

Some morphological characteristics predictive value at the shot put results in students of Faculty of Sport and Physical Education

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Abstract

Sample for this research consisted of 60 male students attending Faculty of Sport and Physical Education, who by taking the practical classes in II semester fulfilled all requirements to take the shot put exam. 13 anthropometric variables were measured as well as the O'Brien technique shot put result.

Aim of the research was to determine the predictive value of the body longitudinal and transversal dimensionality, circular body mass and subcutaneous tissue (as predictive set) at the shot put result (as criterion) efficiency. Regression analysis results show the significant relation between the predictor and criterion.

Key words: **Shot put, anthropometric measures, students**

Sažetak

Uzorak za ovo istraživanje čine 60 studenata I godine Fakulteta sporta i tjelesnog odgoja muškog spola, koji su zadovoljili kriterijume za polaganje praktičnog ispita iz bacanja kugle, nakon provedenog programa redovne nastave Atletike u II semestru. Izmjereno je 13 antropometrijskih mjera i rezultati u bacanju kugle leđnom (O'Brien) tehnikom.

Cilj istraživanja je bio da se utvrdi prediktivna vrijednost longitudinalne dimenzionalnosti skeleta, transferzalne dimenzionalnosti skeleta, cirkularne dimenzionalnosti sa masom tijela i mjere potkožnog masnog tkiva (kao prediktorski sistem) na rezultatsku efikasnost u bacanju kugle (kao kriterijska varijabla). Regresionom analizom je utvrđena značajna povezanost prediktora i kriterijuma.

Ključne riječi: **bacanje kugle, antropometrijske mjere, studenti**

Introduction

Whole set of the important characteristics exists in students who achieve above average results in shot put, which sets them apart from average and under average quality students. This sets a task before researchers working directly or indirectly in athletic sport to determine the key characteristics influencing further improvement in shot put results. Following the principle to point out dominant abilities, it is necessary, during training, increase the level of those dimensions responsible for the high level result achievement in athletic event.

Throwing events, especially linear technique shot put, although having simple kinematics and dynamic structure (mono-structural movements acyclic type), are insufficiently explained in terms of relations with morphological characteristics and basic-motor abilities (Milanović, 1982), which represents the basis for the subject of this experiment. This research investigated morphological characteristics and linear technique shot put results in male students who attended the classes and passed the shot put exam in II semester of the Faculty of sport and physical education.

Prime interest of this investigation is the area of the morphological characteristics and shot put results. Based at structural, biomechanical and functional parameters, dynamic movement stereotype it can be presumed (besides motor area) determining influence at the shot put results variability of this population.

There is a significant positive influence of the change in release height from 180cm to 240 cm, with constant release angle of 41° and initial shot velocity of 13m/sec at the result improvement of approx. 0,5m (18.93 – 19.48), (Linthorne, 2001).

There is absolute top level Shot put throwers superiority in body height, mass and height-mass index in relation to top level athletes in other throwing events. (Milanović, 1982).

Novak (1972) established anthropometric characteristics of the 32 best Shot put throwers in 1969. As a rule the values of the anthropometric characteristics of the group were less then the values determined by other authors in the throwers of the different quality level:

Height	186.47
Weight	101.50
Chest circumference	107.30
Arm span	196.44
Forearm circumference	35.83
Thigh circumference	64.31
Shoulders diameter	44.31
Pelvic diameter	33.09

Investigations (Homenkov, 1977; Milanović, Hofman, Puhanić, & Šnajder, 1986) show that the shot put efficiency of the high quality throwers is conditioned by superiority in morphological dimensionality measures (body mass, body height, upper arm circumference, hips diameter, leg length and wrist diameter) with exclusion of subcutaneous fatty tissue. Besides this, Shot put results depend on equally activated lower and upper extremities, explosive action, where the regulation of excitation in lower extremities is important.

Hadžikadunić (1981), analyzing 17 anthropometric variables as predictor and shot put result criterion in sample of 86 14-year-old male pupils established that shot put result can be predicted by variables of weight, upper arm and chest circumference.

Table 1. Some anthropometric values significance in relation to shot put efficiency (according to Hofman, 1980)

Morphological, motor, cognitive and functional characteristics	Measure of significance
1. MORPHOLOGICAL CHARACTERISTICS	
1.1 longitudinal dimensionality of the skeleton	+5
1.2 transversal dimensionality of the skeleton	+5
1.3 volume and body mass	+5
1.4 subcutaneous fatty tissue	-3

Methods

Sample of the examinees

Research was conducted at the sample of 60 male students attending Faculty of Sport and Physical Education, 20 to 25-year-old, in 2007/2008 academic year. The sample included examinees that were at the moment of testing clinically healthy. Final results processing was performed at the examinees that successfully learned O' Brien shot put technique.

Morphological characteristics assessment instruments

Longitudinal dimensionality of the skeleton:

1. Body height in mm	AVIST
2. Sitting height in mm	ASJEV
3. Leg length in mm	ADNOG

Transversal dimensionality of the skeleton:

4. Shoulder diameter in mm	AŠRAM
5. Pelvis diameter in mm	AŠKAR
6. Hip diameter in mm	AŠKUK

Circular dimensionality and body mass:

7. Middle circumference of the chest in mm	AOGRK
8. Upper arm circumference in mm	AONDL
9. Forearm circumference in mm	AOPDL
10. Body mass in kg	ATEŽT

Subcutaneous fatty tissue:

11. Abdominal skinfold in mm	ANTRB
12. Thigh skin skinfold mm	ANNAT
13. Lower leg skinfold in mm	ANPTK

Suggested anthropometric measures sample model was taken based at the recommendation of the International Biological Program (Lohman, Roche, & Martorell, 1988).

Variables of the Shot put result efficiency assessment (criterion)

- O' Brien technique Shot put result

Data analysis

In order to gain data and make conclusions we calculated:

- Central and dispersion parameters for each anthropometric measures: mean (MEAN), standard deviation (STD: DEV.), minimal (MIN) and maximal (MAX) numeric result. Statistic processing was performed at all morphological characteristics and shot put result.
- Measure discriminative value was determined by two methods:
 - Skewness (SKEW.) &
 - Kurtosis (KURT.).
- Relations of the anthropometric measures of the morphological characteristics were determined using algorithm of the multivariate linear regression analysis in statistical package STATISTICA 12.0 for Windows, which contains parameters of : correlation coefficient vector (R), partial correlation coefficient vector (PART.R.), standardized partial regression coefficient vector (BETA), beta coefficient significance Q (BETA), determination coefficient, as a measure of joint variability between criterion variable and system of predictor variables, which influence the subject of study (DELTA), multiple correlation coefficient between criterion variable and system of predictor variables (RO), level of F-relation (F) and significance of F-relation (Q).

Results and Discussion

Basic statistic parameters of anthropometric measures

Determination of the central and dispersion parameters (Table 2.), confirm the hypothesis of normal distribution and satisfying sensitivity of the applied anthropometric measures. Between minimal (MIN.) and maximal (MAX) results there are more than six standard deviations (STD.DEV.), so it can be concluded that anthropometric measures have satisfying sensitivity, or discriminative value.

Table 2. Basic statistic parameters for the assessment of the morphological characteristics

Var.	N	Mean	Min.	Max.	Std. Dev	St. Error	Skewn.	Kurtos.
AVIST	60	181.18	167.50	194.20	6.75	.872	.223	-.846
ASJEV	60	94.71	87.50	104.30	3.41	.441	.594	.299
ADNOG	60	104.26	95.30	115.40	4.93	.636	.137	-.644
AŠRAM	60	41.82	38.60	47.30	1.70	.220	.331	.480
AŠKUK	60	33.28	29.50	38.80	1.89	.244	.406	.712
AŠKAR	60	29.20	26.80	34.00	1.81	.233	.553	-.032
AOGRK	60	104.52	89.00	113.00	5.90	.762	-.057	-.923
AONDL	60	30.93	26.90	41.00	2.95	.381	.197	.083
AOPDL	60	28.31	25.12	33.40	2.81	.363	.908	1.102
AKNTR	60	8.21	4.20	30.20	4.25	.549	.520	.850
ANNAT	60	10.09	4.00	23.40	4.53	.585	.682	.401
ANPTK	60	7.10	3.00	17.20	3.41	.440	.362	-.430
ATEŽT	60	77.76	55.30	99.00	9.13	1.178	.041	-.224

Basic statistic parameters of O'Brien technique Shot put results

Central dispersion parameters values of the Shot put (Table 3) confirm the hypothesis of normal distribution and satisfying sensitivity. Between minimal (MIN.) and maximal (MAX) results there

are more than six standard deviations (STD.DEV.), so it can be concluded that shot put results have satisfying sensitivity, or discriminative value.

Table 3. Basic statistic parameters for the assessment of the O'Brien technique shot put results

Var.	N	Mean	Min.	Max.	Std. Dev.	St. Error	Skewn.	Kurtos.
REZK	60	857.15	663,00	1225.00	111.29	14.712	.672	1.785

Regression analysis of the shot put using anthropometric measures

Knowledge of size and influence of each success elements in certain athletic event represents so called equation of athletic event specification. Equation of specification represent hierarchically defined structure of most important values (anthropological characteristics) for which we presume high predictive value in relation to top level athletic results.

Table 4. Predictive value of the morphological characteristics and O'Brien technique Shot put efficiency (REZK)

Variable	R	Part-R	Beta	Q (Beta)
AVIST	.47	.35	.386	.015*
ASJEV	.55	.12	.161	.338
ADNOG	.76	.07	.242	.481
AŠRAM	.64	.15	.221	.147
AŠKUK	.70	.17	.353	.111
AŠKAR	.77	.11	.245	.307
AOGRK	.15	.24	.479	.001*
AONDL	.48	.36	.363	.012*
AOPDL	.12	-.18	-.394	.010*
ATEŽT	-.21	-.14	-.341	.036*
ANTRB	.57	-.28	-.443	.014*
ANNAT	-.37	-.19	-.354	.031*
ANPTK	-.46	-.24	-.408	.002*

RO	DELTA	F-test	Q
.69	.48	3.18	.023

Results of regression analysis in table 4 show that the possibility of the prognosis of the Shot put results - REZK (as criterion variable) based at anthropometric measures (as predictor set) is statistically significant at multivariate level, which probability result (Q=.023) confirms. Results of criterion variable and anthropometric set have 48% joint information which can be seen from coefficient of determination (DELTA), and confirms multiple correlation coefficients (RO) with high value .69. Rest of the criterion and predictor variability (52%) belongs to motor abilities and some other characteristics not included in this research.

Results of the regression coefficients (Beta) and their significance Q(Beta) implies that at univariate level statistically significant predictive value at shot put results have longitudinal dimensionality of the skeleton (body height AVIST = .015), predictor measure of circular dimensionality and body mass (middle circumference of the chest AOGRK .001, upper arm circumference AONDL .012, forearm circumference AOPDL .010, body mass

ATEŽT .036) and negative influence of subcutaneous fatty tissue (abdominal skinfold ANTRB .014, thigh skinfold ANNAT .031, lower leg skinfold ANPTK .002). Other measures of the longitudinal dimensionality of the skeleton (sitting height ASJEV, Leg length ADNOG) and transversal dimensionality of the skeleton (shoulder diameter AŠRAM, pelvis diameter AŠKUK, hip diameter AŠKAR) don't have statistically significant explanation of the shot put results.

The best result in shot put is achieved when the release height of the shot is as much above the ground. Considering that the release height depends on throwers height and arm length, this factor remains as the relevant point of each thrower.

Based at total results of standardized partial regression coefficient vector Beta and Q(Beta) it can be concluded that the examinees with higher level of longitudinal and circular dimensionality will have high predictive power at the criterion variable success prognosis. Negative influence in the explanation of the variability of the shot put criterion variable have subcutaneous fatty tissue measures which in shot put result in motor inefficiency and under production of sport results.

In comparison with the students of sport in Belgrade (1975) and Niš (1991), results of the Sarajevo Faculty of Sport and Physical Education students show higher values of longitudinal, transversal and circular dimensionality, and lower values in area of subcutaneous fatty tissue measures, which shows the positive growth of the morphological characteristics level of the student population. This surely is influenced by acceleration in growth and development in last years as a consequence of good living conditions and other factors.

It has been known that shot put throwers are characterized by strong muscles, high body mass, emphasized longitudinal and transversal skeleton measures, and for that they are considered as muscular body type. Shot put, during release acts with force (force of inertia) at the hand and other parts and the force has counter direction than its velocity direction. This force is directly dependent on body mass and its velocity (Mikić, 2004). In this research sample of the examinees consists of Faculty of Sport and Physical Education students and is not selected for the shot put. Theirs transversal dimensionality of skeleton (diameter of shoulders, pelvis and hips) were not according to the model characteristics of selected shot put throwers. It can be presumed that in this investigation for this reason there was no statistically significant influence of transversal dimensionality at the shot put efficiency.

Examinees with higher level of skeleton longitudinal dimensionality are able to apply force at longer path, which increases the possibility to have higher velocity during release. Also, higher measures of longitudinal dimensionality unable higher release height, which is one of the factor that influence shot put length.

The best result in shot put is achieved when the release height of the shot is as much above the ground. Considering that the release height depends on throwers height and arm length, this factor remains as the relevant point of each thrower.

Throwers with larger circumferences of certain body segments are able to produce higher force and as a consequence longer shot flight.

Conclusion

For the research of the morphological characteristics of the Faculty of Sport and Physical Education students, 13 anthropometric variables were measured as well as the O'Brien technique shot put result. Sample for this research consisted of 60 male students attending Faculty of Sport and Physical Education in Sarajevo, who passed the shot put exam. Aim of the research was to determine the relations of the morphological characteristics (as predictive set) with the shot put result (as criterion) in students. In relation to previous research (Schmolinski, 1978; Milanović, Hofman, Puhanić, & Šnajder, 1986) results are largely confirmed, except the relations of transversal skeleton dimensionality with criterion variable. Influence of the measures of the transversal skeleton dimensionality with shot put results in previous research was found in selected sample of throwers with high level of sport achievements. Distinction of the research sample, which is characterized by low level of shot put technique knowledge, as well as the non selection for the shot put event, is the reason for different research findings. Transversal measures which in shot put unable better balance in some important phases, are most important at higher level of the results, while in students there were no statistically significant predictive values.

Of course anthropometric measures are insufficient in determining the parameters of the athlete's physical condition (Hraski, Mejovšek, Antekolović, & Dobrila, 2003).

Throwers with larger circumferences of certain body segments are able to produce higher force and as a consequence longer shot flight.

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