Rocz Panstw Zakl Hig 2018;69(3):257-266

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ORIGINAL ARTICLE

COMPARISON OF SELECTED PARAMETERS OF BODY COMPOSITION IN A GROUP OF SPORTING AND NON-SPORTING WOMEN

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ABSTRACT

Background. Physical activity is bodily movement produced by skeletal muscle that requires energy expenditure and promotes health benefits. Appropriate physical activity is important in the prevention of cardiovascular disease, coronary heart disease, type 2 diabetes mellitus, obesity, metabolic syndrome, breast cancer, and others.
Objective. The aim of the study was to compare the body composition of the selected group of women in relation to physical activity (group of sporting women (S) versus group of non-sporting women (N-S) using an InBody 230 instrument based on the principle of bioelectric impedance.
Material and Methods. The group consisted of 140 women (n_S = 70 vs n_{N-S} = 70) aged 20-63 years (the average age of women doing sport was 41.1 ± 11.9 and 42.3 ± 10.87 for non-sporting women). Anthropometric measurements were made using the InBody 230 (Biospace Co. Ltd., Seoul, Republic of Korea). The Lookin'Body 3.0 software to process the results was used. The collected data concerning the anthropometric measurements were evaluated statistically and graphically in Microsoft Office Excel 2010 (Los Angeles, CA, USA).
Results. The average value of BMI (*Body Mass Index*) of sporting women was 24.20 ± 3.54 kg.m^{-2} and non-sporting women 27.30 ± 5.97 kg.m^{-2} (P<0.5). Average values of WHR (*Waist hip ratio)* were higher than 0.85 for both groups. Average BMR (*Basal metabolic rate*) values of women doing sport ranged from 1364-1585 kcal. The higher percentage of TBW (*Total body water*), ICW (*Intracellular water*) and ECW (*Extracellular water*) from the average body weight was achieved by the group of women doing sport, where the average TBW was 51.51% of body weight, ICW 31.93% and ECW 19.58% of body weight. Higher values of FFM (*Fat free mass*) were achieved by a group of sporting women. The average BFM in the group of women doing sport was 20.10 ± 6.73 kg, in the non-sporting group 27.60 ± 12.73 kg. The minimum PBF in the sporting group of women was 16.40% and a maximum of 43.30%; the minimum value in the group of women doing not sport was 19.30% and a maximum of 50.40% (p <0.01). The average VFA (*Visceral fat area*) in the group of women doing sport was 86.70 ± 28.79 cm^2 and in the group of non-sporting women 113.90 ± 44.95 cm^2 (p<0.01).
Conclusions. The results of the measurements show the positive influence of physical activity on components of body composition in all age categories. Physical activity, along with rational nutrition, should be part of a healthy lifestyle for each individual.

Key words: *body composition, total body water, fat free mass, body fat mass, physical activity*

STRESZCZENIE

Wprowadzenie. Aktywność fizyczna to każda praca, ruch wykonany przez mięśnie szkieletowe organizmu, który charakteryzuje się ponad spoczynkowym wydatkiem energetycznym. To składowa ogólnego wydatku energetycznego, niezbędna nie tylko do utraty nadmiaru masy, ale w ogóle funkcjonowania organizmu. Właściwie dobrana aktywność fizyczna odgrywa istotną rolę w profilaktyce chorób układu sercowo - naczyniowego, cukrzycy typu 2, zespołu metabolicznego, nowotworów oraz innych schorzeń określanych jako niezakaźne choroby przewlekłe.
Cel. Celem badań było porównanie składu ciała wybranych grup kobiet w aspekcie aktywności fizycznej (kobiety aktywne fizycznie (S) vs kobiety nieaktywne fizycznie (NS)). Do badań wykorzystano analizator skladu ciała InBody 230.
Materiał i metody. Badaną grupe stanowiło 140 kobiet (S – n=70, NS – n=70) w wieku 20 – 63 lat (średni wiek kobiet uprawiających aktywność fizyczną wynosił 41,1±11,9 lat i 42,3 ±10,87 – dla kobiet nieaktywnych fizycznie). Pomiary antropometryczne zostały wykonane przy użyciu InBody 230 (Biospace Co. Ltd., Seoul, Republic of Korea). Do

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opracowania wyników wykorzystano opragromowanie Lookin'Body 3.0. Analiza statystyczna oraz opracowanie graficzne zostało przeprowadzone z wykorzystaniem programu Microsoft Office Excel 2010 (Los Angeles, CA, USA).
Wyniki. Średnia wartość wskaźnika masy ciała (*Body Mass Index- BMI*) kobiet aktywnych fizycznie wynosiła 24,20±3,54 kg/m^2, a kobiet nieaktywnych fizycznie 27,30±5,97 kg/m^2 (p=<0,5). Średnie wartości wskaźnika WHR (*Waist Hip Ratio*) były wyższe niż 0,85 w obu grupach. Wartość wskaźnika podstawowej przemiany materii (BMR) kobiet aktywnych fizycznych mieściła się w zakresie 1364 – 1585 kcal. W ocenia składu ciała kobiet uprawiających sport stwierdzono wyższe wartości wskaźników: TBW (*Total body water*), ICW (*Intracellular water*) i ECW (*Extracellular water*), gdzie średnie wartości wynosiły odpowiednio 51,51% masy ciała, 31,93% i 19,58%. Podobnie w tej samej grupie kształtował się wskaźnik FFM (*Fat free mass*) wynosił on w grupie aktywnej fizycznie 20,10±6,73 kg, natomiast w grupie nieaktywnej fizycznie - 27,60±12,73 kg. Minimalna wartość wskaźnika PBF w grupie aktywnej sportowo wynosiła 16,40% i nie przekraczała 43,30%, natomiast w grupie kobiet nieaktywnych wskaźnik ten był wyższy i wynosił 19,30%, pzy artości maksymalnej 50,40% (p<0,01). Parametr VFA (*Visceral fat area*) wynosił średnio 86,70±28,79 cm^2 w grupie kobiet aktywnych, natomiast w grupie nieaktywnej fizycznie - 113,90±44,95 cm^2 (p<0,01).
Wnioski. Wyniki uzyskane w ocenie parametrów antropometrycznych wskazują na pozytywny wpływ aktywności fizycznej na funcjonowanie organizmu, niezależnie od wieku. Aktywność fizyczna wraz z racjonalnym sposobem żywienia powinna być nieodzownym elemnetem zdrowego stylu życia każdego człowieka.

Słowa kluczowe: *skład ciała, zawartość wody w organizmie, masa beztłuszczowa, tkanka tluszczowa, aktywność fizyczna*

INTRODUCTION

Body building, body dimensions and body composition are among the essential factors of motoric performance and physical fitness. The composition of the body can be understood as the proportion of individual tissues in the total body weight, with the weight of the individual segments being evaluated. Muscle, fat and bone components are involved in their weight. When evaluating the correct development of the individual, the information about the proportionality of the body is very important [32]. The human body is composed of fatty and non-fatty mass, which together create the total body weight. The fat free mass consists of water, minerals, skeleton and muscles. We also refer to fat free mass as an active body mass because it needs energy. Body composition information is important for understanding human health, body functions, and disease dynamics. Research in this field deals with methods of evaluation and descriptive body composition depending on development and aging, from changes occurring in diseases and changes manifesting in movement activity [14]. Optimal body composition should be considered as an adequate indicator of the functional status of the organism and its fitness. In order to prove the change of the somatic state, a change in the body composition is a suitable indicator, the ratio of its fractions – the fat component, the fat free mass and the health indicators [28].

The basic component of the living organism is water. Its amount in the body depends on age (with age decreasing), sex and weight. In the adult human, water is formed by 72-75% of the non-fatty matter. Most of the water is in the blood, in the muscle tissue and in the skin. Relatively little is present in bone tissue (22%) and fatty tissue (10%). The water content is therefore low in obese people, with only 45% of body weight. The lowest water content the tooth enamel. Total body water (TBW) is the only component of the body capable of conducting electric current and is thus the basic variable measured by the bioelectric impedance method [32]. tis essential to take care of daily intake and discharge of water, as dehydration or hyperhydration can occur in the event of imbalance. Both cases lead to damage to the body and may result in the death of an individual [21]. Water is divided into two main spaces – intracellular and extracellular. Intracellular water (ICW) accounts for 40% of the adult body weight or 66% of all body water. Extracellular water (ECW) accounts for 20% of the total adult body weight.

In terms of body composition, the weight of the body can be expressed as the sum of fat and fat free mass (FFM). This includes muscle mass (60%), support and connective tissue (25%) and internal organs (15%). The water content in the fat free mass ranges from 72-74%. The total body weight does not have to change due to the increased or decreased physical activity, only the proportion of the fat free mass to the body tis changed by either increasing or decreasing it. The share of FFM is about 75-80% for women, about 85% for men. For athletes, the FFM share can be higher than 90%. These data do not apply to extreme types of body building. Body tis the most frequently observed parameter because tis an indicator of the health condition but also of the physical fitness of an individual. Its quantity can be influenced by nutrition and physical activity. The proportion of body fat mass (BFM) is sex-dependent and increases with increasing age. Boys have a lower body fat share, whereas for 18-year-old girls the upper body fat can be up to 30%. At the age of 20-24, the proportion of fat in women is approximately 25%, in males 20%. Health risk arises when the body fat content is higher than 30% for teenage girls and 25% for adolescent boys

[22]. For non-sporting women, the proportion of body tis between 20-25%, for men tis about 15%. The ideal sporting standard is 14-18% for women and 5-10% for men [15]. For performance athletes, the average body fat fraction is lower, which is due to a higher proportion of muscle mass [22].

The aim of the work was to evaluate the body composition of the selected group of women in relation to the physical activity based on the bioelectric impedance through the InBody 230 instrument.

MATERIAL AND METHODS

The study consisted of 140 women aged 20 to 63 years (average age of women doing sport was 41.1 ± 11.9 and non-sporting women 42.3 ± 10.87), for who body composition measurements were made based on bioelectric impedance. BIA is proved to be a clinically valid tool for assessment of overweight and obesity [2]. Participants were divided into two basic groups based on exercise, respectively non-exercise activity. Each group consisted of 70 women. The group consisted of clients of the nutrition and consulting company Lean Enterprise Slovakia s.r.o.

Anthropometric measurements were made using the InBody 230 (Biospace Co. Ltd., Seoul, Republic of Korea). Each of the participants was informed with the measurement procedure, explained the possible risks of measuring in the case of pregnancy or having an electrical device at the heart. Before the measurement, participants were asked to excrete and refrain from drinking excessive amounts of water [41]. At the same time each participant signed informed consent for the measurement procedure and also agreed to the processing of personal data. We used the Lookin'Body 3.0 software to process the results. We evaluated the collected data from anthropometric measurements statistically and graphically in Microsoft Office Excel 2010 (Los Angeles, CA, USA). The changes in different groups were performed using *t* tests and the data were presented as mean ± SD. The levels of statistical significance chosen for the comparisons were $p<0.05$, $p<0.01$, $p<0.001$.

Height was determined using a wall-fixed measuring device and body mass using a calibrated scale. From these BMI was calculated. The InBody device divides body composition into four components: total body water (TBW), intracellular and extracellular water, proteins, minerals and body fat mass (BFM). Intracellular water (ICW) shows the amount of water in the cell membrane. The extracellular water (ECW) expresses the amount of interspace fluid and blood. In the case of a healthy body, ICW and ECW ratios must be 3:2. Total body water, proteins and minerals create the fat free mass (FFM) in the body. FFM together with BFM create the total body weight of an individual. InBody can accurately determine how much of the total body mass is the skeletal muscle mass (SMM) and the body fat mass (BFM). Body fat mass expresses the total amount of lipids that can be extracted from fat and other cells. The fat mass can not be estimated directly by the BIA method, but is calculated by excluding fat free mass (FFM) from body weight by the formula: body fat mass = body weight – fat free mass [36]. Through the Inbody 230, we also received data such as Body Mass Index, PBF and WHR, which we evaluated the presence of overweight and obesity in the monitored groups. PBF is the percentage of body fat to body weight of the test person. The standard for PBF is 15% for males and 23% for females, while the reference values range between 10-20% for males and 18-28% for females. We also observed visceral fat area (VFA). Its excessive amount causes metabolic and cardiovascular diseases. In the examination, the visceral fat area is defined as the cross-sectional area of visceral fat found in the abdomen. If VFA is greater than 100 cm^2 we talk about abdominal obesity [39].

RESULTS AND DISCUSSION

From the obtained individual values, we calculated basic statistical characteristics. We focused on the evaluation of total body water, intracellular and extracellular water in litres, and analysis of fat free mass in kg, skeletal muscle mass in kg, body fat mass in kg, and percentage of fat mass and visceral fat area in cm^2. The basic descriptive characteristics of participants are shown in Table 1.

Table 1. Basic descriptive characteristics of participants in monitored groups (n = 140)

Parameters	Mean		± SD		Min		Max		Median		Modus		Significance
	S	*N-S*	*S*	*N-S*	*S*	*N-S*	*S*	*N-S*	*S*	*N-S*	*S*	*N-S*	*S/N-S*
Age (years)	41.1	42.3	11.9	10.87	20	23	63	61	38.5	43.5	33	29	0.16
Body height (cm)	165.6	167.9	5.36	7.1	154	152	180	180	165	166.5	164	164	0.4
Body weight (kg)	66.4	77.9	10.36	20.1	47.8	48.8	97.2	124.4	65.35	70.9	60	74.5	0.006
BMI ($kg.m^{-2}$)	24.2	27.3	3.54	5.97	18.7	17.7	33.6	43	23.85	26.5	24.4	28.6	0.01
WHR	0.89	0.94	0.06	0.09	0.77	0.82	1.3	1.2	0.885	0.92	0.84	0.88	0.003
BMR (kcal)	1370	1446	110.49	176.95	1145	1186	1649	1867	1362.5	1374	1358	1580	0.08

Abbreviations: ± SD – standard deviation; Min – minimum value; Max – maximum value; S – group of sporting women; N-S – group of non-sporting women; BMI – body mass index, [$kg.m^{-2}$]; WHR – Waist to Hip ratio; BMR – basal metabolism

Table 2. Basic descriptive characteristics of selected parameters of participants body composition (n = 140)

Parameters	Mean		± SD		Min		Max		Median		Modus		Significance
	S	*N-S*	*S*	*N-S*	*S*	*N-S*	*S*	*N-S*	*S*	*N-S*	*S*	*N-S*	*S/N-S*
TBW (l)	34.2	36.5	4.8	6.11	20.5	27.7	45	50.6	33.65	34.15	32.3	41	0.12
ICW (l)	21.2	22.6	2.96	3.85	12.7	17	27.6	31.7	20.9	21.1	22.8	21.2	0.13
ECW (l)	13	13.9	1.83	2.27	7.8	10.4	17.4	18.9	12.85	13	12.4	12.4	0.1
Proteins (kg)	9.2	9.8	1.26	1.65	5.6	7.4	12	13.6	9	9.2	9.5	9.2	0.11
ML (kg)	3.3	3.5	0.46	0.63	2	2.6	4.2	5.1	3.25	3.28	3.29	3.4	0.1
BFM (kg)	20.1	27.6	6.73	12.73	8.7	10.2	38	62.6	19.4	22.35	19.9	10.2	0.02
FFM (kg)	46.6	49.8	6.53	8.74	28.1	37.8	61.1	69.3	45.85	46.55	43.8	56	0.17
SMM (kg)	25.4	27.4	3.6	4.83	19	20.2	33.3	39.3	25.25	25.4	25.9	25.7	0.13
BCM (kg)	30.1	32.4	3.35	1.73	23.1	24.3	38.8	45.4	29.9	30.1	30.7	30.1	0.09
PBF (%)	29.6	34.2	5.99	8.21	16.4	19.3	43.3	50.4	29.8	34.55	29.8	28.9	0.01
VFA (cm^2)	86.7	113.9	28.79	44.95	35.3	36.5	148.1	202.7	84.2	104.75	90.2	115.8	0.003
Degree of obesity (%)	112.8	127.1	16.47	27.71	86.9	82.4	156.5	200	111.31	121.1	111.67		0.014
Fitness score	74	69	5.15	7.13	62	50	85	82	74	71	73	72	0.0006

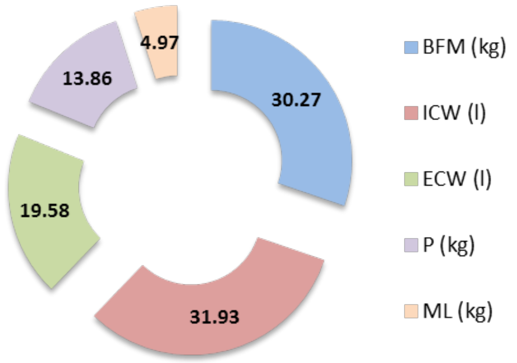
Abbreviations: ± SD – standard deviation; Min – minimum value; Max – maximum value; S – group of sporting women; N-S – group of non-sporting women; TBW – total body water, [l]; ICW – intracellular water, [l]; ECW – extracellular water, [l]; ML – minerals, [kg]; BFM – body fat mass, [kg]; FFM – fat free mass, [kg]; SMM – skeletal muscle mass, [kg]; BCM – body cell mass, [kg]; PBF – percentage of body fat, [%]; VFA – visceral fat area, [cm²].

The average BMI for women doing sport was 24.20 ± 3.54 kg.m^{-2}, for non-sporting women 27.30 ± 5.97 kg.m^{-2}. In the case of BMI, we found a statistically significant difference (P<0.5) among the monitored groups of participants, in the case of body weight up to a highly detectable difference (P<0.01). On the basis of BMI's average values, sporting women can be included in the normal weight category, where the incidence of health risk is minimal. Despite this fact, 25% of the respondents that were in the group of women doing sport were in the overweight group and 8% of the respondents we included into a group with obesity grade 1. The group of women without sport activity can be ranked according to the average BMI in the category of women with overweight when the incidence of health risk is higher. In this group, we have 11% of respondents with obesity in the first grade, 14% of respondents with obesity in the 2nd grade and 3% of respondents with obesity in the third grade, where the incidence of health risk is very high [26, 35]. *Pelclová* et al. [31] found in their study, that only 26.3% of women were of optimal weight, while 51.5% were overweight and 21.6% were obese. An analysis of the BMI indicator in one study showed significant differences between groups of people with no time spent walking, and those with the average amount of walking ca. 30 or 120 minutes [9]. Women who walked vigorously for greater than 150 min/wk had a 35% reduction in coronary heart disease events compared with those who walked infrequently. The most hopeful finding was that women who became active in middle age had a lower risk when compared with women who remained sedentary. By exceeding the minimal recommended physical activity, persons are more likely to improve their personal fitness and prevent unhealthy weight gain [16, 29]. The inverse relationship between walking and BMI values has already been documented in several studies [12, 28, 34, 36].

Average values of WHR were higher than 0.85 in both groups, it means that the participants are at risk for the occurrence of metabolic diseases. In the non-sporting women group the WHR values were higher than 0.85 to 79% of the respondents, in the group of sporting women 67%. Also with this parameter, we found a statistically highly significant difference between the observed groups (P<0.01). *Cacek* et al. [9] found significant differences in WHR values when comparing groups with different intensity of walking. Differences were confirmed between participants with no time spent walking and participants with the average amount of walking ca. 30 and 120 minutes, and between 30 and 60 minutes spent walking and 60 and 120 minutes. Analysis of prospective studies demonstrated that a 1 cm increase in waist circumference was associated with a 2% increase in the relative risk of a cardiovascular disease event [10, 27]. Even minor improvements in waist circumference resulting from walking interventions may have substantial public health gains.

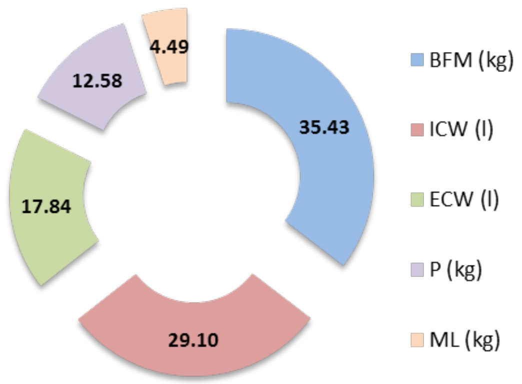
BMR represents the amount of energy required for the essential functions of the organism. In our study the average BMR values ranged from 1364-1585 kcal for sporting women. The average value of this parameter is in this range for women doing sport (1370 ± 110.49 kcal). The average BMR values for non-sporting women were between 1537 and 1796 kcal. The group of non-sporting women reached the average value of the observed parameter of 1446 ± 176.95 kcal, and was below the average of the optimal range. We did not detect a statistically significant difference between the monitored groups.

The total body water is 53% of the body weight in an adult woman. The higher percentage of TBW, ICW and ECW from the average body weight was achieved by the group of women doing sport, where the average TBW was 51.51% of body weight, an average ICW 31.93% and an average ECW 19.58% of body weight. For non-sporting women the average TBW was 46.85% of body weight, an average ICW 29.10% and an average ECW 17.84% of body weight. The percentage of body fat mass (BFM) was 30.27% for women doing sport. The remainder consisted of proteins (13.86%) and minerals (4.97%). The average body weight of women without sport activities was 77.90 ± 20.10 kg. The body fat mass accounted for 35.43% of the body weight of the participants, which is 5% (7.50 kg) more than for a group of women doing sport. Proteins accounted for 12.58% and minerals for 4.49% by weight. Percentage of individual components of the body composition of the participants of both groups is shown in Figure 1, 2.



Abbreviations: BFM – body fat mass; ICW – intracellular water; ECW – extracellular water; P – proteins; ML – minerals

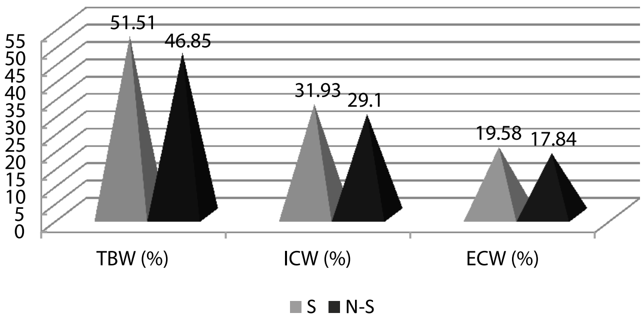
Figure 1. Percentage of individual body composition components of sporting women (n=70)



Abbreviations: BFM – body fat mass; ICW – intracellular water; ECW – extracellular water; P – proteins; ML – minerals

Figure 2. Percentage of individual body composition components of non-sporting women (n=70)

Abulmeaty [3] states that in the context of short-term changes in diet and physical activity the most significant changes in the composition of the body showed a decrease in TBW only in the obese group but not in the overweight group. This indicates that patients with obesity lose water and fat free tissues along with fat loss in early weeks of multimodal-lifestyle intervention for obesity management. The reference values for ICW in the group of women doing sport ranged between 18.50-22.60 l. The weighted average value of 21.20 ± 2.96 l was within this optimal range. The average value of ICW in the non-sporting women group was 22.60 ± 3.85 l and was also within the optimum range for the monitored group 19.20-23.50 l. The average ECW in the group of women doing sport was 13.00 ± 1.83 l and in the non-sporting women group 13.90 ± 2.27 l. Both average values were within the optimal range of values for ECW. Among the monitored women groups we did not confirm statistically significant differences in the evaluation of these parameters. Under physiological conditions a 2:1 ratio should be maintained between extracellular and intracellular fluid. This ratio was confirmed by the analysis in both groups of women. The amount of body water decreases with age, the decrease in age-related body water is due to physiological changes in the body. Percentage of TBW, ICW and ECW on the average body weight of the monitored groups is shown in Figure 3, the effect of physical activity of participants on TBW, ICW and ECW in Figure 4.



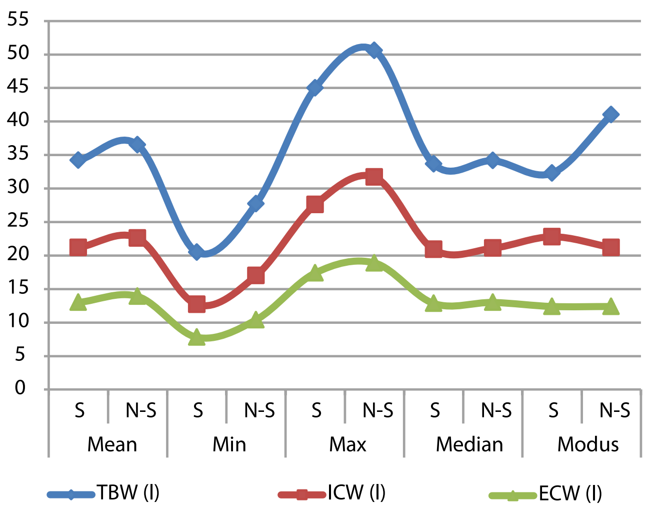
Abbreviations: TBW – total body water; ICW – intracellular water; ECW – extracellular water;
S – group of sporting women; N-S – group of non-sporting women

Figure 3. Percentage of TBW, ICW and ECW on the average body weight of the monitored groups

Fat free mass (FFM) includes all components of body composition, excluding fat. Components of FFM, in addition to total body water, include proteins and minerals. The percentage of proteins and minerals on body weight of participants in the monitored groups is shown in Figure 5.

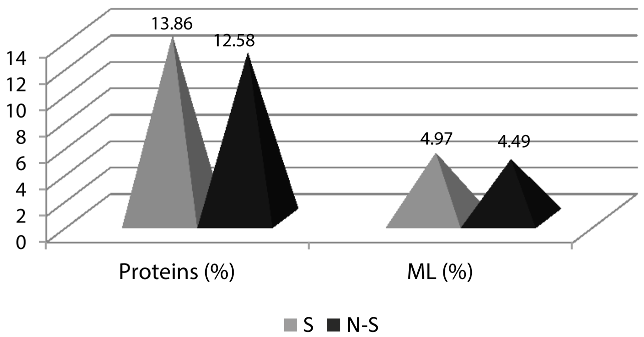
Higher FFM values were achieved in a group of sporting women but without statistical significance (P = 0.17). The average FFM for this group was 46.60 ± 6.53 kg representing 70.18% of the average body weight.

The average FFM for non-sporting women was 49.80 ± 8.74 kg representing 63.93% of the average body weight. Even FFM values decrease with age gradually. Gradual decrease in FFM contributes to a decline in physical function, increased disability, frailty and loss of independence. Kyle et al. [24] found lower FFM in women older than 60 years and observed an accelerated loss in women older than 75 years. The skeletal muscle mass (SMM) is a significant part of the fat free mass. We found a higher proportion of skeletal muscle mass in a group of women doing sport, which has a great deal to do with exercise activity. The average value of SMM in this group was 25.40 ± 3.60 kg representing 38.25% of the total body weight and it was 3.08% higher than the average value measured in the group of women without sport activities (27.40 ± 4.83 kg, 35.17%, P = 0.13). Resistance exercise have the additional benefit of increasing FFM. Aerobic exercise decreases fat mass but have little effect on FFM [38]. Values of body fat mass, fat free mass, skeletal muscle mass and body cell mass in observed groups are shown in Figure 6.



Abbreviations: S – group of sporting women; N-S – group of non-sporting women; Min – minimum value; Max – maximum value; TBW – total body water; ICW – intracellular water; ECW – extracellular water

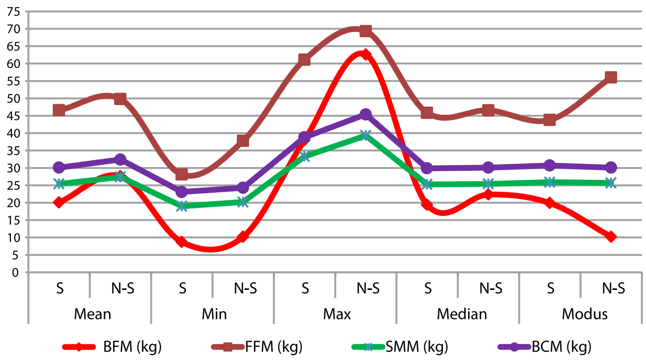
Figure 4. Effect of physical activity of participants on TBW, ICW and ECW



Abbreviations: S – group of sporting women; N-S – group of non-sporting women; ML – minerals

Figure 5. Percentage of proteins and minerals on the average body weight of the monitored groups

The body cell mass (BCM) is composed of muscle tissue cells and organs cells with the exception of nerve tissue and the amount of it form the metabolically active mass of the human body. The group of sporting women achieved higher BCM/body weight ratios than the second study group (45.33 vs. 41.59%). There were significant differences between the maximum and minimum measured values. For sporting women the minimum value was 23.10 ± 1.73 kg and a maximum of 38.8 ± 2.13 kg (average BCM 30.10 ± 3.35 kg). For non-sporting women the minimum value was 24.30 ± 2.30 kg and a maximum of 45.40 ± 2.81 kg (average BCM 32.40 ± 1.73 kg). However, the average BCM values in both groups ranged to the recommended values of the standard ranging from 24-33 kg. There was no statistically significant difference between groups (P = 0.09) (Figure 6).

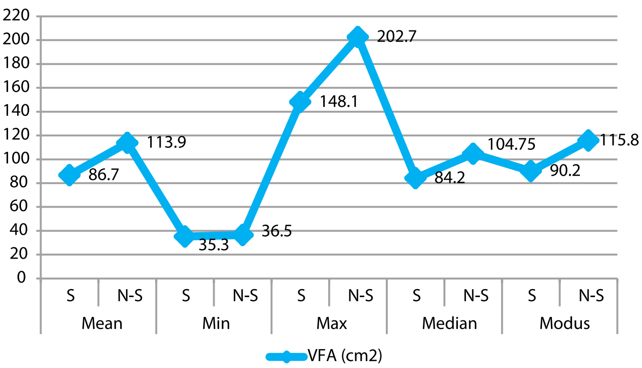


Abbreviations: S – group of sporting women; N-S – group of non-sporting women; Min – minimum value; Max – maximum value; BFM – body fat mass, [kg]; FFM – fat free mass, [kg]; SMM – skeletal muscle mass, [kg]; BCM – body cell mass [kg]

Figure 6. Values of body fat mass, fat free mass, skeletal muscle mass and body cell mass in observed groups

Obesity is a highly prevalent metabolic disorder that is characterized by excessive body fat mass (BFM) [1]. tis generally accepted that the total amount of body fat mass, as well as the level of visceral fat, is associated with the development of several diseases [17, 26]. The BFM value expresses the representation of the fat component in the human body. Together with the PBF is an important indicator of health risk. We can treat it as a variable part of the body composition that can be influenced by physical activity and proper eating habits [8]. The average BFM in the group of sporting women was 20.10 ± 6.73 kg representing 30.27% of the average body weight and average BFM in the group of non-sporting women was 27.60 ± 12.73 kg representing 35.43% of the total body weight (Figure 6). The proportion of body fat mass increases by age. The minimum value of PBF in the women doing sport was 16.40% and a maximum of 43.30%; the minimum value for the group of women without sport activities was 19.30% and a maximum of 50.40%. Among the monitored groups we found a statistically highly significant difference (P <0.01) in this parameter. A clear inverse association had been found to exist between daily accumulated steps and PBF and WHR [18, 28, 37]. Progressive significant reduction of weight, BMI and PBF were observed throughout the study after multimodal-lifestyle intervention [3]. Beavers et al. [6] reported significant loss of FFM together with FM loss among a sample of elderly overweight subjects and those with obesity after 18 months of dietary weight loss program combined with physical activity plan.

We consider VFA as another indicator of health status and obesity. tis one of the important factors used in the assessment of cardiometabolic risk, which is correlated with the metabolic syndrome components in men and women, even at the normal BMI indicating the absence of obesity [4, 23]. The recommended amount of visceral fat should be 100 cm^2. If VFA values are greater than 100 cm^2, we are talking about abdominal obesity that is closely related to the occurrence of cardiovascular diseases [5, 11, 40, 42]. In the group of women doing sport, 27.10% of women had the value of VFA higher than 100 cm^2, in the group of non-sporting women up to 55.7%. The average measured value in the group of women doing sport was 86.70 ± 28.79 cm^2 (Figure 7). The average VFA measured in the group of non-sporting women was 113.90 ± 44.95 cm^2 and indicates the incidence of abdominal obesity in this group. The lowest measured average values were 35.30 cm^2 in the group of women doing sport and 36.50 cm^2 in the group of non-sporting women. The highest measured average values were 148.10 cm^2 in the group of sporting women and 202.70 cm^2 in the group of women without sport activities. When compared to measured visceral fat values, a statistically highly detectable difference (P <0.01) was confirmed in the monitored groups. In the group of women doing sport VFA increased significantly with age [13, 43, 44]. *Gába* et al. [12] described differences in VFA dependent on the physical activity levels experienced by women.

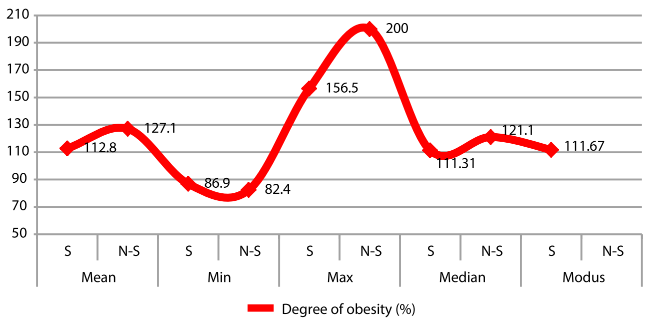


Abbreviations: S – group of sporting women; N-S – group of non-sporting women;
Min – minimum value; Max – maximum value; VFA – visceral fat area [cm^2]

Figure 7. Visceral fat area values in monitored groups

An increased number of steps per day that means increased physical activity contribute to an improvement in human anthropometric parameters. The team of authors examined the effect of physical activity in the number of steps on the amount of visceral fat in women. In steps of less than 7500 per day we found the VFA value 162.7 cm^2, in steps of 7500-9999 per day it was 142.2 cm^2 and at 10000-12000 per day the VFA value was 128.5 cm^2 [31]. Study of Lee revealed that older women are significantly less active in comparison with older men. Many studies confirmed the beneficial effects of regular and moderate levels of physical activities on health status not only of older adults [19, 20, 28, 30].

The degree of obesity is based on the relationship of the actual weight to the ideal weight. According to InBody, the 90-100% range is optimal. Values ranging from 110-120% point to overweight and values above 120% for obesity. The average degree of obesity in the group of sporting women was 112.8 ± 16.47%. Based on this value we rank this female group as overweight. In the group of women without sport activities, the average degree of obesity was 127.1 ± 27.71%, which is why we rank this group of women as obese (Figure 8). Differences in degree of obesity were statistically significant among groups (P<0.05).



Abbreviations: S – group of sporting women; N-S – group of non-sporting women;
Min – minimum value; Max – maximum value

Figure 8. Degree of obesity in monitored groups

We qualify Fitness Score (FS) as a fitness index. The index determines the typology of the individual according to the fat and muscle parts relative to the weight. The limit of the standard is according to InBody 70-90. In the group of non-sporting women the average FS was 69 ± 7.13. This value is just below the norm, we judge the fitness rate as underweight. In the group of sporting women the average FS was 74 ± 5.15. This value is within optimal range and determines physical fitness as an average. We have found a statistically very high level of difference between women doing sport and women without sport activities (P<0.001). When monitoring the intensity of walking effect on the fitness score no significant differences were observed between the men and women (the amount of walking: 0, 30, 60 or 120 minutes) [9]. Individuals with a high level of fitness exhibited a lower risk of death than low-fit individuals [7]. Improvements in metabolic function, body composition, musculoskeletal and psychologic functioning are a few of the myriad benefits of increased physical activity. Even small increments in physical activity via reductions in sedentary behavior are beneficial [33].

The analysis of the anthropometric parameters of a group of sporting and non-sporting women brought as a result a difference in individual values, that if benefiting the group of women doing sport in lower values of body weight, BMI, WHR and BMR. In both groups, WHR values were higher than 0.85, which is a prerequisite for the development of metabolic diseases; however the group of sporting women scored lower values than the group of non-sporting women. Average basal metabolism values were found within the optimal range of values in the group of women doing sport, whereas for non-sporting women these values were below the optimum range. The group of non-sporting women had a lower percentage of proteins, minerals, total body water and skeletal muscle compared to the group of women doing sport. At the same time, this group reached higher body fat values compared to the group of women doing sport. The health status, we can include the percentage of body fat, visceral fat area and the degree of obesity. The group of women without sport activities had the above values higher than the group of sporting women. On the basis of the obtained results of fitness scores, the body performance of the group of non-sporting women was rated as undervalued, while the fitness score of the group of women doing sport as average. The results of the measurements show the positive influence of physical activity on components of body composition in all age categories. Physical activity, along with rational nutrition, should be part of a healthy lifestyle for each individual. Even a person who does not like to sport should include at least 30-60 minutes walk a day.

CONCLUSION

The results of the measurements show the positive influence of physical activity on components of body composition in all age categories. Physical activity, along with rational nutrition, should be part of a healthy lifestyle for each individual.

Acknowledgments

The study was supported by the nutrition and consulting company Lean Enterprise Slovakia s.r.o.

Conflict of interest

The authors declares no conflict of interest.

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Received: 21.02.2018
Accepted: 22.05.2018