DIFFERENCES IN MOTOR SKILLS OF STUDENTS AT THE FACULTY OF SECURITY SCIENCES BASED ON BODY MASS INDEX

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ISSN 1840-152X
UDK: 796.012.1-057.875
https://doi.org/10.7251/SIZ2401165K
https://sportizdravlje.ues.rs.ba/index.php/sah
https://doisrpska.nub.rs/index.php/SIZ

ORIGINAL SCIENTIFIC ARTICLE

Summary: A study was conducted on a sample of 305 participants, students of the Faculty of Security Sciences of the University of Banja Luka, representing the population of 19- to 20-year-old police trainees, to determine differences in motor skills based on body mass index (BMI). The diagnosis of body mass index (BMI) status as a basic measure for the assessment of physical and nutritional status was subjected to a cluster analysis to define six categories of participants hypothetically characteristic for the specificity of the population studied. In accordance with the health epidemiological standards of the World Health Federation, a universal categorization of BMI values was made: underweight individuals, normal weight individuals, overweight individuals or individuals with excessive body weight, pre-obese individuals (mild obesity), obese individuals (moderate obesity), and morbidly obese individuals (severe obesity). The central values of the isolated BMI clusters in the sample studied were as follows: BMI cluster 1 = 18.70 kg/m2, cluster 2 = 20.61 kg/m2, cluster 3 = 22.16 kg/m2, cluster 4 = 23.83 kg/m2, cluster 5 = 25.81 kg/m2, and cluster 6 = 27.38 kg/m2. In the first cluster, 8 participants were identified, representing 2.6 % of the population studied, in the second cluster 57 participants or 18.7 %, in the third cluster 68 participants or 22.3 %, in the fourth cluster 138 participants or 45.2 %, in the fifth cluster 22 participants or 7.2 % and in the sixth cluster 12 participants or 3.9 % of the population studied. The results of this study indicate that there are differences in motor skills variables between certain categories of participants: Standing Long Jump (MSDM) - assessing lower extremity explosive strength - and Cooper 12-Minute Run Test (MKUP) - assessing aerobic endurance, while the Maximum Number of Sit-ups (MPTR) variable - assessing dynamic core strength - is at the borderline of statistical significance.

Keywords: motor skills, students, differences, BMI, cluster

INTRODUCTION

The main feature of the time in which today's youth live is the deficit of physical activity across all social strata. Technological modernization and urbanization have led, alongside all the conveniences for quality of life, to an increase in the prevalence of non-communicable diseases, including increased body weight, defined as obesity. The drastic reduction in movement and physical activity directly affects the health status of young people. The synergistic effect of these two phenomena (obesity and physical inactivity) is a direct cause of the dramatic increase in the prevalence and incidence of serious health issues today, such as pathological cardiovascular conditions, metabolic syndrome, diabetes, osteoporosis, and reduced work and physical capabilities (Caban et al., 2005; Glaner et al., 2010; Stommel & Schoenborn, 2010). The World Health Organization has declared obesity a global risk factor for human health (World Health Organization [WHO], 2000), while hypokinesia, characterized by a significant reduction or even complete absence of physical activity, has been recognized as the biggest practical public health problem in the 21st century (Blair, 2009). The student population is also not exempt from these trends. Contemporary science has established that one of the greatest enemies of the health of adults, and thus of the student population, is the so-called morbid triad: excessive and irregular nutrition, hypokinesia, and stress. These risk factors cause the majority of modern civilization diseases: musculoskeletal disorders, cardiovascular diseases, respiratory and digestive organ diseases, and various neuro-emotional disorders. Given that police work is physically demanding and exhausting, whether it involves fieldwork, office-administrative work, or a combination of both, and that it often takes place in a stressful and socially demanding work environment, it can also be a cause of health problems regardless of the job profile due to long-term continuous exposure (Nagaya et al., 2006; Kales et al., 2009; Jamnik et al., 2010). Thus, it belongs to the category of very demanding, responsible, and stressful professions (Milošević, 1985; Sorensen et al., 2000; Blagojević et al., 2005; Sörensen, 2005; Ignjatović, 2005). Professional pressures can cumulatively lead to a significant decrease in physical capabilities or cause significant negative changes in body structure (Bonneau & Brown, 1995; Sorensen et al., 2000; Sorensen et al., 2005; Kales et al., 2009). For these reasons, it is essential that police officers are adequately selected, professionally trained, and prepared to perform their duties at the necessary level of work efficiency. In relation to the different areas that define the professional and work profile of a police officer (such as the necessary knowledge of police work, which includes knowledge of criminology, police tactics, and law regarding legal basis and action tactics), they must also possess the appropriate health status and body composition (morphological characteristics), adequate cognitive abilities, and conative characteristics (general intelligence, emotional stability, communication skills, stress resilience, etc.), as well as an appropriate level of general and special physical preparedness (physical capabilities, functional characteristics, and relevant knowledge), where motor skills play a crucial role in performing official duties and tasks (Milošević, 1985; Sorensen et al., 2000; Blagojević et al., 2005). Given this, we can conclude that well-developed motor skills and an adequate level of practice in specific motor tasks are fundamental factors that ensure success in the work of

Ministry of Internal Affairs employees and other agencies engaged in security tasks (Milošević, 1985; Dopsaj et al., 2002; Blagojević et al., 2006). Motor skills are generally understood to mean the properties of an individual that express their physical preparedness to perform a specific task and their ability to creatively express their personality, which in experimental research is usually reduced to operationally defined latent dimensions derived from some measurement systems. Previous research on the hierarchical functional model of motor skills (Zaciorski, 1975; Gredelj et al., 1975; Đorđević, 1989; Kukolj, 1996) indicates that in the first-order space, hypothetical factors of the phenomenological model are defined, encompassing coordination, strength, endurance, speed, flexibility, precision, and balance. Based on the research of Kurelić et al. (1975), from the perspective of functional mechanisms in the second-order space, hypothetical factors are defined, which include: the mechanism for structuring movement, the mechanism for regulating tone and synergistic regulation, the mechanism for regulating excitation intensity, and the mechanism for regulating excitation duration. Regarding the relationships between morphological characteristics and motor skills, research conducted by Milošević et al. (1988) indicates positive relationships between longitudinal dimensionality and mechanisms for structuring and reprogramming motor algorithms, as well as a positive relationship between transversal dimensionality and body volume with the same mechanisms, but also a negative relationship between subcutaneous fat tissue and the mechanism for reprogramming the motor algorithm and the mechanism for selective control and regulation of facilitation and inhibition of efferent motor pathways. In studies conducted by (Graf et al., 2004; Wong & Cheung, 2006; Logan et al., 2011; Khodaverdi et al., 2012) a negative impact of obesity on motor skills has been established. Since timely and adequate feedback on the state of morphological characteristics and motor skills of students is a prerequisite for proper programming in teaching, and very few studies have dealt with determining differences in motor skills based on reference values of BMI, the primary aim of this research was to diagnose the current level of body composition, that is, obesity among male members of the student population concerning the body mass index criterion, to determine the current specifics of distribution parameters. The secondary aim of the research was to determine quantitative differences in motor skills concerning the body mass index among students of the Faculty of Security Sciences. Namely, the hypothesis is that there will be a statistically significant difference in the level of motor skills between categories of students divided based on the standards of the World Health Organization into specific sub-samples.

METHODS

Participant sample

The participant sample consisted of students from the Faculty of Security Sciences, former students of the Higher School of Internal Affairs (N = 305), male, aged 19 years ± 6 months, clinically healthy, without visible physical defects or morphological aberrations. Participants belonged to the population of students enrolled in between the 2008/2009 academic year and the 2016/2017 academic year. The baseline descriptive characteristics of the participants were: Height (TV) 181.26 ± 5.65 cm (Min - Max 170.00 - 199.00 cm), Body Mass (TM) 75.70 ± 8.16 kg (Min - Max 56 - 107 kg), Body Mass Index (BMI) 23.00 ± 1.92 kg/m2 (Min - Max 18.30 - 28.40 kg/m2). In relation to the given structure (nine generations of students), it can be said that the sample of participants is representative and can be defined as the general male student population of the Faculty of Security Sciences.

Measuring methods

As a sample of measurement instruments, basic anthropo-morphological characteristics were chosen, represented by two measures: Body weight of the participants (TM) in kilograms was used to assess body volume and mass, while body height of the participants (TV) in meters was used to assess the longitudinal dimensions of the skeleton. All students underwent a standardized measurement at the beginning of each school year during regular physical education classes (Heyward & Stolarczyk, 1996; American College of Sports Medicine, 2006). The body mass index (BMI) was calculated based on these two measured variables. Here, the standard formula for calculating BMI was used (Heyward & Stolarczyk, 1996; Baik et al., 2000; Deitz and Robinson, 2005; National Institutes of Health, 2005; American College of Sports Medicine, 2006):

$$BMI = TM / TV^2$$

- BMI – is the body mass index expressed in kg/m^2;
- TM – represents body mass in kilograms (kg);
- TV – represents body height squared in meters (m).

Based on the World Health Federation standards (National Institutes of Health, 2005) and reference values for BMI, participants were categorized into six subgroups: underweight individuals, normal weight individuals, overweight individuals or individuals with excessive body weight, pre-obese individuals (mild obesity), obese individuals (moderate obesity), and morbidly obese individuals (severe obesity), whose BMI values are shown in Table 1.

Table 1. Body Mass Index (BMI) values in relation to the classification of obesity levels recommended by the World Health Organization (Kostić 2002).

Degree of obesity	**Nutritional Level**	**BMI Values (kg/m^2)**
Zero degree	Normaln nutrition	18,50 – 24,99
First degree	Weight gain: -based on muscle mass -based on fat percentage	 25,00 – 26,49 26,49 – 29.99
Second degree	Weight gain: -First-degree obesity -Second-degree obesity	 30,00 – 34,99 35,00 – 39,99
Third degree	Weight gain: Massive (pathological) obesity	≥ 40,00

Variables

The sample of motor skills assessment variables consists of a battery of seven motor skills tests utilized during the selection process for admission to the School of Security Sciences: Standing long jump (MSDM), number of push-ups in 10 seconds (MSKL), number of sit-ups in 30 seconds (MPTR), mobility with a stick (MOKP), forward roll - backward roll - running (MKNT), hand tapping (MTAR) and Cooper's 12-minute running test (MKUP). The first variable is used to assess explosive leg spring strength, the second and third to assess repetitive strength of the upper extremities and trunk, the fourth to assess body coordination, the fifth to evaluate agility and mobility, the sixth to rate the frequency of hand movements and the seventh to assess the participants' aerobic energy capacity. A detailed description, the implementation method, the measurement conditions, and the assessment standards for the motor skills are provided in the regulation on the admission procedure for candidates at the Faculty of Security Sciences.

Statistical analysis

All variables were first analyzed using basic descriptive statistics, whereby the following measures were calculated: average value, as a fundamental measure of central tendency (MEAN); absolute and relative measures of dispersion, standard deviation (SD). Furthermore, the range of variation (minimum value - min. and maximum value - max.) of the results obtained were also calculated. The regularity of the distribution was tested using the Kolmogorov-Smirnov test (KS). To define categories or classes (clusters) of BMI values for the studied population as characteristic subgroups of the population, the method of cluster analysis, in particular K-Means cluster analysis, was used. The classes were defined as seven characteristic subclasses based on metrological sports methods (Zaciorski, 1982). This categorization made it possible to divide the study population into subclasses that can be considered as hypothetical characteristics related to the police profession and students aged 19 to 24 years. The significance of the variances between the participant groups for the individual variables was tested using analysis of variance (ANOVA). All statistical analyses were conducted using the statistical software program SPSS Statistics 17.0 (Hair et al., 1998).

RESULTS

The basic descriptive indicators for the defined BMI classes for the entire sample of participants are depicted in Table 2. The results show that the central values of the extracted BMI clusters for the examined sample are as follows: BMI cluster 1 = 18,70 kg/m2, cluster 2 = 20,61 kg/m2, cluster 3 = 22,16 kg/m2, cluster 4 = 23,83 kg/m2, cluster 5 = 25,81 kg/m2 and cluster 6 = 27,38 kg/m2, with an average of all achieved results of 23.00 kg/m2.

According to the health epidemiological standards of the World Health Federation, the results of this study show that the population studied at a general level in relation to the BMIValue of population, belongs to the category of normal weight persons with an average value of the achieved results of 23.00 1.92 kg/m2.

Table 2. Basic Descriptive Indicators of Defined BMI Classes in Students of the Faculty of Security Sciences

BMI	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Min.	Max.
7. **Category** 8. **≤ 19.13**	8	18.70	0.33	0.11	18.42	18.97	18.30	19.10
9. **Category 19.14 – 21.55**	57	20.61	0.68	0.09	20.43	20.79	19.20	21.50
10. **Category 21.56 – 22.75**	68	22.16	0.32	0.04	22.08	22.24	21.60	22.70
11. **Category 22.76 – 25.18**	138	23.83	0.69	0.05	23.71	23.94	22.80	25.10
12. **Category 25.19 – 26.40**	22	25.81	0.33	0.07	25.67	25.96	25.20	26.30
13. **Category 26.41 – 28.82**	12	27.38	0.54	0.15	27.03	27.73	26.60	28.40

Legend: BMI - Body mass index**, N -** number of participants**, Mean –** average value of achieved results, **Std. Deviation -** Standard deviation**, Std. Error -** Standard error, **95% Confidence Interval for Mean -** Range of results within a 95% confidence interval, **Lower Bound -** Lower limit of achieved results**, Upper Bound -** Upper limit of achieved results, **Min. -** minimum achieved result**, Max. -** maximum achieved result.

Table 3 shows the distribution of participants in the extracted BMI clusters. The table indicates that in the first cluster, 8 participants or 2.6% of the surveyed population were identified, in the second cluster, 57 participants or 18.7%, in the third cluster, 68 participants or 22.3%, in the fourth cluster, 138 participants or 45.2%, in the fifth cluster, 22 participants or 7.2%, and in the sixth cluster, 12 participants or 3.9% of the tested population.

Table 3. Distribution Structure of Participants in the Extracted BMI Clusters

	BMI Value	Frequency	Percent	Valid Percent	Cumulative Percent
Clusters	19.13 and less	8	2.6	2.6	2.6
	19.14 - 21.55	57	18.7	18.7	21.3
	21.56 - 22.75	68	22.3	22.3	43.6
	22.76 - 25.18	138	45.2	45.2	88.9
	25.19 - 26.40	22	7.2	7.2	96.1
	26.41 - 28.82	12	3.9	3.9	100.0
	28.83 and above	0	0	0	0
	Total	305	100.0	100.0	

Legend: Frequency - number of participants**, Percent -** percentage value**, Valid Percent -** actual percentage value**, Cumulative Percent** - total percentage value

The first cluster that was identified, as the lowest BMI category, shows that only 2.6% of the participants belong to the class defined in the model as underweight or very thin in relation to the students of the Faculty of Security Sciences or police officers in this age group. By medical standards, it can be seen that two participants, or 0.6%, had a BMI of less than 18.50 kg/m^2, while two participants, also 0.6%, were on the borderline of the BMI value of 18.50 kg/m^2 that defines underweight. This is a insignificant percentage in relation to the total number of participants in the population being studied, while the latter four participants may be classified as lean individuals. The second, third and fourth groups include participants classified as being normally nourished, with maximum BMI limits between 19.20 kg/m^2 and 25.10 kg/m^2, and average values of the results attained between 20.61 and 23.83 kg/m^2. According to the results obtained, 86.2% of the total participants fell into this category. For the second cluster, the span of results varies from 19.20 kg/m^2 to 21.50 kg/m^2, with the center of the cluster at 20.61 kg/m^2. For the third cluster, the range of results varies from 21.60 kg/m^2 to 22.70 kg/m^2, with the center of the cluster at 22.16 kg/m^2, while for the fourth cluster, the range of results varies from 22.80 kg/m^2 to 25.10 kg/m^2, with the center of the cluster at 23.83 kg/m^2. In the fifth cluster, being defined as overweight or people with obesity, participants were identified with a median BMI value between 25.19 kg/m^2 and 26.40 kg/m^2, with the center of the cluster at 25.81 kg/m^2. It was found that 7.2% of the total number of participants belonged to the class defined by the model as overweight or obese.

Table 4 contains descriptive indicators for morphological characteristics according to BMI clusters.

Table 4. Descriptive Indicators of Morphological Characteristics by BMI Clusters

Cluster	Variable	N	Range	Min.	Max.	Mean	Std. Deviation	Skewness	Kurtosis	KS p
Cluster	**TV**	8	12.00	175.00	187.00	180.37	4.17	0.371	-0.801	0.986
1	**TM**	8	10.00	56.00	66.00	60.87	3.48	0.302	-1.060	0.816
≤19,10	**BMI**	8	0.80	18.30	19.10	18.70	0.33	-0.092	-2.199	0.811
Cluster	**TV**	57	29.00	170.00	199.00	181.66	6.84	0.655	0.111	0.375
2	**TM**	57	27.00	58.00	85.00	68.40	5.81	0.557	0.396	0.219
19.20 21.50	**BMI**	57	2.30	19.20	21.50	20.61	0.68	-0.369	-1.064	0.074
Cluster	**TV**	68	23.00	170.00	193.00	180.69	5.78	0.207	-0.643	0.823
3	**TM**	68	20.00	63.00	83.00	72.48	4.84	0.341	-0.438	0.068
21.60 22.70	**BMI**	68	1.10	21.60	22.70	22.16	0.32	-0.091	-0.931	0.363
Cluster	**TV**	138	26.00	170.00	196.00	181.14	5.21	0.085	-0.064	0.469
4	**TM**	138	27.00	68.00	95.00	78.17	5.32	0.473	0.011	0.261
22.80 25.10	**BMI**	138	2.30	22.80	25.10	23.83	0.69	0.180	-1.246	0.072
Cluster	**TV**	22	16.00	170.00	186.00	181.18	4.42	-1.196	0.582	0.282
5	**TM**	22	16.00	74.00	90.00	84.81	4.19	-1.155	0.653	0.144
25.20 26.30	**BMI**	22	1.10	25.20	26.30	25.81	0.33	-0.254	-0.794	0.885
Cluster	**TV**	12	22.00	173.00	195.00	184.66	6.22	0.039	0.174	0.962
6	**TM**	12	25.00	82.00	107.00	93.41	6.80	0.471	0.341	0.984
26.20 28.40	**BMI**	12	1.80	26.60	28.40	27.38	0.54	0.266	-0.168	0.837

Legend: **Cluster** – cluster number and range, **Variable** – variable name, **TV** – body height, **TM** – body mass, **BMI** – body mass index, **N** – number of participants, **Range** – result range, **Min**. – minimum achieved result, **Max**. – maximum achieved result, **Mean** – mean value of achieved results, **Std. Deviation** – standard deviation, **Skewness** – skewness coefficient, **Kurtosis** – kurtosis coefficient, **KS p** – Significance level of the Kolmogorov-Smirnov test

The table shows that the values obtained for the central and dispersion parameters for all observed variables fall within the range corresponding to a normal distribution. The values of the skewness coefficient do not surpass the critical value of 1.00, with the exception of the variables height (TV = -1.196) and body mass (TM = -1.155) for the participants who were allocated to the fifth cluster on the basis of their BMI values. The values of the kurtosis coefficient for all variables are below the value of the normal distribution of 2.75, so that the distribution is platykurtic or leptokurtic. The results of the Kolmogorov-Smirnov test imply that the hypothesis of normal distribution is accepted for all variables used.

Table 5 presents descriptive statistics of motor skills by BMI clusters.

Table 5. Descriptive Statistics of Motor Skills by BMI Clusters

Cluster	Variable	N	Range	Min.	Max.	Mean	Std. Deviation	Skewness	Kurtosis	KS p
Cluster 1 ≤19,10	MSDM	8	23.00	240.00	263.00	253.87	8.50	-0.453	-1.326	0.632
	MSKL	8	6.00	9.00	15.00	12.00	2.26	0.196	-1.322	0.945
	MPTR	8	9.00	20.00	29.00	26.00	3.46	-1.320	-0.014	0.241
	MOKP	8	2.70	5.65	8.35	6.79	1.09	0.274	-1.882	0.866
	MKNZ	8	1.95	5.61	7.56	6.33	0.73	0.852	-0.813	0.732
	MTAP	8	7.00	47.00	54.00	51.12	2.35	-1.071	0.171	0.165
	MKUP	8	910.00	2290.00	3200.00	2818.75	321.88	-0.399	-0.999	0.956
Cluster 2 19.20 21.50	MSDM	57	63.00	222.00	285.00	250.54	14.83	0.292	-0.295	0.886
	MSKL	57	9.00	6.00	15.00	11.68	2.07	-0.746	0.119	0.013
	MPTR	57	11.00	22.00	33.00	27.07	2.54	-0.316	-0.323	0.148
	MOKP	57	5.17	4.83	10.00	6.81	1.17	0.515	-0.122	0.905
	MKNZ	57	3.78	5.06	8.84	6.52	0.73	0.810	1.110	0.306
	MTAP	57	14.00	43.00	57.00	50.91	3.36	-0.483	-0.262	**0.035**
	MKUP	57	820.00	2400.00	3220.00	2889.64	218.30	-0.376	-0.808	0.592
Cluster 3 21.60 22.70	MSDM	68	49.00	223.00	272.00	249.38	11.97	-.0045	-0.855	0.424
	MSKL	68	8.00	7.00	15.00	11.80	1.92	-0.069	-0.529	0.455
	MPTR	68	12.00	22.00	34.00	28.23	2.53	-0.403	0.247	0.102
	MOKP	68	5.04	4.96	10.00	6.78	1.20	0.725	0.044	0.633
	MKNZ	68	3.13	5.40	8.53	6.33	0.62	1.120	1.810	0.259
	MTAP	68	12.00	45.00	57.00	52.57	3.05	-0.382	-0.388	**0.015**
	MKUP	68	740.00	2510.00	3250.00	2915.75	187.10	0.100	-0.800	0.755
Cluster 4 22.80 25.10	MSDM	138	74.00	199.00	273.00	245.98	13.27	-0.454	0.293	0.231
	MSKL	138	10.00	7.00	17.00	12.23	1.82	-0.299	0.100	**0.000**
	MPTR	138	12.00	21.00	33.00	27.38	2.67	-0.345	0.068	**0.017**
	MOKP	138	5.73	4.53	10.26	6.98	1.29	0.566	-0.235	0.348
	MKNZ	138	3.66	4.93	8.59	6.34	0.68	0.885	1.176	0.175

	MTAP	138	21.00	38.00	59.00	51.59	3.87	-0.649	0.294	**0.000**
	MKUP	138	1390.00	1860.00	3250.00	2880.65	239.05	-1.252	3.331	0.295
Cluster 5 25.20 26.30	**MSDM**	22	39.00	221.00	260.00	241.59	11.81	-0.194	-1.115	0.620
	MSKL	22	6.00	9.00	15.00	11.81	1.56	-0.328	0.097	0.202
	MPTR	22	12.00	19.00	31.00	27.04	3.01	-1.251	1.181	0.260
	MOKP	22	4.22	5.34	9.56	7.34	1.23	0.015	-1.108	0.840
	MKNZ	22	2.07	5.91	7.98	6.65	0.57	0.820	0.242	0.794
	MTAP	22	17.00	40.00	57.00	50.40	3.89	-0.742	1.306	0.130
	MKUP	22	550.00	2400.00	2950.00	2775.90	126.96	-0.991	2.427	0.776
Cluster 6 26.20 28.40	**MDSM**	12	55.00	220.00	275.00	245.16	16.29	0.064	-0.347	0.983
	MSKL	12	8.00	6.00	14.00	10.75	2.09	-0.601	1.505	0.317
	MPTR	12	9.00	22.00	31.00	26.66	2.80	-0.182	-0.914	0.818
	MOKP	12	4.59	5.41	10.00	7.66	1.52	-0.007	-1.525	0.808
	MKNZ	12	1.88	5.60	7.48	6.36	0.52	0.560	0.461	0.966
	MTAP	12	10.00	47.00	57.00	51.50	4.03	-0.020	-1.786	0.537
	MKUP	12	660.00	2400.00	3060.00	2744.16	175.57	-0.273	0.427	0.708

Legend: **Cluster** – cluster number and range, **Variable** – variable name, **N** – number of participants, **Range** – result range, **Min**. – minimum achieved result, **Max**. – maximum achieved result, **Mean** – average value of achieved results, **Std**. **Deviation** – standard deviation from the mean of achieved results, **Skewness** – skewness coefficient, **Kurtosis** – kurtosis coefficient, **KS p** – Significance level of the Kolmogorov-Smirnov test **MSDM** – standing long jump, **MSKL** – maximum number of push-ups in 10 seconds, **MPTR** – maximum number of sit-ups in 30 seconds, **MOKP** – agility with a stick, **MKNZ** – forward-backward roll and run, **MTAP** – tapping with the hand, **MKUP** – Cooper's 12-minute run test

The table shows that the values obtained for the central and dispersion parameters for all the variables observed are within the values corresponding to a normal dispersion. The values of skewness do not surpass the critical value of 1.00, except for the variables: maximum number of sit-ups in 30 seconds (MPTR = -1.320) and hand tapping (MTAP = -1.071) in group 1, forward-backward rolling and running (MKNZ = -1.120) in group 3, Cooper's 12-minute running test (MKUP = -1.252) in group 4 and maximum number of sit-ups in 30 seconds (MPTR = -1.251) in group 5. The kurtosis values are below the normal distribution value of 2.75 for all variables, apart from the variable Cooper's 12-minute running test (MKUP = 3.331) in cluster 4, which makes the distribution platykurtic or leptokurtic. The results of the Kolmogorov-Smirnov test indicate that the hypothesis of a normal distribution is accepted for most of the variables used. One exception is the variable tapping with the hand (MTAP), where there is a divergence from the normal distribution of the results in cluster 2, cluster 3 and cluster 4. In addition to the variable mentioned above, there are also deviations from a normal distribution of results for the variables maximum number of push-ups in 10 seconds (MSKL) and maximum number of sit-ups in 30 seconds (MPTR) in cluster 4.

The results of the differences in morphological characteristics and motor abilities based on the defined BMI classes for the observed sample of participants are presented in Table 6.

Table 6. Results of differences in motor abilities based on defined BMI classes.

Variable	ANOVA	Sum of Squares	df	Mean Square	F	Sig.
TV	Between Groups	178.919	5	35.784	1.122	0.349
	Within Groups	9540.097	299	31.907		
TM	Between Groups	11935.848	5	2387.170	85.793	**0.000**
	Within Groups	8319.595	299	27.825		
BMI	Between Groups	1019.337	5	203.867	574.300	**0.000**
	Within Groups	106.140	299	.355		
MSDM	Between Groups	2243.531	5	448.706	2.558	**0.028**
	Within Groups	52448.030	299	175.411		
MSKL	Between Groups	34.005	5	6.801	1.881	0.097
	Within Groups	1080.933	299	3.615		
MPTR	Between Groups	78.369	5	15.674	2.194	0.055
	Within Groups	2136.221	299	7.145		
MOKP	Between Groups	12.872	5	2.574	1.636	0.150
	Within Groups	470.561	299	1.574		
MKNZ	Between Groups	2.972	5	.594	1.321	0.255
	Within Groups	134.523	299	.450		
MTAP	Between Groups	124.456	5	24.891	1.929	0.089
	Within Groups	3857.662	299	12.902		
MKUP	Between Groups	576184.549	5	115236.910	2.419	**0.036**
	Within Groups	14246578.022	299	47647.418		

Legend: Variable – variable names, ANOVA – one-way analysis of variance, Sum of Squares – sum of squares, df - degrees of freedom, Mean Square – average sum of squares, F - F test value, Sig. – significance level, Between Groups – between groups, Within Groups – within groups, TV – body height, TM – body mass, BMI – body mass index, MSDM – standing long jump, MSKL – maximum number of push-ups in 10 seconds, MPTR – maximum number of sit-ups in 30 seconds, MOKP – agility with a stick, MKNZ – forward roll - backward roll - running, MTAP – tapping with the hand, MKUP – Cooper's 12-minute run test

According to the results obtained, all classes of the tested variable BMI were shown to be significantly different in the variables: Body Mass (TM) at the significance level (Sig. 0.00), Body Mass Index (BMI) at the significance level (Sig. 0.00), Standing Distance Jump (MSDM) at the significance level (Sig. 0.02) and the variable Cooper's 12-minute running test (MKUP) at the significance level (Sig. 0.03).

DISCUSSION

By analyzing the results obtained, it was concluded that there was a statistically significant difference between the groups of participants classified according to body mass index (BMI), both for the variables "body mass" and "body mass index", which are used to evaluate morphological characteristics, and for the variables related to motor skills: Standing long jump (used to assess explosive strength of the lower extremities) and the Cooper 12-minute running test (used to assess participants' aerobic endurance). The variable "maximum number of sit-ups in 30 seconds" (to assess core strength), on the contrary, is at the limit of statistical significance. If the results of the average values for the individual motor skills variables are analyzed, it is apparent that the participants in the first cluster achieved the best result (253.87) for the variable "standing long jump", which is used to assess the explosive strength of the lower extremities, while the participants in the fifth cluster achieved the worst result (241.59). If we categorize the participants in the second, third and fourth clusters as being normally nourished participants, it can be seen that those classified as thin and normally nourished achieved better results in explosive leg strength than those classified as overweight (participants in the fifth and sixth clusters). This corroborates the findings of previous studies that excessive body weight significantly impacts explosive leg strength. When analyzing the results for the variable "maximum number of push-ups in 10 seconds", which is used to evaluate arm and shoulder strength, the best results were achieved by the participants in the fourth cluster (12.23), while the participants in the sixth cluster achieved the lowest results. It can also be observed for this variable that participants who were categorized as thin and normally nourished achieved better results than participants who were categorized as overweight. They showed greater arm and shoulder strength than the overweight participants. Considering that an increase in body weight is associated with an increase in body dimensions (waist, chest and limbs) that restrict movement, these results are not surprising. As for the variable "maximum number of sit-ups in 30 seconds", it can be seen that the participants in the third cluster achieved the best results (28.23), while those in the first cluster achieved the worst results (26.00). The results for this variable indicate that participants who were categorized as normal weight performed better than overweight or underweight participants, including thin and very thin individuals. They showed greater trunk strength than underweight or overweight participants. Given that body volume increases with a higher BMI, it can be suggested that excess weight around the waist likely restricted trunk flexion during the test of maximum number of sit-ups in 30 seconds, which probably influenced the results obtained. By analyzing the results of the variables for the assessment of body coordination with the stick, the best results were achieved by the participants in the third cluster (6.78), while the weakest results were observed in the sixth cluster (7.66). According to these results, it can be concluded that participants who were classified as normal weight or underweight performed better in body coordination than those who were overweight or obese. Considering that the participants in groups one, two, three and four achieved results below seven seconds, while the individuals in groups five and six achieved results above seven seconds, and taking into consideration that a shorter time in this test indicates a better performance, we can conclude that the coordination skills of the participants in groups one to four are at a higher level than those of the participants with increased or excessive body weight. This is logical, as increased body weight has a negative impact on the development of whole-body coordination, which is confirmed by the results of research conducted by Lopez and colleagues (Lopes et al., 2012). This suggests that as the body mass index increases, the voluminosity of the body also increases, which is a detrimental factor for the development of coordination as a motor skill. When analyzing the results of the variable forward-backward roll and run, which was developed to assess agility, it is apparent that the best results were achieved by the participants in the first cluster (6.33), while the poorest results were found in the fifth cluster (6.65). Almost identical results were achieved by the participants in the third (6.33) and fourth clusters (6.34). Surprisingly, the participants in the sixth cluster achieved a good result (6.36), while the participants in the second cluster achieved a slightly worse result (6.52). This is quite surprising, as a higher body weight generally means that more force is required to move in space, which should have a direct effect on the speed of movement. For the variable " hand- tapping ", which is intended to assess the frequency of individual movements, the participants in the third cluster showed the best results (52.57), while the ones in the fifth cluster showed the worst results (50.40). However, almost all participants achieved similar results for this variable, making it difficult to come to a conclusion based on the BMI categories. For the variable "Kuperov test trčanja 12 minuta", participants in the third cluster achieved the best results (2915.75), while the worst results were observed in the sixth cluster (2744.16). Bearing in mind that participants with lower and normal body weight achieved better results in this variable than participants with increased body weight, it can be concluded that their functional abilities are at a higher level than those of people with increased body weight. These results lead to the conclusion that excessive body weight has several negative consequences and has an indirect effect on motor skills, which is consistent with the results of previous research (Graf et al, 2004; Wong & Cheung, 2006; Logan et al, 2011; Khodaverdi et al, 2012). These findings are also corroborated by a study undertaken by Drid and colleagues (Drid et al., 2013), which found that increased body mass index had a significant negative impact on overall body coordination and arm and shoulder strength in younger school-aged children. The negative effects of increased body mass index on motor skills are generally observed for all motor skills except flexibility, as noted by Tokmakidis and colleagues (Tokmakidis et al., 2006). In a comprehensive review study by Cattuzzo and colleagues (Cattuzzo et al., 2016), which included forty-four studies on the relationship between body weight and motor skills, an inverse relationship was found in thirty-three of the studies. This suggests that lower body mass index values are associated with better motor skills.

CONCLUSION

Considering that future security personnel may perform dangerous and complex tasks; it is crucial that they have optimal skills that can contribute to the successful performance of their professional duties. Given the importance of motor skills in the selection, training, education and supervision systems aimed at improving the work ability of law enforcement officers and employees of other security services, there is a constant need for the development and improvement of training programs and methods for assessing the achieved level of general and specific motor skills (Anderson, Plecas, & Segger, 2001; Dopsaj & Vučković, 2006; Dopsaj et al., 2007; Strating et al., 2010; Vučković et al., 2011). In view of all this, it is necessary to pay attention to the teaching process. In addition to learning and mastering the basic elements of the technique and its correlations as set out in the security guard training program, it is important to influence the selection and development of individual model characteristics for each person. This is critical to ensure that future security guards are successful in their profession. The practical value of this paper lies in the initial assessment of the motor skills and nutritional status of students at the Faculty of Security Sciences, which provides a baseline for monitoring their anthropological characteristics. From the data presented, it is evident that body mass index (BMI) is an important factor in students' motor skills. In addition, the indirect effects on the quality of physical education are not negligible, since students with lower BMI values achieve quantitatively better results in motor tests, which are one of the requirements for better physical education. The results of this research pave the way for further studies with different test batteries, contributing to a more informed selection of candidates and improving the quality of the educational process and, consequently, the quality of staff in the field of security.

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