THE DIAGNOSTICS OF FEMALE BODY COMPOSITION IN ADOLESCENCE AND YOUNGER ADULTHOOD[1]

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- body fat,
- body mass index,
- visceral fat,
- waist to hip ratio,
- InBody 230.

Abstract:

The aim of thesis is to analyse and compare chosen body composition`s components of female population in adolescence and young adulthood, specifically female students of secondary school and university in Prešov. Considering the lifestyle of current population, it is important to point out on body composition as one of health state`s indexes, particularly fat mass` portion which can be influenced by nutrition and appropriate movement regime. Body composition was diagnosed on the basis of bioelectrical impedance analysis using InBody 230. Gained data were processed in LookinBody 3.0 and Statistika 10. program. Monitored group S1 consisted of female students of secondary school (n=62) whose average decimal age was 18.9 years. Their average body height was 169.7 centimetres and average body weight was 59.5 kilograms. Group S2 consisted of university`s female students (n=74) whose average decimal age was 21.4 years. Average body height in the file S2 was 166.2 centimetres and average body weight was 58.7 kilograms. Following the results of monitored components, namely: BMI, WHR, VFA and percentage of fat, we find out that gained average data are situated in zone of recommended health standards within monitored ontogeny stages. At the same time it is important to say that group S1 reached fat percentage on the above level of recommended standard, thus 28%. We did not find statistically significant difference comparing groups S1 and S2 besides fat percentage ($p<0.01$) which was higher in file S1, in the group consisted of secondary school`s female students.

INTRODUCTION

Lifestyle itself includes a complex of procedures, principles and life philosophies and ia determined by the overall economic environment, social norms and organizational structure of society [17]. The World Health Organization reports that health depends by 50% on one's lifestyle. Among the basic lifestyle components that significantly promote health are nutrition, physical activity, mental load, stress and the level of material and cultural demands [12]. Lifestyle thus contributes 50 to 60 percent to the overall health. Among the risk factors related to lifestyle are low volume of physical activity, smoking, high energy intake, stress, alcohol consumption and drugs abuse [4]. Body composition is one of the components of health-related physical fitness, which is indicative of one's health status. The body composition itself can be significantly changed via nutrition and physical activity [9]. The assessment of body

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composition is based on the ratio of body fat, water and muscle mass relative to one's body mass [5]. The volume of body fat is dependent on the balance between energy intake and energy expenditure, as the latter can be altered through physical activity, nutrition and genetics [11]. Body composition is regarded as the most important parameter of the developmental stage throughout ontogeny, health status, physical fitness and performance [13]. With respect to ontogeny, the pubertal period is viewed as highly critical as it is characterized by the onset of hormonal changes, changes in interests, reduction in physical activity and decline in physical fitness [1]. Consequently, the periods of adolescence and young adulthood are characterized by maturity of organism, balanced bodily functions, which results in the achievement of peak performance [8]. Furthermore, the incidence of overweight should be lowest in young adulthood as an individual can apply the health- and exercise-related principles very easily, which leads to the adoption of healthy lifestyle [6]. Body composition is proportionate to physical effort and genetic endowment of an individual [3]. The human body composition can be assessed using 5 models: atomic, molecular, cellular, tissue-system and whole-body [10]. The atomic model differentiates between elements as oxygen, hydrogen, carbon, nitrogen, sodium, potassium, chlorine, phosphorus, calcium, magnesium, sulfur etc. [10]. For the analysis of the atomic model a method of neutron activation and determination of total potassium may be utilized [14]. The molecular model distinguishes between body fat, water, proteins, glycogen and minerals, which are sometimes classified either as skeletal or soft tissue minerals. The quantity of particular components may be determined using the method of isotope dilution and the quantity of bone minerals using DEXA [19]. The cellular model differs between fat and non-fat cells, extracellular fluid and extracellular solids [10]. Within the tissue-system model, the authors differ between fat tissue, skeletal muscles, bone tissue, internal organs and other tissues. This level may be analyzed using computer-aided tomography or magnetic resonance imaging [14]. The whole-body model of body composition includes the size, shape and other external somatic parameters. The model makes use of the body height value, length of particular body segments, transverse and circumferential dimensions, skinfold thickness, total body surface, density and body mass index. These values are obtained using the anthropometric methods used to estimate the somatic components on the basis of the previous four models [19]. The methods used to assess body composition may be viewed at 3 levels: 1st level refers to the direct measurement that can be executed after death, the 2nd level requires laboratory conditions and is referred to as hydrodensitometry, measurement of total body water and measurement using the potassium isotope, and the 3rd level makes use of equations determined on the basis of the results of the 2nd level. The third level includes the anthropometric methods and impedance analysis [7]. The selection of particular method and component for analysis depends on the measurement objective and the method availability.

Lifestyle lacking movement is the problem of whole society. Low level of physical fitness in general population is the result of maladaptation to living conditions present in today's world [18]. The assessment and analysis of body composition as one of the health-related parameters forms the basis of potential targeted changes due to the fact that awareness is the basis of physically active lifestyle, which consequently affects not only body composition but also health [2].

THE AIM OF THE WORK

The purpose of the cross-sectional study was to analyze and compare selected components of body composition in adolescent and young adult females.

THE MATERIAL AND THE METHODOLOGY

The first sample consisted of 62 high schools students attending secondary school in Prešov (S1). The mean decimal age was 18.9 years. The second sample consisted of 74 university students attending University of Prešov in Prešov with average age of 21.4 years. Prior to measurement and body composition analysis, body height was measured using anthropometer with 1 mm precision. Body mass and all examined body composition parameters were measured using bioelectric impedance analysis device InBody 230. Bioelectric impedance analysis uses small alternating current that passes through biological structures. The current passes more rapidly through fat-free mass because of the greater water content. Conversely, fat mass is an insulator. The passing alternating current induces electrical resistance [14]. The body composition analysis included the assessment of total body water and percentage body fat. In women, the physiological fat mass content equals 23 % body mass. The volume of fat equaling 28 % body mass represents the obesity limit [21].

We also assessed and compared the BMI values (BMI), visceral fat value (VFA) and degree of obesity in the abdominal area (DO) with recommended population norms. The BMI is expressed as the ratio of body mass and body height squared. Mean values of studied samples were compared with International classification of overweight and obesity accoding to BMI.

Formula for BMI calculation:

$$BMI = \frac{body\ mass\ (kg)}{height^2(m)}$$

Table 1. The International Classification of adult underweight, overweight and obesity according to BMI [20].

Classification	**BMI (kg/m^2)**
Underweight	<18.50
Severe thinness	<16.00
Moderate thinness	16.00-16.99
Mild thinness	17.00-18.49
Normal range	18.50-24.99
Pre-obese	**25.00-29.99**
Obese	**≥30.00**
Obese Class I	30.00-34.99
Obese Class II	35.00-39.99
Obese Class III	≥40.00

VFA is stored in the upper body in the visceral area. The value over 100cm^2 indicates visceral type of obesity, which is associated with increased health risks.

WHR, which is the waist-to-hip ratio, was assessed using norms. In women, this ratio should equal 0.7. The obesity limit in women equals the value exceeding 0.8 or 0.85 [15].

The degree of obesity expresses the ratio of actual body mass to ideal body mass on the basis of body height and age. This value is expressed as percentage and the normal range of body mass equals 90 to 110 percent [21].

The collected data were processed using the software LookinBody 3.0 and statistical software Statistika 10. To process the collected data, mathematical and statistical methods were applied. Arithmetic mean as the measure of location and standard deviation as the measure of variation were used. The differences between samples were determined using independent samples t-test.

RESULTS

The data of both samples S1 and S2 collected and processed using the above-mentioned methods, were evaluated and mean values of examined parameters were compared. The first investigated parameter was body height. In sample S1, the mean body heights were 164.8 cm and 166.3 cm in S1 and S2, respectively. The inter-sample difference in body height was statistically insignificant. Mean values of body mass were 59.5 kg and 58.7 kg in S1 and S2, respectively. The inter-sample difference was not statistically significant. This finding indicated more favorable values in terms of percentage of fat, BMI, VFA, WHR and DO in terms of sample comparison.

The evaluation of percentage fat mass did not confirm this assumption. Body fat is the most frequently assessed and most variable component of human body that may be to a large extent altered by nutritional and exercise regime. As mentioned, the limit of obesity equals 28 percent body fat. This limit was found in sample S1of high school students. This is a surprising finding as high school students have relatively stable daily schedule with the option of regular food intake and a minimum of 2 classes of physical and sports education per week. University students were found to have lower percentage body fat equaling 24.7 %. The difference between samples was statistically significant. This finding confirms the lowest incidence of overweight in young adulthood due to awareness and easier adoption of appropriate lifestyle.

The mean values of total body water were 30.8 liters and 32 liters in S1 and S2, respectively. The data on the percentage of total body water confirmed that this human body component falls within the recommended reference range, which equals approximately 53 % body mass in females. In obese people, this body component value equals only 45 % because of the low water content in fat tissue [16]. The mean value of total body water (%) expressed as percentage body mass in sample S1 was 51.8 % and 54.5 %in sample S2. Higher mean percentage of total body water in S2 corresponds with lower mean percentage of body fat.

Table 2. Somatic parameters in samples

	DA		**BH** (cm)		**BM** (kg)		**FM** (%)		**TBW** (l)	
	x	s	x	s	x	s	x	s	x	s
S1	18.9	0.3	164.8	5.9	59.5	11.3	28	7.6	30.8	3.4
S2	21.4	1.5	166.3	6.5	58.7	9.2	24.7	7.6	32	2.9
Sig.	-		0.18		0.66		0.01		0.05	

Legend: S1- high school students, S2- university students, Sig.- statistical significance, DCV- decimal age, TV (cm) - body height, TH (kg) - body mass, FM (%)- fat mass, TBW (l)- total body water in liters, x- arithmetic mean, s- standard deviation.

Data on body height and body mass were used to assess mean body mass index in both samples. In S1 and S2, the mean BMI values were 21.9 and 21.2, respectively. The difference between the mean BMI values was not statistically significant. Therefore, it may be concluded that the mean BMI values fall within the normal physiological range. However, it should be noted that this index provides only orientational value of acceptable body mass not only in athletes, but also in non-athletes. The calculation of the BMI value within the physiological range could evoke the sense of self-satisfaction. Therefore, we considered important to complement this index with other indexes. The mean values of VFA were 40.9 cm^2 in S1 and 37 cm^2 in S2, respectively. The difference between the mean VFA values was not statistically significant. The mean values of VFA index indicative of visceral fat volume fell within the recommended reference range, which is 100 cm^2. This may be regarded as a positive finding.
The mean WHR values in S1 and S2 were 0.82 and 0.81, respectively. WHR indicates the degree of obesity in the abdominal area. The values recorded in both samples were close to the obesity limit as the acceptable value for women is 0.8, or 0.85. In this index, no

statistically significant difference between samples was found. The ratio of actual body mass compared to ideal one expressed in percent was the final investigated index. The mean values in S1 and S2 were 101.6 % and 98.7 %, respectively. There was no statistical difference between samples. Both recorded values of DO fall within the recommended range from 90 to 110 %. However, it should be noted that this index could be regarded as misleading because it does not take into account the ratio of muscle mass and fat mass. We agree with the opinion of Riegerová, Přidalová, Ulbrichová [14] who reported that health is negatively affected not only by excess body fat or insufficient amount of body fat, but also its distribution, which affects the risk of cardiovascular diseases.

Table 3 shows comparison of mean values of BMI, VFA, WHR and DO with reference norms in samples S1 and S2.

Table 3. The comparison of index values in samples with recommended norms

	BMI				**VFA (cm^2)**				**WHR**				**DO (%)**			
	S1		**S2**		**S1**		**S2**		**S1**		**S2**		**S1**		**S2**	
	x	s	x	s	x	s	x	s	x	s	x	s	x	s	x	s
	21.9	3.8	21.2	2.9	40.9	24.6	37	22.8	0.82	0.05	0.81	0.05	101.6	18.0	98.7	13.5
Sig.	0.22				0.34				0.27				0.29			
N	18.50-24.99				<100				<0.80 (0.85)				90-110%			

Legend: BMI- Body mass index, VFA – visceral fat cm^2, WHR – degree of obesity in the abdominal area, DO – degree of obesity %, S1- high school students, S2- university students, Sig.- statistical significance, N – norm, x- arithmetic mean, s- standard deviation.

CONCLUSIONS

The purpose of the cross-sectional study was to analyze and compare selected components of body composition in adolescent and young adult females.

We have decided to investigate body composition due to its effect on the quality of life as the increased proportion and distribution of body fat is associated with a variety of health risks. The study findings have confirmed that the issue of being overweight is becoming topical. The high school students have greater problem maintaining the proportion of body fat relative to body mass under the obesity limit. Body composition and the fat mass component can be markedly influenced by lifestyle that should include adequate physical activity and nutrition. The availability and correctness of information about healthy lifestyle and the relevance concerning assessment and changes in body composition are regarded as the basis of prevention, promotion of responsibility for one's own health, or potential targeted changes.

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