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Original research article

ANALYSIS OF CHANGES IN BODY COMPOSITION OF WOMEN BELONGING TO VARIOUS AGE GROUPS*

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Abstract. *The evaluation of body composition was performed on a sample of 152 female participants, aged 20-76, from Novi Sad, by applying a battery of 4 tests and an analyzer of bioelectrical impedance MALTRON 920. The participants were divided into five subsamples according to their age, one group for every decade. The division of participants according to their age groups was done in accordance with some earlier studies. Statistical methods, the Univariate (ANOVA) and multivariate (MANOVA) analyses of variance, determined that there were some statistically significant differences between all the age groups, not only in terms of individual, but also in terms of the mutual system of variables. The differences between the pairs of the majority of age groups were established by using the t-test and it confirmed the results of ANOVA and MANOVA methods.*

Key words: *Body composition, age group, ANOVA, MANOVA.*

INTRODUCTION

There has been a significant decrease in the level of people's physical activity in modern civilization. The trend of a sedentary lifestyle was conditioned by the occurrence and improvement of technological developments (Philipson & Posner, 2003). The necessity of using physical force while performing various tasks is disappearing very quickly and human work is being replaced by machines and new technological achievements, so people's energy loss during a working day has been reduced to a minimum. Such an in-

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active lifestyle has added to the development of a range of connected diseases which mostly include chronic diseases of the locomotor system and deterioration of general body resistance. Body composition is one of the components of physical status and it refers to the elements of the tissue types which constitute a body and is usually used to mark the relative percentage of fatty and non-fatty tissue (Heymsfield, Lohman, Wang, & Going, 2005). When health and fitness are taken into account, the main interest is to establish the relative amount of the fatty tissue in relation to the non-fatty one, as well as the distribution of fat in the body, along with the changes that occur in those components. Physical inactivity is one of the main causes of the increased amount of fat in the body. In the case of elderly people, the increase in the amount of fatty tissue is conditioned by slower walking and functional limitations.

THE METHOD

The sample of participants

The sample consisted of 152 women from Novi Sad, aged 20-76 years (Table 1). A battery of 4 tests was used on this sample and an analyzer of bioelectrical impedance MALTRON 920. The participants were divided into five subsamples according to their age, one group for every decade. The division of participants based on their age groups was done in accordance with some earlier studies. The collected data were used for scientific research within the project "The anthropological status and physical activity of the citizens of Vojvodina" which was carried out by the Faculty of Sport and Physical Education, University of Novi Sad and financed by the Regional Secretariat for Science and Technological Development.

Table 1. The structure of participants according to their sex and age group.

Sex	20-29 years		30-39 years		40-49 years		50-59 years		60+ years		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Women	22	14.5	34	22.4	38	25.0	34	22.4	24	15.8	152	100

N – number of participants; % - percentage of participants.

The sample of measuring instruments

The bioelectrical impedance Maltron 920 was used for the evaluation of body composition.

The sample consisted of the following tests:

1) TT (kg) – body mass,
2) FM (kg) – the proportion of fatty tissue in body composition,
3) MM (kg) – the proportion of muscle mass in body composition,
4) BMI – the Body Mass Index, represents the value used for the evaluation of normal body mass in accordance with the height of the person involved. It was obtained as a quotient of the body mass (kg) and the body mass squared (m^2).

The evaluation of body composition, i.e., transversal measurement was performed at the Faculty of Sport and Physical Education in Novi Sad. During the process of testing, all of the guidelines were adhered to, as well as the preconditions for the implementation of the protocol in accordance with the International Biological Program.

Statistical analyses

The univariate (ANOVA) and multivariate (MANOVA) analyses of variance were used in order to determine the differences on the quantitative level. The testing of the significance of the differences in the variables applied on the pairs of groups was done by the t-test for independent samples. For all the statistical analysis the level of statistical significance was 0.05. The data processing was done using the statistical package SPSS 20.0.

RESULTS

The analysis of the differences in body composition of women belonging to various age groups is showed in the tables 2 and 3.

Table 2. Multivariate and univariate analyses of the variance for the differences in body composition.

Variable	GROUPS	N	AM	SD	f	p
Body mass (kg)	20-29	22	58.25	5.50	5.78	0.00
	30-39	28	61.63	7.23		
	40-49	35	67.85	10.59		
	50-59	30	58.25	5.50		
	60+	22	58.25	5.50		
Muscle mass (kg)	20-29	22	14.54	5.73	9.55	0.00
	30-39	28	18.89	7.05		
	40-49	35	21.48	8.14		
	50-59	30	26.49	9.93		
	60+	22	25.52	6.84		
Fat mass (kg)	20-29	22	23.92	6.40	11.64	0.00
	30-39	28	28.50	7.31		
	40-49	35	31.22	7.25		
	50-59	30	36.05	9.35		
	60+	22	36.49	6.78		
BMI (kg/ м²)	20-29	22	21.41	2.38	8.45	0.00
	30-39	28	23.52	4.41		
	40-49	35	24.66	4.21		
	50-59	30	26.62	3.78		
	60+	22	26.76	3.17		
			F=3.46	P=0.00		

Legend: AM – arithmetic mean, SD- standard deviation, f – the value of the f-test of the univariate analysis of variance, p – the level of significance of the univariate analysis, F – the value of the f-test of the multivariate analysis of the variance, P – the level of significance of the multivariate analysis.

The multivariate analysis of variance established the existence of statistically significant differences in the total space of variables, where F=3.46 was determined at the P=0.00 level of significance. The analysis of quantitative differences by implementing the univariate analysis of variance for individual indicators of body composition confirmed the results of the t-test (Table 10). Statistically significant quantitative differences

at the of p <0.05 level of significance were determined for the variables: Body mass (f=5.78, p <0,00), Muscle mass (f=9.55, p <0.00), Fat mass (f=11.6, p <0.00), BMI (Body Mass Index) (f=8.45 p <0.00).

Table 3. The T-test for independent samples of body composition between the pairs of all age groups.

Variable	Pairs	t	p
Body mass (kg)	20-29 – 30-39	-1.90	0.60
	20-29 – 40-49	-2.95	0.00
	20-29 – 50-59	-4.77	0.00
	20-29 – 60+	-4.27	0.00
	30-39 – 40-49	-0.95	0.34
	30-39 – 50-59	-2.55	0.01
	30-39 – 60+	-2.36	0.02
	40-49 – 50-59	-1.58	0.11
	40-49 – 60+	-1.49	0.14
	50-59 – 60+	-0.07	0.93
Muscle mass (kg)	20-29 – 30-39	-2.00	0.05
	20-29 – 40-49	-3.90	0.00
	20-29 – 50-59	-5.13	0.00
	20-29 – 60+	-5.73	0.00
	30-39 – 40-49	-2.12	0.03
	30-39 – 50-59	-3.89	0.00
	30-39 – 60+	-3.99	0.00
	40-49 – 50-59	-1.65	0.10
	40-49 – 60+	-1.76	0.08
	50-59 – 60+	-0.12	0.90
Fat mass (kg)	20-29 – 30-39	-2.40	0.02
	20-29 – 40-49	-4.23	0.00
	20-29 – 50-59	-5.87	0.00
	20-29 – 60+	-6.52	0.00
	30-39 – 40-49	-1.92	0.05
	30-39 – 50-59	-3.81	0.00
	30-39 – 60+	-4.41	0.00
	40-49 – 50-59	-2.04	0.04
	40-49 – 60+	-2.56	0.01
	50-59 – 60+	-0.39	0.69
BMI (kg/ m²)	20-29 – 30-39	-2.29	0.02
	20-29 – 40-49	-3.34	0.00
	20-29 – 50-59	-6.44	0.00
	20-29 – 60+	-6.19	0.00
	30-39 – 40-49	-1.43	0.15
	30-39 – 50-59	-3.33	0.00
	30-39 – 60+	-3.54	0.00
	40-49 – 50-59	-1.77	0.08
	40-49 – 60+	-2.11	0.03
	50-59 – 60+	-0.53	0.59

Legend: t – value of the t-test, p – the level of significance of the t-test.

The implementation of the t-test for independent samples (Table 3) determined statistically significant differences between the analyzed groups. In the case of most of the indicators of body composition there were high and statistically significant differences. Korovljev (2010) obtained similar results.

DISCUSSION

The notion of 'body composition' refers to the contents of the human body represented by the size and grouping of the existing measurable segments which it consists of (Ugarković, 2001). Body composition, according to *The American Association of Health, Physical Education, Recreation and Dance*, represents the ratio between fat, muscle and bone tissue in the total body mass. According to Mišigoj-Duraković (2006) the non-fat body mass consists of muscles, the skeleton and inner organs, while the fat body mass consists of so-called "important" and "non/important" fat. Taking the amount of certain components in body composition into account, there is a significant sex dimorphism: women have a significantly higher proportion of fat in the total body composition in comparison to men. The ratio between fat and non-fat body components varies throughout life and it is possible to modify it by outside factors, an appropriate and adjusted diet and physical and sport activities. The main characteristic of the period of late adolescence of the female sex is the adjustment of motor abilities and body composition. For girls it starts at the age of 16 and ends at the age of 21 (Korovljev, Mikalački, Čokorilo, 2010).

The multivariate analysis of variance determined a statistically significant difference in the total space of variables for the estimation of body composition. The univariate analysis of the variance determined statistically significant differences between the groups on the quantitative level. Statistically significant differences were also determined for the variables Body mass, Muscle mass, BMI. The significance of the differences between the groups of the participants belonging to various age groups was tested by the t-test for independent samples. The results of the t-test confirmed the results of the univariate and multivariate analyses of variance because the majority of the tested pairs of groups showed a significant difference in the variables Body mass, Muscle mass, BMI. The differences occurred for almost all the pairs of groups of the aforementioned variables and higher values of the stated indicators of the body composition were in favor of older participants. The greatest differences in the obtained values of the analyzed indicators of body composition were determined between the youngest (aged 20-29) and the oldest group of participants (aged 60 and over).

Former research has proved that after the age of 20 women can expect their body mass to increase by 1% every ten years until the age of 60, which is all together an increase of 4%. The amount of fatty tissue usually decreases after the age of 60. The normal amount for middle age is 25% of the body mass for men and up to 30% for women, in relation to the total body composition. Higher values than those indicate that the person is obese. The borderline values of body mass are compatible with the notion of health and are between 5 and 10% for men and between 15 and 18% for women (Vilmore et al., 1985, cited in: Mišigoj-Duraković, 2006). During the period of adolescence, girls have twice as much fat mass in their body composition than boys, expressed in percent, while boys have twice as much non-fat mass than girls (Malina & Buhard, 1991, cited in: Mišigoj-Duraković, 2006).

The changes in female body composition which occur during their life, observed from the aspect of biological theories of aging, especially neuroendocrine theories, refer to, among other things, the occurrence of sarcopenia - gradual loss of muscle tissue (Lexell, Taylor, & Sjostrom, 1988; Kohrt, Malley, Dalsky, & Holloszy, 1992).

In the case of physically active women that loss is on a lower level and the level of keeping and preserving muscle mass is on the same level (Sternfeld et al., 2004; Kyle et al., 2006). In this research paper it was showed that there is a statistically significant difference in the amount of muscle mass in the body composition of women of various age groups.

When muscle tissue is taken into account, there are few data about the average or desirable values for the general population. The increased percent of the amount of muscle tissue in the total body composition, since it is the moving force of the locomotor system, cannot be an obstacle, unlike increased fat tissue.

Poehlman, Toth, & Gardner (1995) started with the assumption that one part of the changes in body composition of women, which is related to aging, is actually the consequence of menopause. In other words, it is the consequence of decreased secretion of female sex hormones, primarily estrogen. With the advent of menopause, there are a lot of changes in body composition. Comparing the women in menopause with the ones in pre-menopause, these authors concluded that women in menopause lose more non-fat mass in comparison to the ones who stay in pre-menopause, when they get more fat mass (Bjorkelund, Lissner, Andresson, Lapidus, & Bengtsson, 1996).

In the studied sample of women belonging to various age groups there were significant differences. Nasis and Geldas (2003) came to similar results for the category of women aged 40-49. Comparing the results obtained in annual measurements for a period of seven years, Sowers et al. (2003) concluded that the increase of the body mass for women in their middle age is connected to the increase of fat mass (10%) and decrease of bone-muscle mass (1%) in the total body composition. Sharkey & Gaskill (2008) concluded that differences in body composition of women belonging to various age groups is a consequence of the amount of activity, regular diet, marital status, genetic and other factors which influence their body composition.

CONCLUSION

All of the abovementioned leads us to the conclusion that there are significant differences in body composition of women belonging to various age groups on the quantitative level. A part of the obtained results can probably be assigned to different life styles of five age groups of women.

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ANALIZA PROMENA U SASTAVU TELA KOD ŽENA RAZLIČITIH STAROSNIH GRUPA

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Procena sastava tela je sprovedena na uzorku od 152 ispitanice starosti 20-76 godina iz Novog Sada, primenom baterije od četiri testa i analizatora bioimpedanse MALTRON 920. Uzorak ispitanica je podeljen na pet sub-uzoraka, u odnosu na njihove godine, po principu jedne grupe za svaku dekadu i u skladu sa određenim ranije sprovedenim istraživanjima. Primenom statističkih metoda univarijantne (ANOVA) i multivarijantne (MANOVA) analize varijanse utvrđene su određene statistički značajne razlike između svih starosnih grupa, ne samo u individualnom, već i u zajedničkom sistemu varijabli. Razlike između parova većine starosnih grupa utvrđene su primenom t-testa, što je potvrdilo rezultate metoda ANOVA i MANOVA.

Ključne reči: *sastav tela, starosna grupa, ANOVA, MANOVA.*