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BODY COMPOSITION AS AN INDICATOR OF PHYSICAL ACTIVITY FEMALE OF PHYSICAL EDUCATION AND SPORTS

Ратко Павлович, Нугрохо Сусанто, Еді Сетіаван, Ірина Скрипченко. Склад тіла як показник фізичної активності жінки у фізичному вихованні і спорту

Ключові слова*: склад тіла (БТ), студентки, аналіз біоелектричного імпедансу, кореляційний аналіз*

Abstract. The aim of this research was to assess and analyze the BC of female students using bioelectrical impedance analysis (BIA) and determine the significance of inter correlation coefficients (ICC). The sample included 11 female students of the Physical Education and Sport, University of East Sarajevo, in their third year of study (height = 169.91 ± 9.48 cm; body weight =64.48±8.48 kg; body mass index). = 22.34±2.75kg/m²). The results showed that the body composition was within the permissible values recommended for this student population (body fat=15.39 kg or 24.46%; body muscles=46.11 kg or 71.88%; body water=55 .86%; Basal Metabolic Rate (BMR) = 1486.00 kCal; Daily Caloric Intake (DCI) = 6217.36 kCal, etc.). Significant ICC were extracted that showed an inverse and significantly high correlation (p=0.000) between (Fat and Muscle $_{ICC}$ = -0.945), (Fat and Water $_{ICC}$ = -0.963) while a direct correlation was achieved between (Muscle and Water $_{ICC}$ = 0.986). The obtained results of the research defined the appropriate physical structure of female students, which is a consequence of their appropriate physical activity and the curriculum at the home faculty, as well as the adequacy of the ICC.

Key words: *Body composition (BC), female students, bioelectrical impedance analysis, correlation analysis*

Introduction. The modern way of life implies significantly less physical activity and movement, which causes numerous negative health consequences, starting from deformations of the locomotor apparatus with a high frequency of

obesity that increasingly affects the young population, to various metabolic and cardiovascular diseases in adults. It has been shown that regular, planned and properly dosed physical activity reduces health risk factors, especially those related to cardiovascular diseases and metabolic syndrome (Reimers, et al. 2012; Wagner, et al. 2012; Pavlović, 2022; Radulović et al. 2023). Stachon & Pietraszewska, (2013), Dorofieieva O. et al. (2021), Anđelić M. et al. (2021) suggest that certain effects of increased physical activity include certain changes in the body composition of each organism, and the level and size of changes depends on the type of physical activity or sport that the individual engages in, as well as on his individual characteristics, abilities and predispositions (gender, age, somatotype and specific dynamics of metabolic processes). Gender is the main determinant of the best sports performance, due to various morphological and physiological differences. Women are generally unable to perform at the same level as men during tasks that require a high level of strength, muscular endurance, or physical work ability (Ben Mansour, et al. 2021). Since muscle volume is significantly lower in women due to lower testosterone production, and the percentage of fat mass is higher due to the influence of estrogen, women's performance can never match that of their male counterparts. Overall BC defines body size and configuration, and is often described by anthropometric measures (body mass, skinfold thickness, hip/waist circumference, and body mass index). The aforementioned anthropometric measurements of athletes are an essential prerequisite for successful sports, affecting the athlete's performance, and are necessary for achieving sports performance. Consistent with the action of sex hormones, a progressive increase in body fat has been observed in adolescent girls with sexual maturation (Krawczynski, et al. 2001).

Body fat percentage is the amount of fat stored in the body and does not include lean body mass and muscle mass, and is the most common negative factor for physical activity. Moving to college leads to changes in the way of life of each individual, where new social relationships and the way of life established in this way are adopted. Usually, the time for physical activity is shortened, the quality of nutrition is reduced, which results in the deterioration of the body composition and physical fitness of students. It is considered that young women are more susceptible to "deterioration" of their body composition and are very often in a dilemma about their physical status, i.e. weight and body shape. Body weight is a psychophysically important factor for young women and is related to self-esteem. A major influence on body care has increased the influence of mass media that supports unrealistically thin bodies, and today's society equates thinness with the beauty and attractiveness of a woman. The prevalence of obesity is constantly increasing in many countries of the world among adults and young people, which suggests that many individuals are not successful in achieving their weight loss goals (Jaworowska, & Bazylak, 2007).

Students of physical education and sports represent a special population of healthy young people for whom PA is primary, which is in accordance with the

specifics of their study plans and programs. Physical activity is manifested through various forms of sports, so it is certain that students of these faculties will have a different physical structure compared to inactive or less active population of the same chronological age. Some research (Grima, & Blay, 2016) shows that physical education and sports students have a healthier lifestyle, a better cardiovascular profile and less body fat than students of other faculties, which may be a consequence of their curricula and programs that promote an active and healthy lifestyle with practical teaching in which students participate. In this regard, some research on the population of male students of physical education and sports (Zaccagni, et al. 2014; Chacón-Cuberos, et al. 2018; López-Sánchez, et al. 2019; Pavlović, 2022) analyze body structure, connection with motor manifestations, fitness index, physical activity of students, differences between students from different geographical areas, eating habits, fitness and anthropometric parameters, which leads to the conclusion that physical status is a variable category and primarily depends on adequate PA of the individual and his way of life. Students of physical education and sports have an appropriate level of motor and functional potential, as well as an adequate physical structure that will enable them to adequately realize the planned activities during their studies. A student's body composition is vital

BC parameters	**Mean ± SD**	**Min –Max**	**CI ± 95.00 %**

because it will be of great benefit in subjects that require physical effort. This is the first research on BC using Bioelectrical Impedance (BIA) in female students of the Faculty of Physical Education and Sports in East Sarajevo. Due to this fact, it was considered useful to analyze and learn more about the physical development of this population who decided to study for physical education and health teachers, sports trainers, recreational and sports activity instructors or sports and recreational activity organizers.

The aim of this pilot study is to use BIA to analyze the BC of female students of physical education and sports at the University of East Sarajevo and determine the inter correlation coefficients (ICC) between body fat, muscle and water in the body.

Methods. This was a cross-sectional pilot study carried out on a total of sample 11 female students, of Physical Education and Sport, East Sarajevo (Height=169.91±9.48cm; Weight=64.48±8.48kg; BMI= 22.34±2.75kg/m²). A total of 19 parameters were measured to assess BC (Table 1). The standard metric instruments were applied according to the ISAK. Body weight and BC were assessed with the method BIA using a body composition analyser (Tanita Inner ScanV BC-545N, Tokyo, JAPAN), in accordance with the measurement protocol. The participants were informed in about the nature of the study and investigational procedures, and all the participants have voluntarily given their consent to be the

part of this study. The measurements were according to the procedures in the Helsinki declaration.

Results and Discussion. The aim of the research was to analyze the BC of female students of Physical Education and Sport. The analysis evaluated 19 body composition parameters and determined the ICC. The obtained results confirm the positive numerical values of all body composition parameters, which indicate a healthy composition.

Table 1 contains statistical parameters of the analyzed sample of female students and ICC. The results confirm that body fat contributes to the physical status of female students with 24.46±4.75% (or 15.39±4.38 kg). The values of body fat and visceral fat are in the healthy category, so their values were not detected as risk factors for some diseases and a negative factor in Physical Activity. The fact is that in women (8-12%) fat is necessary for normal body functions, such as fat that is part of the nervous system or surrounding visceral organs in women, and also serves as an insulator to preserve body heat, is a source of fuel for metabolic energy and as a basis for protection.

The average muscle mass of female students was 46.11 kg (or 71.88%), a share in the total body mass, which is a good indicator of the significant presence of physical activity in this population, while the average proportion of water in the composition of the body is about 56%. It is evident that the segmental status of the muscle component (kg) defines a significant numerical identity between the left and right sides of the cranial and caudal extremities, in a ratio of 1:3, where the values of the muscle component of the caudal extremities are three times higher than the muscle component of the cranial extremities. The respondents recorded the largest muscle mass in the trunk area, 26.16kg (about 57%). The same relationship was maintained in the percentage representation of fat tissue in the cranial and caudal extremities.

Adipose tissue is mostly grouped in the trunk area with about 21%, which is 10% less than in the area of the caudal extremities (about 30%) with a symmetrical relationship between the left and right leg. BC reflects slight heterogeneity within the sample for body fat and muscle mass, which may be due to biological differences, different training process, fitness, higher energy expenditure (BMR and DCI). The increased calorie intake can be explained by the fact that a better metabolic product is necessary in this population, that is, a higher consumption of calories as a result of consumption in physical activity, which defines a negative correlation between physical activity, energy consumption and fat percentage.

Table 1. Statistical parameters of BC

BC parameters		Mean ± SD	Min –Max	CI ± 95.00 %
1.	Body Fat (kg)	15.39 ± 4.38	8.65-21.44	3.06 - 7.68
2.	Body Fat (%)	24.46 ± 4.75	17.00-31.30	3.32 - 8.34
3.	Muscle (kg)	46.11 ± 4.98	37.80-53.40	3.48 - 8.73
4.	Muscle (%)	71.88 ± 4.51	65.35-78.92	3.15 - 7.92
5.	Water%	55.86 ± 3.24	51.30-61.00	2.26 - 5.69
6.	Right arm muscle (kg)	2.35 ± 0.31	1.80-2.80	0.22 - 0.54
7.	Left arm muscle (kg)	2.34 ± 0.33	1.80-2.80	0.23 - 0.57
8.	Trunk muscle (kg)	26.16 ± 2.67	21.80-29.90	1.86 - 4.68
9.	Right leg muscle (kg)	7.66 ± 0.81	6.20-8.80	0.57 - 1.43
10.	Left leg muscle (kg)	7.61 ± 0.96	6.00-9.20	0.67 - 1.68
11.	Right arm fat (%)	21.55 ± 6.04	9.40-32.00	4.22 - 10.59
12.	Left arm fat (%)	22.19 ± 5.85	10.40-31.10	4.09 - 10.26
13.	Trunk fat (%)	20.80 ± 5.48	12.80-28.10	3.83 - 9.61
14.	Right leg fat (%)	30.95 ± 5.12	20.90-39.20	3.58 - 8.99
15.	Left leg fat (%)	30.34 ± 4.52	20.90-36.20	3.16 - 7.93
16.	Viscelar fat	1.36 ± 0.50	1.00-2.50	0.35 - 0.89
17.	Bones (kg)	2,46 ± 0,25	2,00-2,80	0.18 – 0.45
18.	BMR (kCal)	1486.00 ± 150.31	1247.00-1714.00	105.03 - 263.79
19.	DCI (kCal)	6217.36 ± 628.82	5217.00-7171.00	439.37 - 1103.54
Inter Correlation Coefficient (ICC)				
		Fat %	Muscle %	Water %
Fat %		1		
Muscle %		-0.945; p=0.000	1	
Water %		-0.963; p=0.000	0.986; p=0.000	1

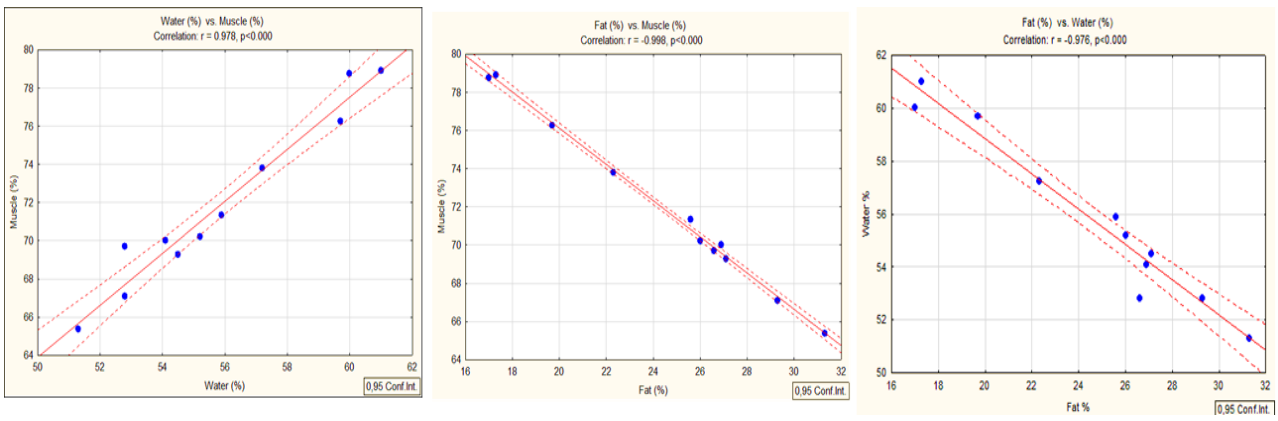

Figure 1. Inter Correlation Coefficient

Statistically significantly high ICCs were recorded between fat, muscle and water parameters in female students (Table 1; Figure 1). The content of muscle mass and water in the body composition of the test subjects shows a very high and statistically significant direct relationship (Muscle vs. Water ICC=0.986; p=0.000), in contrast to the high inverse relationship between body fat and muscle (Fat vs. Muscle ICC= - 0.945; p=0.000), or fat and water content in the body (Fat vs. Water ICC = -0.963; p=0.000). This points to the fact that girls who had a more pronounced muscular component had more water and less fat in their bodies. The greater presence of fat in the body prevents the presence of water, especially in the muscles. These changes are a consequence of the positive effects of students' physical activity during their studies, which supports the findings of some earlier studies (Gremeaux, et al. 2012; Smolarczyk, et al. 2012; Stachon, Pietraszewska, 2013; Zaccagni, et al. 2014; López-Sánchez, et al. 2019). Also, the results of this study support the thesis about the impact of physical activity through the practical teaching of sports faculties on less fat in an individual's body. The results of the study support the conclusions of the research (Grima, & Blay, 2016; Chacón-Cuberos, et al. 2018), which imply a negative influence of fat tissue on the manifestations of individual motor abilities (speed, strength, aerobic endurance).

It is an obvious fact that the physical adaptation of the organism defines a positive response to programmed physical activity, which is associated with an increase in muscle mass and a decrease in body fat. In our study, physical adaptation occurs as a response to a large volume of weekly physical activity through practical lectures and exercises, which results in a reduced percentage of fat and an increase in muscle mass, and simultaneously with the general health condition of the sample of students.

Conclusions. The obtained results of the study defined the appropriate BC of female students (Fat-24.46%; Muscle-71.88%; Water-55.86%; Visceral Fat-1.36; BMR-1486.00kCal; DCI-6217.36kCal). Good body composition of individuals is a prerequisite for good realization of both motor and functional abilities. The ICC results confirmed a highly inverse and statistically significant relationship between the amounts of fat in the body on the one hand and muscle mass and water content on the other. The physical status defined in this way will enable more adequate performance of certain aerobic and anaerobic activities of students.

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