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DIFFERENCES IN MOTOR-FUNCTIONAL STATUS IN STUDENTS TESTED THROUGH ATHLETIC DISCIPLINES

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Abstract

Aim of the study was to determine differences between defined quality groups of students according to the body mass index (BMI), in their motor-functional status tested by certain athletics disciplines. The sample consisted of 24 students (age = 19 ± 0.78, height = 183.3 ± 6.96, body mass = 77.7 ± 10.24) who completed the study course of Athletics at the first year of the Faculty of Sports and Physical Education, University of Sarajevo. Used variables consisted of the following athletics disciplines: sprint running 60 m, hurdles running 60 m, running 300 meters, long jump and shot put. The sample was clustered into three equal groups consisting of 8 students, according to the BMI criterion [Group 1 BMI = 20.3 kg/m^2 (181.3 cm, 67.1 kg); Group 2 BMI = 22.8 kg/m^2 (186.5 cm, 79.3 kg); Group 3 BMI = 26.1 kg/m^2 (182.1 cm, 86.8 kg)]. Analysis of the results in athletic disciplines showed statistically significant differences in variables of running at 300m (1st with 3 – p=0.040 and 2nd with 3 - p=0.049), long jump (1st with 3rd p=- 0.043 *) and shot put (1st with 2nd p=- 0.049 *). The obtained results indicate that motor-functional status of students was primarily differed by the level of anaerobic-aerobic and anaerobic potential, according to the type of speed-endurance, speed-strength and explosive-strength.

Key words: **BMI, Z values, speed-strength, speed-endurance, athletic potential**

Introduction

Contemporary lifestyle is constantly focused on the needs for different technologies that facilitate human work, but also focus on sedentary lifestyle. Accordingly, humans of modern time are both homo technicians and homo - sedens (Bilić et al., 2011). Play sports by personal choice, that is also adapted to the motor-functional and health status of an individual, should be an integral part of every day's life. Contemporary trends have emphasized the importance of regular physical activity, due to reasons of personal health and health of general population (Malina, 2001). Most physiological responses that are caused by moderate physical activity improve health, while reduced physical activity or its complete absence increases the risks of a variety of modern time's diseases (Matković et al., 2010, Ćirić et al., 2015). According to WHO (2006), studies have concluded that elimination of physical inactivity, among other things, could reduce coronary heart disease by 15-39%, hypertension by 12% and diabetes by 12-35%, and also 18% less fractures caused by osteoporosis. Regardless of the inherited tendency to certain diseases, health is not only genetically conditioned. People can significantly influence their health status through changing their lifestyle habits (Matković et al., 2010). Research today focuses on the health benefits of daily intermittent physical activity, and not exclusively aerobic activities (Kesaniemi et al., 2011).

The recommended categorization according to WHO (1995) implies the following values of BMI: malnutrition (<20 kg/m^2), ideal weight (20-25 kg/m^2), excess body mass (25-30 kg/m^2), and obesity (>30 kg/m^2). The higher values of BMI are related to the extent of the waist and hip as well as their intercourse, regardless of age or sex (Anuurad et al., 2003). But, according to its definition, BMI does not differ fatty tissue from mass-free fatty tissue (Khoury et al., 2013). Therefore, the increased value of BMI does not always reflect increased adiposity (Freedman, Wang and Maynard, 2005). Regardless of, BMI is most often used as a surrogate adipose mass.

Athletics is a complex multidisciplinary sport, which most prominently contains phylogenetic components of human motion. The entire spectrum of natural forms of motion, such as walking, running, jumping and throwing, is contained in certain disciplines of athletic specialty (Smajlović, 2005). Athletic movements are the basis for any human motional activity (Idrizović and Jukić, 2006). Accordingly, athletics is a necessary basis for great achievements in most sports. Also, results in athletics can well serve to evaluate the development of human motor abilities, such as speed, endurance and strength, as well as their different manifestations (Smajlović, 2010). Due to the wide range of its qualities that are reflected in its anthropological essence, as well as its historical values, athletics is often called "The Queen of Sports".

The athletic disciplines differ according to the specific biomechanical structures of motion, which may be cyclic, acyclic or cyclic-acyclic, as well as according to their various motor-functional requirements. Depending on the motor-functional requirements of certain athletic disciplines, energy can be dominantly obtained from aerobic or anaerobic sources (Vučetić et al., 2013), or their different combinations.

Through the course of athletics, as well as other extra-curricular activities related to athletics, it is possible to influence student's motor-functional status with a wide spectrum of activities, as confirmed by various studies (Beljak, 2017, Cvenić, 2016, Abazović et al 2014, Žuvela et al 2011). It is good to create a habit for using easily applicable sports-recreational activities that can contribute to raising motor-functional status and also contributing to improving the health status of students.

Aim of the study is to determine the differences between defined groups of students according to the BMI criterion, and their motor-functional status tested by certain athletics disciplines.

Methods

Participants

The sample consisted of 24 healthy, physically active men, students of the first year at the Faculty of Sport and Physical Education, University of Sarajevo. All students realized practical (60 lessons) and theoretical (30 lessons) classes on the Athletic course during the academic year 2016.-'17. Characteristics of the whole sample (mean ± SD) were as follows: age = 19 ± 0.78 yrs; Height = 183.3 ± 6.96 cm; Body mass = 77.7 ± 10.24 kg. All respondents were informed in advance of the reasons and methods of research. They voluntarily decided to participate in the research by signing the written consent. Complete research results are stored at the Sports Institute, Faculty of Sport and Physical Education, University of Sarajevo.

Running variables

Sample of variables for measuring motor-functional status contained a set of 5 athletic disciplines: sprint running 60 m (R60m), hurdles running 60 m (H60m - height 84 cm, range 8.5m), running 300 m (R300m), long jump (LJMP), shot put (SHPT - weight 4kg), while the morphological characteristics used are: body height (HEIGHT), body mass (WEIGHT) and body mass index (BMI).

Testing procedure

The research was conducted during two working days, with the requirement for students not to perform highly intensive physical activity during 24 hours before testing. On the first day, students are given a detailed explanation of the testing protocol. The first day in the early morning hours (9:00h), body height was tested with 0.5 cm accuracy (Čović et al 2017) using a portable anthropometer (Holtain 610, Crymych, United Kingdom), body mass and body mass index (BMI) was tested on bioelectrical impedance scales TANITA BC 420 SMA (TANITA Europe GmbH, Sindelfingen, Germany). Thereafter, athletics disciplines of sprint running 60 m (R60m), 60m hurdles (H60m), long jump (LJMP) and shot put (SHPT - weight 4kg) were tested. On the second day, hurdles running 60 m (R60m - height 84 cm, range 8.5m) and running 300 m (R300m) were tested. The results in the racing disciplines were measured by a pair of photocells (Microgate photocell, Bolzano, Italy).

Statistical analysis

Using the SPSS 23.0 mathematical-statistical program (IBM Corp. Chicago), the obtained research results were processed. For all treated variables, basic descriptive values (arithmetic mean and standard deviation) of entire sample are calculated. After that, the clustering of respondents was done according to the BMI values. A sample of 24 respondents was divided into three equal groups, with a total of 8 respondents, based on the body mass index (BMI) criteria. The basic descriptive values are calculated for each defined quality group of respondents. Using ANOVA (LSD test), the differences between formed groups at the statistical significance level ($p \leq 0.05$) were tested. To analyze the athletic potential of defined quality groups, Z values are calculated according to Dizdar's (2006) recommendation so that the results in the running variables are multiplied by the number -1, since they are reversed scaled and their higher numerical value represents a weaker result-value.

Results

The results of descriptive statistics of variables are presented in table 1 for three defined quality groups of respondents. It is evident that all three defined groups statistically differ significantly according to the BMI ($p \leq 0.05$) variable, which was also the starting point of this research. The first quality group consisted of 8 students with the best BMI values, in the second quality group there were students whose BMI value ranged from 9th to 16th position of the complete sample, while the third quality group was formed by students with the weakest BMI values. Within all tested athletic disciplines, statistically significant differences were found in variables running 300m (R300m) and long jump (LJMP) between third quality group and groups 1 and 2, where it was also noticeable that the first quality group had a better arithmetic mean value of the results. Also, statistically significant differences were found in the variable shot put (SHPT) between the first and second quality groups, where the first group had a lower arithmetic mean, which also means a weaker value of the results.

Table 1 Descriptive statistics and results of ANOVA (LSD test)

	Group 1 (n=8)		Group 2 (n=8)		Group 3 (n=8)		ANOVA
	Mean	SD	Mean	SD	Mean	SD	LSD
Height (cm)	181.37	6.32	186.50	4.65	182.12	8.95	1 with 2 – p=0.151 1 with 3 - p=0.829 2 with 3 - p=0.217
Mass (kg)	67.10	6.92	79.38	3.87	86.83	7.42	1 with 2 - p=0.001* 1 with 3 – p<0.001* 2 with 3 - p=0.027*
BMI	20.37	1.19	22.80	0.56	26.15	0.92	1 with 2 – p<0.001* 1 with 3 - p<0.000* 2 with 3 - p=0.000*
R60m (s)	7.94	.34	7.91	0.40	8.23	0.52	1 with 2 - p=0.900 1 with 3 - p=0.194 2 with 3 - p=0.157
H60m (s)	10.13	0.79	9.99	1.02	10.81	.91	1 with 2 - p=0.768 1 with 3 - p=0.151 2 with 3 - p=0.088
R300m (s)	43.68	4.43	43.90	3.80	48.26	4.26	1 with 2 - p=0.919 1 with 3 - p=0.040* 2 with 3 - p=0.049*
LJMP (m)	4.89	.35	4.97	0.34	4.43	0.54	1 with 2 - p=0.692 1 with 3 - p=0.043* 2 with 3 - p=0.018
SHPT (m)	9.89	1.23	11.11	1.12	10.62	1.21	1 with 2 - p=0.049* 1 with 3 - p=0.232 2 with 3 - p=0.421

*p≤0.05: R60m – Sprint running 60m; H60m – Hurdles running 60m;
R300m – Running 300m; LJMP – Long jump; SHPT – Shot put: LSD – Least sig. difference

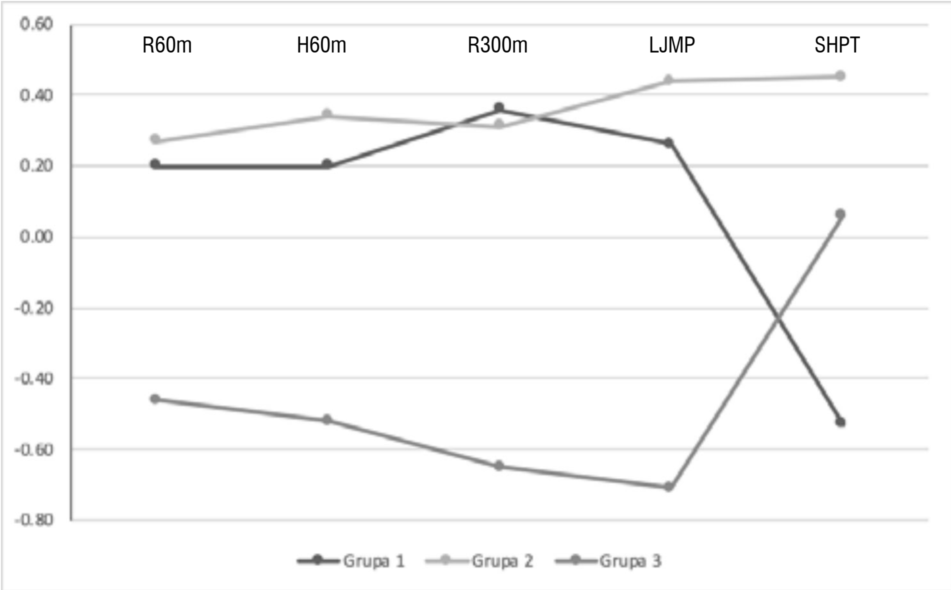
The arithmetic mean values of variables are transformed to Z values in order to calculate and present the values of their athletic potential (Table 2), and also present the typical structures of defined quality groups graphically (Graph 1).

Table 2 Athletics results of quality groups (Z values) and values of athletic potential (Σ Z)

	Group 1	Group 2	Group 3
VARIABLE	Z	Z	Z
R60m (s)	0.20	0.27	-0.46
H60m (s)	0.20	0.34	-0.52
R300m (s)	0.36	0.31	-0.65
LJMP (m)	0.26	0.44	-0.71
SHPT (m)	-0.53	0.45	0.06
Σ Z	0.49	1.81	-2.28

Discussion

The analysis of morphologic characteristics in three defined quality groups of students shows their following characteristics (Table 1): The first quality group is characterized by an extremely low BMI value (20.37 ± 1.19) which is within the limits of normal values according to the World Health Organization (WHO) categorization, and accordingly the lowest average body mass value; The second quality group is characterized by higher body height compared to the first and third group of students, which have almost identical body height values. The second quality group is characterized by an average BMI of 22.80 ± .56 which can indicate a balanced body height and mass ratio, and also suggest an ideal body mass in the case of this group of students, since their BMI value according to WHO categorization is in the middle of the ideal range (20-25); The third quality group is characterized by the highest average body weight value among all three defined quality groups, and is characterized by a significantly higher BMI value (26.15 ± .92). According to WHO categorization, excessive body mass indicates a BMI of 25-30, which is noticeable in the case of a third quality group. However, *Graph 1 Typical structures of quality groups in tested athletics disciplines*



according to WHO categorization, people are at a stage of obesity when they have a BMI above 30 (Alberino et al., 2001; Grotle et al., 2008).

In tested athletic discipline, statistically significant differences were found in variables of running 300m and long jump, between third quality group to groups 1 and 2, ($p \leq .05$). These results point to dominant differences between defined quality groups in athletic disciplines testing the anaerobic-aerobic of speed-endurance type, and anaerobic potential of speed and strength jump type, contrary to the opinion of Singh et al. (2015). In addition, as in previous studies, dominant differences between defined quality groups according to the BMI criteria were identified at the level of their explosive-strength potential (Castro-Piñero et al., 2010; Gontarev et al., 2014; Almuzaini, 2000).

By using a variable shot put, an explosive-strength potential (Terzis et al. 2003) was studied, where statistically significant differences were identified between the first and the second quality groups. These results could point to the fact that larger muscle mass contributes to increased force (Aagaard and Andersen 1998), and thus a better throw result. However, the same was not found in the case of the third group that had the highest BMI value, and as a possible reason it could be inappropriate throwing technique.

In variables sprint running 60m and hurdles running 60m, there were no statistically significant differences between defined quality groups. However, it is noticeable that second quality group had better average values of results in sprint and hurdles running compared to the first, and evidently better average values compared to the third quality group. These variables have exceptionally speed, speed-strength, and speed-coordinative qualities (Bissas et al., 1996).

Based on the results in athletic disciplines that have been converted to Z values, it can be concluded that the highest athletic potential was established in the case of the second quality group ($\Sigma Z = 1.81$), the lower athletic potential was achieved by the first quality group ($\Sigma Z = 0.49$), while the lowest the level of athletic potential was achieved by the third quality group ($\Sigma Z = -2.28$) (Table 2, Graph 1). By analyzing the typical structures of defined quality groups according to the BMI criterion, it was found that the motor-functional status of students differs primarily according to the anaerobic-aerobic potential of the speed-endurance type, and anaerobic potential of speed-strength and explosive-strength type. It can also be concluded that the relationship between height and body mass, and their ratio, may indirectly contribute to the type differentiation of students by the level of motor-functional status and their athletic potential.

Conclusion

The analysis of the morphologic characteristics of the treated sample of students found statistically significant differences between defined quality groups ($p \leq .05$) according to the BMI criterion. The most balanced ratio of body height and mass was identified in the case of the second quality group (BMI = 22.8), which may indicate their ideal body mass, as this BMI value is in the middle of an ideal range of 20-25 according to WHO categorization. Among the defined quality groups, the dominant differences in athletic disciplines were determined in variables running 300m, long jump and shot put. By analyzing the typical structures of defined quality groups according to the BMI criterion, it was found that the students' motor-functional status, tested through athletic disciplines, primary differs in anaerobic-aerobic and anaerobic potential of speed-endurance, speed-strength and explosive-strength type. It was concluded that the relationship between height and body mass, and their ratio, may indirectly contribute to the type differentiation of students by the level of motor-functional status and their athletic potential.

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