a better 50 metre running time have averagely, as boys, a higher length of steps. U. Praprotnik and M. Čoh (2001) have found out that the increase in the maximum running speed with children is primarily linked to the increase in the length of steps. M. Bračić, M. Čoh and K. Tomažin (2007 and 2009) have determined that the length of the leg and the frequency of steps directly influence the running speed so the variable *frequency of steps* has been expected to gain better predictive values. However, the high values of the regressive coefficients for both sexes have not been confirmed. It can thus be concluded that the *length of steps* is the parameter which has the key role in 50 metre running for girls and boys of a younger school age. To determine the differences between boys and girls of a younger school age the univariate analysis of the variance has been used. The obtained results indicate that boys and girls show a statistically significant difference in variables *50 metre running time (KT50), length of contact, length of flight* and *frequency of steps*.

Boys achieve higher values for the variable 50 metre running time (KT50), they have a shorter contact of the foot with the ground, a shorter duration of the flight phase and a higher frequency of steps. The obtained results confirm former knowledge according to which boys achieve better results in their sprinter's running kinematic parameters (U. Praprotnik, M. Čoh, 2001; R. Pišot, B. Šimunić, 2006; M. Bračić, K. Tomažin, M. Čoh, 2009). The duration of the contact is longer for girls for 6.6 percent compared to boys, while the length of flight is longer for 10 percent. On average, girls have a 7.2 percent lower frequency of steps when compared to boys. The length of steps is a variable for which there are not statistically significant differences between boys and girls although girls achieve averagely higher values. As this research, M. Bračić, K. Tomažin and M. Čoh (2009) have determined that boys of a younger school age have a higher frequency of steps, while girls achieve longer steps. R. Pišot and B. Šimunić (2006) claim that boys achieve shorter steps, shorter duration of the flight phase and higher frequency of steps than girls, which is in line with the results of this research. According to the result of accessible researches and this research's results, it can be concluded that boys of a younger school age have in their maximum running a higher frequency of steps, a shorter duration of the flight phase and the contact, while the girls have longer steps.The reasons of such relations between boys and girls at this age can be traced down to the way they play or actively spend their free time. It is possible that games are more active with boys of this age, which can be surely seen on their muscle system. The morphology of the boys' muscle system is of higher quality and intramuscular coordination, which is very important for a seemingly simple motor movement like sprinter's running.

Conclusion

The results obtained in this research show that the variable *length of steps* has a statistically significant negative impact on the 50 metre running time for girls and boys of younger school age. Since running time is an inversely scaled variable, it means that boys and girls who achieve a better 50 metre running time have, on average, longer steps in 50 metre running. It can be concluded, based on the obtained results, that *length of steps* is a parameter which has the key role in 50 metre running with girls and boys of younger school age.

The analysis between boys and girls determined that boys achieve a better time in 50 metre running and a higher frequency of steps, have a shorter duration of the contact of the foot with the ground and a shorter duration of the flight phase, which confirms the knowledge obtained in previous researches about the relations of kinematic parameters on sprinter's running time and speed.

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