RELATIONS BETWEEN SOME ANTHROPOMETRIC DIMENSIONS WITH THE RESULTS ACHIEVED IN SHOT PUT AND JAVELIN THROW

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ABSTRACT

The shot put and the javelin throw are a complex technical discipline that requires a proper execution of the kinetic chain movements, so it is very difficult to determine whether it will be the globe thrower when it starts work with the beginners. In the age of modern technology, when biomechanical analysis is used in prediction of achieving top results in sports, it is desirable to apply the anthropometrical methods in the training process of young children. From this, a need is derived to further explore the morphological features of shot put and javelin throwers, and this research therefore strived to establish a relation between the anthropometric dimensions and the results achieved in shot put and javelin throw. The age of the examinees was 15 years of age (±6 month). The test population encompassed 108 male examinees. The relation between the longitudinal anthropometric dimensions and the results achieved in shot put and javelin throw are presented via predictor system - body height, sitting height, body weight, arm range, arm length, upper arm length, forearm length, hand length, leg length, upper leg length, lower leg length and two criteria systems: results achieved in shot put was one and result achieved in javelin throw was the other. The applied regression analysis showed that there was a statistically significant importance on a level 0.01 in six anthropometric dimensions – sitting height, arm range, arm length, leg length, upper leg length, lower leg length and results achieved in shot put, but there was only one variable that had a statistically significant importance on a level 0.05 with results achieved in javelin throw – sitting height. This research has shown that each of these anthropometric dimensions may be decisive for the accomplishment of a better result. Choosing of this way we can select those children that have a solid base to start the training techniques of the shot put and javelin throw, what will help reduce loss of time and the energy.

Key words: anthropometric dimensions, shot put, javelin throw, relations

INTRODUCTION

One of the major subsystems of sports success in athletics is the proper organization and diagnostics natural characteristics of the organism of children that have relevance to practice athletics. Studies, which were conducted in the javelin and shot put, based on biomechanical analysis and the determination of parameters that are vital for achieving results in these disciplines (Lenz and Rappl, 2010; Tončev, 1991; Stefanović, 1992; **Lanka***,* 1998; Young, 2007; Luhtanen, Blomqvist and Vanttinen, 1997; Terzis and Assoc.,2007; Endo and Assoc., 2008; Kyriazis and Assoc.,2009) and to determine the influence of motoric abilities to achieve results (Pojskić, 2007; Bošnjak, 2006; Tešanović, 2010). A quality selection system in athletics involves selecting those children who have a genetic as well as all the other prerequisites for the development of its resources through well-planned and managed athletic training. It should be noted that the overall evaluation in selecting children for the various branches of athletics should supplement and general professional-level performances of some anthropological characteristics that may be assumed higher predictive value than top athletic results, because we can not disregard trend of biological development, especially anthropometric characteristics. Current knowledge of theory and practice in the field of athletics, which helps to optimize the efficiency of diagnosis of human space, suggests that when it comes to the morphological characteristics, it is necessary to pay attention to body height, body mass and the topological structure of the body, and the selection of athletic throwing should choose children with high levels of longitudinal skeleton dimensionality, movement coordination and explosive power, the great mass of the body and a small amount of subcutaneous adipose tissue (Bošnjak, 2006). Researchers who have studied the research in this area agree that the morphological characteristics are important determinants of success in throwing events (Milanović and Harasin, 2003, Bakarinov, 1990.; Zatciorsky, 2000).

The fact is that in the past twenty years the throwing events for the former Yugoslavia had a top 10 shot putters who threw over 20.50 m, javelin throwers who threw over 75.00 m, from which most of these pitchers was a citizen of Bosnia and Herzegovina or the lead origin from Bosnia and Herzegovina, which was initiated to conduct this research with the aim of obtaining more complete data on the factors and parameters that are critical for achieving results in the throwing events. The aim of the research is to determine the relation between the anthropometric dimensions and the results achieved in the shot put and javelin throw, to attempt to define those that affect the achievement of results and proposed guidelines for the selection of the throwing events.

METHODS

The research was conducted in April and May 2013. The morphological characteristics that have been applied in this study were the following ones: body weight, body height, sitting height, arms range, arm length, upper arm length, forearm length, hand length, leg length, upper leg length, lower leg length, while, for the determination of the result in the shot put, the shot put that weighing 5kg was used and javelin was 600g weight. The reason for selecting a ball and javelin of this weight to avoid hurting of shoulder soft tissues, because the examinees were beginners. Also the ball of 5 kg is the ball which is predicted by IAAF rules for the competitions of these ages.

The anthropometric dimensions variables were measured by the application of the Institutional Biology Program method. To determination of the result in the shot put, the shot put that weighing 5kg was used, the examinees were throwing with glide variant technique. The shot put and javelin throw testing was carried out at the truck and field stadium, while the body weight measured by the Glass Body Fat Scale model, GBF 100 and measuring of the anthropometric dimensions done in accordance with the Martin anthropometer was carried out at the Technical School in Banja Luka. The pupils had a shot put and javelin throw training for 6 weeks – 12 lessons of physical education, planned by the curriculum. All measuring was done in the morning hours, and the shot put and javelin throw testing was done after adequate warming up and stretching exercises. The whole sample was derived from the population of first grade pupils in Banja Luka secondary schools, with the total of 12 schools. The chronological age of the examinees was between 6 months below or above 15 years of age. The test population encompassed 108 male examinees. All examinees attended the same curriculum and program for secondary schools and did not deal with out-of-school activities.

To process the data, it used the statistical package SPSS 17.0 for Windows. In order to formulate valid conclusions, we calculated the following:

- The regression causality between the anthropometric dimension indicators, and the results achieved in the shot put,
- Regression causality between the anthropometric dimension indicators, and the javelin throwing results.

RESULTS

By analyzing the dispersive parameters presented in table 1, one can observe that the examinees mean value of measured variables is average for this stature.

Table 1 The medium value measuring variables

VARIABLES	MEDIUM VALUE
Body weight	64.1796 ± 1.19667
Body height	1.7558±.00716
Sitting height	91.6204±.39548
Arms range	177.5648±.91923
Arm length	82.5833±.42162
Upper arm length	34.1759±.21206
Forearm length	48.4074±.25948
Hand length	19.5926±.10108
Leg length	97.7963±.44628
Upper leg length	55.7407±.33004
Lower leg length	42.0556±.29705
Shot put	8.6268±.13688
Javelin throw	21.3050±.57642

Table 2 Regression analysis (dependent variable: shot put)

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
(Constant)	-7.573	2.711		-2.794	.006
Body height	-2.990	3.761	-.156	-.795	.429
Body weight	.033	.011	.293	3.155	**.002**
Sitting height	.168	.048	.485	3.488	**.001**
Arms range	.022	.024	.148	.934	.352
R=.678 R^2 =.459 F=21.858 p=.000					
(Constant)	-5.273	2.618		-2.014	.047
Arm length	.104	.046	.320	2.276	**.025**
Leg length	.054	.043	.177	1.260	.211
R=.473 R^2 =.224 F=15.130 p=.000					
(Constant)	-4.334	2.433		-1.781	.078
Forearm length	.204	.078	.388	2.637	**.010**
Upper arm length	.046	.071	.071	.647	.519
Hand length	.076	.197	.056	.387	.700
R=.480 R^2 =.231 F=10.393 p=.000					
(Constant)	-4.338	2.643		-1.641	.104
Lower leg length	.117	.041	.254	2.883	**.005**
Upper leg length	.144	.036	.348	3.958	**.000**
R=.433 R^2 =.187 F=12.105 p=.000					
Total					
R=.697 R^2 =.486 F=10.277 p=.000					

Looking at variables independently (table 2), it could be noted that statistically important influence on results achievement in shot put could have variables sitting height, body weight, forearm length, upper leg length and lower leg length at 0.01 level, while at 0.05 level it has been shown that variable arm length is statistically important. Too, regression analyses shown that looking at systems it could be noted that system Body height-Body weight-Sitting height-Arms range could have 45.9% quota in results achieving at shot put, system arm length-leg length 22.4%, system Forearm length-Upper arm length-Hand length 23.1% and system lower leg length-upper leg length 18.7%. Considering all variables as one system that is a part in conduction of the kinetic chain of shot put technique, it could be noted that it can contribute to results at shot put 48.6%.

Table 3 Regression analysis (dependent variable: javelin throw)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-1.477	14.747		-.100	.920
Body height	3.164	20.463	.039	.155	.877
Body weight	.068	.058	.140	1.170	.245
Sitting height	.528	.262	.363	2.017	**.046**
Arms range	-.200	.128	-.319	-1.558	.122
	R=.312	**R^2 =.097**	**F=2.777**	**p=.031**	
(Constant)	9.907	12.462		.795	.428
Arm length	.012	.217	.009	.056	.955
Leg length	.106	.205	.082	.517	.606
	R=.089	**R^2 =.008**	**F=.424**	**p=.656**	
(Constant)	7.024	11.502		.611	.543
Forearm length	-.202	.367	-.091	-.550	.584
Upper arm length	-.143	.335	-.053	-.427	.671
Hand length	1.476	.932	.259	1.584	.116
	R=.174	**R^2 =.030**	**F=1.089**	**p=.357**	
(Constant)	9.831	12.289		.800	.426
Lower leg length	.056	.188	.029	.295	.768
Upper leg length	.164	.170	.094	.966	.336
	R=.098	**R^2 =.010**	**F=.513**	**p=.600**	
Total					
	R=.346	**R^2 =.120**	**F=1.484**	**p=.164**	

Looking at variables independently (table 3), it could be noted that statistically important influence on results achievement in javelin throw could have only the variable sitting height at 0.05 level. Too, regression analyses shown that looking at systems it could be noted that the system Body height-Body weight-Sitting height-Arms range could have 9.7% quota in results achieving at javelin throw, system arm length-leg length 0.8%, system Forearm length-Upper arm length-Hand length 0.3% and system lower leg length-upper leg length 0.1%. Considering all variables as one system that is a part in conduction of the kinetic chain of javelin throw technique, it could be noted that it can contribute to results achievement at javelin throw 12%.

DISCUSSION

The results obtained, showed that there is a statistically important influence by the body weight and longitudinal skeleton dimensions - sitting height, forearm length, upper leg length, lower leg length and arm length on the results achieved in shot put. Considering all variables as one system that is a part in conduction of the kinetic chain of shot put technique, it could be determined that morphological characteristics can contribute 48.6% to results achieved at shot put; while residual part represents influence of some other anthropometrical abilities (motor skills, functional, cognitive, conative) and as well exogenous and endogenous factors. At population by age 13-14 it is seen statistical significance of anthropometric dimensions for achieving results in shot put (Petruševska-Aleksovska, 2011). As for the javelin throw, it could be determined that only the variable sitting height can have an influence on results achievement, while all variables as all in one system which helps the conduction of the kinetic chain of javelin throw have negligible influence on results achievement (12%), so the rest of 88% presents influence of some other anthropometrical abilities (motor skills, functional, cognitive, conative) and as well exogenous and endogenous factors. The similar significant non effect of anthropometrical variables in achieving results in javelin throw 25% is deducted by Bošnjak (2006). The statistical significance of longitudinal skeleton dimension for achieving results in the shot put – glide variant technique is associated with a longer range of motion and action of the ball. Longer arm for throwing are longer leverages, which provide a greater range of motion, longer action on the ball and better result. It turned out that the length of the legs has no statistically significant effect on the result achieved, which can be associated with the time of execution of the entire chain of movement. Namely, it is likely that longer legs might increase the time for execution of the entire technique, hence the initial velocity of launchers would be decreased, acting on the ball would be less explosive, which would have worse result. The research indicated that for achieving results in the javelin throw, only sitting height could be significant, which is assumed that body length could influence the result because longer body enables higher motion amplitude in a transition moment from starting run-up into faze of maximum tensile tension ("javelin throw arch") and longer time effecting on the javelin. These results could be affected by a number of classes detached for examinees training, as well as technical abilities of examinees.

CONCLUSION

Research has shown that to achieve results in the shot put, at age 15 years ± 6 months can be critical body weight and some of longitudinal skeleton dimensions - sitting height, forearm length, upper leg length, upper leg length and arm length. As for the javelin throw, it can be concluded that only sitting height can have an impact on results achievements. It can be noted that during conduction of this research, on this sample, is determined that anthropometric dimensions have almost the same proportion in results achievements as all other factors and capabilities, while to achieve results in the javelin throw is vice versa - anthropometric dimensions do not matter, so it is assumed that other skills and factors that may have importance.

In reviewing and drawing conclusions, it must be taken into account the number of training hours, which is insufficient to overcome the throwing technique; but it is a sign that on physical education classes could be created satisfactory base for doing throwing disciplines. These are important information for all teachers of physical education; how should be organized lessons of athletics program realization, during which it should be intensively trained shot put, while javelin throw should not be implemented at this age; and for all

professionals involved in the implementation of athletes training process in order to realize comprehensive training process to mature years, when it will definitely determine discipline for young athletes.

REFERENCES

Bakarinov J.(1990): Theoretical aspetcs of training control for highly qualified

Bošnjak, G. (2006). Relacije antropoloških obeležja sa rezultatskom efikasnošću u bacanju koplja kod srednjoškolske omladine. Doktorska disertacija. Novi Sad: Fakultet fizičke kulture. Univerzitet u Novom Sadu.

Kyriazis,T., Terzis,G., Boudolos,K. & Georgiadis,G. (2009). Muscular power, neuromuscular activation, and performance in shot put athletes at preseason and at competition period. The Journal of Strength & Conditioning Research, 23(6), 1773-1779.

Lanka,L.(1998). Methods for the evaluation of effectiveness and acquired level of shot put technique. 16 International Symposium on Biomechanics in Sports. http://w4.ub.uni-konstanz.de/cpa/article/view/1234

Lenz,A. & Rappl,F. The optimal angle of Release in Shot Put. (http://arxiv.org/abs/1007.3689)

Luhtanen,P., Blomqvist,M. & Vanttinen,T. (1997). A comparison of two elite shot putters using the rotational shot put technique. New studies in athletics, 12(4),25-33.

Milanović, D., Harasin, D. (2003.): Kondicijski trening atletičara bacača. U: D. Zatciorsky,V.M.(2000): Biomechanics in sport. International Olympic Commitee.

Petruševska-Aleksovska,L.(2011). The influence of certain anthropometric variables on the result in the shot put among students of 13-14 years of age. Proceeding book 6th FIEP EUROPEAN CONGRESS, 647-650.

Pojskić, H. (2007.) Utjecaj motoričke spremnosti i morfoloških karakteristika studenata na rezultate ostvarene u određenim bacačkim, skakačkim i trkačkim disciplinama. (www.untz.ba), 2007.

Stefanović,Đ. (1992). Atletika 2. Beograd.

Terzis,G., Karampatsos,G. & Georgiadis,G. (2007). Neuromuscular control and performance in shot-put athletes. The journal of sports medicine and physical fitness, 47(3), 284-290.

Tešanović,G., Mihaljlović,I, Bošnjak, G. and Dragosavljević P.(2010) Relations between the body mass index and the anthropometric dimensions and the results achieved in shot put. Acta Kinesiologica, 4 (2),78-82.

Tončev, I. (1991). Atletika - tehnika i obučavanje. Novi Sad

Young,M. & Li,L. (2005). Determination of Critical Parameters among Elite Female Shot Putters. Sports Biomechanics, 4(2), 131–148.

Zatsiorsky, V. M., Lanka, J. J., Schalmanov, A. A. (1981). Biomechanical Analysis of Shot Put Technique. Exercise and Sport Sciences Reviews, 9, 353-389.