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**THE EFFECTS OF SPECIFIC PHYSICAL PREPARATION
ON THE DEVELOPMENT OF EXPLOSIVE AND
REPETITIVE STRENGTH IN YOUNG SKIERS****Abstract**

The aim of this research was to determine the effects of training for specific physical preparation on transformation of motor and functional abilities in young skiers. The sample of participants consisted of 28 participants, primary school pupils (members of the Ski center "Stara Planina" from Knjaževac), aged 13 and 14. Motor abilities were defined by dimensions of repetitive strength: trunk lifting on the Swedish bench (MDTK), squats (MČUČ) and push-ups (MSKLE) and explosive strength: standing long jump (MSDM), standing triple jump (MTRS) and tossing a ball (MBLP). Functional abilities were evaluated by tests: Vital lung capacity (FVKPL), Margaria test (FMARG) and Puls frequency after the load (FFPOP). Analysis of variance were calculated at multivariate (MANOVA) and univariate (ANOVA) level. It was determined that at the end of the experimental period under the influence of specific specific physical preparation, there was a statistically significant increase of motor and functional abilities in young skiers at multivariate level.

Key words: *explosive and repetitive strength, functional abilities, multivariate and univariate analysis of variance, young skiers.*

1. INTRODUCTION

Skiing as sport requires great physical and mental efforts of skiers, demanding exceptional agility, coordination, strength and stamina, because in competitive skiing, winners are determined by a hundredth of a second. Skiing is not just lowering down the slope but also includes turning, climbing, walking and falling, during which different groups of muscles participate and which skier must functionally control, regardless of the achieved speed.

Motor abilities are of special importance for achieving significant results in skiing and represent dimensions which are under control of the mechanism of energy regulation: explosive and repetitive strength, basic bodily strength and maximum force of attempted movements (Krsmanovic and Lukman 1993). Among other motor abilities, speed of alternative movements

and speed of simple movements are important. Accuracy, balance, coordination and flexibility have considerably less impact on the result in skiing.

Explosive power is an ability that allows athletes to achieve maximum acceleration of their own body, an object or a partner. This dimension has a dominant role in rapid changes of direction in skiing, during transition from one leg to another with appropriate reflection. Genetic determination of explosive power is 80%, so by training process its increase (except in the period of early school age), can be a little influenced, especially by the following motor exercises: riding on rough terrain, terrain jumps and leap techniques (Krsmanovic 2006).

Repetitive strength is an ability of enduring work, when it is necessary to master certain external load up to 75 % of maximum. If it is about mastering external loads (weight or partner), it is absolute strength, and if an athlete repeatedly masters their own body weight (chin-ups, push-ups) it is relative repetitive strength.

Some researchers (Bompa, 2006, Duraković, 2008) have repeatedly found positive correlation between morphological characteristics and functional abilities and results of explosive and repetitive strength that are realized in training process with young athletes.

Training work is characterized by organized exercises for development of anthropological characteristics and motor knowledge achievement and by constant adaption of work contents, methods, loads and recoveries to the current state of abilities and characteristics, for the achievement of optimum reaction of organism (Krsmanović, 2009).

In this paper, the problem was investigation of the efficiency of specific physical preparation, as process of motoric exercises aimed to development of anthropological characteristics in young skiers.

The aim of the research was to determine statistically significant changes of motor and functional abilities in the final relation in comparison to the initial measurement in participants.

2. METHOD

The sample of participants was composed of 32 young skiers, aged 12 and 13, who were active participants in training process in skier's center "Stara Planina" in Knjaževac.

Motor abilities were evaluated by tests of repetitive strength (trunk lifting on the Swedish bench - MDTK, squats - MČUČ and push-ups - MSKLE) and tests of explosive power (standing long jump - MSDM, standing triple jump - MTRS and tossing a ball - MBLP). Tests of motor abilities were taken from the research of Kurelić and associates, 1975.

For the evaluation of functional abilities, the following tests were applied: Vital lung capacity (FVKPL), Margaria test (FMARG) and pulse frequency after the load (FPPO). Functional tests in this study were taken according to the research of Heimer & Medved, 1997;

During the experimental period which lasted four weeks, participants exercised three times a week per three hours.

The following exercises were applied: Side step test (exercise that improves lateral acceleration and agility due to the strengthening of adductor and abducts muscles, and there-

fore, it is crucial exercise for coordination); Lateral trunk flexion (exercise for strengthening the muscles of lateral sides of trunk because it increases the range of motion in the hips); Depth jumps (exercise for development of explosive and repetitive strength, especially significant at the start of skiing); Trunk extension (exercise for strengthening the muscles of the lower back, while skiing on curving terrain).

To determine quantitative differences of motor and functional abilities of participants between two measurements, analysis of variance at multivariate (MANOVA) and univariate level (ANOVA) was applied. The obtained data were processed by means of the statistical package Statistika 7.0.

3. RESULTS

Table 1. Multivariate analysis of variance of motor abilities of participants

Wilks' Lambda	Rao's F	Q
.136	12.25	.000**

Legend: Bertlet test value (Wilks' Lambda); Rao's F -approximation (Rao's F); the level of significance (Q)

The results of multivariate analysis of variance, shown in table 1, indicate that in motor abilities, there are statistically significant differences between initial and final measurement, because Wilks' Lambda is .136, what by means of Rao's F -approximation of 12.25 gives the significance of differences at the level of significance $Q = .000$. Accordingly, in applied system of motor abilities of the participants were determined significant differences.

Table 2. Univariate analysis of variance of motor abilities of participants

Variables	Measurement	N	Mean	F-relation	P-level
MDTK	IN	32	12.45	5.42	.000**
	FI	32	17.68		
MSKL	IN	32	9.56	4.62	.031*
	FI	32	14.61		
MDTK	IN	32	11.28	6.24	.000**
	FI	32	16.63		
MSDM	IN	32	160.28	5.23	.000**
	FI	32	175.45		
MTRS	IN	32	515.27	1.75	.134
	FI	32	543.46		
MBLP	IN	32	28.36	3.84	.043*
	FI	32	36.35		

Legend: initial measurement (IN); final measurements; arithmetic mean (Mean); F-test coefficient (F-relation); the level of significance (P-level)

In table 2, univariate analysis of variance of motor abilities tests is shown, calculated by comparing results of arithmetic means of the initial and final measurements. Based on the coefficients of F-test (F-relations) and their significance (P Level), it can be noticed that statistically significant difference exists in all tests: lifting troops on the Swedish bench (MDTK 000 **), push-ups MSKL (.031 *), standing long jump (MSDM .000 **) and tossing a ball (MBLP .043 *), except in test standing triple jump (MTRS .134).

Table 3. *Multivariate analysis of variance of functional abilities of participants*

Wilks' Lambda	Rao's R	Q
.182	17.24	.000**

Legend: Bertlet test values (Wilks' Lambda) Rao's F -approximation (Rao's F) and the level of significance (Q)

The results of multivariate analysis of variance, shown in table 3, indicate that in functional abilities there were statistically significant differences, because the Wilks' Lambda coefficient is .182, which by Rao's F-approximation coefficient (17.24) gives a significant difference at the level $Q = .000$. Accordingly, in the applied system of functional abilities of the participants statistically significant differences are determined.

Table 4. *Univariate analysis of variance of functional abilities of participants*

Variables	Measurement	N	Mean	F-relation	P-level
FVKPL	IN	32	3240.00	1.68	.120
	FI	32	3360.00		
FMARG	IN	32	4.25	4.62	.041*
	FI	32	3.56		
FPPOP	IN	32	178	5.42	.000**
	FI	32	166		

Legend: initial measurement (IN); final measurements; arithmetic mean (Mean); F-test coefficient (F-relation); the level of significance (P-level)

In table 4, univariate analysis of variance of functional abilities tests is shown, obtained by comparison of the arithmetic means of the results obtained at the initial measurement with the results obtained at the final measurement. Based on the coefficients of F-relations and their significance (P Level), it can be concluded that there were statistically significant

differences in functional abilities between the experimental and control groups in Margaria tests: the Pulse frequency after the load (FPPO .000) and Vital lung capacity (FVKP .000).

4. DISCUSSION AND CONCLUSION

The results of multivariate analysis of variance on the multivariate level (Tables 1 and 2), showed that it came to adaptive changes and statistically significant improvement of motor abilities in young skiers ($Q = .000^{**}$).

It probably occurred because the contents of applied exercises of specific physical training were intensified the activity of agonist muscles and strength of the whole body, as well as because the applied loads (volume and intensity) were close to the boundaries of functional abilities.

In training process of specific preparation, special attention was devoted to intensity and volume of loads as well as to the duration of rest phases, processes of energy recovering, during which energy is recovered the physiological changes occur, caused by process of exercises.

A large number of authors (Lanc, 1988, Heimar, 1989, Krsmanović, 2008; Joksimović, 2010) support this approach to work, which, in young skiers, enables significant formation of motor basis on which, later, complex motor abilities can be comprehensively developed, which facilitates the transition to the phase of specialization.

The obtained results of multivariate analysis of variance (Tables 3 and 4) have shown statistically significant improvement of functional abilities ($Q = .000^{**}$) in young skiers.

It can be assumed that adaptive processes of functional abilities, among other things, represent consequences of the application of selected specific means of physical exercises of explosive and repetitive character, for functional abilities improvement of phospho-creatine and glycolytic energy mechanisms and for increase of efficiency of neural structures in specific conditions of oxygen debt.

Optimal changes of work and rest interval in the training process with participants, according to some authors (Kurelić et al., Krsmanović, 2006), contribute to the increase of working capacity in relation to the initial level and enable development of functional abilities. Increase of these abilities is then based on positive functional reaction of organism, and it allows further enhancing and development of training status.

A great number of researchers whose object of interest was development of functional abilities of athletes (Jukić, 1998, Heimar, 1997; Duraković, 2008), supports such conception of functional preparations in young skiers.

The results obtained in this study confirm that programs of specific physical preparation with young skiers are generally designed with large intensity of physical activities and they contributed to enhancing of both motor and functional abilities.

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