THE IMPACT OF SOME MORPHOLOGICAL CHARACTERISTICS AND MOTOR ABILITIES TO HIGH JUMP RESULTS OF 14 YEAR'S OLD PUPILS

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Original scientific paper

Abstract

Physical education teacher's databases are usually used for clubs recruitment. The impact of some morphological characteristics and motor abilities to scissors high jump results in elementary school has been researched. Sample N=25 elementary school male pupils aged 14 (±6 months) have been tested by 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 high jump result has been used as criterion. The standard statistical procedures and regression have been used. Results show that body height, tapping and long jump have statistically significant positive impact to high jump result. Research confirmed correlations of the predictor with the result in high jump. Reduced standard battery can be applicable for high jump result prediction and for recruiting pupils in school sport clubs.

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 arises. One of them is why somebody won't to predict high jump result of the pupils instead to test a high jump and measure result. Answers arise 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, high jump result in elementary school is measured on scissors technique, and flop technique is prescribed for 8th grade. Thirdly, teachers databases about pupil's characteristics and abilities are usually used for schools and athletic sports clubs. Fourthly, measuring scale for high jump in elementary school is rough (5cm). Fifthly, teachers have numerous prescribed obligations with a lack of time for complex technique improvement, as well as for high jump technique as a significant part of high jump result. High jump as a sport technique is prescribed in Croatian plan and program for elementary school (2006). On the other hand, general prescription for systematic high jump training told us that orientationally beginning is between 11th and 12th year of age (Martin, 1982), when pupils are in 5th or 6th grade. High jump technique in elementary school differ from usual sport technique depending on educational demands that are related with training volume and needs for spread and 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. 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) two techniques of high jump have to be learned, scissors technique from 5th to 8th grade and flop technique in 8th grade. Performance and result for both techniques in global depend on: explosive power defined by Milanović (1993) as capability which enables the giving off maximum acceleration to the body, flexibility defined by Milanović (1993) as capability for movement performing with maximum amplitude and body height. Furthermore, performance of high jumpers depends on run-up velocity, take-off action as well as optimal flight trajectory (Blažević, Antelković, & Mejovšek, 2006). Nowadays, the take-off in athletic events leads up to an explosive execution – a short and strong contact with the ground (Langer, & Langerova, 2008). Most researchers agreed about technique as a vital part of high jump result, but kinematics tracked on elite high jumpers shoves individual motion patterns and impacts of different segmental motions to the whole body movement (Ritzdorf, 1989.; Brüggemann, Loch, 1992.; Hommel, 1993.). 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 (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 impact of five measured anthropological characteristics and motor abilities to pupils high jump result in elementary school, performed with scissor technique. Relations between measured abilities and characteristics to scissors high jump results have been examined. As well as, results can be useful to practitioners,

athletic trainers for timely recruitment using collected data from elementary school teacher, because time is unrecoverable resource and it not reasonable to perform multiplying tests when collection of data exists.

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. From full battery consisting of 11 instruments, 5 tests have been used (Table 1): ATV (body height), ATT (body weight), MTR (hand tapping), MSD (long jump from the position) and MPR (body bend). Result in high jump with scissors technique has been measured as dependent variable. Sample N=25, that presents 14 years old (±6 moths) male pupils in 8th grade of elementary school is intentional (Šošić, 2001). Results have been collected during physical education classes. Results have been 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. Dilema about using regression analyse arrise based on sample size of respondents and number of predictors. Statistica for Windiws manuel sugest that most authors recommendent 10 times bigger sample size of examinees than the number of independent variables, but we are inclined to oppinion 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
MTD – 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 168 cm and average weight is 62 kg. Average result for tapping in 15'' is 38 taps, for long jump average result is 173 cm, for body bend is 54.4 cm and average result in high jump is 120 cm. 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. Difference between pupils in long jump is between 115 and 235 cm and in high jump between 80 and 145 cm.

Table 2. Results of descriptive Statistics

Variable	Valid N	Mean	Median	Minimum	Maximum	Std.Dev.
ATV	25	168.08	167	147	183	7.99
ATT	25	61.92	58	43	95	14.49
MTR	25	37.96	38	31	47	4.00
MSD	25	173.56	180	115	235	36.00
MPR	25	54.44	55	35	85	13.45
SVS	25	119.6	120	80	145	16.64

ATV - body height; ATT - body weight; MTR - leading hand tapping; MSD - long jump; MPR - body bend; SVS - high jump result

Table 3. Results of Kolmogorov-Smirnov test

VAR	ATV	ATT	MTR	MSD	MPR	SVS
K-S d	0.5	0.11	0.12	0.1	0.1	0.63
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 statistically significance on the level of conclusion 95%, was shown in Table 4. Correlation between body height (ATV) and body weight (ATT) is significant (0.54). High and significant correlations are detected between high jump and: body height (ATV, 0.59), leading hand tapping (MTR, 0.50) and long jump (MSD, 0.80).

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

	ATV	ATT	MTR	MSD	MPR	SVS
ATV	1.00					
ATT	0.54	1.00				
MTR	0.30	0.12	1.00			
MSD	0.36	-0.17	0.30	1.00		
MPR	0.10	0.35	-0.02	-0.27	1.00	
SVS	0.59	-0.06	0.50	0.80	-0.29	1.00

ATV - body height; ATT - body weight; MTR - leading hand tapping; MSD - long jump; MPR - body bend; SVS - high jump result; p - level of significance.

Results of regression analyses for 3 motor ability tests and 2 tests for morphological characteristics presented in Table 5 show the impact of three variables to the result in high jump with scissors technique.

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

	R=.091		R^2=0.83			Adjusted R^2=0.78
	F(5.19)=18.41		p<.00000			Std.Error of estimate:7.74
Variables	Beta	St. Err. of Beta	B	St. Err. of B	t(19)	p-level
ATV	0.47	0.13	0.97	0.28	3.45	0.00
ATT	-0.21	0.13	-0.24	0.15	-1.58	0.13
MTR	0.23	0.10	0.95	0.42	2.24	0.04
MSD	0.49	0.12	0.23	0.06	4.13	0.00
MPR	-0.12	0.10	-0.15	0.13	-1.17	0.26

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; ATV - body height; ATT - body weight; MTR - leading hand tapping; MSD - long jump; MPR - body bend; SVS - high jump result.

The group of selected tests explained 83% of variance (p<0.00) in high jump successfulness of 14 (±6 months) years old pupils. As it was assumed, the body height (ATV) of this sample show impact to final high jump result with standard coefficient of regression (Beta=0.35) and with high impact to dependent variable (B=0.97). Tapping test with leading hand (MTR) shows positive impact to high jump (Beta=0.23) (B=0.95). At the same time the result of regression factor for MSD (Beta=0.49) (B=0.23), guide us to conclusion that long jump result tested with standard test, have the highest impact to high jump result. Negative but not significant impact of body weight to high jump result exist (Beta=-0.21; B=-0.24) Hereinafter, results for body bend (MPR) shows small but not significant negative impact to high jump result (Beta=-0.12) (B=-0.15) which is not expected because of scissors technique.

Discussion and conclusion

Several conclusions can be drawn from the findings of this research. Firstly, the determination coefficient (Table 4) shows high explanatory power (R^2=0.83) and hypothesis H_1 can be accepted because this research confirmed general correlations of the predictor variables with the result in high jump. This reduced standard battery can be applicable for high jump result prediction in elementary school with a purpose of selecting children for high jump training in sport clubs. Secondly, this study shows expected statistically significant correlations on the level of conclusion 95%, between body height and body weight, what is expected and in line with many researches. High jump result is in expected significant correlations on the level of conclusion 95% with: a) body height, b) movement frequency speed regardless that horizontal velocity of run-up has to be optimal (Antekolović, Antekolović & Jularić, 2009), and c) explosive power what is in line with explosive execution – a short and strong contact with the ground described by Langer, & Langerova, (2008).

Negative but not statistically significant relation between high jump result and flexibility is not expected because of measured high jump technique – scissors. This can be explained with thesis that pupil's poses explosive power but they do not perform enough stretching during physical education classes. It seems that major activities in curriculum are not focused onto flexibility, what can be one of direction for rethinking the importance of stretching before and after practicing. Thirdly, according to regression analyses, it can be concluded that results of this study shows impact of 3 variables; 2 as motor abilities measurement and one as morphological characteristic measurement onto the result in high jump with scissors technique. As it was assumed, body height has impact to final high jump result what is in line with Milanović, Hofman, Puhanić & Šnajder (1986) findings. It can be concluded that results in tapping test with leading hand, for leading hand movement frequency speed have statistically significant impact to high jump result what can fulfill the picture of most important high jumpers morphological characteristics given by Milanović, Hofman, Puhanić & Šnajder (1986), where speed of alternative movements are ranked as very important for high jump result.

This finding can be accepted but future research will be applicable because of small statistically significant result in partial standard coefficient of regression. Result of regression factor for long jump guides to conclusion that long jump result tested with standard test, has impact to high jump result for this sample of respondents. This seems to be logical because in both explosive power is beside this different type of jumps, and explosive power has influence to vertical velocity. Many authors pointed out that the biggest influence on the height of the jump can be contributed to *vertical velocity of CG at the end of the take-off* (Krazhev et al., 1989; Conrad & Ritzdorf, 1990; Brüggemann & Loch, 1992; Čoh, 1992; Slamka & Moravec, 1999; Dapena, 2000; Greig & Yeadon, 2000. Regression analyses for body bend result lead us to conclusion that flexibility does not predict high jump result regardless how important flexibility is for basic body preparation and how lumbar flexibility is important for flop technique. Furthermore, this result is not expected because of scissors technique where body bend with leg momentum seems to be helpful for this technique. Quite contrary, negative but not statistically significant relation between flexibility and high jump result was shown.

Finally, these findings can help teachers to decrease number of testing hours and professional trainers for simple recruiting in the school athletic sports teams as well as athletics sport clubs. Practical open question arises, do teachers in elementary school need to test booth jumps to fulfill clear picture abut pupil's capabilities, or only one of them? This can open more space for practicing other techniques, for example, high jump flop technique and teachers can spend more time for other motor learning processes or stretching.

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Received: September 27, 2012
Accepted: December 20, 2012
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UTJECAJ NEKIH MORFOLOŠKIH ZNAČAJKI I MOTORIČKIH SPOSOBNOSTI NA REZULTATE SKOKA U VIS 14-GODIŠNJIH UČENIKA

Sažetak

Baze podataka učitelja tjelesnog često se koriste kao osnova regrutiranja učenika u sportske klubove. U ovom radu istražit će se utjecaj nekim morfoloških karakteristika i motoričkih sposobnosti na rezultat skoka u vis tehnikom škare. Uzorak ispitanika N=25 učenika osnovne škole, starosti 14 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 skoka u vis kao kriterij. Rezultati su obrađeni standardnim statističkim postupcima i regresijskom analizom. Rezultati pokazuju da visina, taping rukom i skok u dalj s mjesta imaju pozitivan statistički značajan utjecaj na rezultat skoka u vis. Istraživanje potvrđuje korelaciju prediktora sa rezultatom skoka u vis. Reducirana standardna baterija može biti primijenjena za predviđanje rezultata skoka u vis kao i dobra osnova za bazu podataka za regrutiranje učenika u atletske škole.

Ključne riječi: *visina i težina tijela, taping, skok u dalj, gibljivost, osnovna škola*