THE IMPACT OF SOME MORPHOLOGICAL CHARACTERISTICS AND MOTOR ABILITIES TO 60M SPRINT RESULTS OF 13 YEAR'S OLD FEMALE PUPILS

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Original scientific paper

Abstract

Technique, functional and motor abilities are the most responsible for short track running success. The impact of some morphological characteristics and motor abilities to 60m sprint results in elementary school has been researched. Sample N=29 elementary school female pupils aged 13 (±6 months) have been tested with standard tests for tracking pupils development in elementary school. From full battery that consists of 11 tests, 5 tests for: body height, body weight, legs explosive power, flexibility and hand movement frequency speed as predictors, as well as measured 60m sprint result has been used as criterion. The standard statistical procedures and regression have been used. Results show that only long jump has statistically significant positive impact onto 60m sprint result. Research confirmed statistically significant correlation between body weight and 60m sprint result. In the future researches for 60m sprint result prediction and for recruiting pupils in school sport clubs, reduced and reconstructed standard battery should be used.

Key words*: body weight and height, tapping test, long jump test, flexibility test, elementary school*

Introduction

At the beginning of this research many opened questions appeared. One of them was why would anyone want to predict pupils sprint successfulness instead to test a sprint and measure result. Answers arisen quickly. Firstly, teachers are obliged to measure abilities and characteristics at the beginning of each schooling year and they have collected database about each pupil. Secondly, sprint result in elementary school is measured independently from teacher to teacher as a motor achievement and it is not prescribed by legislation. Thirdly, teachers databases about pupil's characteristics and abilities are usually used for schools and athletic sports clubs. Fourthly, sprint measuring process in elementary school is rough and susceptible to timekeepers' error and most often start is performed without starting blocks. Fifthly, measuring require large time consumption due to repetition and small number of measuring devices, while teachers have many other prescribed obligations for other sport technique improvement, as well as for sprinting technique improvement as a very complex and significant part of sprint result. There are many researches about relations and impact of motor abilities onto running disciplines results. (Pavlović, 2005, 2006, 2008; Stojiljković S, Pržulj, D, Branković, N. & Pavlović, R.. 2006; Veličković, 2009; Babić & Čoh, 2010; Šolaja i Šolaja, M, Golik-Perić, D, Kovačević, R. & Petrović, M.. 2010). Sprint is fast and short trail running. Running is cyclic motor activity, which consist of recurring racing steps and belongs to elementary movement forms. Sprint is one of the most important element of many different sports disciplines, tennis for example, in which sprint practicing on athletic track improve players' performance (Burcar, 2014). Final result in sprint depends on the reaction rate on the start, the ability of showing speed in the shortest possible time and by keeping the maximum reached speed until the finish line. The 60m sprint comprises five separate but interlinked components which the athlete must be trained to recognize, understand and practice. *Reaction time:* The athlete is required to make a rapid physical response to the external stimulus of the starting pistol. Reaction time is measured by the time taken between the introduction of the stimulus and the first muscular reaction or movement performed by the athlete. *Starting ability:* The ability to clear the starting-blocks cleanly and powerfully is crucial to success.

The athlete must adopt a mechanically sound starting position and generate great power in order to overcome inertial and frictional forces in the opening strides. *Acceleration:* The athlete must accelerate from the start to maximum velocity in as short a time as possible. A low body position should be maintained in the first 15-20m. The athlete must then strive to increase velocity. *Maintaining speed:* Maintenance of horizontal speed may be achieved through a mechanically sound striding technique, which allows an equal emphasis on work performed behind and in front of the centre of mass (e.g. 'high knees in front, full leg extension behind').*Overcoming deceleration:* The athlete must stay relaxed but strive to resist an inevitable decline in velocity in the final stages of the sprint performance. There should be an emphasis on work performed ahead of the centre of mass (e.g. 'high knees, high hands in front'). Further, the most important factors for sprint high results are technique, alternative movement speed, explosive power, and maximum force of attempted movement. It is believed that the functional and motor abilities are the most responsible for success in short trail running (Homenkov 1977, Milanović 2007, Mihajlović & Tončev, 2008).

Sprint phases, start and starting acceleration, run at maximum speed (achieving and maintaining maximum speed) and deceleration phase (crossing the finish line) explain Babić (2005, 2007, 2008). Performance and result for sprint depend on explosive power and this type of power Milanović (1993) defined as a capability which enables the giving off maximum acceleration to the body. Mihajlović (1996) and Željaskov (2004) explained that high results in running on short distance achieved female athlete with different morphological characteristics. Although in recent times increase in average height and other dimensions of the body at the top sprinters has been observed. General strict prescription for systematic sprint training does not exist but sprint researches among pupils indicate examinee sample between 3rd and 10th year of age (Babić, Blažević & Radetić, 2011). On the other hand athletes usually begin with specialized sprint training between 13th and 18th year of age and only 13.5 % begin after 19. (Tabačnik, Žadan & Sultanov, 1977). Sprint technique in elementary school does not differ from usual sprint sport technique, but differs depending on educational resources, measuring tools and start blocks. Sprint training volume in elementary school cover only basic needs for spreading the basic kinematical knowledge in regular education. Elementary school in Croatia is based on 8 grades. Pupils start at the age of 6-7 (±6 months) and finish at the age of 13-14 (±6 months). They start physical education in the first grade. Burcar (2012) indicates total amount of regular sport practicing included in national curriculum varies between 4725 minutes/year (105 hours/year) to 3150 minutes/year (70 hour/year). According to Plan and program for elementary schools (2006) fast run up to 20m is prescribed in the 1st grade, fast run up to 30m in the 2nd grade and up to 40m in the 3rd grade but all from high starting position. In the 4th grade 50m fast run from the middle starting position is included. Fast running – sprinting up to 60 m from the low starting position is prescribed in the curriculum for the 5th grade of elementary school. Fast running - sprinting is offered in higher grades through various themes in Module named running. Burcar (2012) concluded, that in Croatian educational system pupils' anthropological characteristics have been tracked a long time ago, but systematically from the year 1992 when normative values have been revealed (according Findak, 1992, 1996) with the purpose of tracking changes and evaluation of teaching process as well as checking the level of some motor, functional and morphological characteristics of pupils. Full battery consists of eleven instruments for estimation anthropological characteristics: 6 tests for basic motor ability, 1 test for functional and 4 tests for morphological characteristics. The goal of this paper is to research the impact of five measured anthropological characteristics and motor abilities to female pupils result in 60m sprint running in elementary school, performed from low starting position. Relations between measured abilities and characteristics to sprint results have been examined. Results can be useful to practitioners, athletic trainers for timely recruitment using collected data from elementary school teacher.

Methods

In this study, standard tests suggested for elementary school teachers in Republic of Croatia for tracking motor abilities and anthropometric status, published in "Overview of physical and health education 5th to 8th grade of elementary school", based on standard tests according to Gredelj, Metikoš, Hošek & Momirović (1975), have been used. Burcar (2012) in his research about impact of motor abilities to high jump result, from full battery consisting of 11 instruments extracted 5 tests that will be appropriate for this research as well (Table 1): AVT (body height), ATT (body weight), MTR (hand tapping), MSD (long jump from the position) and MPR (body bend). Result in 60m sprint has been measured as dependent variable. Sample N=29, that presents 13 years old (±6 moths) female pupils in 7th grade of elementary school is intentional (Šošić, 2001). Results have been collected during regular physical education classes. Results have been organized in Microsoft Excel and computed in Statistica for Windows. Firstly, basic statistics have been used. Mean as a measure of central tendency and standard deviation as a measure of variability, minimum and maximum of results have been used as well as median and mod. Correlations between variables have been computed. Secondly the Kolmogorov-Smirnov test was carried out showing that all the variables were normally distributed. After preliminary processing procedures relations between predictor variables and criterion were determined by regression analysis. Dilemma about using regression analyzes arise based on sample size of respondents and number of predictors. Statistica for Windows manual suggests that most authors recommend 10 times bigger sample size of examinees than the number of independent variables, but we are inclined to opinion of Green (1991) that numerous rules-of-thumb have been suggested for determining the minimum number of subjects required to conduct regression analyses. These rules-of-thumb are evaluated by comparing their results against those based on power analyses for tests of hypotheses of multiple and partial correlations. The results did not support the use of rules-of-thumb that simply specify some constant (e.g., 100 subjects) as the minimum number of subjects or a minimum ratio of number of subjects (N) to number of predictors (m). In this research, one hypothesis has been tested: H_1 Impact of measured anthropological characteristics to high jump result exists.

Table 1. List of variables

Variable (name)
AVT - body height
ATT - body weight
MTR – leading hand tapping
MSD – long jump
MPR – body bend with spread legs

Results

In this study by using statistical modules, all data have been computed with descriptive statistics, correlations determination and regression analyses. All results shown in Table 2 are distributed according to normal distribution tested with Kolmogorov-Smirnov test presented in Table 3. Average height is 160 cm and average weight is 53 kg. Average result for tapping in 15'' is 37 taps, for long jump average result is 145 cm, for body bend is 62.6 cm and average result in 60m sprint is 11,37". Differences between minimum and maximum results in measured height and weight, according to standard deviation, show morphological differences between pupils of this age, which was expected for this age group. Difference between pupils in long jump is between 97 and 200 cm and in 60m sprint between 8,86 and 14,29 seconds.

Table 2. Results of descriptive Statistics

	Mean	Median	Minimum	Maximum	Std.Dev.
AVT	159,90	160,00	149,00	174,00	6,11
ATT	52,62	50,00	37,00	77,00	9,39
MTR	36,66	36,00	29,00	50,00	4,31
MSD	144,59	150,00	97,00	200,00	26,16
MPR	62,59	56,00	25,00	90,00	15,63
S60	11,37	11,11	8,86	14,29	1,34

AVT - body height; ATT - body weight; MTR - leading hand tapping; MSD - long jump; MPR - body bend; S60 - sprint 60m result

Table 3. Results of Kolmogorov-Smirnov normality test

VAR	AVT	ATT	MTR	MSD	MPR	S60
K-S d	0,74	0,13	0,08	0,13	0,17	0,18
p	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

K-S d – Kolmogorov-Smirnov test for normality; p – level of significance, n.s. – not significant

Results presented in correlation matrix with statistical significance on the level of conclusion 95%, was shown in Table 4. Correlation between body height (AVT) and body weight (ATT) is significant (0.39). Significant negative correlation (-0,55) was shown between body weight (ATT) and long jump (MSD) what is expected. Significant correlation (0,38) between leading hand tapping (MTR) and body bend (MPR) arisen and surprised us.

Significant correlation (0,43) between 60m sprint (S60) and body weight (ATT) and negative significant correlation (-0,59) between long jump result (MSD) and 60m sprint (S60) was strongly expected. Results of regression analyses for 3 motor ability tests and 2 tests for morphological characteristics presented in Table 5 show the impact of only one variable to the 60m sprint result for female pupils in elementary school. The group of selected tests explain only 38% of variance ($p<0.04$) in 60m sprint successfulness of 13 (±6 months) years old female pupils.

Table 4. Results of Correlations: Marked correlations are significant at $p < .05000$.

	AVT	ATT	MTR	MSD	MPR	S60
AVT	1,00					
ATT	0,39	1,00				
MTR	-0,16	-0,24	1,00			
MSD	-0,20	-0,55	0,36	1,00		
MPR	-0,17	-0,20	0,38	0,36	1,00	
S60	0,09	0,43	-0,27	-0,59	-0,12	1,00

AVT - body height; ATT - body weight; MTR - leading hand tapping; MSD - long jump; MPR - body bend; S60 - sprint 60m result; p - level of significance.

Table 5. Results of Regression Summary for Dependent Variable: S60

	R= 0.62 R^2= 0.38 Adjusted R^2= 0.25 F(5,23)=2.85 p<.03815 Std.Error of estimate: 1.16					
Variables	Beta	St.Err.of Beta	B	St. Err. of B	t(19)	p-level
AVT	-0,07	0,18	-0,02	0,04	-0,39	0,70
ATT	0,18	0,21	0,03	0,03	0,86	0,40
MTR	-0,10	0,18	-0,03	0,06	-0,56	0,58
MSD	-0,51	0,21	-0,03	0,01	-2,42	0,02
MPR	0,13	0,18	0,01	0,02	0,69	0,50

R - correlation; R^2 - coefficient of determination; Adjusted R^2 - adjusted coefficient of determination; F - value of F-test; p - significance level of F-test; Beta - partial standard coefficient of regression; St. Err of Beta - Standard error for coefficient of regression; B - independent contributions of each independent variable to the prediction of the dependent variable; p-level - value of significance threshold; AVT - body height; ATT - body weight; MTR - leading hand tapping; MSD - long jump; MPR - body bend; S60 - sprint 60m result.

As it was assumed, because of explosive power in a background, the result of regression factor for MSD (Beta=-0.51) (B=-0.03), guide us to conclusion that long jump result tested with standard test, has the highest impact to 60 meters female pupils sprint result. From other results we can explain that we can find some trends but we can not made conclusions without relevant significant statistical indicators.

Discussion and conclusion

Running is cyclic motor activity that belongs to elementary movement forms. Sprinting is demanding motor skill with regard to coordination (Luhtanen & Komi, 1978). The most important success factors for a short track run are: technique, speed of alternative movements, explosive power and maximum force of attempted movement (Homenkov 1977, Milanović 2007, Mihajlović & Tončev, 2008). Most of the authors in their research papers for motor speed claim that the innateness coefficient is 0,95%, which means that the variability of these capabilities can be possibly improved only about 5% (Wilmore & Costill, 1994). Several conclusions can be drawn from the findings of this research. Firstly, the determination coefficient (Table 5) shows questionable explanatory power (R^2=0.38) and hypothesis H_1 can be compromised because the coefficient of determination the criterion and used battery of

tests has only 38% common relations. The remaining 62% of common variability in explaining the criterion contain other dimensions of anthropological area, which was not the subject of research in this study. This used, reduced standard battery should be modified in a future before that can be applicable for 60m sprint result prediction in elementary school. Secondly, this study shows low but expected statistically significant correlations on the level of conclusion 95%, between body height and body weight, what is in line with many researches. 60m sprint result is in significant correlation on the level of conclusion 95% with body weight (ATT) which means that lighter runners have better sprint results. Further, 60m sprint is in significant negative correlation with long jump (MSD) what is expected, because leg explosive power in the background of starting explosive execution as a base of successful start and starting acceleration, explained by Babić (2005, 2007, 2008) in her studies. Almost significant results in correlation matrix (0,36) arisen between long jump (MSD) and: body bend (MPR) and hand tapping (MTR) where we expected explainable significance.

Thirdly, according to regression analyses, it can be concluded that results of this study show impact of only 1 variable as motor abilities measurement onto the result in 60m sprint for female pupils in primary school. Result of regression factor for long jump guides to conclusion that long jump result tested with standard test, has impact to 60m sprint result for this sample of respondents. This seems to be logical because in both explosive power is beside this different activities. As it was assumed, leg explosive power has impact to final 60m sprint result what is in line with many previous studies (Homenkov 1977, Milanović 2007, Mihajlović & Tončev, 2008). It can be concluded that results in tapping test with leading hand, for leading hand movement frequency speed, has not statistically significant impact to 60m sprint result, what partially surprised us, because of movement frequency speed in a background of the MTR test. The same goes to body height where we expected significant impact because some recent studies suggest increasing of body height in the female sprinters sample (Pavlović & Stević). Quite contrary, Dintiman *et al.* (1997) concluded that athletes possessing shorter legs seem to have an advantage over athletes with long legs. Regression analyses for body bend result lead us to conclusion that flexibility does not predict 60m sprint result regardless how important flexibility is for basic body preparation and how hamstrings flexibility is important for sprint running technique. All of these findings we accepted but future researches will be applicable because of small statistically significant result in partial standard coefficient of regression. For future studies bigger sample of respondents would be suggested and revision of tests included in battery as well. Further, tests from CROFIT norms as 60m sprint successfulness predictor would be welcomed. Finally, in practice these findings can help teachers to decrease number of testing and evaluating hours, to professional trainers for simple recruiting in the school athletic sports teams as well as athletics sport clubs and to researchers to extract better battery for 60m sprint prediction in elementary school. Practical open question arises, do teachers in elementary school need to test booth, long jump test and 60m sprint to fulfill clear picture abut pupil's capabilities, or only one of them? Testing only one of them can probably open more time for practicing other techniques, for example starting technique, running through the curve, acceleration technique or can preserve more time for other motor learning processes or stretching. Or, 60m sprint can simply still be one of the most motivating and interesting class or school athletic competition.

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UTJECAJ NEKIH MORFOLOŠKIH KARAKTERISTIKA I MOTORIČKIH SPOSOBNOSTI NA REZULTATE U SPRINTU NA 60M KOD 13 GODINA STARIH UČENICA

Sažetak

Tehnika, funkcionalne i motoričke sposobnosti najodgovornije su za uspjeh u trčanju na kratke staze. U ovom radu istraživan je utjecaj nekim morfoloških karakteristika i motoričkih sposobnosti na rezultat sprinta 60 metara. Uzorak ispitanika N=29 učenica osnovne škole, starosti 13 godina (±6 mjeseci) testiran je standardnom baterijom testova koja koristi učitelju za praćenje razvoja učenika u osnovnoj školi. Iz cjelokupne baterije koja sadrži 11 testova, korišteno je 5 testova za : visinu, težinu, eksplozivnu snagu nogu, gibljivost i brzinu frekvencije pokreta ruke kao prediktori i rezultat sprinta na 60 metara kao kriterij. Rezultati su obrađeni standardnim statističkim postupcima i regresijskom analizom. Rezultati pokazuju da jedino skok u dalj s mjesta ima pozitivan statistički značajan utjecaj na rezultat sprinta na 60 metara. Istraživanje potvrđuje statistički značajnu korelaciju težine tijela sa rezultatom sprinta na 60 m. Za buduća istraživanja u svrhu predviđanja rezultata sprinta na 60m, kao pomoćnog alata za regrutiranju učenika u atletske škole, trebalo bi koristiti reduciranu i revidiranu bateriju testova.

***Ključne riječi**: visina i težina tijela, taping, sprint 60m, gibljivost, osnovna škola*

Received: October 11, 2015
Accepted: December 05, 2015
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