DIFFERENCES IN BASIC MOTOR SKILLS AMONG STUDENTS AT THE UNIVERSITY OF CRIMINAL INVESTIGATION AND POLICE STUDIES REGARDING SPECIAL PHYSICAL EDUCATION 1

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Abstract: The aim of this research was to determine the differences between the levels of basic motor skills (BMS) at the entrance exam in relation to BMS in the semester exam in Special Physical Education 1 (SPE 1). The sample consisted of 119 students (39 girls and 80 boys) enrolled at the University of Criminal Investigation and Police Studies. Student's t-test was used to determine the differences between the observed variables, while the eta square ($\eta2$) was calculated to determine effect size. There was a statistically significant improvement for the maximum isometric force of the fingers of the dominant hand ($t = -4.296$; $p < 0.000$), the repetitive strength of the forearm extensors ($t = -4.218$; $p < 0.000$), the repetitive strength of the trunk flexors ($t = -4.191$; $p < 0.000$) and general aerobic endurance ($t = -2.473$; $p < 0.018$) in female students, as well as for the explosive strength of the leg extensors ($t = -2.246$; $p < 0.028$), the repetitive strength of the trunk flexors ($t = -5.152$; $p < 0.000$), general aerobic endurance ($t = -2.512$; $p < 0.021$) and maximum isometric force of the back ($t = -14.283$; $p < 0.000$) among the students. The results of $\eta2$ demonstrated that the effect of SPE 1 classes on most observed motor skills in the students of both sexes was strong.

Keywords: motor skills, special physical education 1, students, police.

INTRODUCTION

In addition to other courses, students at the University of Criminal Investigation and Police Studies (Kriminalističko-policijski univerzitet KPU) (here-

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inafter: KPU) in Belgrade also attend classes in the subject of Special Physical Education (SPE). SPE is aimed at increasing the emotional resistance of future professionals to stressful and conflict situations and general resistance of the organism, including the psychosomatic professional training of future police officers through achieving and maintaining basic and special knowledge and skills (Blagojevic, Dopsaj, and Vuckovic, 2006; Milosevic & Milošević, 2014; Amanović, Baić, Nikač, & Ljubisavljević, 2015a; Amanovic, Masic, Kostovski, & Ljubisavljevic, 2015b). The course consists of two sub-units – the first unit deals with special and professional skills in the area of self-defense, while the second one deals with general physical preparation, that is, students' basic motor status (BMS) (Blagojević, Vucković, and Dopsaj, 2009). However, SPE has undergone transformations such as the reduction of the total number of hours and elimination of certain topics from the course.

Since the founding of the Police Academy in 1993 to 2000, SPE classes were taught in all four years – eight semesters. The basic part consisted of a total of 724 hours of classes in all four years, which were conducted in the form of morning exercises, such as swimming and skiing (4 lectures, 45 lectures having a training characteristic, and 675 practical classes). The special part consisted of lectures having training and exercise characteristics, which were conducted during eight semesters (16 lectures, 120 lectures having a training characteristic, and 225 practical classes). From 2000 to 2006, SPE teaching was conceived through two subjects: SPE 1, which was taught in the first and second years during four semesters through regular classes amounting to 180 hours (24 lectures and 156 practical classes) and through special forms of classes (70 hours of skiing and 58 hours of swimming) and aerobic conditioning (240 hours of exercise). SPE 2 classes were taught in the third and fourth year (four semesters) through 180 hours of regular classes (24 lectures and 156 practical classes) and aerobic conditioning (240 practical classes). With the establishment of the Academy of Criminalistics and Police Studies in 2006, the SPE course was divided into SPE 1 – general part, SPE 2 – special part, and SPE 3 – the use of coercive means, which is included in the undergraduate studies program, in the second, fourth and sixth semester, that is, in the first two years of vocational studies (Janković, 2009). SFO 1 classes are realized in the undergraduate studies program in the second semester and include 45 practical classes and 15 lectures (Blagojević, Vucković, and Dopsaj 2012).

In the selection procedure for admission to the KPU or for employment within the Ministry of the Interior of the Republic of Serbia, one of the basic criteria is the quantitative qualification of morphological characteristics and motor skills (Mudrić and Jovanović, 2000; Dopsaj, Milošević, Blagojević, and Vucković, 2002; Milošević, Mudrić, Jovanović, Amanović, and Dopsaj, 2005; Dopsaj, Vucković, and Blagojević, 2007; Amanović et al., 2015a). For enrollment in the KPU, candidates take an entrance exam and one of the selection criteria is the prescribed level of BMS. The selection of candidates according to the BMS criterion is important for achieving educational results in the area of

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SPE and better performance of those police tasks that require extremely great physical effort (Sorensen, Smolander, Louhevaara, Korhonene, & Oja, 2000; Amanović, 2003; Dopsaj et al., 2007). The levels of BMS in candidates applying for admission to the KPU are tested by assessing the maximum isometric forces of the back muscles and lumbar muscles (male students), the maximum isometric forces of the flexor muscles of the dominant hand (female students), general aerobic endurance, the repetitive strength of the extensor muscles of the forearm and trunk, the explosive strength of leg extensor muscles and assessment of motor educability (Dopsaj, Milošević, Blagojević, and Vucković, 2002; Amanović, Milošević, and Mudrić, 2004; Milošević et al., 2005; Dopsaj et al., 2007; Milošević & Milošević, 2014).

However, after passing the entrance exam, students do not have organized or systematic physical activities for eight months. More precisely, since SPE 1classes are organized in the second/spring semester, a decrease in the level of physical abilities occurs during the mentioned period (Mitrović et al., 2016). Due to all this, the importance of this research is reflected in the fact that the results obtained on the observed population may indicate the effectiveness of SPE teaching contents. The aim of the research was to determine the differences between the results achieved by students in the entrance exam in BMS and the results achieved by students in the semester exam in BMS, resulting from regular SPE 1 classes.

RESEARCH METHODS

Sample of respondents

The sample consisted of 119 students of both sexes, aged 19 to 21, who had passed the selection tests – passed the entrance exam and enrolled in the first year at the KPU as undergraduate students, as follows: 39 female students (body height TV = 169.34 ± 6.17cm, body mass TM = 65.89 ± 10.18kg, body mass index BMI = 22.98 ± 4.78kg/m²) and 80 male students (body height TV = 181.81 ± 7.31cm, body mass TM = 79.19 ± 8.09kg, body mass index BMI = 23.96 ± 1.79kg/m²).

Testing procedure

The motor variables that have been found in previous research to cover the area of importance for the specific structure that dominates in the professional work performed by the police were used in this research (Vuckovic, Dopsaj, & Blagojevic, 2001; Paspalj, 2013; Jankovic & Koropanovski, 2017), including the tests used in the methodology of testing the basic physical properties of athletes, which have also been used by law enforcement agencies (Dopsaj, Mi-

lošević, & Blagojević, 2000; Amanović et al., 2004). All measurements were performed in the research laboratory for SPE at at the KPU by the subject teachers. The initial BMS measurement was performed at the entrance exam and the retest was performed after 45 hours of regular SPE 1 classes that students had 3 times during the week during the semester. Prior to testing, all tests were explained in detail and demonstrated to the subjects with the possibility of rehearsal, thus creating the necessary conditions for their application. The same meter measured the same variables on both the initial and final measurements.

The maximum isometric muscle force was assessed using a tensiometric probe aided with a hardware-software system for physical ability testing PAT 01 (Physical Ability Test 01), using standardized measurement procedures (Dopsaj et al., 2000; Janković, Dimitrijević, Koropanovski, Vucković, & Dopsaj, 2010a; Kolarević, Dimitrijević, Vucković, Koropanovski, & Dopsaj, 2014).

The maximum isometric force of the flexor muscles of the fingers of the dominant hand (F_{max} HAND) in female students was assessed using the hand grip test – expressed in decanewtons (DaN), (Dopsaj & Vuckovic, 2006; Dopsaj et al., 2010; Dimitrijevic, Koropanovski, Dopsaj, Vuckovic, & Jankovic, 2014; Kolarevic et al., 2014).

The maximum isometric force of the low back extensor muscles (F_{max} BACK) in students was assessed using the dead-pull test – expressed in DaN (Dopsaj et al., 2010; Janković et al., 2010a; Dimitrijević et al., 2014).

The explosive strength of the leg extensor muscles (female students – JUMP_Ž and male students – JUMP_M) was assessed using the standing long jump with arm swing test. The jump distance (the distance from the takeoff line to the mark made by the heels) was measured in centimeters (cm) and the accuracy of the measurement was 1 cm (Dopsaj et al., 2010; Dimitrijević et al., 2014).

The repetitive strength of the forearm extensor muscles (PUSH-UP) in female students was assessed by the "Push-ups" test from the front resistance in 10 seconds (s). The number of correctly performed push-ups in 10 s was evaluated (Dopsaj et al., 2010; Janković, Dimitrijević, Vucković, & Koropanovski, 2013; Kolarević et al., 2014).

The repetitive strength of the trunk flexors (TRUNK_F) in female students was assessed using the trunk lift test in 30 s. The number of correctly performed trunk lifts in 30 s was estimated (Dopsaj et al., 2007; Dopsaj et al., 2010; Kolarević et al., 2014).

The repetitive strength of the trunk flexors (TRUNK_M) in students was assessed using the trunk lift test with rotation to the left and right in 30 s. The number of correctly performed trunk lifts in 30 s was estimated (Blagojević, 2003; Dopsaj et al., 2010).

General aerobic endurance (female students – COOPER_F and male students – COOPER_M), was assessed using the Cooper 12-minute run test. The distance travelled was measured in meters (m), with an accuracy of 5 m (Dopsaj et al., 2010; Janković, Dimitrijević, & Koropanovski, 2010b; Dimitrijević et al., 2014).

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Statistical methods

The results obtained were processed by descriptive and comparative statistical procedures using the application program SPSS 20.0. For each variable, the arithmetic mean (Mean), standard deviation (SD), minimum and maximum value of each variable observed (Min, Max), the coefficient of variation (sV%), the indicator of the level of asymmetry – the asymmetry coefficient (the coefficient of skewness) and the flatness level (the coefficient of kurtosis). In order to determine the significance of differences in the observed variables, the Student's t-test for dependent samples was used. Statistical significance was defined at the level of 95% confidence, that is, at the level of p> 0.05 (Hair, Anderson, Tatham, & Black, 1998). To determine effect size (*ES*) of educational treatment, the eta square ($\eta2$) expressed in numerical value was calculated, where $\eta2 \leq 0.01$ represents small effect, $\eta2 = 0.06$ moderate effect, and $\eta2 \geq 0.14$ large effect (Pallant, 2009).

RESULTS AND DISCUSSION

The obtained results, in line with the study objective which is related to determining the differences between the results which were achieved by the students in the entrance exam and the semester exam after 45 hours of regular SPE 1classes, are shown in Table 1 and Table 2.

***Table 1**. Results of descriptive statistics, t-test, and effect size for female students*

	F_{max} HAND (DaN)		JUMP_F (cm)		PUSH-UP (s)		TRUNK_F (s)		COOPER_F (m)	
	I	II	I	II	I	II	I	II	I	II
Mean	34.90	37.40	179.90	182.20	6.40	8.20	21.80	23.80	2226.80	2288.20
SD	4.47	3.68	14.94	11.67	2.92	1.91	2.95	2.45	277.07	218.27
Min	25.80	31.40	146.00	166.00	0.00	5.00	16.00	20.00	1675.00	1970.00
Max	47.40	46.10	213.00	211.00	14.00	14.00	27.00	29.00	3075.00	3080.00
cV%	12.81	9.83	8.31	6.41	45.85	23.46	13.53	10.33	12.44	9.54
Skewness	0.22	0.65	-0.11	0.80	0.03	0.67	-0.18	0.17	0.54	1.38
Kurtosis	0.53	-0.29	-0.32	0.29	0.44	0.93	-0.53	-0.50	1.22	3.24
t		-4.30		-1.01		-4.22		-4.19		-2.47
P(T ≤ t)		0.00		0.32		0.00		0.00		0.02
η^2		0.33		0.03		0.32		0.32		0.14

	F_{max} BACK (DaN)		JUMP_M (cm)		TRUNK_M (s)		COOPER_M (m)	
	I	II	I	II	I	II	I	II
Mean	158.80	190.50	233.90	237.40	27.40	29.20	2747.80	2847.70
SD	21.44	21.00	18.75	15.56	3.29	2.63	237.03	185.77
Min	121.50	155.60	190.00	220.00	18.00	23.00	2235.00	2610.00
Max	216.20	250.10	280.00	283.00	34.00	34.00	3440.00	3250.00
cV%	13.50	11.02	8.02	6.56	12.00	9.01	8.63	6.52
Skewnes	0.47	0.58	0.42	1.13	-0.43	-0.15	0.49	0.62
Kurtosis	0.01	-0.22	-0.02	0.80	-0.15	-0.41	0.30	-0.77
t		-14.28		-2.22		-5.15		-2.51
P(T ≤ t)		0.00		0.03		0.00		0.02
η^2		0.72		0.06		0.25		0.07

The values obtained in all types of analyses indicate the high reliability of the research results obtained. Descriptive analysis indicated that the values of standard deviation are small for all monitored variables, that is, less than 15% of the average value, while the estimation error of the average value among the students is very low amounting to less than 5% of the average value in the sample, including the coefficient of variation which is relatively low. Our research results demonstrated that the students achieved statistically significantly better results in in F_{max}HAND, PUSH-UP, TRUNK_F and COOPER_F, while the JUMP_F test did not show statistical significance (Table 1).

For F_{max}HAND test, it was determined that the absolute difference amounts to 2.5 DaN, while the relative value of the final compared to the initial testing is higher by 7.2%. The value of $\eta 2 = 0.33$ shows that the effect of SPE 1 teaching on the maximum isometric force of the flexor muscles of the fingers of the dominant hand in female students is strong (Table 1). The results of the maximum isometric force of the flexor muscles of the fingers of the dominant hand are in accordance with the research conducted by Dopsaj et al. (2007), in which the subjects achieved an average score of 37.68 ± 5.09 DaN on the F_{max}HAND test. Additionally, Janković (2009) found an increase in F_{max}HAND by 2.79 DaN in the female students, which is slightly higher than the results obtained in this research.

In the PUSH-UP test, an increase in the absolute value by 1.8 was found, while the change in the relative value at the final compared to the initial measurement was 27.4%. The value of $\eta 2 = 0.32$ shows that the effect of SPE 1 classes on the repetitive strength of the extensor arm muscles in female students is large (Table 1). The results also showed that the female students, in relative terms, achieved a 32.2% better score on the final test compared to the similar population respondents in the research conducted by Dopsaj et al. (2010), whose average result was 6.20 ± 3.40 push-ups in 10 s.

The results demonstrated that, on the TRUNK_F test, female students on average improved their score by 2 in absolute values and by 9.0% in relative values, respectively. The value of $\eta 2 = 0.32$ for the repetitive strength of the trunk flexors shows a strong impact of SPE 1 on the female students (Table 1). Compared to the results in the study conducted by Dimitrijević (2016), in which the average value for the TRUNK test amounted to 20.89 ± 2.45, the students in this study achieved a 14.4% better result in relative values in the final test.

In the COOPER_F test, female students achieved a statistically significantly better average result by 61.4 m in absolute values, that is, by 2.8% in relative values. The value of $\eta 2 = 0.14$ shows a strong impact of SPE 1 on general aerobic endurance in the female students (Table 1). the female students achieved a better result in the final test by 232.36 m in absolute or 11.3% in relative values compared to the respondents in the study conducted by Dimitrijević (2016).

The standing long jump with arm swing test performed by the female students was the only test whose statistical significance was not determined. However, the results of the JUMP_F test showed that the absolute value for the explosive power of the leg extensor muscles increased by 2.3 cm, while the relative value increased by 1.3%. The value of $\eta 2 = 0.03$ indicates that the impact of SPE 1 on this motor skill in the female students is minimal (Table 1). The reason for this result may be the fact that the movement in performing this test belongs to complex motor structures. More precisely, to achieve maximum results, the entire body musculature has to be synchronized perfectly, and it can be assumed that the students simply did not sufficiently master the correct jumping technique.

In the student population, the results showed that the respondents achieved statistically better results in the final testing compared to the initial testing in all tests. In the F_{max}BACK test, the absolute difference was found to be 31.70 DaN, while the relative change amounted to 19.9%. The value of $\eta 2 = 0.72$ indicates that the influence of SPE 1 on the maximum isometric force of lower back muscles in students is strong (Table 2). The result achieved on the final test for this motor skill amounts to 25.3 DaN, or 15.3% higher in relation to the average results achieved by the respondents in the study conducted by Dopsaj et al. (2010).

The results of the JUMP_M test indicated that the students achieved an absolute higher average value by 2.3 cm in the final test, while the relative value increased by 1.5%. However, despite the established statistical significance, the value of $\eta 2 = 0.06$ shows that the impact of SFO 1 on the explosive strength of the leg extensor muscles in students is moderate (Table 2). The obtained average values of long jump are in line with the results of Janković (2015), in whose study the students, in order to construct and validate the test as a measuring instrument for assessing the specific dexterity of police officers, achieved an average score of 235.78 ± 10.88 cm.

In the TRUNK_M test, the change in the final testing, compared to the initial testing, is 1.8 for absolute values, while the change in relative value is 6.5%.

The value of η2 = 0.25 for the repetitive strength of the trunk flexor muscles indicates that the impact of SPE 1 on students is strong (Table 2). Similar results were found in the study conducted by Janković (2015), in which the repetitive strength of the trunk flexor muscles expressed in the number of trunk lifts with rotation to the left and right amounted to 28.55 ± 2.55.

In the COOPER_M test, the students statistically significantly improved the average score by 99.9 m in absolute value, while the change in relative value was 3.6%. The value η2 = 0.07 indicated that the impact of SPE 1 on the general aerobic endurance of students was moderate (Table 2). The average result achieved on the initial measurement is almost identical to the result determined by Dopsaj et al. (2010), where the average value achieved on the Cooper test was 2750.30 ± 209.42 m, while the result of the final test in this study is by 97.4 m or 3.5% in relative terms higher.

Based on the analysis of the results obtained, it can be assumed that the changes in the level of BMS in the observed population occurred as a result of SPE 1 teaching. However, it must be taken into account that the KPU students, along with teaching contents, participate in sport and recreational clubs and other independent physical activities. Therefore, it is necessary to conduct further research which would take into account the overall physical activities of students with the aim of improving the educational and training process.

CONCLUSION

In accordance with the objective of this study, differences in the levels of BMS among the KPU students were determined, as well as the extent of the impact of SPE 1 on the observed changes. The results demonstrated a statistically significant improvement in all observed motor skills, except for JUMP_F. Also, according to the Pallant's classification (Pallant, 2009), the effect of teaching on the level of the observed motor abilities was found to be strong in six cases, moderate in two and minimal in only one case. However, in order to avoid a decrease in the levels of motor skills in the forthcoming period, and especially in the period between the entrance exam and the beginning of the SPE 1 course, it is necessary to conduct mandatory extracurricular activities such as morning gymnastics, conditioning, and swimming. Additionally, to improve the effect of teaching on motor skills, it is necessary to propose an increase in the total number of practical classes, the introduction of the subject Special Physical Education in all eight semesters, the realization of additional and mandatory contents such as swimming, skiing, outdoor summer and winter classes, including fitness training (Milojkovic, Dopsaj, & Bachanac, 2003; Dopsaj, Jocic, Blagojevic, and Vuckovic, 2004; Vuckovic & Dopsaj, 2007; Vuckovic, Dopsaj, Radovanovic, & Jovanovic, 2008; Vuckovic, Dopsaj, 2009 Vuckovic, Dopsaj, 2011). Finally, it may be concluded that such a designed and systematically implemented physical activity during the entire study process would significantly contribute to the

improvement of the educational and training process among the KPU students and represent a significant basis in training them for work in the Ministry of the Interior of the Republic of Serbia.

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