

Postmenopausal obesity: 12,500 steps per day as a remedy? Relationships between body composition and daily steps in postmenopausal women

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Abstract

Introduction: To verify relationships between physical activity (steps per day) and obesity (components of body composition) among postmenopausal women.

Material and methods: Physical activity (ActiGraph GT1M accelerometer; worn for 7 days) and obesity (body composition analyzer InBody 720) were assessed among 79 healthy postmenopausal women (age 63.25 ± 5.51 years; range: 51-81 years). In order to determine differences in body composition in women with different levels of physical activity, one-way analysis of covariance (ANCOVA) was conducted, with age of participants as a covariate.

Results: Significant intergroup differences in almost all analyzed components of the body composition (weight, body mass index, waist-hip ratio, visceral fat area, body fat mass and percent of body fat) were obtained. Highly active women (≥ 12,500 steps/day) had lower weight and adiposity parameters than those that represented low (< 7,500 steps/day) or somewhat active (7,500-9,999 steps/day) groups. Besides, a noteworthy difference between active (10,000-12,499 steps/day) and low active women was recorded. Noticeably, only in the most active group was the BMI within normal ranges.

Conclusions: The higher physical activity, the lower obesity in postmenopausal women. The recommended 10,000 steps/day seems insufficient for this age group. Based on the obtained results, postmenopausal women should walk at least 12,500 steps per day to improve their health.

Key words: obesity, body composition, physical activity, daily steps, postmenopausal women.

Introduction

Menopause makes women particularly prone to gain weight (fat tissue) with decreasing muscle and fat-free mass (FFM). Perimenopause changes in hormone balance and decrease in metabolism are contributing factors [1, 2]. Fat tissues tend to deposit in abdominal parts leading to abdominal obesity, which correlates with dyslipidemia, hypertension and insulin resistance. Co-occurrence of these symptoms is defined as a metabolic syndrome. It is a risk factor for numerous, mostly cardiovascular system-related, diseases, whose prevalence rises with age [3].

Nonetheless, menopausal obesity is also related to women's lifestyle [4], among other things to decrease in physical activity in the period before menopause [1, 2]. Physical activity (PA) is a recognized pro-health factor [5]. In accordance with current guidelines, moderate-intensity physical activity (3-6 MET) is recommended for at least 30 minutes daily [5]. It lowers the risk of cardio-

vascular and musculoskeletal diseases, diabetes and particular tumors, assuages emotional disorders (anxiety, depression) [6] and menopausal symptoms [7, 8], as well as favors positive emotions (see meta-analysis [9]). Moderate PA is sufficient to lower body mass index (BMI), total body fat (subcutaneous and visceral), decrease waist circumference and arterial blood pressure, as well as increase maximal oxygen consumption, carbohydrate and lipid profile [6]. The study on a longitudinal relationship between self-reported PA and mortality rate for women indicates a link between a sedentary lifestyle and a threefold higher mortality rate in 17 years' perspective in comparison with an active lifestyle [10]. Importantly, by the initial measurement the group of inactive women were characterized by worse health (more health-related problems) and other anti-health behaviors (cigarette smoking, a vegetable- and fruit-poor diet). Other studies in women at the earlier stage of menopause point to positive effects of physical

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training for bone mineral density [11] and body composition: increase in the percentage of FFM (significance of maintenance of muscle mass) [12], decrease in waist circumference, percent of body fat and increase in maximal oxygen uptake [13]. Still, other data, e.g. with regard to lean mass (component of FFM) [14] or bone mineral density [15], do not confirm these results.

Intensive walking is classified as a PA of a moderate intensity. With respect to walking, at least 10,000 steps a day are recommended [16]. The availability of objective measurement methods of this PA through pedometers and accelerometers allows to document the benefits of walking. The studies among postmenopausal women showed that an increased number of steps per day is related to lower obesity as measured by the bioimpedance method (even in the case of controlling women's age and calories intake) [1, 17]. Besides, there is evidence confirming the efficiency of intervention, such as Nordic walking, i.e. a remarkable decrease in body mass and percent body fat in body composition was recorded among women doing Nordic walking regularly for a period of three months in comparison to the controlled group [18], and increase in positive emotions (yet no differences in obesity indicators between active and passive groups were recorded) [19]. Also, quality studies confirm a positive effect of walking in relieving menopausal symptoms [20]. Thus, there are grounds to seek potential in walking, which may greatly influence women's health in the menopausal and postmenopausal period.

Hence, the aim of the study was to establish a relationship between the level of physical activity, based on an objective measure of number of steps per day using accelerometer, and obesity, measured with the body composition of postmenopausal women.

Material and methods

Participants

The sample comprised 79 healthy women between 51 and 81 years old ($M = 63.25$; $SD = 5.51$), attendants of the University of the Third Age. The participation in the research was voluntary and required informed consent (the study was approved by the bioethics committee). Inclusion criteria were: at least a 1-year absence of menses and generally good health (absence of serious co-morbidities like cancer, neurological diseases, etc.; additionally, somatic [number of diseases] and psychological health [number of symptoms of depression] were controlled). Table I presents basic characteristics of the study group, divided according to PA. The participants usually entered menopause at the age of 50 ($M = 50.06$; $SD = 4.25$ in the whole sample) and 31.3% of them used hormone replacement therapy. The analyses showed that around a half of the participants in each group was in a stable relationship, and an overwhelming majority had secondary or higher education. The mean number of diseases in the whole sample was 1.30 ($SD = 1.02$), and number of depression symptoms – 7.04 ($SD = 3.31$), which indicated generally good health of the examined women.

Tab. I. Characteristics of the sample across physical activity levels ($n = 79$)

Variable	Steps per day				Differences ^a
	< 7,500	7,500-9,999	10,000-12,499	≥ 12,500	
N	13	25	21	20	$\chi^2_{(3)} = 3.00$; $p = 0.392$
Age: M ± SD; range	64.23 ± 5.66 55-72	65.84 ± 6.43 56-81	62.57 ± 4.39 55-74	60.70 ± 4.24 51-70	$F_{(3,75)} = 3.78$; $p < 0.05$
Marital status (% of married or cohabiting)	76.9	52.0	66.0	45.0	$\chi^2_{(3)} = 4.27$; $p = 0.234$
Education (% of secondary or higher)	92.3	78.0	100.0	85.5	$\chi^2_{(3)} = 3.54$; $p = 0.316$
Age of M: M ± SD; range	49.38 ± 3.55 39-53	49.14 ± 5.21 38-58	51.43 ± 3.47 44-57	50.78 ± 3.44 41-58	$F_{(3,75)} = 1.48$; $p = 0.227$
YSM (n)					
1-3 yrs	1	0	2	2	$\chi^2_{(3)} = 2.52$; $p = 0.471$
≥ 3 yrs	12	25	19	18	
HRT (% yes)	15.4	32.0	28.6	40.0	$\chi^2_{(3)} = 2.29$; $p = 0.514$
Health Som: M ± SD; range	1.44 ± 1.24 0-3	1.53 ± 0.96 0-4	1.39 ± 0.98 0-3	0.80 ± 0.94 0-3	$F_{(3,75)} = 1.66$; $p = 0.185$
Health Psyc: M ± SD; range	6.52 ± 2.34 1-9	8.22 ± 4.20 3-25	6.16 ± 2.54 0-10	6.81 ± 3.07 1-16	$F_{(3,75)} = 1.75$; $p = 0.165$

Age of M – age of the last menses, YSM – years since the last menses, HRT – hormone replacement therapy, Health Som – number of diseases, Health Psyc – number of depression symptoms

^aSignificant differences between groups (for age) are shown in bold font.

Measures

With regard to the body build, obesity was diagnosed based on weight, BMI (the body mass to the square of the body height [21]), and waist-hip ratio (WHR, i.e. the circumference of the waist to hips; ratio above 0.85 means abdominal obesity). Body height was measured to 0.5 cm accuracy using P-375 anthropometer in a standing upright position, without shoes. Body weight was determined to the nearest 0.1 kg.

Evaluation of body composition and adipose tissue distribution were estimated by means of multifrequency bioelectrical impedance analysis (MFBIA) with body composition analyzer InBody 720 (Biospace Co., Ltd., Seoul, Korea; 1-1000 kHz). MFBIA is non-invasive, uses the body's electrical properties and changing opposition to the flow of an electrical current through particular body tissues. It may be applied to measure the body composition of middle-aged or older persons [22]. It allows to distinguish components of individual variation in body composition. The participants were examined in the standing position, lightly dressed with the use of eight electrodes. During examination electrode surfaces were constantly connected with each of the five fingers; the participants' feet were placed on double electrodes. The examination took less than two minutes and required only a standing position [23]. The measured components for this study included the following measurements:

- visceral fat area (VFA) – absolute waist circumference (correlation level of the results obtained with computed tomography and InBody 720 was $r = 0.92$) [23],
- body fat mass (BFM) – the total mass of body fat,
- percent body fat (PBF) – the percentage of body fat to body weight,
- fat-free mass (FFM), including skeletal muscle mass (SMM); fat-free body mass consists of muscles, connective tissues, dense connective tissues and internal organs.

Physical activity was measured for seven consecutive days with accelerometer ActiGraph GT1M (ActiGraph, LLC, Pensacola, FL, USA). ActiGraph activation is directly proportional to the whole body movements. It is worn on an elastic belt with a small pocket, positioned near the right iliac rest. Women were demanded to keep an ordinary lifestyle during the study. As a dividing criterion, Tudor-Lock and Bassett PA classification among adults and elderly people was applied, according to which less than 7,500 steps a day means low activity, 7,500-9,999 steps a day means somewhat activity; 10,000-12,499 steps a day – active, and 12,500 steps a day or more – highly active [24].

As to the controlled variables, somatic health was measured with the Functional Comorbidity Index [25] supplemented with other chronic diseases (e.g. thyroid disease). Symptoms of depression were assessed with the Beck Depression Inventory BDI [26].

Statistical analysis

Before entering proper analyses, χ^2 non-parametrical Pearson and H Kruskal-Wallis tests were made to compare the analyzed groups (varying in the level of PA) with regard to basic sociodemographic data and those related to menopausal period transition. Variables significantly differentiating the groups were included in major analyses on differences between the average obesity indicators in groups with various PA. One-way analysis of covariance (ANCOVA) with Bonferroni's tests was made, the assumed statistical significance level was $p < 0.05$. The analyses were made with SPSS 21.0.

Results

Preliminary analyses showed significant differences between groups in chronological age: highly active women ($\geq 12,500$ steps/day) were significantly younger than the somewhat active ones (7,500-9,999 steps/day). Hence, the participants' age was included as a covariant in further analyses.

The results of one-way analysis of covariance (ANCOVA) showed in most cases that the analyzed body build and composition of women were statistically dependent on the PA based on steps/day achieved (see Table II).

Intergroup comparisons showed a significant difference in obesity indicators primarily among the highly active and low or somewhat active groups. The first group represented lower weight and other parameters: BMI, WHR, VFA, BFM and PBF (see Fig. 1). Almost identical differences were noted among a group of active and low active women (no differences were noted only in weight). The differentiating parameter for active women from highly active ones turned out to be PBF: women walking 12,500 steps per day and more had the lowest fat percentage.

No statistically significant differences between groups of varying PA as regards fat-free body mass (FFM and SMM) were noted. None of the body build and body composition parameters indicated a difference between low and somewhat active groups, and somewhat active and active ones.

Discussion and Conclusions

The obtained results confirm the importance of physical activity – walking (based on daily steps) – for the body build and composition of postmenopausal women [see 1, 12, 13, 17]. Generally, an increased number of daily steps was linked with decreased obesity: lower weight, BMI, WHR and total fat mass and fat percentage in body composition. The differences emerged between more ($\geq 10,000$ daily steps) and less ($< 10,000$ daily steps) active women, although the most explicit results were obtained when comparing highly active group ($\geq 12,500$

Tab. II. Comparison of obesity indicators across activity degrees: results of ANCOVA

Variable	Reference range ^a	Steps per day				F _(3,74)
		< 7,500 N = 13	7,500-9,999 N = 25	10,000-12,499 N = 21	≥ 12,500 N = 20	
Weight (kg)	n/a	M = 78.89 SD = 16.59	M = 73.00 SD = 9.59	M = 68.06 SD = 10.47	M = 62.36 SD = 7.96	6.33**
Height (cm)	n/a	M = 156.61 SD = 5.23	M = 157.84 SD = 5.11	M = 159.12 SD = 6.16	M = 158.37 SD = 4.83	0.69
BMI (kg/m ²)	18.5-25	M = 32.14 SD = 6.25	M = 29.34 SD = 3.58	M = 26.78 SD = 3.19	M = 24.83 SD = 3.10	9.74***
WHR (cm)	< 0.85	M = 1.04 SD = 0.06	M = 1.00 SD = 0.04	M = 0.98 SD = 0.03	M = 0.96 SD = 0.04	10.07***
VFA (cm ²)	< 100	M = 170.08 SD = 43.05	M = 150.45 SD = 24.78	M = 136.93 SD = 24.09	M = 117.03 SD = 23.81	10.30***
PBF (%)	18-28	M = 44.40 SD = 6.69	M = 40.25 SD = 4.60	M = 37.75 SD = 5.16	M = 32.14 SD = 6.88	12.31***
BFM (kg)	n/a	M = 35.92 SD = 12.23	M = 29.80 SD = 6.60	M = 25.97 SD = 6.43	M = 20.38 SD = 6.30	10.87***
FFM (kg)	n/a	M = 42.98 SD = 5.23	M = 43.29 SD = 4.07	M = 42.04 SD = 5.37	M = 41.87 SD = 3.15	0.35
SMM (kg)	n/a	M = 23.18 SD = 3.05	M = 23.43 SD = 2.45	M = 22.68 SD = 3.09	M = 22.65 SD = 1.88	0.39

BMI – body mass index, WHR – waist-hip ratio, VFA – visceral fat area, PBF – percent body fat, BFM – body fat mass, FFM – free-fat mass, SMM – skeletal muscle mass

p < 0.01; *p < 0.001.

^aAge-adjusted reference range for females over 50 years; n/a – not available. Estimation of covariance in models: Age = 63.41 years.

daily steps). The data shed new light on the relationship between pedometer-measured steps taken per day and body composition variables in postmenopausal women. For obesity-prone women due to natural aging processes (hormonal and metabolic changes), the recommended 10,000 daily steps may not be enough. Although no significant differences in the body composition of active (10,000 daily steps) and highly active women (≥ 12,500 daily steps) were recorded, a differentiation marker turned out to be only percentage of body fat (PBF), better in the second group. Nonetheless, the results obtained for active women, i.e. similar results in comparison to the somewhat active group in terms of body composition, suggest that intensifying physical activity to 12,500 steps per day brings more positive results in this age group. Analogical results were obtained for another criterion of health-related PA: recommended 30 minutes of moderate-intensity PA daily turns out to be associated with positive pro-health results, but not with weight reduction, e.g. no changes in analyzed adiposity parameters in body composition or body mass indicators were observed [27]. Obese people intending to decrease their body mass must undertake more effort than the recommended one and walk at least 45 minutes daily [27].

Similar conclusions can be drawn from other results obtained in the study. No significant differences between low (< 7,500 daily steps) and somewhat active (7,500-9,999 daily steps) women were recorded, as well

as between the latter and active ones (recommended 10,000 daily steps). Apparently, a proper level of PA is indispensable, exceeding of which is necessary to obtain pro-health results.

Importantly, the whole study group was generally rather active (M_{steps/day} = 10658; SD = 3629; range: 3528-19,958). Healthy people over 65 are usually expected to walk 6,000-8,500 steps a day [28]. An average number of steps in the whole group was higher than expected even though a variable range also reveals women who walked on average slightly over 3,000 steps daily.

Another important aspect is that the study group comprised obese women (independently of the PA level) with abdominal obesity, which is a health hazard. Mean values of fat components in body composition (BFM, PBF and VFA), and WHR for all the participants exceeded acceptable norms. Hormone and metabolic disorders, also due to going through menopause, could influence the results. Only the BMI for the highly active women was within norms. Similar results were found in Krumm *et al.*' study, yet in fact they concerned only a group of somewhat active women (7,500-9,999 daily steps) [1]. BMI is an 'imperfect' obesity indicator from all the analyzed ones (it defines obesity, but it cannot provide comprehensive information about the variability of body fat mass). However, the results show that high daily activity based on the number of steps/day achieved may bring positive results despite biological

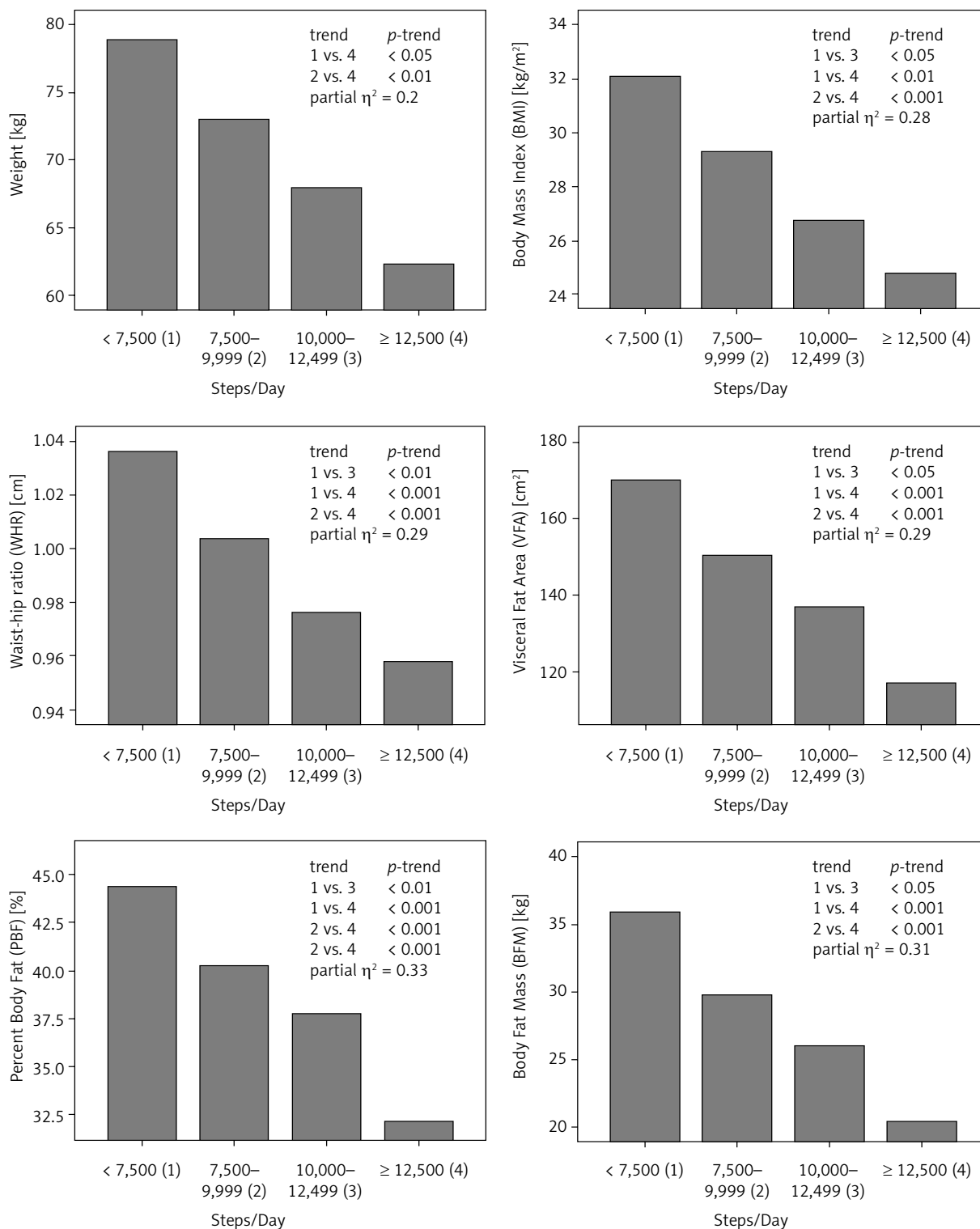


Fig. 1. Significant Bonferroni's comparisons in ANCOVA. Body built and composition in groups of varying physical activity (steps/day)

changes linked with menopause. The body built and composition are associated with lifestyle, e.g. daily walking. Walking is the most accessible form of PA, does not require equipment or financial expenditures and is recommended for all age groups, including the el-

derly and ill persons [29]. Hence, it is worthwhile to encourage menopausal women to undertake this kind of physical effort. As the study shows, they should be motivated to walk 12,500 or more steps per day, especially that intervention studies indicate recommendations as

to the number of daily steps are more efficient than recommendations as to the time devoted to walking [30].

The participants did not differ in terms of fat-free components (FMM and SMM). This result corresponds with Sims *et al.*'s study, in which the PA level was not associated with changes in lean mass [14], thus pointing to the fact that this body composition component is independent of the level of physical activity, and decreases with age.

The presented studies are not free from certain limitations. Namely, in the measurements and analyses, a number of daily calorific intake was not taken into account. Besides, only data from one measurement were presented. This is why cause-effect relationships between the level of PA and body composition of the participants cannot be conclusive. Arguably, women's body composition (obesity level) cannot be excluded as the determinant of daily steps. Finally, a special group of women under study, attendants of the University of the Third Age, whose awareness of health issues, also owing to the participation in lectures and exchange of experience in social contacts, may be higher.

Nonetheless, it can be concluded that postmenopausal women of varying PA measured with a number of daily steps differed in terms of body composition components. Those who walked 12,500 steps or more a day had the best parameters and their BMI remained within normal. In conclusion, postmenopausal women are recommended to walk at least 12,500 steps per day to improve their health.

Disclosure

Authors report no conflicts of interest.

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