THE EFFECTS OF SPECIAL PHYSICAL EDUCATION ON CHANGES IN THE MAXIMUM ISOMETRIC MUSCLE FORCE OF THE BACK EXTENSOR MUSCLES IN THE STUDENTS AT THE UNIVERSITY OF CRIMINAL INVESTIGATION AND POLICE STUDIES[1]

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Abstract: The aim of this research was to determine the differences between the addmission exam results and the results achieved at the end of the first year of study in the maximum isometric muscle force of the back extensor muscles among the students at the University of Criminal Investigation and Police Studies (UCIPS) in Belgrade, which occurred as a result of regular Special Physical Education (SPE) classess. The study sample consisted of 80 male students aged 19-21 (TV = 181.81 ± 7.31cm, TM = 79.19 ± 8.09kg, BMI = 23.96 ± 1.79kg / m²). The results achieved by the students on the Basic Motor Skills (BMS) admission test, as an initial measurement, and the results achieved on the BMS assessment tests within the subject of SPE, as a final measurement were analyzed.To determine the significance of the differences between the results of the initial and final measurements, a T-test was used for the dependent samples. After SPE classes were conducted, the results of measurement demonstrated mprovement in the final measurement (Mean $\pm$ SD = 190.5 ± 21.0 DaN) compared to the initial measurement (Mean $\pm$ SD = 158.8 ± 21.44 DaN), at a statistically significant level (t = -14,283; p <0.000). Based on the results obtained, it can be concluded that, during the first year, SPE teaching has had a statistically significant impact on the improvement of the maximum isometric muscle force of the back extensor muscles in students.

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INTRODUCTION

The system used for the selection of candidates for admission to the University of Criminal Investigation and Police Studies in Belgrade was designed as a positive selection model, consisting of the results achieved in previous schooling, health status, psychological structure, personality preferences and basic motor skills test (Dopsaj, Vučković, & Blagojevic, 2007; Jankovic & Koropanovski, 2017). Basic motor skills testing was conducted by assessing repetitive strength of arm and trunk muscles, the speed of leg muscles, the aerobic ability of the body, maximal isometric force of the back extensors (male students), or flexor muscles of the dominant arm (female students) and the assessment of motor education (Jankovic, 2009). Additionally, one of the basic criteria in the selection of candidates for admission to the UCIPS, as well as for prospective employment at the Ministry of the Interior of the Republic of Serbia, is the quantitative qualification of the morphological characteristics and motor skills in the candidates (Milošević et al., 1994; Božić, 1995; Amanović, Jovanović, and Mudrić, 1999; Blagojević, 2003; Dopsaj et al., 2007; Arlov, 2007b; Strating, Bakker, Dijkstra, Lemmink, & Groothoff, 2010).

Special Physical Education is a specialist subject that belongs to the scientific disciplines of system support (Blagojevic, Dopsaj, & Vuckovic, 2006). As an integral part of overall education, SPE aims to psychosomatically train future police officers through the achievement and maintenance of basic and specialized knowledge and abilities, to increase the emotional resilience of future police officers to professional conflicts and stressful situations and the overall resilience of the organism. Based on the current curriculum, SPE course is taught during the second semester of the first year of study (Blagojević, Vučković, and Dopsaj 2012).

The contractile abilities of the muscles are one of the elements of the motor space, and they manifest themselves as the maximal, explosive, speed, and repetitive force or strength, or as force or strength endurance (Milošević, 1985; Kukolj, 1996; Jukić et al., 2007). Each of the aforementioned characteristics of the manifestation of the muscle force is of great importance for the successful performance of certain police duties (Milošević, 1985; Lord, 1998; Vučković & Dopsaj, 2007a).

Maximum isometric force can be defined as the ability of muscles to endure maximum resistance, whereby the length of the muscle does not change (Kukolj, 1996). One of the tasks of SPE teaching is to develop basic physical abilities and the basic contractile abilities of muscles, that is, to developm a higher maximum muscular force exertion level (Milošević, Zulić, & Božić, 2001; Blagojević, 2003).

There is evidence that a certain level of contractile characteristics manifestation, including the maximal isometric force of the back and leg extensors, regardless of whether they are absolute or relative indicators, is of great importance for the successful and efficient performance of police tasks (Vučković, Jovanović, and Dopsaj, 2001; Vuckovic and Dopsaj, 2007b; Mihaljcic, 2016).

The subject of this study was the selected motor skill among the first-year undergraduate male students at the University of Criminal Investigation and Police Studies, that is, the maximum isometric force of the back extensor muscles.

The research problem was to determine the effects of SPE teaching on changess in the maximal isometric force of the back extensor muscles in male and female students.

The aim of this research was to determine the changes in the results achieved in the maximal isometric force of the back extensor muscles on the admission test and the results at the end of the first year of undergraduate studies in male and female students, which occurred as a result of SPE teaching.

METHODS

Prior to conducting this study, all male and female respondents were informed of the tests and the purpose of this study which belongs to applied research in which, for the purposes of new knowledge, the experimental method was used, using the methods of field testing (Ristanović and Dačić, 1999).

The results achieved by the students in the BMS admission exam as an initial measurement were analyzed, and the results on the BMS assessment tests in the subject of SPE at the end of the first year, as a final measurement. The same meter measured the same variables at the initial and final measurements to minimize the impact of parasitic factors.

Sampling

The study sample consisted of 80 male students aged 19-21 who were accepted to an undergraduate degree program at the UCIPS. The sample characteristics are as follows: body height 181.81 ± 7.31 cm, body weight 79.19 ± 8.09 kg, and body mass index 23.96 ± 1.79 kg / m².

Variable sampling

The students were tested in the BMS assessment lab and easurements were made using a hardware-software system with standardized measurement procedures (Dopsaj et al., 2010).

The sample of variables consisted of one variable, and the computer system for testing physical abilities entitled *Physical Ability Test 02 - PAT 02* (UNO-LEX, Novi Sad, Serbia; as cited in Janković, 2015) was used to make measurements. The maximum isometric force value of the variable tested among the students is expressed as DaN (Dopsaj et al., 2007). The aforementioned variable – an integral part of the test battery used to assess BMS among the students is $F_{max}BACK$ – the maximum value of the dead-pull test in the students (the maximum isometric muscle force of the extensor muscles in the back-loin musculature – DaN).

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DATA PROCESSING METHODS

The results obtained were analyzed using descriptive statistics to calculate the basic parameters of the central tendency: arithmetic mean (*Mean*), the coefficient of variation (*sV%*), standard deviation (SD), the minimum and maximum value of each variable observed (Min, Max), skewness (Skew), kurtoisis (Kurt). In order to determine the significance of the differences in the variable observed, that occurred as a result of SFO teaching, Student's T-test for dependent samples was used. Statistical significance was defined at the 95% probability level, that is, at $p > 0.005$ (Hair, Anderson, Tatham, & Black, 1995). All analyzes were determined using the SPSS 20.0 statistical data processing package.

RESULTS

In accordance with the research objective which relates to the determination of differences in the results of maximum isometric force of the backbone muscles among the students at the UCIPS achieved on the BMS entrance examination, as an initial measurement, and the results achieved on the BMS assessment tests after SPE classes at the end of the first year, as the final measurement, the results obtained are presented in Tables 1, 2, and 3. The results obtained are presented in the order in which the appropriate statistical procedures were applied.

Table 1 shows the results of the descriptive statistics of the maximum isometric force of the back extensor muscles among the students at the UCIPS.

Table 1 *Results of the descriptive statistics of the maximal isometric muscle force of the back extensor muscles among the students (N = 80) at the University of Criminal Investigation and Police Studies (initial and final measurement)*

Variable	Maximal isometric muscle force of the back extensor muscles (DaN)	
Descriptive parameters	Initial measurment	Final measurment
Mean	158.80	190.50
Standard deviation	21.41	21.00
Coefficient of variation %	13.50	11.02
Min.	121.50	155.60
Max.	216.20	250.10
Skew.	0.458	0.584
Kurt.	0.010	-0.223

Key: N – the number of respondents; Mean – arithmetic mean; SD – standard deviation; CV% – the coefficient of variation; Min. – the minimum value of the variable observed; Max. – the maximum value of the variable observed; Skew. – skewness; Kurt. – kurtoisis; FmaxBACK – the maximum isometric force of the back extensor muscles (expressed as deca Newtons)

The Student's T-test for dependent samples was used on the final versus initial measurement to determine the significance of the differences in the variable observed, which occurred as a result of SPE classess; the results are shown in Table 2.

Table 2 *Results of the T-test for dependent samples – the determination of significance of the differences of arithmetic means at initial and final measurement – the students at the UCIPS (N = 80)*

Variable	Mean		DF	T- value	T-test (significance)
	Initial	Final			
Max. isometric force of the back extensors	158.80	190.50	79	-14.258	0.000*

Key: Mean – arithmetic mean; DF – the degree of freedom; t-value – the value of the Sudent's t-test; Sig. – significance. *significance<0.01

The results of the dependent-samples Student's t-test indicated that a statistically significant influence of SPE teaching was determined at the end of the first year among the students at the UCIPS in the maximal isometric force of the backbone muscles (t = -14.258; Sig. = 0.000).

DISCUSSION

Maximum isometric force is one of the components responsible for the exertion of muscle force and can be defined as the ability of a muscle to exert as much force as possible with maximal contraction, through an attempt to move, that is, when the maximum resistance is exerted, while the length of a muscle remains unchanged (Kukolj, 1996; Blagojevic, 2003).

Regarding SPE teaching during undergraduate studies at the UCIPS, classes are organized in such a way that students, after enrolling in the first year of studies, do not have SPE classes for eight months, that is, they start attending SPE classes in the second semester. During those eight months without SPE classes, a decrease in the level of body status and certain parameters of muscle force and strength compared to the entrance exam was evident (Mitrovic et al., 2016).

Based on the results of descriptive statistics in the initial and final measurements (Table 1), it can be concluded that the respondents achieved better average score (Mean) in the final measurements.

The results of measuring the maximum isometric force of the back extensor muscles (Figure 1) obtained in this study on a sample of students (N = 80) demonstrated statistically significant changes (t = -14.283; p <0.000) in the final result (Mean ± SD = 190.5 ± 21.0 DaN) compared to the initial measurement (Mean ± SD = 158.8 ± 21.44 DaN) following the Special Physical Education course at the end of the first year of undergraduate studies at the UCIPS. The absolute difference amounts to 31.7 DaN, while the relative value is 19.9% higher.
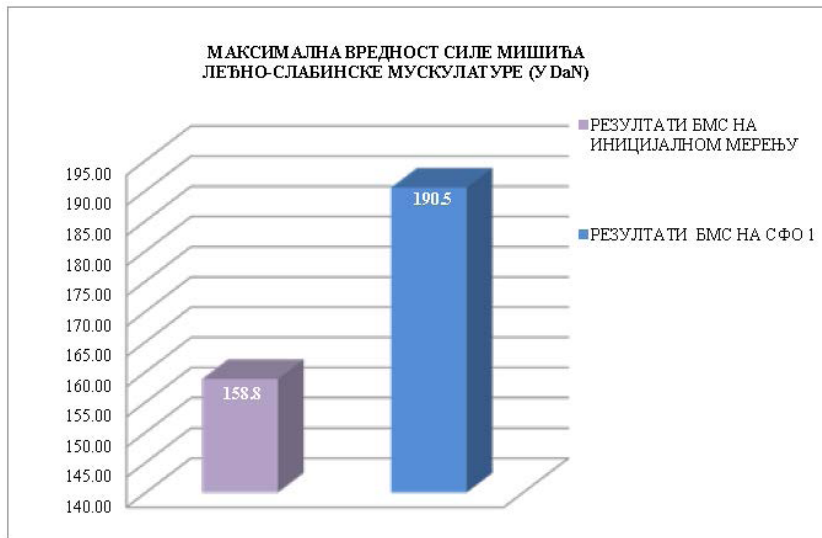
Figure 1 *Difference in the mean values of the maximum isometric muscle force of the back extensors in a sample of the students at the UCIPS, initial and final measurements (N = 80)*

The study conducted by Blagojević (2003) on the population of first-year, second-year, and third-year students at the Police Academy conducted at the end of winter semester (the 1995/1996 generation), the average values of the F_{max}BACK variable were found to be: 169.31 ± 21.65 DaN for the first year; 169.61 ± 23.07 DaN for the second year, and 176.01 ± 22.67 DaN for the third year of study. Compared to the data obtained in the final measurement, it can be determined that the average values in the student population observed (N = 80), compared to the 1995/1996 generation – the average at the first-year student population level, increased by 21.19 DaN (or 11.12%).

The results of the study conducted by Koropanovsky and Jankovic (2007) among the first-year students at the Academy of Criminalistics and Police Studies indicated that the average value of the F_{max}BACK variable amounted to 170.84 ± 22.36 DaN, which is by 19.66 DaN (or 10.32%) lower than the result achieved in the final measurement.

The study conducted by Dopsai et al. (2010) in a sample of 1579 respondents aged 18-24 (1223 male students and 356 female students), most of them being the first-year students at the Academy of Criminalistics and Police Studies, while a small number of the respondents consisted of the students at the Sports Academy in Belgrade and the Faculty of Sport and Physical Education, University of Belgrade, demonstrated that the mean values Mean $\pm$ SD = 165.2 ± 25.26 DaN were found for the F_{max}BACK variable among the students at the UCIPS. Compared to the results of this study, it can be stated that in the final measurement, as a result of the impact of SPE teaching, the F_{max}BACK values were higher by 25.3 DaN (or 15.3%).

The results achieved by the students at the University of Criminal Investigation and Police Studies in the final measurement compared to the initial measurement are probably the result of a larger number of the students actively involved in sports, as well as those involved in various sports activities, especially given that these activities have positive effects on raising the level of physical abilities (Australian Federal Police, 2004). There are many sport clubs at the UCIPS, so it is likely that a larger number of students were involved in them (*http://www.kpa.edu.rs/cms/studenti/sekcije/*).

Also, another reasons might be the students' high persistence and motivation to pass the SFO test, that is, BMS, where one of the tests being evaluated is the dead-pull test used to assesses the maximum isometric force of the back extensor muscles (Dopsay , Milosevic, Blagojevic, and Vuckovic, 2002).

CONCLUSION

The effect of SPE teaching was determined by monitoring the changes in the maximum isometric muscle force of the back extensor muscles in a sample of 80 first-year undergraduate students aged 19-21 at the UCIPS. This study is significant because the monitoring of the changes in the maximum isometric muscle force of the back extensor muscles among the students at the UCIPS, as future managers in police departments, is used to evaluate the efficasy of SPE teaching and, based on the results obtained, propose measures to improve and advance the quality of personnel educated at the UCIPS for the needs of the Ministry of the Interior of the Republic of Serbia.

The results obtained in this study showed that SPE teaching caused a statistically significant change in the absolute value of the maximum isometric force of the back extensor muscles in this sample of students.

Also, based on the study results presented and comparison with the results of the mentionied studies, it can be concluded that the current mumber of SPE classes in the first year of studies at the UCIPS is insufficient, even though it has effects on the improvement of the maximum isometric muscle force of the back extensor muscles.

However, the possibility of generalizing the results of this study is limited in terms of sample size and data collection method. It is necessary to undertake new and similar research to confirm these results as relevant.

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