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DEPENDENCIES OF SPEED ABILITIES AND PHYSICAL DEVELOPMENT OF CHILDREN AT THE AGE OF 6 – 7 YEARS

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Abstract

In this article, we present the results of selected parameters of the running speed of young school children. The aim of this research is to determine the dependence of parameters of speed abilities and physical development of 6 – 7 year old children. The sample consisted of 67 probands (42 boys and 25 girls) with a decimal average age of 6.72 ±0.3 year. We used the test 4 x 10m shuttle run with changes of direction for diagnostics of running speeds. We used the test of lower-limbs frequency in 6s to find out the parameters of movement frequency. We established basic somatic parameters: body height, body weight, BMI. All obtained results were compared with each other and evaluated using correlation analysis. We stated that in somatic parameters high statistical dependence was recorded (p < 0.01), which we consider as a natural developmental indicator. In the group of girls, we recorded a slightly shorter contact time with the pad; however, a significantly longer flight time with single stride cycles. In intrasexual comparison, we recorded statistical significant difference in flight time and in stride frequency (p < 0.05). Boys achieved a higher stride frequency and a shorter flight phase, so they also achieved a higher number of step cycles. In the group of boys, we recorded statistical dependence (p < 0.01) between a running speed with changes of direction and stride frequency.

Key words: *younger school age, shuttle run, movement frequency, somatic parameters, correlation analysis*

Introduction

Movement speed is the ability to respond as quickly as possible to a stimulus or to perform a motion as quickly as possible with minimal resistance [10]. Authors state that the long-term influence of speed abilities of human movement is a very complex issue, because speed abilities are genetically conditioned up to 80 % [8].

Speed abilities belong to expresions of movements that should be developed as soon as possible. Refering to children´s preparation, development of speed abilities along with coordinating skills belong to an area that should have a high priority [9].

Authors [5] consider speed abilities in children as a basis and primarize them together with dexterity over all other abilities. Furthermore, they state that we must not in any case put emphasis on special speed development in children using special exercises, but develop the speed through general training.

Authors [1] consider the age between six and eight years in girls and between seven and nine years in boys to be the first critical period in the development of speed abilities. Authors [7] state that speed abilities, unlike strength abilities, depend on age rather than gender and they are the most genetically determined.

Authors [4] state that by the age of 10 it is recommended that children develop, in particular, the frequency of movement, as the best conditions for frequency development and movement coordination are created in this given period. [6] They add that significant sensitivity for speed frequency begins between the 6th and 7th year.

Methods

Children of a younger school age participated in this research. The sample monitored consisted of 67 probands (42 boys and 25 girls) at the age of 6.72 ±0.3 years.

Procedures

For diagnostics, we used the test 4 x 10m shuttle run to measure running speed with changes of direction [3]. Author [2] recommends using this test for diagnosing a selection of talents in given age category.

The frequency of lower limbs was diagnosed using the test of lower-limbs frequency [13]. The time for performing the test was 6s, due to the age of the probands. We used the device FiTRO tapping check (FiTRONiC, Bratislava, Slovak Republic) for measurement. The device consists of two contact switches firmly attached to the floor, connected via a communication interface to a computer. The role of the tested subject is to do as many alternate touches with a lower limb on the contact mats as possible in 6 s. The system measures the frequency and the number of individual touches, as well as contact time with a mat and flight time in milliseconds. The better of two attempts is counted.

We established basic somatic indicators: body height, body weight, BMI.

Statistical analysis

The statistical significance of differences between genders in the parameters of physical abilities was determined using a T-test for independent samples. The data were processed using correlation analysis to determine relationships between individual parameters. Statistical significance was evaluated at the level of significance $p < 0.05$ and $p < 0.01$.

Results

Basic indicators of physical development are comparable to measurements of the school population [3].

Arithmetic averages and values of variability point to high homogeneity in intersexual comparison (Table 1).

Table 1. Characteristics of age indicators, somatic parameters in the group of boys and girls

		Decimal age [years]	Body height [cm]	Body weight [kg]	BMI [i]
Boys (n = 42)	M	6.77	124.56	24.81	15.88
	SD	0.3	5.69	4.13	1.7
	X_{max}	7.3	137	40.4	21.5
	X_{min}	6.25	112	19.8	13.2
Girls (n = 25)	M	6.64	122.08	23.09	15.92
	SD	0.28	5.38	3.67	1.3
	X_{max}	7.15	134	32.4	19.5
	X_{min}	6.27	113	18.2	13.3

Based on the results of physical development, we state that boys are about 0.13 years older, 2.48 cm taller and 1.72 kg heavier when compared with the girls; however, they have a lower BMI index of about 0.04. Although we recorded differences in intersexual comparison, in parameters of age and physical development these differences were not statistically significant.

Table 2. Characteristic of parameters of speed abilities in the group of boys and girls

		SR 4 x 10m [s]	Step cycles [n]	Contact time [ms]	Flight time [ms]	Stride frequency [Hz]
Boys (n = 42)	M	14.27	34.8	136.17	207.27	6.04
	SD	0.92	7.32	25.79	52.26	1.26
	X_{max}	16.4	54	209	323	9.13
	X_{min}	12.2	23	93	101	4.32
Girls (n = 25)	M	14.61	31.12	136.08	243.48	5.32
	SD	1.36	7.42	27.43	65.09	1.35
	X_{max}	19.3	54	217	356	9.5
	X_{min}	12.1	22	92	118	3.9
P-value		0.046*	0.053	0.989	0.016*	0.032*

Note: M – mean value; SD – standard deviation; * – statistical significance p < 0.05

When comparing the parameters of speed abilities in terms of intersexual comparison, we conclude that boys reach better average results in speed parameters (Table 2). In the group of girls, we recorded a slightly shorter (-0.09 ms) contact time with the pad; however, a significantly longer flight time (+36.22 ms), with single stride cycles. Boys reached a higher stripe frequency and a shorter flight phase, so they also achieved a higher number of stride cycles. In intersexual comparison, we recorded statistical dependence (p < 0.05) in flight time and in stride frequency.

Boys use the stride frequency while running more significantly. It enables them to achieve a better performance in the 4 x 10m shuttle run in comparison to the girls.

Table 3. Correlation matrix of significant correlates between the variables in the group of 6 and 7 year-old boys.

BOYS	*Age*	*Body height*	*Body weight*	*BMI*	*4 x 10m*	*No (n)*	*Tc (ms)*	*Tf (ms)*	*F (Hz)*
Age	_								
Body height	≤.05	_							
Body weight	n.s.	≤.01	_						
BMI	n.s.	≤.05	≤.01	_					
4 x 10 m	n.s.	≤.05	n.s.	n.s.	_				
No (n)	n.s.	n.s.	n.s.	n.s.	≤.01	_			
Tc (ms)	n.s.	n.s.	n.s.	n.s.	≤.05	≤.01	_		
Tf (ms)	n.s.	n.s.	n.s.	n.s.	≤.01	≤.01	≤.05	_	
F (Hz)	n.s.	n.s.	n.s.	n.s.	≤.01	≤.01	≤.01	≤.01	_

Note: BMI – body mass index; No – Number of stride cycles; Tc –contact time; Tf – flight time; F – stride frequency; n.s. – statistically insignificant

A significant statistical dependence in somatic indicators in the group of boys was found between body height and body weight, as well as between body weight and body mass index, which we consider to be a natural developmental indicator (Table 3).

In the group of boys, we noted significant dependencies in the parameters of frequency of speed. In the group of boys, we found significant dependencies ($r = 0.985$, $p < 0.01$) between the movement frequency and the number of performed stride cycles. Equally high dependence ($r = 0.912$, $p < 0.01$) was found between the flight time and the number of performed cycles, which means that the shorter the duration of the flight, the greater the number of stride cycles.

Statistically significant dependencies were also noted between the parameters of speed frequency and running speed with changes of direction, which proves a close relationship between these abilities in the group of boys. Negative statistical dependence was observed in the parameters of physical development and speed abilities between body height and 4 x 10m shuttle run ($p < 0.05$), which confirms that higher body height is a disadvantage at this age in running with changes of direction. On the contrary, body height does not affect the speed frequency of lower limbs.

In the group of girls as well as in the boys´ group, a significant statistical dependence between body height and body weight was found from somatic indicators, as well as between body height and body weight index, which we evaluate as a natural developmental indicator (Table 4).

Table 4. Correlation matrix of significant correlates between the variables in the group of 6 and 7 – year-old girls.

GIRLS	*Age*	*Body height*	*Body weight*	*BMI*	*4 x 10m*	*No (n)*	*Tc (ms)*	*Tf (ms)*	*F (Hz)*
Age	_								
Body height	≤.01	_							
Body weight	≤.01	≤.01	_						
BMI	n.s.	n.s.	≤.01	_					
4 x 10 m	n.s.	n.s.	n.s.	n.s.	_				
No (n)	n.s.	n.s.	n.s.	n.s.	n.s.	_			
Tc (ms)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	_		
Tf (ms)	n.s.	n.s.	n.s.	n.s.	n.s.	≤.01	n.s.	_	
F (Hz)	n.s.	n.s.	n.s.	n.s.	n.s.	≤.01	n.s.	≤.01	_

Note: BMI – body mass index; No – number of stride cycles; Tc – contact time; Tf – flight time; F – stride frequency; n.s. – statistically insignificant

In the group of girls, we found significant dependencies ($r = 0.986$, $p < 0.01$) between the movement frequency and the number of performed stride cycles.

However, we did not record statistically significant dependencies between the parameters of speed frequency and parameters of running speed with changes of direction, as in the group of boys. We note that the speed frequency of lower limbs and running speed with changes of direction are two relatively independent factors in girls.

Discussion and conclusions

On the basis of the obtained results, we note that in the group of boys there is a more significant correlation dependence between the parameters of speed abilities. From the interdependencies between the frequency and the number of performed cycles, it is clear that the increase of frequency significantly contributes to a greater number of stride cycles in boys as well as in girls.

The relationship between the 4 x 10m shuttle run and the frequency of lower limbs in the boys' group (Figure 1) achieves a significant strength of relationship (r = 0.467, p < 0.01). In the girls' group, the relationship between the 4 x 10m shuttle run and the movement frequency (Figure 2) does not reach a statistically significant correlation (r = 0.244). This means that the girls' better performance in a 4 x 10m shuttle run was not conditioned by increasing the frequency of the stride, but rather by lengthening the running stride.

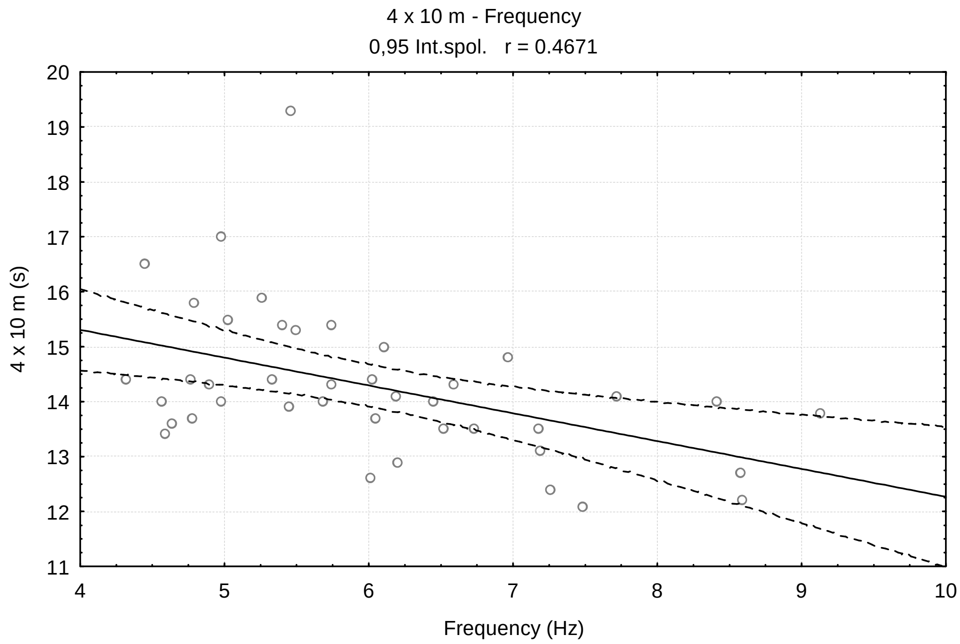

Figure 1. Analysis of relationships between the 4 x 10m shuttle run and stride frequency in the group of boys.

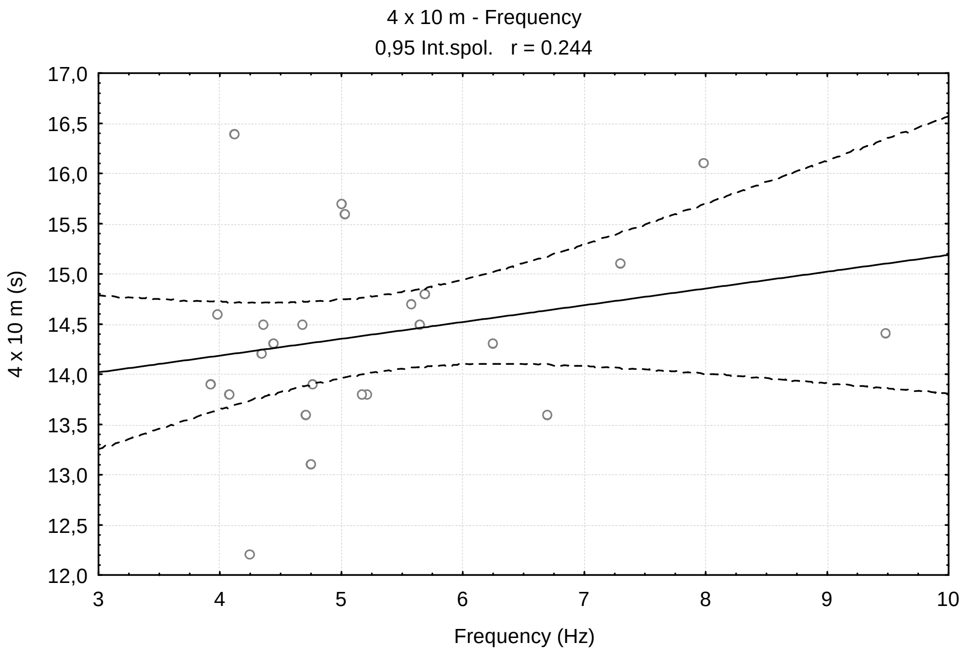

Figure 2. Analysis of relationships between the 4 x 10m shuttle run and stride frequency in the group of girls.

Authors [3; 12] note a statistically significant difference in intersexual comparison in favor of boys in the test of 4x10 m shuttle run.

In our groups, we found that the difference also results from the different implementation of running in boys which is focused on the stride rate, while girls´ running is focused on the stride length. [12] did not record statistically significant dependence between the 4 x 10m shuttle run and BMI in the group of boys. The authors also note significant dependencies of body height and body weight with speed and strength abilities, except for the 4 x 10m shuttle run.

This was not confirmed in our group of girls and in the group of boys we recorded statistical dependence ($r = 0.333$, $p \leq 0.05$) only between body height and the 4 x 10m shuttle run.

We recorded a statistical dependence in the somatic parameters, which we evaluate as a natural developmental indicator.

When comparing the parameters of speed abilities in intersexual comparison, we note that boys achieve on average better results in the shuttle run with changes of direction (4 x 10m). In the group of girls we recorded a slightly shorter contact time with the pad, but significantly longer flight time in individual step cycles. Boys achieve a higher stride frequency and shorter flight phase and that is the reason why they have a greater number of stride cycles.

In the group of boys we recorded a statistical dependence ($p < 0.01$) between the parameters of speed with changes of direction and frequency of lower limbs. In the group of girls we did not record any statistical dependence between the parameters of speed with changes of direction and frequency.

In the group of boys we recorded significant dependences in the parameters of frequency rate. We also recorded statistically significant dependences between the parameters of frequency rate and running speed with changes of direction, which proves a close relationship between these abilities in the group of boys. Higher body height is shown more as a disadvantage in running with changes of direction.

Our measurements confirmed that mainly boys use frequency abilities in running while girls lengthen their stride at the expense of frequency, so they prefer using take-off power. Implementation of boys´ running seems to be more natural and appropriate, considering the age and level of the children´s assumptions.

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