

# EFFECTS OF INDIVIDUAL FITNESS PROGRAMS ON POWER INCREASING OF DYNAMIC KNEE STABILIZERS IN STUDENT POPULATION

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*Original research:*

## Abstract

This research aimed to determine effects of individual fitness programs on power increasing of dynamic knee stabilizers in student population. Respondents who participated in the research were 110 male students from Faculty of Sport and Physical Education in Sarajevo. They were divided into two groups, an experimental and a control group. Maximum strength of dynamic knee stabilizers was tested on an isokinetic apparatus (Biodex System 3) with angular speed of 60°/s. The experimental group conducted additional individual fitness program three times a week in the period of 12 weeks. Obtained results lead to the conclusion that individual fitness programs produced significant effects on development of maximum strength of dynamic knee stabilizers and that those results are statistically significantly different from results of the control group which only practiced regular study program classes.

Key words: isokinetic, flexors, extensors, strength, training

## Introduction

One of the fundamental principles of sports training is the principle of individualization. It refers to the idea that training must be conducted individually, in accordance with the individual's abilities, his/her potential, learning characteristics and specificities of the sport, regardless of the level of sports results (Bompa, 1994). All forms of individual training of athletes are based on information obtained through accurate diagnostic procedures. The diagnosis of the condition is performed to determine the level of anthropological dimensions of athletes, Health status, motor and functional abilities, morphological characteristics and psycho-sociological dimensions are assessed by general and specific procedures and tests (Milanović, 1997, Beachle & Earle, 2000, Cook, 2000.). Research dealing with the effects of the training process implementation contributes to the valorization of planned and programmed training operators as being less or more applicable to achieve a specific goal. Like any transformation process, training has hypothetically defined operators who

from some state of  $S_i$  need to transform person X to the desired state  $S_f$ . The difference between the  $S_i$  and  $S_f$  states represents the effects of the transformation process (Jukić et al.2002). In sport, the fundamental goal of transformation process is the quantitative changes in abilities, traits, knowledge and sports achievements. A great deal of scientific research suggests that between 4 and 8 weeks is required for minimal advances in motor development (Fleck & Kraemer, 1997). Isokinetic dynamometer provides fast and reliable quantification of variables related to muscle performance at different angular velocities, including the maximum torque, total work, reciprocity between agonist and antagonist muscles and fatigue index (Perrin et al., 1987). The aim of many previous studies was to evaluate muscle performance, primarily for the purpose of objectively documenting and reviewing the effectiveness of certain therapeutic procedures for the rehabilitation of injuries to the locomotors system, as well as for determining deficiencies in muscle strength and determining the relative strength of antagonistic muscle groups due to the influence of dominance (Siqueira et al., 2002). This research aimed to determine effects of individual

fitness programs on power increasing of dynamic knee stabilizers in student population.

## Methods

### Respondents sample

Population of physically active man. 110 male students of the Faculty of Sport and Physical Education in Sarajevo. was divided into two groups with a random selection method: an experimental group (n = 42) and a control group (n = 68). The population included physically active man between the age of 19 and 25. Morphologic characteristic of the sample include the average height of 184 cm and weight of 94.9 kg. None of the selected respondents could have a history of injuries of lower limbs in the last two years. All subjects gave written consent to participate in the isokinetic tests.

### Variables sample

Variables for an assessment of the knee extensors and flexors strength with an isokinetic dynamometer:

1. EXTLEF60- extension left – 60°/s – peak torque
2. EXTRIG60 – extension right – 60°/s – peak torque

A protocol for an isokinetic evaluation of the dynamic knee stabilizers strength:

1. Skeletal muscle screening
2. General warming up and body stretching
3. Setting the respondents in an optimal stabilization
4. Alignment between the joint and dynamometer rotation axis
5. Verbal introduction to the concept of isokinetic exercise
6. Correction of gravity
7. Warming up (3 sub - maximum. 1 maximum repetition).
8. Maximum test at test speed of 60°/s (5 repetitions).
9. Testing extremities.

### Experimental procedure description

**Table 1** Outline of the control and experimental group work plan

Control group	Initial testing 1 week	<i>Basic study program</i> 12 weeks of full-time practical training 6 x 90 minutes each week.	Final testing 12 week
Experimental group	Initial testing 1 week	<i>Basic study program</i> 12 weeks of full-time practical training 6 x 90 minutes each week + <i>Additional individual fitness program</i> fitness training / 3 times a week for 20 min.	Final testing 12 week

3. EXLFTW60 – extension left – 60°/s – total work
4. EXRGTW60 – extension right – 60°/s – total work
5. FLXLEF60 – flexion left – 60°/s – peak torque
6. FLXRIG60 – flexion right – 60°/s – peak torque
7. FXLFTW60 – flexion left – 60°/s – total work
8. FXRGTW60 – flexion right – 60°/s – total work
9. AGANLF60 – left side – 60°/s – agonist/antagonist ratio
10. AGANRG60 – right side – 60°/s – agonist/antagonist ratio

### Methods of data processing

Data collected were analyzed by testing the statistical software package SPSS 12.0 and presented in the tables. To determine the significance of the differences between the dynamic stabilizers of experimental and control group under the influence of individual designed fitness programs was used independent samples t-test. Statistical significance at level  $p < 0.05$  was set for all analysis.

During this training period both groups performed physical activities related to a program of regular classes at the Faculty of Sport and Physical Education. but the experimental group also performed an additional individual designed fitness program. The experimental group performed additional individual training activities 3 times a week on fitness trainers. A standard repetition method was implemented. This method is characterized by overcoming a constant load of 80% in 3 to 5 batches with repetition rates between 7 and 10. Breaks between series last for 3 or 4 minutes. The control group acted according to a regular curriculum and a practical training program of a year of study regularly attended by students.

## Results

Analyzing the results of the t-test for independent samples (table 2), it can be seen that there are no statistically significant differences in the strength variables of the dynamic knee stabilizers between the control and experimental group in the initial measurement. Differences were not noticeable and statistically significant in any of the variable. In the section of the final measurement table, we can see that the experimental group achieved better results in arithmetic means in all variables. The results of the t-test for independent samples show that the differences in the following variables are statistically significant: EXTLEF60, EXTRIG60 (peak torque extension), FLXLEF60, FLXRIG60 (peak torque flexion), EXLFTW60, EXRGTW60 (total work extension) i FXRGTW60 (total work flexion). Other variables do not indicate statistically significant differences.

## Discussion

By the analyses of the results of initial and final measurements. there have been shown to be significant differences in some parameters tested between control and experimental groups after the programed period. The 12-week additional training on fitness trainers significantly increased the strength of dynamic stabilizers of the knee in the experimental subject group. The largest increase in values of tested variables was in the variables: EXTLEF60. EXTRIG60 (peak torque extension). FLXLEF60. FLXRIG60 (peak torque flexion). EXLFTW60. EXRGTW60 (total work extension) and FXRGTW60 (total work flexion right side). which leads that the individual designed fitness program effected on peak torque (extension and flexion) of dominant and no dominant limb in students population. The values also increased in total work of extension in both sides. but also showed increasing in total work flexion (FXRGTW60) only on right side

which was obviously dominant limb of the respondents? Aagaard et al. (1996) state that different regimes of muscle work can improve isokinetic strength of knee extensors and flexors (quadriceps - hamstring). followed by better performance of complex leg movements and ball kicks. In his research Kazazović (2007) defined influence of individually formed training programs on increase of maximum strength of dynamic knee stabilizers of students from Faculty of Sport and Physical Education. In this research the experimental group (which conducted additional fitness program) showed significant quantitative changes influenced by a fitness treatment. LCA injurie can be prevented when femoral biceps strength is increased. Using training loads with body weight intensity is a good way to establish prevention to possible knee injurie with simultaneous power increase. with minimum of chance to reach unwanted overtraining (Rado et al.. 2016.). Analyzing differences between arithmetic means of the experimental group from the initial and final measuring at angular speed of 60°/s we realize that an average result of knee extensors in the final measuring is higher for 33.5 Nm. while that result is 19.95 Nm higher for flexors. Such results and sizes of effects of the implemented individual fitness program of the experimental group measured at angular speed of 60°/s can be explained with a phenomenon of specificity of the implemented training. The fact that effects of a training are the strongest in an exercise that is used as a training asset and as a test for evaluation of effects of so-called "training specificity" is well known (Sale and MacDougall, 1981). The control group indicates that results of peak torque of the knee extensor measured at angular speed of 60°/s are decreased for 2.27 Nm in the final measuring in regard to the initial measuring. Quantitatively expressed. the control group records small increase of maximum strength of the knee flexor measured at the same angular speed

**Table 2** Results of initial and final measurements of the control and experimental groups

	INITIAL MEASUREMENT					FINAL MEASUREMENT						
	Con (n=68)		Exp (n=42)		T - test		Con (n=68)		Exp (n=42)		T - test	
	Mean	SD	Mean	SD	t	p	Mean	SD	Mean	SD	t	p
EXTLEF60	223.1	36.9	215.6	40.6	1.0	0.3	218.8	38.9	251.4	37.2	-4.4	0.0
EXTRIG60	217.1	36.1	214.8	39.7	0.3	0.8	216.9	35.5	246.2	36.8	-4.1	0.0
FLXLEF60	125.5	22.8	121.9	24.3	0.8	0.4	131.2	24.3	142.8	25.0	-2.4	0.0
FLXRIG60	125.2	23.6	122.2	21.5	0.7	0.5	131.0	24.0	141.1	23.1	-2.2	0.0
EXLFTW60	928.6	154.0	927.1	197.2	0.0	1.0	930.9	184.2	1082.4	206.7	-4.0	0.0
EXRGTW60	902.5	163.8	897.6	200.4	0.1	0.9	926.2	186.2	1068.8	194.7	-3.8	0.0
FXLFTW60	626.4	135.8	617.8	154.4	0.3	0.8	675.3	133.3	716.2	150.5	-1.5	0.1
FXRGTW60	625.7	143.9	620.5	142.0	0.2	0.9	674.2	141.3	738.4	137.5	-2.3	0.0
AGANLF60	56.0	7.3	56.8	9.1	0.6	-0.8	58.8	6.6	57.2	6.1	1.3	0.2
AGANRG60	57.3	6.8	57.5	8.6	0.9	-0.1	60.9	7.4	58.3	5.7	1.9	0.1

of 5.7 Nm. An analysis of differences between the groups clearly shows that the additional individual fitness programs produced very significant transformation effects on development of maximum strength of dynamic knee stabilizers measured at the isokinetic dynamometer.

## Conclusion

According to the obtained results we can conclude that the additional individual fitness programs produced positive transformation effects on maximum strength of the knee extensor and flexor expressed through peak torque (extension and flexion) and total work (extension and flexion – right side) measured at angular speed of 60°/s. Based on this research, a number of specificities related to differently designed individual fitness programs can be identified. As in earlier studies (Heitkamp et al. 2002; Drid et al. 2007; Dokmanac et al. 2007), characteristic imbalances were observed between antagonistic muscle groups in the initial measurement

resulting from the specificity of the performance of the moving structures. In the case of asymmetry, the proper treatment of its removal should be mandatory part of the exercise of power. It is well known that there are no related movement structures among the athletes, basically, each sport represents a model situational motor structure. Considering that the specific technique is used to achieve athletic performance, some athletes most commonly practice by a unilaterally dominant side so appearance of this specificity is completely understandable. However, in order to reduce the risk of injury, it is necessary to obtain the results in the initial measurement in this way when planning the training and then, as in this longitudinal monitoring study, closely monitor the further development and progress of the athlete. Correcting these imbalances and optimizing the tested parameters can significantly reduce the possibility of injury and increase the possibility of achieving superior results.

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**Submitted:** 16.07.2019.

**Accepted:** 12.08.2019