International Journal of Occupational Safety and Ergonomics

ISSN: 1080-3548 (Print) 2376-9130 (Online) Journal homepage: https://www.tandfonline.com/loi/tose20

Work ability, functional exercise capacity and prevalence of obesity in peri- and post-menopausal women with non-manual employment

Dorota Raczkiewicz, Iwona Bojar & Ewa Humeniuk

To cite this article: Dorota Raczkiewicz, Iwona Bojar & Ewa Humeniuk (2019): Work ability, functional exercise capacity and prevalence of obesity in peri- and post-menopausal women with non-manual employment, International Journal of Occupational Safety and Ergonomics, DOI: 10.1080/10803548.2019.1676565

To link to this article: https://doi.org/10.1080/10803548.2019.1676565

Accepted author version posted online: 04 Oct 2019.

Publisher: Taylor & Francis & Central Institute for Labour Protection – National Research Institute (CIOP-PIB)
Journal: *International Journal of Occupational Safety and Ergonomics*
DOI: 10.1080/10803548.2019.1676565

Work ability, functional exercise capacity and prevalence of obesity in peri- and post-menopausal women with non-manual employment

Running title:

Work ability in peri- and post-menopausal women

Dorota Raczkiewicz[a], Iwona Bojar[b], Ewa Humeniuk[c]

[a] *Institute of Statistics and Demography, SGH Warsaw School of Economics, Poland;*

[b] *Department of Women's Health, Institute of Rural Health in Lublin, Poland;*

[c] *Department of Pathology and Rehabilitation of Speech, Medical University of Lublin, Poland.*

Corresponding author:

Dorota Raczkiewicz

Institute of Statistics and Demography, SGH Warsaw School of Economics.

Al. Niepodleglosci 162, 02-554 Warsaw, Poland.

Email: dbartos@sgh.waw.pl

Tel: +48605313261

Abstract

Objectives: To evaluate work ability, functional exercise capacity and their correlation to each other and to obesity in peri- and post-menopausal women with non-manual employment.

Material and Methods: The study included 300 women aged 44–66 years. The following measures were used: work ability index (WAI), 6 minute walk test (6MWT), body mass index (BMI), waist-hip ratio (WHR) and adipose tissue accumulation. Regression models of WAI and distance in 6MWT were estimated.

Results: The examined women obtained WAI 39.0 ± 5.0, BMI 26.2 ± 4.6, WHR 0.819 ± 0.060, adipose tissue accumulation 30.1 ± 6.1% on average. About 19% women obtained a very good work ability score, 55% □ good, 23% □ medium, 3% □ poor. About 17% women were obese, 39% - overweight, 44% □ with normal body mass, 29% had abdominal obesity, 19% had elevated accumulation of adipose tissue and 21% □ high. Those results did not differ significantly between peri- and post-menopausal women The post-menopausal women obtained a significantly lower functional exercise capacity score than peri-menopausal women.

Conclusion: Work ability correlates positively to functional exercise capacity, which correlates negatively to adipose tissue accumulation in perimenopausal women with non-manual employment, but not in post-menopausal cases.

Key words: 6 minute walk test; functional exercise capacity; obesity; peri-menopause; post-menopause; work ability index.

1. Introduction

As a result of the increase in the average life span and other demographic changes, the duration of occupational activity of women continues to increase. More than 3.5 million employees in the United Kingdom are women aged 50–65 years old [1], and in the United States, Canada and Sweden, more than one third of women are aged over 45 years [2]. It is estimated that the number of occupationally active older women will continue to increase in the Western countries [3], and a considerable percentage of them will be during or after menopause [4].

The results of studies on the effect of menopause on work ability are equivocal. Some indicate that this ability remains on a good or even excellent level [5], while others confirm that menopause may exert a negative effect on work ability [6–8], and in this age group the highest annual decrease in work ability is observed [9].

Limitation of abilities, and hindering of occupational tasks in peri- and post-menopausal women may be caused by actual physical changes taking place in the body. The cessation of generative function of the ovaries, as well as androgen deficiency, can cause a number of unfavourable symptoms, such as: hot flashes and sweats, insomnia, headaches, decreased life force energy, loss of motivation to act, and decreased mood [5,10,11]. A big problem at this age is also an increase in body mass index (BMI), the total amount of adipose tissue increases, and its distribution in the body changes [12–14]. An increase in body weight and increasing abdominal obesity exert an effect not only on appearance, self-esteem and social functioning, but also on the level of health and, as a further consequence, on the general condition and efficiency of the body [15–17]. It was found that an increasing amount of adipose tissue decreases muscle mass and strength, which contributes to the limitation of the capability of the body to maintain extended effort without the feeling of fatigue [18]. Deterioration in the functioning of the musculoskeletal system during the period of menopause is also the result of hormonal changes. A decrease is observed in the ability of muscles and tendons for adaptation, weakened muscle contractility and hypersensitivity to muscle injuries [19,20]. As a result of these changes in the body during the peri- and post-menopausal period, physical capacity and fitness decrease, which has an impact on the ability to perform work.

The objective of the study was to evaluate work ability and functional exercise capacity as well as their correlation to each other and to obesity measures (BMI, WHR and adipose tissue accumulation) in peri- and post-menopausal women with non-manual employment.

The hypothesis being tested is that work ability decreases in women at peri- and post-menopausal age and that the lower their functional exercise capacity as well as the higher the prevalence of obesity, the lower their work ability.

2. Material and methods

2.1. Study group

The study was conducted in the years 2016–2017. It included 300 women aged 44–66 years, employed in various institutions as non-manual workers. The study inclusion criteria were as follows: falling within the specified age bracket, engaging in non-manual jobs, absence of chronic diseases, and stable clinical status as determined medically during a physical examination. Based on criteria of the Stages of Reproductive Aging Workshop (STRAW) [21,22], the examined women were divided into two subgroups according to their reproductive status: peri-menopausal (143 women) and post-menopausal (157 women).

Informed consent for participation in the study was obtained from all the women.

Consent for the study was obtained from the Ethical Commission at the Institute of Rural Health in Lublin, Poland.

2.2. Work ability

Work ability was assessed by the workers themselves using the work ability index (WAI) [23]. The result of the WAI remained within the 7□49 score range and were classified as follows: 7–27 = *poor* (reinstate work ability), 28–36 = *medium* (improve work ability), 37–43 = *good* (support work ability), and 44–49 = *very good* (maintain work ability).

2.3. Measurements of obesity

In all the women in the study, the measurement of height, body weight, waist circumference and hips circumference was performed and the following calculation arrived: BMI (standards: < 18.5 = *underweight*; $18.5 \leq$ BMI ≤ 24.9 = *normal weight*; $25 \leq$ BMI ≤ 29.9 = *overweight*; BMI > 30 = *obesity*) and waist-hip ratio (WHR) (presence of abdominal obesity if WHR ≥ 0.85).

The accumulation of adipose tissue was assessed in three parts of the body: the thigh, biceps, and abdominal fold using a digital body fat calculator, the Finesse Body Fat Gauge 'Take it easy'. The standards for accumulation of adipose tissue according to age are as following: *very low* ($<$ 18 for age 40–49 years; $<$ 19 for age 50–59; and $<$ 20 for age $\geq$ 60), *low* (18–21, 19–22, 20–23 for age groups respectively), *optimum* (22–30, 23–31, 24–32), *elevated* (31–33, 32–34, 33–35), *high* ($>$ 33, $>$ 34, $>$ 35) [24].

2.4. Functional exercise capacity

Functional exercise capacity was assessed using 6 minute walk test (6MWT) according to the American Thoracic Society guidelines [25,26]. This test is most often used to assess aerobic capacity and endurance in diseases of the respiratory and circulatory systems, but also in healthy elderly people who are 60 or more years of age. Functional exercise capacity in peri-menopausal and post-menopausal women decreases, making them particularly prone to cardiovascular diseases risk. The 6MWT is safe and does not require excessive physical effort as may be the case with other tests dedicated to younger people and athletes, which would be too strenuous for women in this study.

The examined women did not rest during the 6 minute walk. After the test, they did not experience shortness of breath, not even to a minimal degree (grades equal to 0 or 0.5 on the Borg scale).

The following measures were used:

a. Distance that a person can quickly walk on a flat, hard surface during 6 minutes. The minimum for healthy individuals is 350 m, whereas the maximum is 700 m. The standards are: < 150 m = *high limitation*; 150–250 m = *medium limitation*; 250–350 m = *low limitation* of functional exercise capacity. The examined women passed from 300 to 667 m. Results below 350 m, indicated a small limitation of functional exercise capacity, and were found in only 3 peri-menopausal women, i.e. 2.1% of this group. No similar low results were found in post-menopausal women.
b. Mean walking speed (km/h) is calculated by dividing the distance walked during 6 minutes (in meters) by 100. An individual usually walks with the speed of 5 km/h.
c. Metabolic equivalent (MET) expresses how much more energy the person expends while performing physical effort, than while sitting quietly at rest. One MET means the expenditure of one kilocalorie of energy per 1kg body weight during one hour of sitting quietly (kcal/kg/h). The MET was estimated based on the following equation:
   MET = (1.667 x V + 3.5) / 3.5, (1)
   where MET = metabolic equivalent (kcal/kg/h); V = mean walking speed (km/h).
   The standards are: MET < 3 = *low*, 3–6 MET = *moderate*, MET > 6 = *high physical activity*.
d. Percentage of predicted distance is assessed based on the regression of the distance walked during 6 minutes versus gender, age, height and body weight of the examined persons. The distance walked by the women examined in this test did not significantly correlate with their body height (r = □0.533, p = 0.358) and weight (r = □0.094, p = 0.103), but correlated significantly with age (correlation coefficient r = □0.221, p < 0.001). The

predicted distance in 6MWT was estimated based on the regression equation as follows:

$Y = 609.997 - 2.285 \times A$, (2)

where Y = predicted distance to walk in 6MWT (m); A = age (years).

Percentage of predicted distance was calculated as follows:

$PPD = (Z / Y) \times 100$, (3)

where PPD = percentage of predicted distance; Y = predicted distance to walk in 6MWT (m); Z = distance walked in 6MWT (m).

The lower limit for the standard percentage of predicted distance is 82%.

e. Consumption of energy (kcal) is calculated based on the following equation:

$CE = MET \times BW \times t$, (4)

where: CE = consumption of energy (kcal); MET = metabolic equivalent (kcal/kg/h); BM = body weight (kg); t = duration of activity (h).

According to the Institute of Food and Nutrition in Poland, the standards for consumption of energy are: walk-run 8.33 kcal/min, i.e. 50 kcal during 6 minutes; walking with moderate speed 3.33 kcal/min, i.e. 20 kcal during 6 minutes; fast walking 5 kcal/min, i.e. 30 kcal during 6 minutes.

2.5. Statistical methods

The data from the study were analyzed for the whole study group and for two sub-groups depending on reproductive life status: peri-menopause and post-menopause. Statistical analysis was carried out using STATISTICA version 13.1 software. Mean values (*M*) with standard deviations (*SD*) for continuous variables, and absolute (*n*) and relative numbers (*%*) of occurrence of items for categorical variables were estimated.

Student's *t* test for two means in independent samples was used to compare age, WAI, measures of obesity and functional exercise capacity between peri- and post-menopausal women, as well as to compare consumption of energy in 6MWT between women with WHR < 0.85 and higher. The χ^2 test was used to compare educational level, place of residence, obesity and WAI intervals, the intensity of physical activity between peri- and post-menopausal women. *F* test in analysis of variance was used to compare consumption of energy in 6MWT between intervals of BMI and adipose tissue accumulation.

Three regression models were estimated in this study. In the first one, a dependent variable was the distance walked in the 6MWT by the women examined while independent variables were their age, body height and weight. The selection of explanatory variables into this model was performed using a backward method. This model was used to calculate percentage of predicted distance in 6MWT for every women.

In the second model, a dependent variable was the distance walked in 6MWT by the women examined while independent variables were characteristics of the women examined and their obesity measures. In the third model, a dependent variable was WAI (in scores), while the independent variables were characteristics of the women examined, their obesity measures and results in the 6MWT. Two last regression models were used to find determinants of work ability or functional exercise capacity in the total group of the women examined, as well as separately in peri-menopausal women and post-menopausal women.

The value of $p < 0.05$ was considered as a significant difference.

3. Results

3.1. Study group characteristics and prevalence of obesity in the women examined

The examined women during the post-menopausal period were significantly older and of lower education than those in the peri-menopausal period. Place of residence and measures of obesity did not significantly differ between both of the groups of women examined. Most of them lived in urban areas, had normal weight, no abdominal obesity and optimum accumulation of adipose tissue (Table 1).

3.2. Work ability in the women examined

In the examined women, the WAI score range from 26 to 49 scores; mean 39.0 ± 5.0 scores, indicating a good work ability, on average. The largest number of women in the study (55%) obtained a good work ability score which should be supported. Fewer women (23%) obtained medium work ability scores which should be improved, and 19% obtained very good work ability scores which should be maintained. A very small number of women (3%) obtained results indicating poor work ability which should be reinstated. Both numerical results (in scores), and the distribution of the ranges of the WAI did not significantly differ between peri- and post-menopausal women (Table 2).

3.3. Functional exercise capacity in the women examined

The examined women during post-menopausal period obtained significantly lower results in 6MWT than those in peri-menopausal period: shorter distance walked (mean 452 m for post-menopausal women vs 474 m for peri-menopausal), smaller speed (4.5 vs 4.7), and lower metabolic equivalent value (3.2 vs 3.3). Percentage of predicted distance in the total group of the examined women was above the standard (mean 94.6%) and consumption of calories equivalent to walking with a moderate speed (mean 22.4) was not significantly different between peri- and post-menopausal women (Table 3).

Low physical activity (MET < 3) was observed in a higher percentage of post-

menopausal women (25.5%) than in peri-menopausal women (10.5%), moderate activity (3–6 MET) in a higher percentage of peri-menopausal than post-menopausal women (89.5% vs. 74.5%), while high activity was not observed in any of the women in the study.

3.4. Functional exercise capacity vs characteristics and obesity measurements

Older age, lower educational level, living in rural areas and higher accumulation of adipose tissue significantly decreased the distance walked in 6MWT by the examined women in post-menopausal period (Table 4). However, BMI and WHR did not correlate significantly to the distance walked in 6MWT. The more obese women, with higher abdominal obesity and higher accumulation of adipose tissue consumed more energy during 6MWT than the women with parameters in the normal range (Figure 1).

3.5. Work ability vs characteristics, obesity measurements and functional exercise capacity

The WAI in the total group of women examined and in peri-menopausal women was better, with higher functional exercise capacity (the longer distance walked, with higher speed, the more MET used, the greater the percentage of predicted distance walked), especially if they lived in an urban area (Table 5). However, the WAI did not correlate with the results of the 6MWT in post-menopausal women, as well as with obesity measures (BMI, WHR, adipose tissue accumulation), educational level, and age in the 44–66-year interval in any of the groups of women analyzed.

4. Discussion

The results of this study confirm that peri- and post-menopausal women, who engaged in non-manual employment, obtained the good WAI scores, which ranged from 26 to 49, (mean 39.0 ± 5.0), which indicating, on average, the study groups good work ability. Half of all the examined women (55%) scored in the good work ability range, while medium work ability was noted in 23% of the cases, and poor work ability was seen in only 3% of the women. Very good work ability was confirmed in nearly 1/5 of all the women in this study.

The results of this study are similar to those obtained by other researchers. In one other Polish study of a working population, the WAI was on average 37.5 ± 7.7 and did not correlate with age or gender [27]. The results of WAI among peri-menopausal women in Nigeria ranged from 20 to 49, with a mean result of 42.16 ± 6.13. The perceived work ability of the respondents was rated as very good by 44.0%, and good by 36.5%. The percentage of women with medium or poor work ability was 13.5% and 6.5%, respectively [28]. A very good, or good work ability was observed in 81.5% of women aged 40–65 in Australia, while

medium or poor by 18.5%. Generally speaking, 4 out of 5 women functioned well at work [5]. Observations performed over the period of 28 years in Finland showed that a considerable number of women successfully maintained work ability at a medium level from middle until old age [29]. This period in life was not significantly related with the degree of engagement in work and work satisfaction [30].

It is important to identify factors which may be responsible for a decrease of the work ability, and which may influence women at peri- and post-menopausal age. In this study we considered the measures of obesity (BMI, WHR, accumulation of adipose tissue) and functional exercise capacity.

Our study demonstrated that 56% of the examined women were overweight or obese, with approximately 30% presenting with abdominal obesity, and 40% with excessive accumulation of adipose tissue. Bijelic R et al. in their study of European post-menopausal women found that in 28% of cases, BMI was within the normal range, while 57% were overweight and 15% obese [31]. Comparing this finding with women aged 45–54 in the USA, 32% qualified as obese [32]. In two studies of Polish women, 48% were overweight, and 17.5% were obese among post-menopausal women, and their WHR was on average 0.79 ± 0.05 [33,34].

The results of our study indicate that the WAI and obesity measures (BMI, WHR, adipose tissue accumulation) did not significantly differ between peri- and post-menopausal women who were engaging in non-manual employment. It seems that a decrease in work ability and an increase in obesity may occur in most women before they reach the peri-menopausal period and remains at the same level during the post-menopausal period. It may be important to encourage peri-menopausal, and even younger women, to take preventive actions early in order to maintain their work ability and proper body mass later in life.

In our study, in both of subgroups of women, no correlation was found between the WAI and BMI, WHR and the accumulation of adipose tissue. Similarly, Andersen LL et al. in their study on the general population, did not find significant correlation between BMI and work ability in relation to the mental demands of the job [35]. However, some studies have indicated that obesity is associated with reduced cognitive function [36] and that overweight and obese women had a lower work ability [2,5,37]. It is important to identify women with low work ability and to proactively assist them to reinstate their work ability.

In this study, a positive correlation between the WAI and functional exercise capacity was found in the total group, and in peri-menopausal women. This means they had better work ability with higher functional exercise capacity, i.e. the longer distance and the longer

the percentage of predicted distance walked, with higher speed, the more their MET expanded. However, no correlation was found between WAI and the results of the 6MWT in post-menopausal women. The results of various studies confirm a correlation between work ability and general fitness and body capacity [38,39]. Women who were asked to indicate the factors which decrease their work ability mentioned: fatigue/lack of energy (83.2%) and impairment of physical fitness (50%) [40–42]. In other studies, in older workers no correlation was found between work ability and the majority of the tests for physical functioning [43].

In order to improve their work ability, women should be encouraged to prevent peri-menopausal related worsening of physical activity. Since more than 50% of peri-menopausal women are obese or overweight, it seems plausible that increasing physical fitness, introducing healthy diet, and some other lifestyle modifications may improve their work ability. Physical exercises during the menopausal period prevent joint changes, loss of bone and muscle mass. Rutanen et al. conducted an interesting study in which he examined whether physical activity affects WAI in women with menopausal syndrome symptoms. They found that 6 months of physical activity had a positive effect on work ability in older post-menopausal women with symptoms [44].

Contradictions in some reports concerning work ability in peri- and post-menopausal women, and lack of consistency in correlation studies highlight the need for further studies. Women have to work for increasingly longer periods of time, and in the majority of cases their occupational activity has a positive effect on their psychological health, while the lack of employment is a strong predictor of somatic and anxiety disorders [45]. Likewise, the threat of losing a job is the strongest predictor of vasomotor symptoms [46]. Women should be encouraged to maintain a healthy body, which includes proper body mass, exercise capacity, as well as work ability, given current trends and expectations of an extended professional career.

Disclosure statement

No potential conflicts of interest were reported by the authors.

Funding

This study was conducted under the auspices of the Institute of Rural Health, Lublin, Poland. The project was entitled “Mental and physical health of women in the peri-menopausal and post-menopausal period in terms of preserving their work ability”. The project is in part the

third stage of the multi-annual program of "Improving the operational safety and working conditions", which is financed for the years 2014–2016, by the Ministry of Science and Higher Education/National Centre for Research and Development. The Program Coordinator is the Central Institute for Labour Protection – National Research Institute.

References

1. Office of National Statistics (ONS). Table A05: Labour Market by Age Group: Women by Economic Activity and Age (Seasonally Adjusted). 2017. Available from: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/employmentunemploymentandeconomicinactivitybyagegroupseasonallyadjusteda05sa (17 February 2017, date last accessed).
2. Geukes M, van Aalst MP, Nauta MC, et al. The impact of menopausal symptoms on work ability. Menopause. 2012; 19(3):278–282, https://doi.org/10.1097/gme.0b013e31822ddc97.
3. Hammam RA, Abbas RA, Hunter MS. Menopause and work – the experience of middle-aged female teaching staff in an Egyptian governmental faculty of medicine. Maturitas. 2012; 71(3):294–300, https://doi.org/10.1016/j.maturitas.2011.12.012.
4. Hunter MS, Hardy C, Norton S, et al. Study protocol of a multicentre randomised controlled trial of self-help cognitive behaviour therapy for working women with menopausal symptoms (MENOS@Work). Maturitas. 2016;(92):186–192.
5. Gartoulla P, Bell RJ, Worsley R, et al. Menopausal vasomotor symptoms are associated with poor self-assessed work ability. Maturitas. 2016;(87):33–39.
6. Geukes M, van Aalstb MP, Robroekc SJ, et al.. The impact of menopause on work ability in women with severe menopausal symptoms. Maturitas. 2016;(90):1–8.
7. Whiteley J, Di Bonaventura MD, Wagner JS, et al.. The impact of menopausal symptoms on quality of life, productivity, and economic outcomes. J Womens Health (Larchmt). 2013; 22(11):983–990, https://doi.org/10.1089/jwh.2012.3719.
8. Hardy C, Hunter MS, Griffiths A. Menopause and work: an overview of UK guidance. Occup Med (Lond). 2018;68(9):580–586, https://doi.org/10.1093/occmed/kqy134.
9. Ilmarinen JK, Tuomi K, Klockars M. Changes in the work ability of active employees over an 11-year period. Scand J Work Environ Health. 1997; (23):49–57.
10. Collins FH, Sutherland MA. Hormone therapy for the management of menopause symptoms. J Obstet Gynecol Neonatal Nurs. 2014; 43(2):226–235.

11. Geukes M, Anema JR, van Aalst MP, et al. Improvement of menopausal symptoms and the impact on work ability: A retrospective cohort pilot study. Maturitas. 2019; 120:23-28. https://doi.org/10.1016/j.maturitas.2018.10.015.
12. Rödström K, Bengtsson C, Milsom I, et al. Evidence for a secular trend in menopausal age: a population study of women in Gothenburg. Menopause. 2003;(6):538–543.
13. Abdulnour J, Doucet E, Brochu M, et al. The effect of the menopausal transition on body composition and cardiometabolic risk factors: a Montreal-Ottawa New Emerging Team group study. Menopause. 2012; 19(7):760–767, https://doi.org/10.1097/gme.0b013e318240f6f3.
14. Davis SR, Castelo-Branco C, Chedraui P, et al. Understanding weight gain at menopause. Climacteric. 2012; 15(5):419–429, https://doi.org/10.3109/13697137.2012.707385.
15. Li J, Herr RM, Allen J, et al. Validating the short measure of the Effort-Reward Imbalance Questionnaire in older workers in the context of New Zealand. J Occup Health. 2017;59(6):495–505, https://doi.org/10.1539/joh.17-0044-OA.
16. Dulac MC, Carvalho LP, Aubertin-Leheudre M. Functional capacity depends on lower limb muscle strength rather than on abdominal obesity in active postmenopausal women. Menopause. 2018; 25(2):176–181.
17. Nimkuntod P, Tongdee P. Atherosclerotic index and traditional anthropometry for predicting carotid intima media thickness in perimenopausal/menopausal women. J Med Assoc Thai. 2016;(99):93–98.
18. Orsatti FL, Nunes PR, Souza AP, et al. Predicting functional capacity from measures of muscle mass in postmenopausal women. PMR. 2017; 9(6):596–602, https://doi.org/10.1016/j.pmrj.2016.10.001.
19. Nedergaard A, Henriksen K, Karsdal MA, et al. Musculoskeletal ageing and primary prevention. Best Pract Res Clin Obstet Gynaecol. 2013; 27(5):673–688.
20. Velez MP, Rosendaal N, Alvarado B, et al. Age at natural menopause and physical function in older women from Albania, Brazil, Colombia and Canada: A life-course perspective. Maturitas. 2019; 122:22–30. https://doi.org/10.1016/j.maturitas.2018.12.015
21. Soules MR, Sherman S, Parrott E, et al. Executive summary: Stages of Reproductive Aging Workshop (STRAW). Climacteric. 2001; 4(4):267–272. https://doi.org/10.1080/cmt.4.4.267.272.

22. Harlow SD, Gass M, Hall JE, et al. STRAW + 10 Collaborative Group. Executive summary of the Stages of Reproductive Aging Workshop + 10: addressing the unfinished agenda of staging reproductive aging. J Clin Endocrinol Metab. 2012; 97(4):1159–1168, https://doi.org/10.1210/jc.2011-3362.
23. Tuomi K, Ilmarinen J, Jahkola A, et al. Work Ability Index. Occupational Medicine. 2007; 2(57):160. doi:10.1093/occmed/kqm008.
24. Jackson AS, Pollock ML, Ward A. Generalized equations for predicting body density of women. Med Sci Sports Exerc. 1980; 12(3):175–182.
25. ATS Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories. ATS statement: guidelines for the six-minute walk test. Am J Respir Crit Care Med. 2002; 166(1):111–117. doi: 10.1164/ajrccm.166.1.at1102
26. Gibbons WJ, Fruchter NP, Sloan SP, et al. Reference values for a multiple repetition 6 minute walk test in healthy adults older than 20 years. J Cardiopulm Rehabil Prev. 2001; 21(2):87–93.
27. Juszczyk G, Czerw AI, Religioni U, et al. Work Ability Index (WAI) values in a sample of the working population in Poland. Ann Agric Environ Med. 2019; 26(1): 78–84. doi: 10.26444/aaem/91471.
28. Olajubu AO, Olowokere AE, Amujo DO, et al. Influence of menopausal symptoms on perceived work ability among women in a Nigerian University. Climacteric. 2017; 20(6):558–563. doi: 10.1080/13697137.2017.1373336.
29. von Bonsdorff ME, Kokko K, Seitsamo J, et al. Work strain in midlife and 28-year work ability trajectories. Scand J Work Environ Health. 2011; 37(6):455–463, https://doi.org/10.1080/13697137.2017.1373336.
30. Hickey M, Riach K, Kachouie R, et al. No sweat: managing menopausal symptoms at work. J Psychosom Obstet Gynaecol. 2017; 38(3):202–209, https://doi.org/10.1080/0167482X.2017.1327520.
31. Bijelic R, Balaban J, Milicevic S. Correlation of the lipid profile, BMI and bone mineral density in postmenopausal women. Mater Sociomed. 2016; 28(6):412–415. doi: 10.5455/msm.2016.28.412-415.
32. Alexander CM, Landsman PB, Teutsch SM. Third National Health and Nutrition Examination Survey (NHANES III); National Cholesterol Education Program (NCEP). NCEP-defined metabolic syndrome, diabetes and prevalence of coronary

heart disease among NHANES III participants age 50 years and older. Diabetes. 2003; 52(5):1210–1214. doi: 10.2337/diabetes.52.5.1210.

33. Stefańska A, Odrowąż-Sypniewska G, Senterkiewicz L. Wpływ masy ciała na nasilenie stanu zapalnego u zdrowych kobiet w okresie okołomenopauzalnym i pomenopauzalnym [Influence of body weight on intensity of inflammation status in healthy perimenopausal and postmenopausal women]. Endokrynologia, Otyłość, Zaburzenia Przemiany Materii 2006, 4(2):122–128. Polish.
34. Ostrowska Z. Menopauza, otyłość a stan kośćca [Menopause, obesity, and bone status]. Postepy Hig Med Dosw. 2009; 63(11):39–46. Polish.
35. Andersen LL, Izquierdo M, Sundstrup E. Overweight and obesity are progressively associated with lower work ability in the general working population: cross-sectional study among 10,000 adults. Int Arch Occup Environ Health 2017;90:779–87. 10.1007/s00420-017-1240-0.
36. Wang H, Odegaard A, Thyagarajan B, et al. Blood folate is associated with asymptomatic or partially symptomatic Alzheimer's disease in the Nun study. J Alzheimers Dis 2012; 28: 637–45. doi: 10.3233/JAD-2011-111271.
37. Rostamabadi A, Zamanian Z, Sedaghat Z. Factors associated with work ability index (WAI) among intensive care units' (ICUs') nurses. J Occup Health. 2017; 59(2):147–155. doi: 10.1539/joh.16-0060-OA
38. Nygård CH, Eskelinen L, Suvanto S, et al. Associations between functional capacity and work ability among elderly municipal employees. Scand J Work Environ Health. 1991; 17(1):122–127.
39. Dulac M, Boutros GE, Pion C, et al. Is handgrip strength normalized to body weight a useful tool to identify dynapenia and functional incapacity in post-menopausal women? Braz J Phys Ther. 2016; 20(6):510–516. doi: 10.1590/bjpt-rbf.2014.0184.
40. Griffiths A, Cox S, Griffiths R. Women police officers: ageing, work and health. Report produced for the British Association for Women in Policing (BAWP). University of Nottingham, Institute of Work, Health and Organizations; 2006.
41. Griffiths A, Maclennan S, Wong YYV. Women's experience of working through the menopause. A report for the British Occupational Health Research Foundation. University of Nottingham, Institute of Work, Health and Organizations; 2010.

42. Gazibara T, Rancic B, Radovanovic S, et al. Climacteric women at work: What lurks behind poor occupational quality of life? Health Care Women Int. 2018; 39(12):1350–1365. https://doi.org/10.1080/07399332.2018.1464573
43. Padula RS, Comper L, Moraes SA, et al. The work ability index and functional capacity among older workers. Braz J Phys Ther. 2013; 17(4):382–391, https://doi.org/10.1590/S1413-35552013005000107.
44. Rutanen R, Luoto R, Raitanen J, et al. Short- and long-term effects of a physical exercise intervention on work ability and work strain in symptomatic menopausal women. Saf Health Work. 2014 Dec;5(4):186–90. doi: 10.1016/j.shaw.2014.08.003.
45. Hunter MS, Hardy C, Norton S, et al. Study protocol of a multicentre randomised controlled trial of self-help cognitive behaviour therapy for working women with menopausal symptoms. Maturitas. 2016; 92:186–192, https://doi.org/10.1016/j.maturitas.2016.07.020.
46. Kakkar V, Kaur D, Chopra K, et al. Assessment of the variation in menopausal symptoms with age, education and working/non-working status in north-Indian sub population using menopause rating scale (MRS). Maturitas. 2007; 57(3):306–314, https://doi.org/10.1016/j.maturitas.2007.02.026.

Table 1. Characteristics and obesity measures in the women examined (N=300).

Variable	Characteristic	Total	Peri-menopause	Post-menopause	*p* *
Age (years)	*M* ± *SD*	53.1 ± 4.8	49.5 ± 3.2	56.4 ± 3.4	**<0.001**
Educational level	university, *n (%)*	194 (64.7)	108 (75.5)	86 (54.8)	**<0.001**
	lower than university, *n (%)*	106 (35.3)	35 (24.5)	71 (45.2)	
Place of residence	urban, *n (%)*	252 (84.0)	121 (84.6)	131 (83.4)	0.781
	rural, *n (%)*	48 (16.0)	22 (15.4)	26 (16.6)	
BMI	*M* ± *SD*	26.2 ± 4.6	26.1 ± 4. 9	26.4 ± 4.4	0.635
	normal, *n (%)*	132 (44.0)	67 (46.9)	65 (41.4)	0.623
	overweight, *n (%)*	118 (39.3)	54 (37.8)	64 (40.8)	
	obesity, *n (%)*	50 (16.7)	22 (15.4)	28 (17.8)	
WHR	*M* ± *SD*	0.819 ± 0.060	0.817 ± 0.062	0.821 ± 0.058	0.531
	≥0.85, *n (%)*	88 (29.3)	43 (30.1)	45 (28.7)	0.789
	<0.85, *n (%)*	212 (70.7)	100 (69.9)	112 (71.3)	
Accumulation of adipose tissue (%)	*M* ± *SD*	30.1 ± 6.1	29.6 ± 6.1	30.5 ± 6.1	0.240
	very low, *n (%)*	6 (2.0)	4 (2.8)	2 (1.3)	0.796
	low, *n (%)*	19 (6.3)	9 (6.3)	10 (6.4)	
	optimum, *n (%)*	153 (51.0)	69 (48.3)	84 (53.5)	
	elevated, *n (%)*	58 (19.3)	28 (19.6)	30 (19.1)	
	high, *n (%)*	64 (21.3)	33 (23.1)	31 (19.8)	

*Student's *t* test or χ^2 test were used to compare continuous variables or categorical variables respectively between peri-menopause and post-menopause.

Note: Bold *p* values indicate statistically significant differences between peri-menopause and post-menopause.

BMI = body mass index; WHR = waist-hip ratio.

Table 2. Work ability index in the women examined (N=300).

Work ability index	Total	Peri-menopause	Post-menopause	*p* *
score, *M* ± *SD*	39.0 ± 5.0	39.2 ± 4.9	38.8 ± 5.0	0.475
poor, *n (%)*	8 (2.7)	3 (2.1)	5 (3.2)	0.936
medium, *n (%)*	69 (23.0)	34 (23.8)	35 (22.2)	
good, *n (%)*	165 (55.0)	78 (54.5)	87 (55.4)	
very good, *n (%)*	58 (19.3)	28 (19.6)	30 (19.1)	

*Student's *t* test or χ^2 test were used to compare work ability index (scores) or work ability index (categories) respectively between peri-menopause and post-menopause.

Table 3. Results of 6 minute walk test in the women examined (N=300).

Result of 6 minute walk test	Characteristic	Total	Peri-menopause	Post-menopause	*p* *
Distance (m)	*M* ± *SD*	462.1 ± 60.0	473.8 ± 63.9	451.5 ± 54.3	**0.001**
Mean speed (km/h)	*M* ± *SD*	4.6 ± 0.6	4.7 ± 0.6	4.5 ± 0.5	**0.001**
MET value	*M* ± *SD*	3.2 ± 0.3	3.3 ± 0.3	3.2 ± 0.3	**0.001**
Percentage of predicted distance	*M* ± *SD*	94.6 ± 12.0	95.4 ± 12.9	93.8 ± 11.1	0.268
Consumption of energy (kcal)	*M* ± *SD*	22.4 ± 4.2	22.8 ± 4.7	22.0 ± 3.6	0.071
Intensity of physical activity	low (MET < 3), *n (%)*	55 (18.3)	15 (10.5)	40 (25.5)	**0.001**
	moderate (3 ≤ MET ≤ 6) , *n (%)*	245 (81.7)	128 (89.5)	117 (74.5)	
	high (MET > 6) , *n (%)*	0 (0.0)	0 (0.0)	0 (0.0)	

*Student's *t* test or χ^2 test were used to compare continuous variables or categorical variables respectively between peri-menopause and post-menopause.

Note: Bold *p* values indicate statistically significant differences between peri-menopause and post-menopause.

MET = metabolic equivalent.

Table 4. Regression model of distance in 6 minute walk test vs characteristics and obesity measures in the women examined (N=300).

Covariate	Characteristic	Distance (m) in 6MWT					
		Total		Peri-menopause		Post-menopause	
		b	*p*	*b*	*p*	*b*	*p*
Age	years	−2.79	**<0.001**	−0.96	0.571	−3.39	**0.008**
Educational level	university = ref.						
	lower than university	−16.72	**0.021**	−7.06	0.572	−15.76	0.070
Place of residence	urban = ref.						
	rural	−18.11	**0.049**	−5.25	0.724	−28.26	**0.015**
BMI		−0.89	0.239	−0.38	0.727	−1.32	0.186
	normal = ref.						
	overweight	−0.14	0.984	0.53	0.961	−1.12	0.894
	obesity	−17.65	0.096	−12.27	0.475	−19.34	0.126
WHR		−106.77	0.065	−57.22	0.512	−143.84	0.053
	≥ 0.85	−13.22	0.082	−13.86	0.236	−13.36	0.164
	< 0.85 = ref.						
Accumulation of adipose tissue	%	−2.80	**<0.001**	−4.40	**<0.001**	−1.11	0.121
	low or very low	23.06	0.104	31.90	0.118	−8.26	0.649
	optimum = ref.						
	elevated	−21.17	**0.023**	−36.74	**0.008**	−17.13	0.358
	high	−34.48	**<0.001**	−58.53	**<0.001**	−21.98	0.207

Note: Bold *p* values indicate statistically significant slope term.

6MWT = 6 minute walk test; b – slope term i.e. mean change in distance (m) in 6MWT per unit of covariate; BMI = body mass index; ref. = reference category of covariate; WHR = waist-hip ratio.

Table 5. Regression model of work ability index vs characteristics, obesity measures and results in 6 minute walk test in the women examined (N=300).

Covariate	Characteristic	Work ability index (score)					
		Total		Peri-menopause		Post-menopause	
		b	*p*	*b*	*p*	*b*	*p*
Age	years	−0.05	0.372	−0.16	0.231	0.04	0.731
Educational level	university = ref.						
	lower than university	−1.10	0.066	−1.26	0.191	−0.92	0.252
Place of residence	urban = ref.						
	rural	−1.69	0.031	−2.48	0.030	−0.99	0.358
BMI		−0.08	0.221	−0.10	0.231	−0.04	0.630
	normal = ref.						
	overweight	−0.16	0.793	0.98	0.265	−1.12	0.193
	obesity	−0.59	0.500	−1.98	0.121	0.51	0.673
WHR		−6.48	0.177	−5.46	0.419	−7.28	0.290
	≥ 0.85	−0.44	0.481	−0.17	0.854	−0.72	0.416
	< 0.85 = ref.						
Accumulation of adipose tissue	(%)	−0.06	0.222	−0.05	0.473	−0.06	0.350
	low or very low	−0.27	0.796	0.35	0.817	0.96	0.512
	optimum = ref.						
	elevated	−0.67	0.370	−1.38	0.227	0.95	0.603
	high	−0.64	0.383	0.41	0.694	−0.82	0.688
6MWT	Distance (m)	0.01	**0.020**	0.01	**0.049**	0.01	0.251
	Mean speed (km/h)	1.11	**0.020**	1.27	**0.049**	0.85	0.251
	MET value	2.33	**0.020**	2.67	**0.049**	1.78	0.251
	Percentage of predicted distance (%)	5.31	**0.027**	5.88	0.068	4.42	0.221
	Consumption of energy (kcal)	−0.01	0.832	−0.01	0.875	−0.03	0.792
Intensity of physical activity	low (MET < 3)	−0.81	0.274	−1.27	0.348	−0.49	0.593
	moderate (3 ≤ MET ≤ 6) = ref.						

Note: Bold *p* values indicate statistically significant slope term.

6MWT = 6 minute walk test; b – slope term i.e. mean change in work ability index (score) per unit of covariate; BMI = body mass index; MET = metabolic equivalent; ref. = reference category of covariate; WHR = waist-hip ratio.

Figure 1. Mean consumption of energy vs measurements of obesity in the total group of the women examined (N=300).

Note: Error bars denote $M \pm SD$.

p for Student's t test to compare consumption of energy between WHR intervals, or F test to compare consumption of energy between BMI groups or between intervals of adipose tissue accumulation.

BMI = body mass index; WHR = waist-hip ratio.