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Original research article

HOW AN EIGHT-MONTH PERIOD WITHOUT SPECIALIZED PHYSICAL EDUCATION CLASSES AFFECTS THE MORPHOLOGICAL CHARACTERISTICS AND MOTOR ABILITIES OF STUDENTS OF THE ACADEMY OF CRIMINALISTIC AND POLICE STUDIES

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Abstract. *A reduced level of work abilities of a police officer caused by the reduced level of physical abilities have an adverse influence on the efficient and safe performance of a wide range of complex police measures. The aim of this paper was to determine whether morphological characteristics (MC) and motor abilities (BMA) before the beginning of specialized physical education (SPE) are on the same level as during the entrance exam, that is, the effects of an eight-month-long period during which the students of the Academy of Criminalistic and Police Studies did not have organized SPE. 137 candidates participated in the study (67 male and 70 female candidates). BH, BW and BMI were observed to determine MC and for estimation of BMA: Push-ups 10 seconds (PU), Sit-ups 30 seconds (ABD), Standing long jump (LJ), Abalak (VJ), as well as Isometric dead lift (F_{max}BE), for the males, and Hand grip (F_{max}HG) for female candidates. The results of the MANOVA have shown that between both measurements it was not determined that there are statistically significant differences for MC in candidates of both genders (female p=0.160; male p=0.203), generally, while for BMA it was determined that there are significant differences in candidates of both genders (female p=0.003; male p=0.033). Individually by variable, during the eight-month-long period, of the MC among the female, BMI statistically significantly increased (3.97%; p=0.029), and among the male candidates (2.53%, p=0.034), respectively; concerning BMA among the female, a significantly poorer result was achieved in F_{max}HG (6.99%; p=0.006), LJ (4.59%;*

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p=0.024) and VJ (7.3%; p=0.006) and in male candidates in LJ (2.83%; p=0.035) and VJ (4.27%; p=0.031), respectively. It can be concluded that the eight-month-long period without any organized SPE classes had a bad influence on BMA.

Key words: *police work, physical ability, students, specialized physical education.*

INTRODUCTION

Physical education, sport and recreation, i.e. physical culture is increasingly becoming an important factor of everyday life in a modern society. As a system that encompasses physical, psychical, social and health characteristics of people, it makes it possible for physical labour or physical exercising to be done in a rational, adequate and satisfying way (Dopsaj et *al.*, 2010). The consequences of inadequate physical abilities, i.e. their development below the critical level of a person's needs for normal functioning, influence an inadequate level of work abilities. The reduced level of work abilities because of the reduced level of physical abilities is notable in all aspects of modern society, in relation to health, economic, social and educational, sports, and security aspects of the society (Trottier & Brown, 1994; Kallings, Leijon, Hellénius, & Ståhle, 2008). It is considered that policing requires a whole spectre of complex measures and activities done primarily with the purpose of preventive actions, potential preventing and combating possible incident situations (Mitrović, Djordjević, & Dopsaj, 2015). Police officers should be qualified to overpower and detain a suspect, break up conflicts and control masses (Anderson & Plecas, 2000; Vučković, Subošić, & Kekić, 2011). They also have to be able to help the injured after accidents and in emergency situations such as floods or fires (Anderson, Plecas, & Segger, 2001). Completing such tasks can be extremely physically demanding, dangerous for all the participants, and it may lead to physical exhaustion (Strating, Bakker, Dijkstra, Lemmink, & Groothoff, 2010). To efficiently and safely fulfil the said tasks, police officers must be physically fit (Bonneau & Brown, 1995). For all these reasons, police officers should be adequately chosen, professionally trained and qualified to do their job on the necessary level of work efficiency (Vučković et al., 2011). For successful performance of police work and fulfilling professional obligations of police officers, it is necessary to be of adequate health (Sörensen, Smolander, Louhevaara, Korhonene, & Oja, 2000), morphological characteristics (Arvey, Landon, Nutting, & Maxwell, 1992; Dopsaj, Milošević, Vučković, Blagojević, & Mudrić, 2005; Malavolti et *al.*, 2008; Mitrović, Djordjević, Dopsaj, & Vučković, 2015) as well as basic and specific physical abilities (Copay & Charles 1998; Strating et *al.*, 2010; Mitrović & Vučković, 2014; Janković et *al.*, 2015).

The Academy of Criminalistic and Police Studies (ACPS), as an institution of higher education, is engaged in educating candidates for the needs of the Ministry of Interior of the Republic of Serbia (MoI) where they adopt professional theoretical knowledge and acquire specific skills needed for the duties of a police officer (Stajić, 2003; Milojević, Vučković, & Janković, 2011; Obradović, 2011). A multidimensional positive selective model of the entrance exam is applied with the aim of selecting the most adequate candidates that will be educated at the ACPS. The candidates were evaluated for the following: success in secondary school, health status, psychological characteristics and personality aptitude, general knowledge and Serbian language, as well as the level of basic motor skills development (Dopsaj, Vučković, & Blagojević, 2007; Janković, Dimitrijević, Vučković, & Koropanovski, 2013). The selection must be understood as a permanent process that lasts from the

moment of preparation for the entrance exam, enrolling in the ACPS, through signing an employment contract with the MoI, as well as during work in the MoI. The ACPS student is obliged to fulfil certain criteria each year which at the same time show the degree of his adaptation to the applied training load during Specialized physical education classes (SPE) (Blagojević, 2003; Dopsaj & Vučković, 2006; Dimitrijević, Koropanovski, Dopsaj, Vučković, & Janković, 2014).

SPE is a narrow specialized field that, as a teaching discipline, derived from the scientific field of Physical Education, and it deals with studying principles that prevail in relation to motor skills, i.e. in relation to the movement structures that are essential for the professional needs of the police, as well as laws of education in relation to the processes of police education (Blagojević, Vučković, & Dopsaj, 2012). There have been three curricula of SPE since the foundation of the ACPS. By comparing the effects of different programs, it was determined that the present curriculum, unlike the previous ones, due to the reduced number of SPE classes, manages to achieve a weaker influence on basic motor abilities (BMA). The current SPE program is organized in such a way that students have classes in the second, third and sixth semester and not in all eight semesters as it used to be (Dimitrujević et *al.*, 2014).

In the process of selection for the entrance at the ACPS, the integral level of BMA development was assessed and expressed with the general score. The obtained result positions the individual in percentiles based on the BMA criterion in relation to the whole tested population (Dopsaj et *al.*, 2007; Dopsaj et *al.*, 2010). The conducted research confirms that the selection model which assesses the level of BMA development integrally, by using the general score, is the adequate one because it has been shown that candidates who enroll in the ACPS achieve statistically significantly better results on the test for BMA assessment than candidates who failed to enroll in the faculty on the basis of the total score (Janković et *al.*, 2013). By an adequate selection of candidates on the basis of BMA development, a higher qualitative level of the group is achieved, which again provides the basis for the higher final product of the educational system (Dopsaj et *al.*, 2007). However, SPE classes begin eight months after the entrance exam, and in that period students have no organized physical activity whatsoever (Dimitrijević et *al.*, 2014). The question that emerges is the following: are morphological characteristics and BMA, defined as the initial condition of the ACPS students, on the same level in the beginning of educational process of SPE as those in the entrance exam? As we know, there have been no studies dealing with the influence of a period without organized SPE classes on morphological characteristics and BMA of the ACPS students. Consequently, the aim of this study was to investigate the influence of eight-month-long period (from entrance exam till the beginning of SPE) on the basic morphological characteristics and BMA of ACPS students of both genders.

THE METHOD

The testing procedure was conducted according to the *Declaration of Helsinki for recommendations guiding physicians in biomedical research involving human subjects* (www.cirp.org/library/ethics/helsinki/), and with the permission of the Ethics Committee of the Faculty of Sports and Physical Education, University of Belgrade. All of the participants were informed about the assessment and research aim. This study belongs to the group of applied studies in which the method of experiment with inductive deduction

was used to gain new knowledge. The experiment was realized by the method of field testing (Ristanović & Dačić, 1999).

The sample of participants

137 candidates participated in the study, and there were 51.1% (N=70) female and 48.9% (N=67) male candidates. The average age of the female candidates in the first testing was 18.2±0.4 years of age, and the average age of male candidates was 18.4±0.6 years of age. All the candidates passed the selection process and they enrolled in the first year of the ACPS as students of basic academic studies.

The sample of measuring instruments

To determine basic morphological characteristics, the following was studied: body height (BH), body weight (BW) and body mass index (BMI), measured by standard procedures (Onis & Habicht, 1996). The following variables were observed in the battery of tests for the assessment of BMA in candidates of both genders:

- Repetitive strength of arm extensors was assessed with a maximum number of Push-ups done in a 10-second time interval (PU);
- Repetitive strength of abdominal flexors was assessed with the Sit-ups for 30 seconds test (ABD);
- The horizontal component of the speed strength of leg extensors was assessed with the Standing long jump with arm swing test (LJ);
- The vertical component of the speed strength of leg muscles was assessed with the Abalakov test with an arm swing (VJ);
- For male candidates - maximal isometric force of back extensors – the "Isometric dead lift" was measured (F_{max}BE),
- For female candidates - maximal isometric force of finger flexors – the "Hand grip" of dominant hand (F_{max}HG).

Assessment and measurement of BMA was completed with a standard procedure used in the entrance exam for the assessment of motor abilities in the ACPS (Dopsaj et *al.*, 2007; Janković et *al.*, 2013).

All of the candidates were tested twice, the first time during the entrance exam for the ACPS and the second time eight months later, at the beginning of the second semester, immediately before the beginning of SPE teaching to determine their current basic morphological characteristics and BMA.

Statistical procedure

All the data were analyzed using the descriptive statistics to calculate the basic parameters of central tendency: the arithmetic mean (mean), standard deviation (SD) and the limit values of range tolerance (minimal – Min and maximal – Max values). Regularity of the distribution of results is defined by skewness (Skew.), and kurtosis (Kurt.). The existence of a general difference of variability between two tests was determined by the multivariate analysis of variance (MANOVA). Statistical significance was defined at 95 percent probability, i.e. at the level of 0.05 (Hair, Black, Babin, Anderson, & Tatham, 2006). All statistical analyses were done by the application of software package SPSS for Windows, R. 22.0.

RESULTS

Tables 1 and 2 present the results of both the measurings of basic descriptive indicators of morphological characteristics and motor abilities of female candidates. By analyzing the results of morphological characteristics, it can be seen that female candidates have higher values of BH, and lower values of BW and BMI at the entrance exam in relation to the measurement at the beginning of the second semester. Female candidates had better results of BMS at the entrance exam in relation to the second measuring in F_{max}HG, LJ and VJ, while the results of PU and ABD were lower.

Table 1 Basic descriptive parameters of morphological characteristics and BMA of female candidates at the entrance exam

Variables	Mean	SD	Min.	Max.	Skew.	Kurt.
BH (cm)	168.5	4.8	162	185	0.967	0.798
BW (kg)	60.1	6.3	51	75	0.615	-0.272
BMI (kg/m^2)	21.1	1.6	18.6	26.3	0.726	0.187
F_{max}HG (DaN)	32.9	4.9	22.9	44.5	0.030	-0.419
PU (No)	7.2	2.6	0	12	-0.686	0.322
ABD (No)	22.7	2.6	17	27	-0.068	-0.754
LJ (cm)	176.5	21.2	115	222	-0.548	0.523
VJ (cm)	31.8	5.3	20.7	47.3	0.245	-0.130

Table 2 Basic descriptive parameters of morphological characteristics and BMA of female candidates before the start of the SPE teaching program

Variables	Mean	SD	Min.	Max.	Skew.	Kurt.
BH (cm)	168.3	4.9	160.0	185.4	0.926	0.883
BW (kg)	62	8.1	48.0	84.1	0.693	0.245
BMI (kg/m^2)	21.9	2.3	17.6	29.5	0.720	0.497
F_{max}HG (DaN)	30.6	4.8	21.1	44.7	0.477	0.255
PU (No)	7.5	2.3	2.0	13.0	0.221	-0.019
ABD (No)	23	4	12.0	30.0	-0.515	0.204
LJ (cm)	168.4	20.8	129.0	225.0	0.282	-0.111
VJ (cm)	29.5	4.6	19.7	43.8	0.807	1.437

Results of both measurings of basic descriptive indicators of morphological characteristics and BMA of male candidates are presented in Tables 3 and 4. Based on the results of morphological characteristics it can be concluded that male candidates achieved higher values of BH during the entrance exam, and lower values of BW and BMI in relation to measurings at the beginning of the second semester. Male candidates achieved better results of BMA for LJ and VJ at the entrance exam in relation to the second semester, and lower for F_{max}BE, PU and ABD.

Table 3 Basic descriptive parameters of morphological characteristics and BMA of male candidates at the entrance exam

Variables	Mean	SD	Min.	Max.	Skew.	Kurt.
BH (cm)	182.4	6.6	170	198	0.305	-0.580
BW (kg)	79.1	7.4	63	99	0.046	-0.030
BMI (kg/m^2)	23.7	1.3	21.1	26.8	0.274	-0.274
F_{max}BE (DaN)	131.7	22.5	76.0	177.8	-0.051	-0.536
PU (No)	12.4	1.4	8	14	-1.188	1.468
ABD (No)	27.4	2.4	21	32	0.026	-0.358
LJ (cm)	232.9	18.0	181	277	-0.402	0.452
VJ (cm)	44.5	5.6	29.0	56.2	-0.385	0.015

Table 4 Basic descriptive parameters of morphological characteristics and BMA of male candidates before the start of the SPE teaching program

Variables	Mean	SD	Min.	Max.	Skew.	Kurt.
BH (cm)	182.2	6.6	170	198	0.257	-0.614
BW (kg)	80.8	8.0	64	98	0.039	-0.466
BMI (kg/m^2)	24.3	1.7	20.1	28.2	-0.011	0.118
F_{max}BE (DaN)	133.5	18.1	94.2	178.2	0.013	-0.064
PU (No)	12.5	1.7	8	15	-0.709	0.038
ABD (No)	28.3	3.1	21	35	-0.116	-0.185
LJ (cm)	226.3	18.0	190	280	0.209	0.243
VJ (cm)	42.6	4.7	32.4	57.0	0.511	0.508

The results of the multivariate analysis of variance (MANOVA) have shown that statistically significant difference between the first and the second measurement was not determined for morphological characteristics on the general level in candidates of both genders. The value of Wilks' Lambda for the female candidates was 0.936 ($F = 1.750$, $p = 0.160$), and for the male candidates 0.965 ($F = 1.555$, $p = 0.203$).

However, in the case of the studied BMA, the results of MANOVA have shown a statistically significant difference between the first and the second measurement was determined in candidates of both genders. The value of Wilks' Lambda for the female candidates was 0.874 ($F = 3.869$, $p = 0.003$), and for the male candidates 0.911 ($F = 2.514$, $p = 0.033$). Tables 5 and 6 present absolute and relative values of the difference of results of morphological characteristics and studied BMA from the first and second measuring for candidates of both genders.

Table 5 Differences of morphological characteristics measured at the entrance exam and before the start of the SPE teaching program (MANOVA)

Variables	Female candidates			
	Aps.	Rel. (%)	F	p
BH (cm)	-0.2	-0.12	0.055	0.816
BW (kg)	1.9	3.16	2.606	0.109
BMI (kg/m^2)	0.8	3.79	4.864	**0.029***
Variables	Male candidates			
	Aps.	Rel. (%)	F	p
BH (cm)	-0.2	-0.11	0.044	0.834
BW (kg)	1.7	2.15	1.534	0.218
BMI (kg/m^2)	0.6	2.53	4.603	**0.034***

* p<0.05

Table 6 Differences of BMA measured in the entrance exam and before the start of the SPE teaching program (MANOVA)

Variables	Female candidates			
	Aps.	Rel. (%)	F	p
F_{max}HG (DaN)	-2.3	-6.99	7.853	**0.006****
PU ($_N$)	0.3	4.17	0.436	0.510
ABD ($_N$)	0.3	1.32	0.230	0.633
LJ (cm)	-8.1	-4.59	5.176	**0.024***
VJ (cm)	-2.3	-7.23	7.793	**0.006****
Variables	Male candidates			
	Aps.	Rel. (%)	F	p
F_{max}BE (DaN)	1.8	1.37	0.246	0.621
PU ($_N$)	0.1	0.81	0.077	0.782
ABD ($_N$)	0.9	3.28	3.037	0.084
LJ (cm)	-6.6	-2.83	4.547	**0.035***
VJ (cm)	-1.9	-4.27	4.767	**0.031***

** p<0.01; * p<0.05

DISCUSSION

The results of the MANOVA of measured morphological characteristics have found that on the general level there are no statistically significant differences. However, it was determined that BMI statistically significantly increased by 3.79% (p=0.029) among the female candidates, while among the male candidates it increased by 2.53% (p=0.034). When the BMA results are observed, we can claim that at the general level a statistically significant difference was determined for candidates of both genders. Nevertheless, when individual variables are observed, it was determined that female candidates individually achieved statistically significantly lower results for variables in testing immediately before the beginning of the SPE classes in comparison to the entrance exam, namely in

F_{max}HG for 6.99% (p=0.006), LJ for 4.59% (p=0.024) and VJ for 7.3% (p=0.006). Male candidates achieved a statistically significant reduction in the results during the eight months, namely: LJ for 2.83% (p=0.035) and VJ for 4.27% (p=0.031). There were no statistically significant differences between two testings for the other variables.

Bearing in mind that BW increased in relation to BH in both genders (female 1.9 kg, male 1.7 kg, respectively), it can be concluded that the statistically significant increase of BMI is actually a consequence of the increase of BW. When the studied increase of BW is compared with the study by Sörensen et *al.* (2000) with the police of Finland, where the trend of increase of BW of 0.5 kg by year was determined during a fifteen-year-long period of work, it can be concluded that an eight-month-long period without SPE had an adverse influence. Moreover, there is the assumption that the statistically significant increase of BMI (female 3.79%, male 2.53%, respectively) is a consequence of an eight-month-long period without organized SPE classes, especially if we take in take into account that, according to former studies (Dimitrijević, Koropanovski, & Janković, 2015), since enrolling in the ACPS to the end of three years of SPE classes, there is no statistically significant increase of BMI (just 1.76%). The increase in BW and BMI, together with simultaneous decline of physical abilities, in this case BMA, shows that BW and BMI increased on the basis of the fat component, which is not acceptable in relation to the profession of a police officer (Coldiz, 1999; Völgyi et *al.*, 2008; Dopsaj et *al.*, 2010). Also, Copay & Charles (1998) confirm that in police officers there is a notable trend of being less physically fit and with a more increased percentage of adipose tissue.

When the population of police officers is in question, it is supposed that the more physical activity there is in relation to professional and working demands, the more physically fit individuals at the adequate level there are (Collingwood, 1988). If we take that into account, according to the valid curriculum of the ACPS, organized classes of SPE begin eight months after the entrance exam, as well as the fact that in the mentioned period students have no organized physical activity whatsoever (Dimitrijević et *al.*, 2014), this is a probable reason for the statistically determined significant decline of BMA. The decline of BMA is reflected on the statistically significant F_{max}HG in female candidates exactly as a consequence of the lack of physical activities, because doing various sports and sports activities, especially those involving elements of martial arts (which is one of the segments of SPE), has a positive influence at the level of maximal isometric force of finger flexors (Dopsaj, Vučković, Milojković, Subošić, & Eminović, 2012). In other words, systematic and programmed exercising directed towards the development of physical abilities is very important for adequate physical preparation of police officers and is one of ways to be positioned better in relation to the work environment (Charman, Savage, & Cope, 1999). The level of maximal isometric force of finger flexors - Hand grip, according to certain studies (Bohannon, 2001) is in correlation with muscle groups of lower limbs which probably influenced the statistically significant decline of physical abilities in female candidates in LJ and VJ tests.

The SPE program should improve the physical abilities of candidates and raise them to the necessary professional level (Dimitrijević et *al.*, 2014). In previous studies it was determined that students of the Norwegian Police University College during their three years of study statistically significantly improve maximal and repetitive strength, while speed strength remains at the level of initial testing (Lagestad & Van den Tillaar, 2014). Analysis of the four-year program for students of the Military Academy in Serbia showed that the program influences abilities of cadets satisfyingly because it enables the

prescribed norms to be fulfilled, but is insufficient to achieve maximal results (Marić et *al.*, 2013). A positive influence of a six-month *supervised fitness* program on body composition and cardiovascular and muscular fitness in police officers was also achieved. However, testing was also repeated a year after the completion of the organized program. It was found that BW and BMI increased in 6 to 18 months. The time needed to cross training ground statistically significantly increased, with changes of morphological characteristics indicating a decrease in the overall fitness. Authors concluded that if it is required to secure that police officers are able to perform their duties on the job, it is necessary to apply the monitored program for development of physical abilities during the whole year (Rossomanno, Herrick, Kirk, & Kirk, 2012).

Results of this study have shown that a period without organized physical exercise had an adverse effect on body composition and speed strength in candidates of both genders, while in female candidates also had the maximal isometric force of hand grip. In relation to obtained results and results from previous studies which revealed a positive influence of continuous programs and negative influence of periods without organized and monitored physical exercise, it can be recommended that the ACPS students be provided with various forms of physical activities during their entire studies.

CONCLUSIONS

It can be concluded that an eight-month-long period without organized physical activity, in this case SPE teaching, had an adverse influence on the basic morphological characteristics and BMA of students, and that the results of entrance exam do not correspond to the present condition.

The recommendation that comes out of this study is that students of ACPS should be provided with organized physical actives, at least during regular education, that would improve the level of their BMA or at least keep them at the level they had at the entrance exam.

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UTICAJ OSMOMESEČNOG PERIODA BEZ NASTAVE SPECIJALNOG FIZIČKOG OBRAZOVANJA NA MORFOLOŠKE KARAKTERISTIKE I MOTORIČKE SPOSOBNOSTI STUDENATA KRIMINALISTIČKO-POLICIJSKE AKADEMIJE

Smanjeni nivo radnih sposobnosti policajaca, usled smanjenja nivoa fizičkih sposobnosti, loše utiče na efikasno i bezbedno obavljanje složenih policijskih mera. Cilj ovog rada bio je da utvrdi da li su morfološke karakteristike i bazične motoričke sposobnosti (BMS), pred početak nastave Specijalnog fizičkog obrazovanja (SFO), na istom nivou kao i na prijemnom ispitu, odnosno kako je na njih uticao period od osam meseci tokom kojih studenti KPA nisu imali organizovanu nastavu SFO. U istraživanju je učestvovalo 137 kandidata (70 ženskog i 67 muškog pola). Za utvrđivanje morfoloških karakteristika posmatrani su: telesna visina (BH), telesna masa (BW) i indeks mase tela (BMI). Za procenu BMS posmatrani su: broj urađenih sklekova za 10 sekundi (PU), podizanje trupa za 30 sekundi (ABD), skok udalj iz mesta (LJ), Abalak test (VJ), kao i za kandidate izometrijska sila mišića opružača leđa (F_{max}BE), a za kandidatkinje izometrijska sila pregibača prstiju dominantne ruke (F_{max}HG). Rezultati MANOVA pokazali su da između prvog i drugog merenja na generalnom nivou za morfološke karakteristike nije utvrđeno da postoje statistički značajne razlike kod kandidata oba pola (ženski p=0.160; muški p=0.203), dok je za BMS utvrđeno da postoje statistički značajne razlike kod kandidata oba pola (ženski p=0.003; muški p=0.033). Pojedinačno po varijablama, tokom osmomesečnog perioda, od morfoloških karakteristika BMI je kod kandidatkinja statistički značajno povećan za 3.97% (p=0.029), a kod kandidata za 2.53% (p=0.034); dok je kod posmatranih BMS kod kandidatkinja statistički značajno lošiji rezultat ostvaren kod F_{max}HG za 6.99% (p=0.006), LJ za 4.59% (p=0.024) i VJ za 7.3% (p=0.006) i kod kandidata je došlo do statistički značajnog smanjenja rezultata LJ za 2.83% (p=0.035) i VJ za 4.27% (p=0.031). Može se zaključiti da je osmomesečni period bez organizovane nastave SFO loše uticao na BMS.

Ključne reči: *policijski posao, fizička sposobnost, studenti, specijalno fizičko obrazovanje.*