

# BODY COMPOSITION OF FEMALE SENIOR INHABITANTS OF BIAŁA PODLASKA VS THEIR PHYSICAL ACTIVITY

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## Abstract

**Introduction.** The aim of this study was to analyze body composition of female inhabitants of Biala Podlaska aged 60 years and older and characterized by different levels of physical activity. **Material and methods.** The study material were results from a survey conducted with 180 female inhabitants of Biala Podlaska aged 60 years and older ( $\bar{x}$  65.30  $\pm$  4.68). The women were analyzed for body height, body mass, BMI and body composition. Their physical activity was determined using the IPAQ questionnaire and according to results achieved the women were classified into two groups: low physical activity (n=132), and moderate and high physical activity (n=48). The average frequency, duration and weekly energy expenditure of physical activities undertaken by the respondents were estimated in both groups. In addition, a social enquiry was conducted that enabled gathering information on the level of education, marital status and family status of the women. Results achieved were elaborated statistically. **Results.** The marital status ( $\chi^2=11.001$ ,  $p<0.05$ ) and family status ( $\chi^2= 4.113$ ,  $p<0.05$ ) of the female senior inhabitants of Biala Podlaska were modifying their physical activity to a greater extent than the educational status did ( $\chi^2= 30.360$ ,  $p>0.05$ ). In addition, significant correlations were observed between absolute values of tissue components of the body and physical activity of the senior women. The average total energy expenditure in the group with a low physical activity accounted for 236.5 MET, whereas in the group with moderate and high physical activity – for 2255.3 MET. **Conclusions.** The study demonstrated that not only time devoted to physical activity but also its intensity affected the levels of tissue components. Results achieved in the survey indicate the necessity of continuing studies to examine correlations between body composition and physical activity of older population.

**Key words:** women, physical activity, BMI, body composition

## Introduction

The World Health Organization adopts the 60<sup>th</sup> year of life as the beginning of old age, however it distinguishes its three main stages, i.e. advanced aged (the so-called early old age) spanning from 60 to 75 years of age; followed by the period of 75 to 90 years acknowledged as the senile age (the so-called late old age); and finally the period over 90 years noted as the ripe old age also referred to as longevity [1]. The process of ageing involves a number of changes and impairments in the functioning of tissues and organs [2]. At the advanced age skeletal muscles lose their mass and become less resilient and efficient. This is due, among other things, to changes in the nervous system and the muscles themselves, and may result from a lower physical activity of older persons. Apart from a decreasing number of motor neurons, the condition of muscles may be influenced by damages generated during muscle contractions and oxidative stress, changes in cells enveloping the muscles, displacement of the muscle tissue by connective and fatty tissue, suppressed synthesis of muscle proteins, increased concentration of pro-inflammatory cytokines, and diminished muscle perfusion. Losses in muscle mass and strength are undoubtedly influenced by age-dependent reduction in the production of testosterone, estrogens and growth-hormone and by an increased serum level of insulin-like growth factor-1 (IGF-1) [3]. In the described pe-

riod of ontogenesis, changes are also observed in the structure and resistance of the osseous tissue, that are characterized by progressing losses in bone mass, deterioration of the spatial structure of bones and increased susceptibility to fractures [4]. The process of ageing is determined genetically and modified by environmental factors and lifestyle [5]. In turn, a person's health and functioning in the environment are determined by the physical activity, which prolongs physical fitness and functional independence of an individual. A cross-sectional study demonstrates that the maximum aerobic capacity of the body ( $VO_{2max}$ ) decreases with age [6]. Self-dependent functioning requires some minimum of the aerobic yield of the body which is stipulated at 18 mL/kg/min in men and at 15 mL/kg/min in women [6]. Physical training increases physical fitness and delays  $VO_{2max}$  decline in physically-active persons compared to those leading a sedentary lifestyle. Even an insignificant increase in  $VO_{2max}$  may extend the period of independence of the third persons. In addition, physically-active persons are less exposed to the risk of development of many chronic diseases including cardiovascular diseases, cerebral stroke, hypertension, type 2 diabetes, obesity or neoplastic diseases [7].

The complexity of body response to physical exertion causes that it is very difficult to determine the optimal intensity and duration of a health-supporting training. Both the excessive and insufficient physical activity may have adverse effects [8].

Hence, of crucial significance is the analysis of correlations between the level of physical activity and physical condition of the body.

The aim of this study was to analyze body composition of female inhabitants of Biała Podlaska aged 60 years and older and characterized by different levels of physical activity.

**Material and methods**

The study material were results from a survey conducted with 180 female inhabitants of Biała Podlaska aged 60 years and older ( $\bar{x}$  65.30 ± 4.68). The surveyed population (sample) was selected using administrative division of the city considering all housing estates. The criteria excluding the women from the study included: disorders of carbohydrate metabolism, arterial hypertension, neoplastic diseases and long-term administration of body mass-determining drugs (diuretics, corticosteroids, psychotropic drugs). The above criteria resulted from the procedure of electric resistance measurement in the body of the surveyed women using a body composition analyzer. Examinations were conducted in morning hours. The women were on an empty stomach, in light clothing uncovering forearms and feet, and shoeless. One kilogram was deduced from their body mass as the weight of clothing.

Body height measurements were made using an anthropometer exact to 0.1 cm. Body mass was measured with a TP-150 WTL B electronic scales exact to 0.1 kg. Results obtained were used to calculate Body Mass Index (BMI) defined as the ratio of body mass to the square of body height (kg/m<sup>2</sup>) [9].

Tissue composition of the body was estimated with the method of bioelectric impedance using an Akern BIA body composition analyzer [10]. Particular body components were computed with BODYSTAT 1.3 software.

The physical activity of the senior female respondents was evaluated with the use of an individual interview using a short version of the IPAQ questionnaire [11]. Energy expenditure was expressed in MET (min/week). The respondents were asked about their physical activity linked with everyday life, work and leisure time undertaken within the last week. Based on the results achieved, the respondents were divided into two groups:

- women with low physical activity who declared no physical activity or whose activity did not involve the energy expenditure of 600 MET (lACT);
- women with moderate and high physical activity, the energy expenditure of which reached min. 600 MET (hACT).

The average frequency, duration and weekly energy expenditure of physical exertions undertaken by the respondents were estimated in the above groups [12].

In addition, a social enquiry was conducted that enabled gathering information on the level of education, marital status and family status of the women. The following categories were adopted in analyses:

- education: primary, occupational, secondary, higher;
- marital status: maid, married, widow, single (divorced, in separation);
- family status: living alone, living with the family (household with adults), living with the juveniles (household with the juveniles).

The survey was conducted in compliance with the Helsinki Declaration and was approved by the Senate Ethical Commission acting at the Academy of Physical Education in Warsaw.

Results achieved were elaborated statistically. The following descriptive statistics were used for the characteristics of variables: arithmetic mean ( $\bar{x}$ ) and standard deviation (SD). Differences in values of somatic traits, BMI, body composition and physical exertions of the women with different levels of physical

activity were evaluated using the Student's t-test for independent data. In turn, the  $\chi^2$  test was applied to evaluate correlations between non-parametric variables. Differences were found significant at p 0.05.

**Results**

Table 1 presents the general characteristics of the surveyed senior women. Their mean body height was at 159.4 cm, whereas body mass was at 73 kg. The correctness of mass-to-height proportion is indicated by BMI value which in the analyzed population pointed to incorrect mass-to-height proportion in 78.83% of the women, including overweight in 39.44% and obesity in 38.89% of the surveyed female seniors. In addition, alarmingly high was the percentage of fatty tissue in the total body mass of the women (40.5%). The fatty tissue content of the body was exceeded compared to WHO standards in 88.88% of the women. In turn, lean body mass constituted 59.6% whereas water content reached 47.3% of the total body mass.

**Table 1.** Statistical characteristics of somatic traits in the surveyed women

	x	SD
Body height [cm]	159.4	6.0
Body mass [kg]	73.0	12.1
BMI [kg/m <sup>2</sup> ]	28.3	4.5
Fatty tissue [kg]	30.2	9.4
Fatty tissue [%]	40.5	7.0
Lean body mass [kg]	42.8	4.4
Lean body mass [%]	59.6	6.9
Total water [L]	34.0	3.4
Total water [%]	47.3	5.1

The educational status of the women had no significant effect on differences in the level of their physical activity ( $\chi^2 = 30.360$ ;  $p > 0.05$ ). In both groups of physical activity, the highest percentage of the seniors had secondary education (72.81% lACT, 54.17% hACT). In the group with low physical activity, 10.68% of the women completed occupational school, whereas 8.74% of the women finished their education on primary school. The lowest percentage of women had higher education (7.77%). In turn, amongst the senior female inhabitants of Biała Podlaska with moderate or high physical activity, 37.51% had higher education. The percentage of women with primary and occupational education was low and reached 4.15% in both categories (Tab. 2).

**Table 2.** Social determinants of physical activity of the surveyed women

	Low physical activity (IACT) (n 132)		Moderate and high physical activity (hACT) (n 48)		$\chi^2$ test	
	n	%	n	%	p	$\chi^2$
<b>Education</b>						
Primary	12	8.7	2	4.2	3.589	30.360
Occupational	14	10.7	2	4.2		
Secondary	96	72.8	26	54.2		
Higher	10	7.8	18	37.5		
<b>Marital status</b>						
Maid	0	0	1	2.1	0.001*	11.001
Married	105	79.6	28	58.3		
Widow	24	18.3	13	27.1		
Single	3	2.2	6	12.5		
<b>Family status</b>						
Living alone	17	12.5	12	25.1	0.042*	4.113
Living with the family	113	85.2	35	72.9		
Living with the juveniles	3	2.3	1	2.1		

\* statistically significant differences at  $p \leq 0,05$

The marital status ( $\chi^2 = 11.001$ ;  $p < 0.05$ ) and the family status ( $\chi^2 = 4.113$ ;  $p < 0.05$ ) turned out to be factor that significantly determined the level of physical activity in the senior female inhabitants of Biała Podlaska. Married were 79.57% of women with IACT and 58.33% of women with hACT. Another most numerous group were widows (18.28% IACT, 27.08% hACT) as well as divorcees or women in separation (2.15% IACT, 12.50% hACT). Only the group with hACT included women who had never been married (maids), but they constituted barely 2.08% of the women from this group. The above described differences were statistically significant (Tab. 2).

The most numerous group amongst the women compared included female seniors living in households with adults (85.23% IACT, 72.86% hACT). The percentage of women living alone reached 12.50% in the group with IACT and 25.08% in the group with hACT. Respectively 2.27% and 2.06% of the female seniors from the physical activity groups were living with juveniles. All these differences were statistically significant (Tab. 2).

Considering the physical activity of the female seniors in the groups compared, a significantly lower body mass was noted in the women declaring moderate and high physical activity (Tab. 3). The difference in the value of this somatic trait reached 5.94 kg. The significant disproportions in body mass were reflected in the BMI value that was significantly lower (by 1.77  $\text{kg/m}^2$ ) in the physically-active group. Considerable differences were additionally observed in the levels of particular tissue components. Worthy of notice is, however, that those differences were statistically significant only in the case of absolute values. The group with moderate and high physical activity was characterized by lower body adiposity (by 3.14 kg), a lower lean body mass (by 1.98 kg), and a lower absolute content of water in the body (by 1.57 L). In contrast, in the case of percentage values only some tendencies may be pointed out as no significant differences were noted in these values. The women who declared moderate or high physical activity were characterized by a lower percentage of fatty tissue (by 1.23%) as well as by higher lean body mass (by 1.47%) and higher water content in the body (by 1.14%), (Tab. 3).

**Table 3.** Statistical characteristics of the surveyed women in groups of physical activity

	Low physical activity (IACT) (n 132)		Moderate and high physical activity (hACT) (n 48)		Value of Student's t-test
	x	SD	x	SD	
Calendar age [years]	65.7	4.8	64.3	4.2	1.8
Body height [cm]	159.5	6.4	159.0	5.1	0.4
Body mass [kg]	74.6	12.1	68.7	11.1	3.0*
BMI [ $\text{kg/m}^2$ ]	28.8	4.4	27.0	4.6	10.7*
Fatty tissue [kg]	31.0	9.5	27.9	8.8	2.0*
Fatty tissue [%]	40.9	7.0	39.4	7.1	1.3
Lean body mass [kg]	43.3	4.5	41.4	3.4	2.7*
Lean body mass [%]	59.2	6.9	60.6	7.1	1.3
Total water [L]	34.5	3.6	32.9	2.7	2.7*
Total water [%]	47.0	5.0	48.1	5.3	1.3

\* statistically significant differences at  $p \leq 0,05$

Furthermore, differences were observed in the frequency and duration of physical activity undertaken by the surveyed female seniors from Biała Podlaska. In all categories of physical exertion (intensive, moderate, walking), higher mean values were noted in the case of women with moderate and high physical activity. The differences noted between groups were statistically significant ( $p < 0.05$ ). This was reflected in the mean total energy expenditure, which in the group of women with low activity accounted for barely 236.5 MET, whereas in the case of women with moderate and high activity – for 2255.3 MET. In particular categories of physical exertion, the differences between the analyzed groups of women were statistically significant ( $p < 0.05$ ) (Tab. 4).

**Table 4.** Average frequency, duration and weekly energy expenditure of physical activities undertaken by the surveyed women

Physical activity	Low physical activity (IACT) (n 132)		Moderate and high physical activity (hACT) (n 48)		Value of Student's t-test
	x	SD	x	SD	
<b>Frequency [days/week]</b>					
Intensive	0.1	0.51	0.6	0.93	4.4*
Moderate	2.2	1.89	3.7	2.53	4.3*
Walking	4.7	2.25	5.8	1.92	3.0*
<b>Duration [min/week]</b>					
Intensive	1.9	8.63	24.4	45.74	5.4*
Moderate	7.0	35.71	72.4	59.24	9.0*
Walking	11.3	37.08	56.4	41.04	7.0*
<b>Weekly energy expenditure [min/week]</b>					
Intensive	1.7	18.5	115.1	133.4	9.6*
Moderate	60.2	353.6	1059.6	767.6	11.9*
Walking	174.6	426.5	1080.6	492.4	12.1*

\* statistically significant differences at  $p \leq 0,05$

## Discussion

Literature provides ample reports addressing factors that determine wholesome behaviors of adult persons [13,14,15]. They indicate that we differ in terms of physical capabilities and level of physical activity as influenced by social, biological but also behavioral determinants. Among these, the educational status constitutes a significant factor that determines undertaking physical activity. The higher the level of education, the higher the health awareness, health-promoting lifestyle and more rational eating habits are. It confirms the observations made among older inhabitants of Poznań [16] and Upper Silesia [17]. However, this thesis was not corroborated in our survey, as no significant differences were noted in our case in the educational status between women representing different levels of physical activity.

In contrast, the physical activity was significantly determined by marital and family status of the surveyed female seniors. According to Pettee et al. [18] and Sobal and Hanson [19], married women were significantly more frequently physically active than the unmarried women. Opposite observations were made by Prus and Gee [20]. According to these authors, this dependency is strictly related to the fact that the unmarried persons have no household nor family chores, and therefore may devote more time to, e.g., participation in organized forms of physical activity. The correlation demonstrated in our study between family situation and the level of physical activity may be complex in character. On the one hand, running a household with other family members enforces everyday physical activity. It has been confirmed by results of our study and these made by Chad et al. [21], where a higher level of physical activity was noted in the person living in a household with a spouse, compared to persons living alone. In addition, support of other family members has a positive effect on undertaking different forms of physical activity and on the amount of time spent to these activities [22]. On the other hand, living with a family is often a necessity owing to impaired functional and locomotive fitness. This may result in the loss of self-dependence and the necessity of remaining under the care of other persons.

Systematic physical activity retards involution processes, lowers the risk of civilization diseases and contributes to good well-being. It additionally affects the quality of man's life [23]. Results obtained in our study demonstrate significant differences in the body mass of the surveyed female seniors depending on their physical activity. A significantly lower level of this somatic trait in the women who declared moderate or high level of physical activity influenced also lower BMI values in this group. Such a correlation has already been confirmed in a research by Sternfeld et al. [24], who emphasize the key significance of regular physical activity in maintaining body mass at a stable level. What is more, Ekezie et al. [25] show that everyday exercises with low and medium intensity may exert a positive effect on BMI changes and that continued physical activity may contribute to the improvement of cognitive functions [26] as well as physical and locomotive fitness [27]. Unfortunately, the number of persons continuing systematic exercises is decreasing with age. It is worth emphasizing, however, that even if women spent a significant part of the day on everyday chores, too little intensity of these activities and consequently too low consumption of energy provided with food diminish their effect on reduction or maintenance of a stable body mass.

There is no explicit data on what type of undertaken physical activity is the most effective. The positive impact of regular physical exercises on body composition in the post-menopausal period in women was described, among others, by Sims et al. [28]. In turn, Chubak et al. [29] noticed that aerobic exercises with moderate intensity had no effect on contents of particular tissue components in post-menopausal women. In a survey

conducted with women at the age of 65-72, Traaffe et al. [30] proved that differences in body composition of female seniors could be observed already when the group declaring to be physically-active underwent a special strength training. Furthermore, Genton et al. [31] prove that energy expenditure caused by undertaking physical activity substantially reduces the loss of lean body mass. Moreover, persons with a higher physical activity are less exposed to motion impairments than those with excessive body mass who lead a sedentary lifestyle [32,33]. Although Rolland et al. [34] claim that the loss of muscle tissue does not necessarily have to be linked with functional impairments. However, most researchers, e.g. Brach et al. [35], prove that older persons who perform 20-30-min exercises of moderate intensity in most days of the week show a significantly better physical fitness.

## Conclusions

In the surveyed population of older female inhabitants of Biała Podlaska the marital status and the family status were modifying the level of physical activity to a greater extent than the educational status did. In addition, significant correlations were demonstrated between absolute values of tissue components of the body and the physical activity of the female seniors. On contrast, moderate and high physical activity differentiated to a low extent the body composition of the women expressed in per cents. The differences noted enable concluding that not only time devoted to physical activity but also its intensity affected the levels of tissue components. Results achieved in the survey point to the necessity of continuing studies in terms of correlations between body composition and physical activity of older people considering their nutritional habits.

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