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EFFECT OF MOTORIC SPACE ON EXPLOSIVE STRENGTH OF LOWER EXTREMITIES IN BOYS

ABSTRAKT

In a sample of 70 seventh-grade male students from Belgrade attending primary school Marija Bursać a research was carried out to assess the effect of motoric space on the hypothetical motoric factor for the assessment of explosive strength of lower extremities. By the Linear regression analysis there was revealed a statistically significant effect of the predictor system (motoric factors) on the criterion. Based on the value of the standardized coefficients Beta the largest and statistically significant effect on the criterion variable was made by the variables which evaluate the hypothetical motoric factor of agility, subordinate to the functional mechanism for structuring of movement and hypothetical motoric factors of the static muscle strength of arms and shouldersand static muscle strength ofthe hand flexor, subordinate to the functional mechanism for the regulation of excitation. Statistically significant effect was not achieved regarding the functional mechanism for synergetic regulation and regulation of muscle tone.

Keywords*:* motoric, boys, linear regression analysis

1. INTRODUCTION

Movement expressions of the human are diverse, there is practically unlimited number of possible movements of different kinematic and dynamic structures that are simultaneously determined by some complex internal factors. The movement is perceived visually and expressed with some physical quantities - length, time, altitude, etc.. However it is important to note that the manifest forms of motion can be expressed primarily due to some hidden (latent) abilities of an individual that are impossible to be measured directly, but the existence of their presence can be felt (Bala, Stojanovic, Stojanovic, 2007). One of the main goals of kinesiology itself is among other determining the functional mechanisms responsible for latent motoric dimensions of man.

In the essence of every programmed and accurately determined physical activity there is a large number of physiological and metabolic processes. A body involved in a physical activity in such a manner respond with changes in almost all physiological systems, primarily musculoskeletal, cardiovascular, respiratory, endocrine and immune system (Mišigoj-Durakovic, 2006).

Given that the explosive strength belongs to the factor of the functional mechanism for the regulation of excitation intensity, and it was scientifically proven to be genetically quite predestined with 80% (the impact with the kinesiology treatment is still present) and to

have a specific feature of a general type, which in the field of physical education and sport has a huge role, and in practice that means that an individual who has a strong service in volleyball would have good jumping ability, and somewhat rapid change of direction. The explosive strength with its existence fulfills each equation of the specification in any movement activity which is agonology (competitive) directed.

Research conducted by (Stojanovic, Nikolic and Nesic, 2006) supports the effect of morphological characteristics on the explosive strength on a sample of 40 male volleyball players aged 13. They took nine anthropometric measures as a system of predictor variables and 3 motoricic tests to assess explosive strength. By regression analysis the existence of the effect of the system of predictors on the criterion was confirmed, which allows to securely predict the results in manifestation of the explosive strength (the mechanism for the regulation of excitation intensity).

On a representative stratified sample consisted of 49 sport dancers divided into subsamples of 25 girls and 24 boys Lukic, Bijelic, Zagorc and Zuhrić-Sebic (2011) investigated the importance of the effect of strength on the technique of performance in sport dancing. By regression analysis it was determined teh existence of a statistically significant effect of strength on performance of Latin American dances, and a statistical significance of the effect of the strength on the performance of standard dances was not determined In a sample of 42 students of Faculty of Kinesiology of the University of Split, Rogulj, Foretić, Srhoj, Cavala and Papic (2007) analyzed the effect of basic motoric abilities on the speed of the ball in handball. The system of predictors consisted of 8 variables for assessing agility, speed, frequency of motion, endurance and explosive and repetitive strength, while the speed of the ball as the criterion variable was assessed with a radar gun. The results of the regression analyzes indicate that the motoric efficiency to a great extent determines the efficiency of the speed of the ball. Individually analyzed the speed of the ball is statistically determined only with the explosive strength. This is understandable because this motoric ability from the kinesiological and anatomical point of view (in terms of the kinetic chain and sequence of movements) defines the result of the speed of the ball.

The strength of children decreases as they grow and get heavier. This especially happens in puberty in the period of rapid growth and development. Most often the strength of children in childhood and puberty decreases because during maturation the muscles of an adult produce more power per unit weight. So, in childhood there are two simultaneous processes going on with different effects - growth (increase in body size) and maturation. Due to growth the strength decreases, while at the same time it increases due to maturation. The superposition of the two processes determines the increase or decrease of the demonstrated strength, and their interaction in the development of a child is very important (Zatsiorsky, Kraemer, 2009).

The aim of the research is to determine which of the hypothetical motoric factors most affect the expression of the motoric factor of explosive strength of the lower extremities of children aged 13 and 14 from Belgrade.

2. METHOD

For the purpose of the research will be used empirical and statistical methods. The research will be of transversal character (it implies only one measurement on a sample of schoolchildren from Belgrade). A non-experimental research design will be applied, that is *ex post facto design*.

The research was conducted on a sample of 70 male subjects who attended the seventh grade of primary school Marija Bursac in Belgrade, aged 13 and 14. To assess the motoric space as the predictor system there were applied seven motoric variables that covered following hypothetical motoric models. The motoric model of functional mechanism for synergistic regulation and regulation of muscle tone which is superior to the hypothetical motoric factor of the general equilibrium was assessed with the motoric test *Flamingo balance test* (MFLAMI); the hypothetical motoric factor of the speed of alternative hand movements with the motoric test *Hand tapping test* (MTAPRU) and the factor of mobility in the hip joint with the motoric factor *Forward bend in sitting test* (MPRETS). The motoric model of the functional mechanism for the regulation of excitation duration which is superior to the hypothetical motoric factor of the static strength of the hand flexor muscles with the motoric test *Hand grip* (MSTSAK); the hypothetical motoric factor of the repetitive body muscles strength and the flexor in the hip joint with the motoric test *Body lifting in 30 seconds* (MPODTR) and the motoric factor of the static strength of the muscles of the arms and shoulder with the motoric test *Endurance in pull-ups* (MIZDZG). The motoric model of the functional mechanism for structuring of movement which is superior to the hypothetical motoric factor for assessment of agility was assessed with the motoric test *Pin running 10x5 meters* (MT10X5).

The functional mechanism for the regulation of excitation intensity superior to the hypothetical motoric factor of the explosive strength of the leg extensor muscle as a criterion variable in this paper is assessed with the motoric test *Standing long jump* (MSKODA).

The modified "Eurofit" battery of tests prescribed by the Committee for the Development of Sport of the Council of Europe was applied (Council of Europe, 1993).

Statistical data processing with the Kinesiology statistics will be carried out in several stages:

1) For all variables were determined the descriptive statistics, of the measures of central tendency: the arithmetic mean (AM), median (M), the modal value (MOD), of the measures of variability: the standard deviation (S), the minimum value of the results (MIN), maximum value of the results (MAX), and of the measures of the forms of distribution: the measure of symmetry of distribution-skewness (SKEW) and the measure of homogeneity of distribution-kurtosis (KURT).

2) Then the normality of distribution for all variables using the Kolmogorov-Smirnov test was tested.

3) With the linear regression analysis there was determined the effect of the set of hypothetical motoric factors (which presented the system of independent variables in this paper) on the assessment of the motoric factor which is based on the mechanism for the regulation of excitation intensity for the

assessment of explosive strength of the lower extremities in male children (as the criterion variable in the paper).

3. RESULTS

Table 1. DESCRIPTIVE STATISTICS OF MOTORIC VARIABLES

VARIABLE	AM	M	MOD	S	MIN	MAX	SKEW	KURT
MFLAMI	16,44	16,00	20	6,340	6	30	0,280	-809
MTAPRU	12,300	12,200	13,0	1,1890	10,0	15,0	0,200	-414
MPRETS	17,30	15,00	12	7,498	8	40	1,018	0,346
MSKODA	172,04	171,50	161	25,241	114	221	-231	-557
MSTSAK	32,83	30,00	26	9,299	19	64	0,992	0,754
MPODTR	24,29	24,50	25	3,620	17	33	0,192	-503
MIZDZG	17,159	13,650	1,0	11,7240	1,0	60,0	1,286	1,807
MT10X5	20,797	20,250	19,0	2,1164	16,8	25,7	0,702	-112

Legend: AM-arithmetic mean; M-central value; MOD-the most frequent value; S-standardn deviation; MIN-minimum value of results; MAX-maximum value of results; SKEW-measure of symmetry of distribution; KURT-measure of homogeneity of distribution.

Table 1. shows the measures of central tendency, the measures of variability and the measures of distribution shapes of the tested motoric variables. Based on the measures of asymmetry of distribution (Skewness) and their coefficients it can be seen that all skewness values have a positive sign and that it is below 1.00, except for the variables: *Forward bend in sitting* (MPRETS) 1.018 and the variable *Endurance in pull-ups* (MIZDZG) which have slightly higher value of 1.286. This suggests a grouping of the results in the zone of lower values and a slight positive asymmetry of these variables, which may indicate the severity of the motoric test in this sample of subjects, since the arithmetic mean, the median and the mode are in the zone of lower values. Mild negative skewness value is observed in the criterion variable *Standing long jump* (MSKODA) -0.231 which indicates a slight grouping of the results in the zone of higher values. Based on the measures of homogeneity (Kurtosis) it can also be seen from Table 1 that the variables which have a negative sign and a mild platicurtic distribution, and that indicates the increased dispersion of the results, that is, slightly reduced homogeneity. This is expressed in the following variables: *Flamingo balance test* (MFLAMI), *Hand tapping* (MTAPRU), *Standing long jump* (MSKODA), *Body lifting* (MPODTR) and *Pin running 10x5* (MT10X5). In the variables *Forward bend in sitting* (MPRETS), *Hand grip* (MSTSAK) and *Endurance in pull-ups* (MIZDZG) there can be seen a positive curtic distribution ie. (leptocurtic distribution) in which is expressed the grouping of the measurement results around the arithmetic mean, that is increased homogeneity of the measurement results in the three mentioned variables.

Table 2. KOLMOGOROV – SMIRNOV TEST OF NORMALITY OF DISTRIBUTION

VARIABLE	KS	MEA	p
MFLAMI	0,891	0,106	0,406
MTAPRU	0,444	0,053	0,989
MPRETS	1,486	0,178	0,024
MSKODA	0,531	0,063	0,941
MSTSAK	1,217	0,145	0,103
MPODTR	0,780	0,093	0,577
MIZDZG	1,314	0,157	0,063
MT10X5	1,135	0,136	0,152

Legend: KS-value of Kolmogorov-Smirnov test; MEA-absolute extreme deviation; P-statistic significance for KS-test.

From Table 2. based on (MEA) absolute extreme deviation, the values of the Kolmogorov-Smirnov coefficient (KS) and the significance of two-way testing for KS coefficient (p) it can be seen that all KS values are above the value of the absolute extreme deviation, and the statistical significance of the two-way testing above the values 0.01. Based on the above it can be concluded that the distributions in all variables do not differ statistically significantly from the normal distribution. With the review of the statistical significance of the variable: Forward bend in sitting (MPRETS) and the variable *Endurance in pull-ups* (MIZDZG) it can be seen that in these variables deviation occurs most. This can be seen by ordinary inspection of the coefficients for assessment of the shape of distribution. For the purposes of this research it is sufficient that the distribution of the tested variables do not statistically significantly differs from the theoretical distribution.

Table 3. STATISTICS OF LINEAR REGRESSION ANALYSIS OF CRITERION VARIABLE

VARIABLE	r	rpart.	Beta	t	p
MFLAMI	-0,366	-0,197	-0,149	-1,585	0,118
MTAPRU	-0,357	-0,183	-0,133	-1,466	0,148
MPRETS	0,268	0,177	0,123	1,418	0,161
MSTSAK	0,178	0,247	**0,182**	2,008	**0,049**
MPODTR	0,440	0,027	0,024	0,213	0,832
MIZDZG	0,451	0,248	**0,199**	2,011	**0,049**
MT10X5	-0,665	-0,465	**-0,459**	-4,140	**0,000**
	R=0,757	R^2=0,573	F=11,865	P=**0,00**	

Legend: r- Pearson coefficient of correlation; rpart.-coefficient of partial correlation; Beta-standardized regression coefficients; t-distribution; p-level of significance of effect of predictors on criterion; R-coefficient of multiple correlation; R^2-coefficient of determination; F-testing of relations of multiple correlation; P-level of significance of F relations.

We will start the interpretation of the shown results of the linear regression analysis with the values of the coefficient of the multiple correlation, as an indicator of the predictive

value of the system of predctor variables as a whole. From Table 3 we can see a very high value of the coefficient of the multiple correlation (R = 0.757), indicating that the applied system of predictors is statistically significantly associated with the criterion variable. The testing of significance of the multiple correlation of F relation and the level of its significance can be seen that the value of F relation is (F = 11.868) high, and its significance is less than p = 0.01, p = 0.000 respectively. The system of predictor variables explaines 57.3% of thhhe variability of the criterion (R^2 = 0.573) while for the rest of the variability of the criterion variable, which is not included in this research, responsible other characteristics and abilities of the anthropological space of the subjects. The values of the standardized coefficients (Beta), indicate the predictive value of the motoric variables. From Table 3 it can be observed, based on the beta coefficient, that the greatest effect on the criterion variable *Standing long jump* (MSKODA) has the variable *Pin running 10x5* (MT10X5) whose coefficient has a mathematical negative, but logical positive sign, considering it is about the inverse metric -0.459 at the level of significance p = 0.000. Variable *Endurance in pull-ups* (MIZDZG) with Beta coefficient of 0.199, and the variable *Hand grip* (MSTSAK) 0.182 are also statistically significant at the level p = 0.049. It is these variables that show the highest correlation with regular inspection of the Pearson correlation coefficient (r) and partial correlation (rpart.) with the criterion variable, after partialisation of the effect of other variables in the system of predictors.

4. DISCUSSION

Probably the majority of kinesiology experts will agree that one of the most important abilities in most motion activities is explosive strength, the ability to produce maximum force values in a time-limited period. Most of the key movement structures in a large number depends primarily on this ability (fast first step in running, sprinting over short distances, change of direction and pace of movement, performance of high jump and many other movement structures). Understanding and knowledge of the kinanthropology analysis of motion allows us to analyze the performance of movement in humans in terms of muscle contractions. To be able to predict, prevent and eliminate certain lack in respect of the movement structure it is necessary to determine which of the factors most affect and define that structure.

As can be summarized from so far mentioned, the greatest effect on the factor for assessment of the explosive strength of the leg extensor muscle (which, with quite high coefficient, makes specific movement structures) was achieved by the factor for the assessment of the agility with the largest effect, followed by the factor of the static strength of muscles of arms and shoulders and the factor of the static strength of the hand flexors muscles.

Position of the agility in the general motoric space was considered differently. Gredelj et al. (1975) classify agility among the capabilities that are subordinate to the mechanism for structuring of movement, within which are also coordinating abilities and the speed of alternative movements.

Bompa (1999) treats the agility as a combined motoric ability of the fundamental abilities of speed and coordination and explains the high incidence of the agility in the development of the abilitiy of stregth along with the abilities of the maximum strength and maximum speed. Given that the sample of subjects is specific for defining such problems, the major effect of the agility can be explained by the fact that children in addition to the regular practice of physical education also practice additional kinesiology activities included in the training process of complex sports in which the agility dominates (football, basketball). Of course, physical education at this age is practiced in a part of such vacant teaching contents in which the agility is developed. Since the factors of the static muscle

strength of arms and shoulders and hand flexors muscles also influenced the explosive force of the leg extensor muscles in children, it is to assume that one part of the sample is probably involved in a training process in the field of martial arts in which the static strength of these two factors has a big impact. The children may have been subjected to earlier estimates of motoric abilities in sports organizations, and so this also must be taken into account. Internal and external validity of the research was not controlled, nor the sample was randomized (randomly selected) and it cannot certainly be said that there are no children who are involved in different types of training process in the sample. In any case, the usefulness of this research for practice reflects primarily on the help for teachers in schools, who are a link in the chain for the selection in sports. Based on the value of the results obtained there could be planned the majority of the sample for the section of complex and partly polystructural sports within the school if there are conditions for that or direct the children to sports clubs.

5. CONCLUSION

The research was conducted in order to determine which of the hypothetical motoric factors mostly affects the expresion of the motoric factor of the explosive strength of the lower extremities of the seventh grade children aged 13 and 14. Linear regression analysis showed the highest effect of the hypothetical motoric factor of the agility that is subordinate to the functional mechanism for structuring of movement and the hypothetical motoric factors of the static strength of muscles of arms and shoulders and the static stregth of the hand flexor muscles subordinate to the functional mechanism for the regulation of excitation duration. Statistically significant effect was not achieved in terms of the functional mechanism for synergetic regulation and regulation of muscle tone.

It can be concluded that, with increasing of the factors of the explosive strength of the lower extremities, physical education in schools which can be less affected (given that there is a curriculum that is already prescribed) or a training process within the school sections (whose influence can be greater) should be directed and conceived at training the agility, training to increase the static strength of arms and shoulders and the static strength of hand flexor.

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