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**UDK: 796.012.11-053.6**

DOI: 10.7251/SHT1015048O

**THE CANONICAL CORRELATION OF THE FUNCTIONAL ABILITIES WITH THE EXPLOSIVE STRENGTH IN YOUNG ATHLETES****Abstract**

*The research was carried out on a sample of 64 subjects, primary school pupils in Niš, aged 13 years  $\pm$  6 months, who regularly took part in Physical Education classes and trained in additional Physical Education teaching classes. The research problem was to examine statistically significant relations between functional abilities tests and explosive strength of young athletes. The determination of these relations is important in certain sports activities, in order to check and maintain the desired anthropological harmony, to realize the desired training technology and update the program contents. The aim of the research was to determine statistically significant canonical relations between system of functional abilities tests and explosive strength results of the participants, in order to verify harmonization of their development and if it is possible, to determine more valid and more purposeful guidelines of their further anthropological development. For the estimation of functional abilities four tests were applied: Margaria test (FMAR), Pulse frequency after the load (FPPO), Vital capacity of the lungs (FVKPL) and Pulse frequency at rest (FPUM). Explosive strength was also measured by four tests: High Jump from place (MSKV), Long Jump from place (MSDM), Triple jump from place (MTRS) and Medicine ball chest toss (MBMG). The results of canonical correlation analysis have indicated that between functional abilities (as a predictor system) and explosive power (as a criterion system), exist one significant canonical factor and statistically significant connection.*

**Key words:** functional tests, explosive strength, young athletes, canonical correlation analysis.

**1. INTRODUCTION**

Integral development of the anthropological status of young athletes is one the main goals of the training process. Achievement of this goal requires a comprehensive knowledge of the mutual relations and the degree of conditionality of great number of specific anthropological status dimensions.

Knowledge of the internal structure, directions and size of the relations of anthropological characteristics is important in the process of planning and programming of training contents, in order to optimize the training process and enable overall harmonic development of different anthropological dimensions of school children.

Success in achieving sports results is determined by a considerable number of complex abilities, and some among them, such as functional and motor abilities, which can be measured and analyzed, are preconditions for preserving and improving their psychophysical health, as well as for achieving high sports results.

The research into the correlations between functional abilities and achieved results in explosive strength tests, was the subject matter of a large number of research studies conducted on the population of quality athletes (*Kurelić, Momirović, Stojanović, Šturm, Radojević, i Viskić-Štalec, 1975; Heimar i Medved, 1999; Malacko, i Doder, 2008; Malacko, 2010*). It has been shown existence of statistically significant correlations and significant contribution of functional abilities to the achieved results in explosive strength in schoolchildren athletes.

Functional capacity refers to the working capacity of the work involved organs or organ systems, especially the cardiovascular, respiratory, metabolic and regulatory, in stable conditions (homeostasis). It is, in other words, the ability to adapt to the increased demands of work and maintaining of the stability in the regulation and coordination of organs and organ systems.

These abilities are highly complex and depend on numerous factors, first of all on the vegetative nervous and endocrine system. In a physiological sense, they can be described as aerobic and anaerobic abilities. They have a major impact on the results of motor behavior of athletes, since in an appropriate correlation with motor abilities they positively contribute to the achievement of sports results (*Malacko i Rađa 2005*).

Explosive strength is the ability that allows the athlete to achieve maximum acceleration of own body, an object or partner and it is manifested in the activities of throwing and shooting, jumping, hitting and sprint.

The determination of the relations between functional abilities and other segments of anthropological status among which is the explosive strength, at present represents a very current practical and theoretical problem.

There aren't enough studies carried out on the population of young athletes, elementary school students aged 13 years. It can be assumed that at this age there are statistically significant correlations between functional abilities and explosive strength. It would provide reliable data which may be useful for any corrective intervention in the practical implementation of the program of work (*Zdanski i Galić, 2002; Višnjić, 2006*).

The aim of this study was to determine the statistically significant canonical relations between prediction's system of functional abilities and criterion explosive strength's variables at students involved in training process in additional Physical Education classes, in order to verify harmonization of their development and if possible, to determine more valid and more purposeful guidelines for their further anthropological development. By the realization of such an objective one would create possibility to enable the establishment of more rational procedures for more optimal planning, programming and monitoring of the Physical Education and training process classes (*Malacko i Rađa, 2004*).

## 2. METHODS

### The sample of participants

The research was conducted on the sample of 64 subjects, elementary school pupils in Niš, aged 13 years  $\pm$  6 month, who were involved in regular and additional Physical Education teaching process.

### The sample of measuring instruments

For the evaluation of functional abilities, the samples of the following standard tests were applied: Margaria test (FMARG), Pulse frequency after the load (FPPO), Vital capacity of the lungs (FVKPL) and Pulse frequency at rest. These tests were selected according to the research of *Heimer & Medved, 1997*.

Explosive strength was evaluated by using the following tests: High Jump from place (MSKV), Long Jump from place (MSDM), Triple jump from place (MTRS) and Medicine ball chest toss (MBMG). The applied set of variables for explosive strength was taken from the research of *Kurelić et al., 1975*.

### Data processing

In order to determine the relationship between functional abilities and variables for assessment of explosive strength, canonical correlative analysis has been applied, using the statistical package Statistic 7.0.

## 3. RESULTS

**Table 1.** Basic statistical parameters for the evaluation of functional abilities

Testovi	N	Mean	Min.	Max.	St.dev.	Skewn.	Kurtos.
FMAR	64	3.78	3.54	4.05	3.00	0.274	1.320
FPPO	64	85.28	82.00	90.00	2.86	0.314	2.410
FVKP	64	2870.00	2650.00	3180.00	3.52	0.302	1.024
FPUM	64	87.46	84.00	90.00	2.75	0.186	2.013

Legend: arithmetic mean (Mean), minimum (Min), maximum (Max), standard deviation (SD), skewness (Skewn.), kurtosis (Kurtos.)

**Table 2.** Basic statistical parameters for the evaluation of explosive strength

Testovi	N	Mean	Min.	Max.	St.dev.	Skewn.	Kurtos.
MSKV	64	29.42	24.00	34.00	2.52	0.268	1.084
MSDM	64	158.43	136.00	196.00	3.46	0.345	2.236
MTRS	64	498.52	426.00	543.00	3.47	0.342	2.238
MBMG	64	374, 26	346.00	425.00	2.75	0.274	1.453

Legend: arithmetic mean (Mean), minimum (Min), maximum (Max), standard deviation (SD), skewness (Skewn.), kurtosis (Kurtos.)

Based on the results shown in tables 1 and 2, it can be concluded that there isn't statistically significant deviation of the results of the functional abilities (table 1) and explosive strength (table 2) from normal distribution. It is confirmed by the results of the asymmetry of distribution (skjunis) which not exceeding 1.00, which means that the applied tests are not heavy (up to +1.00) nor easy (to -1.00), but correspond to subject population and do not exceed 1.00. Homogeneity of the results (kurtozis) indicates that there is good sensitivity (discrimination of tests), because the obtained values are below 2.75.

**Table 3.** Canonical correlation analysis of functional abilities with explosive strength on the multivariate level

Can R	Can R <sup>2</sup>	Chi-sqr.	Df	P
.68	.48	53.42	64	.00

Legend: coefficient of canonical corellation (Can.R), coefficient of determination (Can.R<sup>2</sup>), Chi-square test (Chi-sqr.), degree of freedom (df.), significance (p- Level)

The results of canonical correlation analysis showed (table 3) that in the relations between predictor system consisted of functional abilities variables and criteria, consisted of variables for assessment of explosive strenght results, was obtained one statistically significant canonical pair obtained (Can R), which with 68% significantly explains the degree of correlation of the predictor with the criteria. The coefficient of determination (Can R<sup>2</sup>) indicates that the percentage of common variance for both sets of variables is 48%. Canonical factor is statistically significant at level P=.00, which is confirmed by a high coefficient of Chi-square test (Chi-sqr.=53.42).

**Table 4.** The structure of statistically significant canonical factors in the system of functional variables

Functional variables	Canonical factors
FMAR	0.78
FPUM	-0.53
FPPO	-0.64
FVKP	0.75

Based on the values of the correlation coefficients of the canonical factors of functional variables (Table 4), it can be concluded that general functional ability of the participants is well defined. This factor shows that the largest projection on the canonical factor has Margaria tes (FMAR 0.78), than to a smaller extent Vital capacity of the lungs (FVKP 0.75) and Puls frequency after the load (FPPO -0.64), and and least by the test Puls frequency at rest (FPUM -0.53).

**Tabela 5.** The structure of statistically significant canonical factors in the system of explosive strength variables

Explosive strength variables	Canonical factors
MSKV	0.75
MSDM	0.79
MTRS	0.64
MBMG	0.58

Based on the values of the canonical factors of correlation coefficients of the explosive strength variables (Table 5), it is indicated that general motor ability of explosive strength is also well defined by the size of the correlation coefficients of the canonical factors of applied tests. This factor shows that the largest projection on the canonical factor has Long Jump from place (MSDM 0.79), than slightly less High Jump from place (MSKV 0.75) and Triple jump from place (MTRS 0.64), and least by test Medicine ball chest toss (MBMG 0.58).

#### 4. DISCUSSION

The results of canonical correlation analysis, shown in tables 3 to 5, show that functional abilities (Margarija test (FMAR), Pulse frequency after the load (FPPO), Vital lung capacity (FVKP) and Pulse frequency at rest (FPUM), as a predictor system, have statistically significant relations with achievements in explosive strength tests: High Jump test (MSKV), Triple jump test (MTRS), Long jump test (MSDM) and Medicine-ball throwing at chest height (MBMG).

According to some researchers (*Heimar and Medved, 1997; Malacko, 2002; Komesis, (2003) Jukić, Milanovic, and Greg, 2008*) functional abilities and efficiency in explosive strength tests are most defined by mechanism of the intensity of the excitation.

The results of scientific research and practical experiences, according to some authors (*Brown, Ferrigno, Santana, 2000; Milanović, 2007; Duraković, 2008*), indicate that for achievement a high level of explosive strength is also necessary a greater activity of neuromuscular system, greater flexibility and ability to relax muscles, the quality of sports techniques and biochemical situations on the outskirts of the locomotor system. It is also confirmed by research conducted by many other authors (*Čoh, 1988; Jerković i Barišić, 1997; Bompa, 2006.*), who excelled in their studies approximately the same parameters of functional abilities which are of a special importance for more efficient expression of explosive strength.

At this age, differentiated explosive power is not yet sufficiently developed, but it is contained in the complexity of morphological dimensions and functional abilities, which just means that they generate explosive power due to increased values of anthropometric measures and functional abilities in regulation of the intensity and duration of excitation.

#### 5. CONCLUSION

The results of the research have indicated a statistically significant relations between functional abilities, as a predictor system, and explosive strength as a criterion, which is indicated by high projection of tests of functional abilities and explosive strength on the canonical factor.

The obtained results of this study may contribute to the rationalization of the training process with young athletes, primary school pupils, so that in additional teaching Physical Education process, a special attention should be paid to the development of those functional abilities which most provide achievement in explosive strength tests, which will contribute to achieving the better sports results.

Furthermore, the obtained results of functional abilities and explosive power will contribute to the individualization of regular and additional physical education process in planning, programming and control of the work in order to the individual abilities and characteristics of young athletes.

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