POWER AS A FACTOR OF SUCCESSFUL RESULTS IN SHOTPUT

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Abstract

Motor parameters in this study are defined by space forces (explosive, repetitive, static); the total included nine predictor variables in order to determine their impact on the performance of a score shot put. The study included 40 male subjects, students of FFVS, in East Sarajevo. As a multivariate method for determining the research objectives one applied regression analysis and calculated the relevant parameters. The results confirmed the statistical significant effect on the power aspects of a score success throwing the balls in the group. On the basis of the research findings analysis one can reach an overall conclusion that the subjects with better results achieved in the variables of power, have also achieved better results in shotput, performed by the rational technique. In this case, there is a direct influence of the mechanism of the duration of excitation and the intensity of excitation, as relevant indicators of the success in shotput.

Keywords: *students of sport, explosive power, repetitive power, static power, predictor variables, criterion variable, regression analysis*

INTRODUCTION

Power as a basic motor ability has always attracted the attention of the experts and scientists, more than any other motor ability. There are more than one reason for this interest. First of all, no movement can be executed without, at least minimal participation of some form of power. Secondly, there is the inevitable fact that power in men's evolution has always played a vital role in his survival, because primarily with the power man could resist and overcome the dangers lurking on him. Thirdly, power is man's characteristics that was decisive in war waging. Fourthly, power is the ability that substantially influences the achievement of sports results in various sports (martial arts, sports gymnastics, sports games, athletics, etc. (Verhošanskiy, 1979; Nićin, 2000).

Power as a motor ability is a multidimensional phenomenon. Taking this into consideration we can differentiate between the action (explosive, repetitive, static) and topological (arms and shoulders, power of the trunk, power of the legs) division of the power (Nićin, 2000; Stojiljković, 2003). All three action factors of power are more or less primary in the realization of different motor tasks and different movements forms. Participation of these factors varies and depends on the type of activities, that is on the type of the task, where the power is going to manifest itself. For example, explosive power is dominant in the activities where in the shortest time possible, one should execute short, strong and quick movements (running, throwing, jumps…), repetitive power (power of the repeated work), as one of the forms of power which prevails in long lasting activities of the moderate intesity (long distance running, sports games, martial arts, cycling, swimming, etc.), static power (activities where one needs endurance – some elements of sports gymnastics, weight lifting, etc. (Pavlović, 2010).

There is a large number of research studies where power is taken as a prerequisite in implementation of various motor taks with high statistical significance (Babiak,1974; Šturm,

1975; Smajić, 1976; Milanović, 1980). Also, numerous authors (Ropret, 1969; Schpenke, 1973; Milanović, 1976, 1979; Čalija, 1977; Milanović, 1982; Zagorac, Kordić, & Katić, 1988; Stojanović, & Radić, 2003), have tackled the problem of the influence of the motor and morphological parameters on the success in results in shotput, in different populations.

Shotput belongs to derived forms of movements, and dominant influence on the success in results achievement is attributed to certain morphological dimensions, first of all to the body mass, body voluminosity and skeleton longitudinality. Also, in shotput there are some parameters, that is, motor abilities that exert remarkable influences on the results success in shotput. Those parameters are motor abilities, primarily velocity, coordination and balance. Top results achievement in athletics is possible by combining scientific research findings and application of contemporary training methods.

Results obtained in researching certain athletic disciplines should be placed toward function of finding the best possibilities for most efficient training processes implementation (Milić, 1982). Such a manner of work contributes to the significant improvement of the athletic results, and this is the main aim and purpose of each and every training work (Bompa, 1994). Practical approach to the problems of athletics can not provide successful resolving of the extremely complex expert and scientific problems of the athletics discipline in general, nor its problems of the practice in the individual athletic disciplines. To illustrate this statement, we should observe the process of selection and classification of the prospective candidates who are to be included into the athletic sport, as well as programming and control of the training processes of the single disciplines, which have to rely substantially on the results of the extensive body of research, oriented towards determination of the relation of certain psycho-somatic characteristics and single athletic disciplines (Prokop, 1973; Tončev, 1988).

This paper represents an analysis of one of the throwing disciplines (shotput) with the aim to determine predictive validity of the battery of the basic tests of power (explosive, repetitive, static) in relation to the results efficiency in shotput (criterium variable). The structure of the rest of dynamic parameters is composed of muscle forces that a thrower develops and manifests in the course of motor activities, and the realised forces that are present during the throw, and are the result of the inertness of mass and reactive interaction of the basis and throw (Tončev, 2000; Jovović, 2006). On the basis of the all before mentioned, and having in mind the effect of power in different motor activities, this research should contribute toward finding the answer to the question of power influence on results efficiency in shotput, within the students population. *Research subject* is the motor area, that is, the influence of the power variable (explosive, repetitive, static) on the result in shotput. *Research aim* is to determine the scope of the influence of the applied set of variables of power on the resuls efficiency in shotput, as well as its statistical significance on the given level.

METHODS

Subjet sample

Subject sample was composed of the third year male students population that were taking practical part of exam in Athletics I. Total number of students subjected to measurements and evaluation was 40.

Sample of variables

Predicting set of variables was defined with 9 variables divided into three sets:

1. *Explosive power* (Standing long jump – MSDM; Triple standing jump - MTRS; Sargent test- MSAR).

2. *Repetitive power* (Bar grip - MZGV; Trunk lift on bench - MDTK; Squat with load 2/3 (MDČO).

3. *Static power* (Hang grip – MVIS; Load endurance in half squat ½ -MIZP); Load endurance in arm flexion 30 kg - MITF).

Criterium variable is shotput (MBKUG) performed by O'Braen technique weight of 7,257 kg. Results in shotput were obtained within the colloquium taking (norm) and executed by the rules of the international athletic competitions. All subjects were performing throwings three times each, and each individual was registered by his best result, expressed in centimeters. All numeric values were processed by means of the univariant method, with the calculations of the basic central and dispersion parameters. In order to calculate the influence and correlations of the results among the contrasting sets of variables, we have applied regression analysis within which relevant regression parameters were calculated.

RESULTS AND DISCUSSION

The obtained values of the majority of the parameters of the applied motor variables show that it is the case of the normal Gaus division. In the range of the minimal and maximal results there are enough standard deviations, which in

turn, enables the conclusion on high sensitivity of the variables, researched in this paper. By analysing values of SD, the least homogeneity, that is, the least deviation from AS is seen in the variable of the repetitive power and the variable high jump, when explosive power is in question. Somewhat higher values of SD were shown in other values of the predicting set (Table 1.). Based on the analysis of CV, predicting and criterium variables have shown good homogeneity of the results. The least varying in the results, that is, the best homogeneity of the students, is in the realization of the tasks of explosive power in the standing long jump and triple standing jump (5.34-6.17), and also in criterium variable (7.74-9.72).

Central and dispersion parameters of criteria have also shown a normal distribution. (Table 2.). Mean value is 950 cm, Min. 780 cm and max. results 1320 cm. Within these values there is a range of 540 cm which points out to a relativelly heterogenous group, in terms of the results, so CV% is bigger, too.

Defined system of nine tests of power (explosive, repetitive and static) has reached significant correlation with the results success in shotput (Ro=.88), whereby 60% of common information was defined (R^2=59%), and with high degree of certainty, one can assume that there is high correlation between predictors and criterium variables on a high level of statistical significance p=.000 (Table 3.). Therefore, a chosen set of predictors is a valid represent of the power and its manifestations in the motor area. Other 41% in explaining the total variability of the criterium variables MKUG, is attributed to

Table 1. Basic statistical parameters of predictive variables

Variables	*As*	*Med*	*Min*	*Max*	*Rasp*	*SD*	*Skew*	*Kurt*	*CV %*
MSDM	246.03	248.00	210.00	280.00	70.00	13.14	-.44	.56	5.34
MTRS	753.49	760.00	645.00	886.00	241.00	46.51	-.12	-.27	6.17
MSAR	53.85	53.50	38.00	79.00	41.00	8.06	.33	.07	14.97
MZGV	10.50	10.00	3.00	20.00	17.00	3.15	.42	.48	30.00
MDTK	28.16	29.50	10.00	48.00	38.00	6.76	.08	.80	24.00
MDČO	22.76	21.00	9.00	50.00	41.00	7.82	.53	.29	34.36
MVIS	64.83	63.80	20.00	99.00	79.00	19.61	-.02	-.85	30.25
MIZP	85.68	81.96	40.08	185.00	144.92	26.81	.93	1.64	31.29
MITF	66.52	61.86	26.60	143.85	117.25	21.77	.97	1.24	32.73

Table 2. Basic statistical parameters of criterium variable MBKUG

Variable	*AS*	*Min*	*Max*	*Rang*	*SD*	*Skew*	*Kurt*	*CV %*
MBKUG	950	780	1320	540	2.34	1.11	1.75	24.63

Table 3. Regression analysis for criterium variable MBKUG

	BETA	*Part.Cor*	*t(31)*	*p-level*
Intercpt			12.198	.000
MSDM	-.095	-.078	-.879	.081
MTRS	.072	.056	.634	.527
MSAR	-.168	-.243	-.812	.006
MZGV	-.232	-.123	-1.397	.065
MDTK	-.243	-.253	-1.034	.034
MDCO	-.348	-.151	-1.719	.008
MVIS	-.250	-.145	-1.143	.003
MIZP	.303	.110	1.339	.008
MITF	-.219	-.020	-1.229	.019

Ro= .883 *R^2= .590* *p<.000*

Table 4. Analysis of Variance MBKUG

	Sums of Squares	*df*	*Mean Squares*	*F*	p-level
Regress.	249.40	9	27.712	2.891	.000
Residual	424.26	31	3.367		
Total	673.67				

other dimensions, foremost to all morphological dimensions, especially voluminosity and body mass, as well as the longitudinality. It is well known that in the throwing disciplines body mass has a big influence where bigger mass exerts effect on smaller mass (shot), so in this area, a power of the absolute type is exerted.

The obtained results give statistically significant influence in explaining of the criterium variable by means of the system of predicting variables (p=.000), therefore we can conclude that system impacts the obtained result in criterium variable MBKUG. After a detailed analysis of the values of regression coefficients (BETA), it is clearly seen that, for the anticipation of results in shotput, significant variables of static power are (MVIS, MIZP, MITF) as leading represents, then variables of the repetitive power (MZGV, MDTK, MDČO) and the explosive power (MSDM, MSAR). Only the variable MTRS did not show statistically significant correlation. Value of the partial coefficients shows also significant correlations of the predicting motor variables with criterium ones. The biggest individual contribution (t) to the explanation of the criteria was assigned to the variables of static power (MIZP, MITF, MVIS), then follow the variables of the repetitive power. In explosive power only the variable MTRS did not show significant correlation on a given level.

On the basis of all afore mentioned it is possible to conclude that for the successful results in shotput (MBKUG), significant contribution is given by the students with high values in variables, primarily, static and repetitive power, and the least in the variables of the explosive power. Also, the analysis of variance has confirmed significant inluence and differences of the residual and regression variability (Table 4.), which confirms direct linear stochastic model of regression function. It can be assumed that it is all about latent dimension that in the previous research (Milanović, 1976; Babiak, 1979; Tončev, 1988) was identified as a factor of the power of the absolute type, dependent on the functioning of regulation of excitation lasting, in locomotor apparatus central and periferal zones. It is obvious that results in shotput, performed by the rational technique, according to the results of this research, directly depend on static and repetitive power, and partly on the explosive power.

However, although it is not represented in our research, it is not to forget that latent dimensions of the morphological area, voluminosity and body mass, are significant factors in achieving successful results in shotput (Smajić, 1976). Also, prominent part plays a skeleton longitudinality. That can be seen if we analyse elite shotputters, their ratio of body height and body mass. Shotputters possess great body height and body mass. They have the absolute power which manifests during the glide of the implement, when the bigger mass of the shotputter is acted on the smaller mass of the shotput (Branković and Bubanj, 1997; Pavlović, 2010).

Judging by the height and body mass of the throwers, shotputters are in advantegous position over the javelin throwers, who are somewhat shorter, and of smaller body mass. It was also noticed that body mass is bigger in the throwers who throw implements of greater weight and this is in positive correlation with the results success (Stefanović, 1992). Limbs in most throwers are long and of strong musculature. Athletic throws belong to the group of balistic movements where one in the space catapult athletic implements in order to achieve the longest shot. Throws are initiated by the explosive activation of the muscle agonists (Stojanović and Radić, 2003), whereafter follows the period of their relaxation, and are finished by the period of deceleration, due to the activation of the muscles antagonists or passive extension of the connective tissue.

Most researchers that have investigated the area of the morphological characteristics agree on the fact that throwers have, in comparison to other athlets, greater quantity of muscle mass, so according to Sheldon's classification they are closest to the mezomorphe type. Weight ranges from 110-120 kg for men, and 85-95 kg for women. Average height ranges from 187-194 cm in men, and 178-183 cm in women. In javelin throw discipline except from the quantity of subcutane adipose tissue that restricts success, as a significant predictor there are no variables in morphological area (Milanović, 1982).

Important influence on the variability of the athletic throws area is exerted by some parameters of the balance factors, which is conditioned by the characteristic one-support positions, which focus is on absolute balance in the tandem of the thrower and the implement. In shot-

put maximal power is not dominant, as is the case in shotput and discus, but a domineering precision and speed coordination that enables gliding of the javelin under certain angle and the angle of longitudinal axis of the athletic implement. Since the energy capacity consumes the alactate-anaerobic energy.

CONCLUSION

With the aim of investigating and determining the influence and relation of the power as a dominant motor ability in throwing discplines, a research study was conducted on the sample of students. Total number of subjects who participated in the research was 40, male, aged 21 ± 6. Research aim was to determine the influence of the types of power (predicting) on the results success in shotput (criterium variable). Applied regression analysis has shown statistically significant multiple correlations with the predicting variable.

On the basis of the research findings analysis one can reach an overall conclusion that the subjects with better results achieved in the variables of power, have also achieved better results in shotput, performed by the rational technique. In this case, there is a direct influence of the mechanism of the duration of excitation and the intensity of excitation, as relevant indicators of the success in shotput. Although there was no definition of the area of morphological dimensions, primarily of the voluminosity and body mass, results that were obtained by this research, give confirmation of the correlation and mutual influence found between the tests for the estimation of power and shotput, while the rest of 40% encompasses the influence of the morphological dimensions.

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СНАГАТА КАКО ФАКТОР НА УСПЕШНИТЕ РЕЗУЛТАТИ ПРИ ФРЛАЊЕТО НА ЌУЛЕ

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(Оригинален научен труд)

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Апстракт

Во рамките на моторните параметри во ова истражување е дефиниран просторот на мускулната снага (експлозивна, репетитивна, статичка). Во истражувањето вкупно се применети девет предикторски варијабли со цел да се утврди нивното влијание врз успехот на резултатите при фрлањето на ќуле. Истражувањето е реализирано со 40 испитаници, студенти од машки пол на Факултетот за физичко воспитување и спорт во Источно Сараево. Податоците од истражувањето се обработени со регресивна анализа. Добиените резултати, укажаа на статистички значајно влијание на видовите мускулна снага врз успехот на резултатите при фрлањето на ќуле. Врз основа на нивната анализа може да се донесе еден генерален заклучок дека испитаниците со подобри постигнати резултати во применетите тестови за проценување на снагата остварile подобари резултати во фрлањето на ќуле со рационална техника. Притоа, постои директно влијание на механизмот за траење и интензитетот на ексцитацијата како релевантни показатели за успешноста при фрлањето на ќуле.

Клучни зборови: *студенти по спорт, експлозивна снага, репетитивна снага, статичка снага, предикторски варијабли, критериумска варијабла, регресивна анализа*

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