

# Walking as a prevention of overweight and obesity in women of middle age

## Abstract

**Background:** Women overweight and/or obesity status is dependent on realized physical activities-number of steps during the day.

**Objective:** This study summarizes the use of walking as a means to prevent overweight and/or obesity in middle-aged women.

**Methods:** It follows a 5months 1500kcal intervention programme for middle-aged women, where at least 85% of women were walking, pointing to significant changes in fitness and body composition. 42 healthy women of middle age were evaluated (mean age 49.5±3.6years, body mass 63.8±4.9kg, body height 163.7±5.2cm, body fat 29.8±3.5%,  $VO_{2peak}$  26.2±4.1ml.kg<sup>-1</sup>.min<sup>-1</sup>,  $v_{peak}$  6.1±1.2km.h<sup>-1</sup>).

**Results:** The daily number of steps before the intervention ranged from 6450 to 8350steps.day<sup>-1</sup>(mean of 7520±790steps.day<sup>-1</sup>). During the intervention the daily number ranged from 7860 to 10900steps.day<sup>-1</sup>-mean of 9430±840steps.day<sup>-1</sup>. During the programme, the daily realized movement activities increased by 25.4±3.8%. Fitness, characterized by the peak oxygen uptake, improved by 15±2.3%. Similarly, the motor performance-maximal walking speed on the treadmill -was increased by about 14±1.9%. The percentage of body fat was decreased by about 16.2±3.1%. In addition, the predispositions for physical and workload variables, evaluated by ECM/BCM coefficient, were significantly improved. The mean decrease was 4.8±3.3%.

**Conclusions:** We may conclude that walking with the mean energy content of 1500kcal p. week<sup>-1</sup>(9430±840 steps per day) is able to reduce significantly overweight and/or obesity (due to current lifestyle) in middle-aged women, and may also be used for the improvement of general physical fitness.

**Keywords:** walking, overweight, obesity, body composition, physical fitness, intervention programmes

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## Introduction

Obesity is blamed for over 2.8million annual deaths all over the world with increasing prevalence of related comorbidities, including metabolic disorders (e.g. diabetes mellitus, hyperlipidemia, hypertension) and non-metabolic disorders (e.g. cancer, stroke, depression, polycystic ovary syndrome, fat liver disease, glomerulopathy, bone fragility etc.).<sup>1,2</sup> Fontaine et al.<sup>3</sup> revealed that a 25-year-old obese patient has a 22% decrease in life expectation. Adams et al.,<sup>4</sup> revealed that compared with cases who were nonsmokers and had no preexisting illnesses, there was a from 2- to 3-fold greater risk of death among obese individuals. Movement belongs to the basic biological needs of man, its deficiency can cause a number of problems whether health or employment.<sup>5-7</sup> Obesity has increased alarmingly in all social and age groups in the world<sup>5,8</sup> as determined by genetic, metabolic, socio-cultural, economic, psychological and environmental factors. Urban areas are most affected due to changes in lifestyle (especially in regard to eating habits) and in the reduction of levels of physical activity. As a result, the practice of physical exercise has been recommended for reducing body mass and cardiovascular risk factors in all age groups.<sup>6,9-12</sup> Hypokinesia and resulting complications are one of the major consequences of a contemporary, sedentary lifestyle. In addition to declining efficiency, a reduction in the conditions for work and the marginal time spent pursuing leisure time activities all contribute to and are cited as the most frequent reasons for the rise of population overweight and/or obesity.<sup>6,8,13</sup> The efficacy of physical

activity in reducing weight, maintaining weight loss, and preventing weight gain has been the subject of numerous excellent reviews.<sup>9,14-23</sup>

Increase in leisure-time physical activity and work-based physical activity can be caused by behaviours such as the inclusion of family walks, kicking a football around with the children, using the stairs instead of the lift and walking short distances in the work instead of asking for a ride. Lack of an exercise regimen in adulthood is most commonly the result of inappropriate way when and especially inappropriate forms of physical activity (PA) offered to women resulting in lack of physical experience. Another possible cause can be economic and skill demands of commonly recommended PA.<sup>6,8,10</sup> Therefore, only the PA, which is cheap, safe, easily manageable and available for sale in the times and conditions, complying with the intervened individuals has any chance of success in reducing the effects of hypokinesia.<sup>6,10,24</sup> Walking during weight reduction leads to modest weight loss, abdominal fat loss, and total fat loss. The response is barely observable at a prescribed level of 150-200min.wk<sup>-1</sup>. Hence, 250-300mins.wk<sup>-1</sup> (or 35-45mins daily) seems more suitable for weight reduction purposes. The walking can be split into shorter (10-20min) periods. There is a dose response between the amount of completed physical activity and weight-loss maintenance. An exercise energy expenditure of 9-10MJ.wk<sup>-1</sup> (2200-2400kcal), corresponding to walking 70-80mins.day<sup>-1</sup>, seems to be associated with stable weight after weight reduction. A smaller amount of walking may slow down, although not prevent, weight regain.

From a number of forms of PA what meets the above requirements and activities based on it. What is illustrated by the effect of movement-based programmes on walking in influencing the muscular strength,<sup>25</sup> weight,<sup>6,26</sup> physical fitness.<sup>11,15,16,24,27-29</sup> The intensity and volume of the musculoskeletal load can be evaluated by using the number of steps per day. We often find that, in order to influence positively fitness or weight loss, it is recommended to do at least 7,000 steps a day for senior citizens<sup>30</sup> or 10,000 steps for children and adults.<sup>24,31</sup> By the evaluation of the imposed exercise intensity we need to know the time that was necessary for the appropriate realization of exercise.<sup>16,24</sup>

The benefits of walking compared with running were summarized by Bunc:<sup>6</sup>

- i. Highest adaptation,
- ii. Low probability of injury
- iii. Absence of a flight phase
- iv. Surface contact power, is about 1.8 times of the body mass
- v. The opportunity to communicate during activity
- vi. May be done at any time and in any weather

Active travel to place of work, shopping and/or leisure time activities have been identified as an important source of physical activity for adults. Many developed countries are now promoting walking as a way to increase the amount of physical activity, aiming to tackle the epidemic of adult obesity.<sup>32</sup> For the use of walking to cultivate a man can successfully take advantage of the fact that the energy consumption of walking depending on the rising intensity of the load, shows a clear minimum. This dependency can be described using a parabolic curve.<sup>33</sup> The curve describing this dependence shows a minimum at a speed of movement in the range of 3-3.5 km.h<sup>-1</sup>. This fact can be successfully used in physical rehabilitation of persons with a high health risks when there is a need to make an impact of an individual's PA was as small as possible. For example, when the PA is used, this fact (minimum of energy cost) may be use in the rehabilitation of cardiac patients.<sup>5,28</sup>

The basic cause of actual overweight or obese state in majority cases is higher subject's energy intake than the energy output.<sup>6,8</sup> This definition has a significant practical importance, since individuals with low output energy is easier to edit than to change the diet significantly. Our investigation shows that the weekly amount of physical activities for the last two decades has decreased by about 30% compared with the values of the eighties.<sup>6,12,16</sup> The regular implementation of PA is clearly influenced by the positive experience with physical activities.<sup>15</sup> The basic problem is the way and the form of the energy supply of appropriate physical activities. The PA offer must correspond to their current physical fitness, the previous motion experience, must be understandable for intervened subjects. Currently, it is the only difficult to go with the classic range of physical activities such as running, walking, cycling, etc. Increasingly on the importance of experience in realization of physical activities and rising proportion of new or unusual activities with adventure accent must be offered.<sup>6</sup>

Another problem that is associated with lack of physical movement is ever declining fitness of the population.<sup>34</sup> Fitness is not currently understood only as a prerequisite for the realization of any given performance, but it is increasingly emphasized for its preventative effect. As a therapy it is an important prerequisite for an active lifestyle.

We understand it as the ability of the organism to cope with or resist external stress.<sup>34</sup> You can only influence proportionate to the prowess effect of the PA, a suitably designed mobility programme. Fitness affects not only the physical, but also mental working performance and thus affects the application of the individual in society.<sup>5,35</sup> The aim of the study was to verify whether the exercise programme based on walking, is able to induce positive changes in body composition and fitness in middle-aged women.

## Subjects and methods

A group of 42 women (mean age 49.5±3.6years, body mass 78.6±4.6kg, body height 163.7±5.2cm, body fat 29.8±3.5%, VO<sub>2peak</sub> 26.2±4.1ml.kg<sup>-1</sup>.min<sup>-1</sup>, v<sub>peak</sub> 6.1±1.2km.h<sup>-1</sup>) participated in this study. All were from the Prague region and were without objective health problems, which have been checked, together with an examination of the information when possible, and without regular locomotive programme. Before the start of the programme, their functional tests were examined by a cardiologist. None of our subjects were systematically trained. Functional parameters were evaluated in an open system using appliance Cortex Metalyzer 3. The load was carried out on treadmill. Walking speed in warm-up loads was 3 and 5km.h<sup>-1</sup> with zero inclination of the treadmill. Graduation on load speed of 3 km/h and the inclination of 5% was incremented by 1km.h<sup>-1</sup> up to the moment of subjective exhaustion.

Body composition was determined for the whole-body bio impedance in a lying position. The electrodes were in a tetra polar configuration in the places recommended by the manufacturer (BIA 2000, Data input, Germany). Predictive equations for calculation of body composition variables (BC, BCM-body cell mass, ECM - extracellular mass) were modified for the Czech population according to verification by DEXA method. Current physical activity guidelines<sup>28,36</sup> recommend 150 to >250minutes per week of moderate-intensity continuous training such as brisk walking to target overweight/obesity and maintain an optimal body weight. These physical activity guidelines are similar to those recommended by the World Health Organization for general health.<sup>37</sup> However, randomized controlled trials suggest that brisk walking interventions (≥12weeks) elicit only a small beneficial effect on body weight and adiposity outcomes in overweight and obese adults.<sup>38-40</sup> Hence, this modality of exercise, despite being recommended,<sup>10,28,36</sup> may not be particularly effective for inducing clinically meaningful reductions in body fat.

The proposed movement programme came from walking (at least 85% of the total duration of the physical intervention) and was supplemented by activities that individuals typically have previously implemented (home gymnastics, swimming, cycling, etc.). The duration of the intervention was 5months. Weekly energy intensity (energy expenditure) of the proposed intervention programme was 1500kcal (6270kJ). The intensity of the load was controlled by the heart rate by use of the Sportesters and to estimate the energy intensity of the walk, we used a relationship between VO<sub>2</sub>.kg<sup>-1</sup> and walking speed gained from walking on the treadmill in the laboratory for middle-aged women (n=86). The equation used to estimate the energy intensity of the walk after the plane in the speed walk 3-9km.h<sup>-1</sup> is the following:

$$VO_2.kg^{-1} \left( ml.kg^{-1}.min^{-1} \right) = 5.6767 * v \left( km.h^{-1} \right) - 5.8761$$

$$r=0.896, p<0.005, S_{EE}=1.41 ml.kg^{-1}.min^{-1}, T_{EE}=1.63 ml.kg^{-1}.min^{-1}$$

The number of steps was evaluated for selected individuals using the pedometer Omron HJ 720IT and energy content was controlled by Caltrac. Qualitative data on realized PA were collected using a questionnaire. All PA that lasted at least 5 minutes or longer were recorded. Before the intervention, all participants were informed in detail about the objectives of the study, the potential risks, as well as about the overall arrangement of the study. In the framework of this information were also basic facts on the creation and design of the intervention programme and the explanation of basic physical education and health concepts. The accuracy of the functional parameters determination was on the level of 5%, the parameters of body composition have a precision of around 1.5% and the determination of energy performance of physical activities is around 12%. For factually significant changes of the coefficient of ECM/BCM, we consider the value of 0.02. The results are presented in the form of mean $\pm$ s<sub>D</sub>. The significance of differences was assessed by t-test for pair values. We consider differences to be significant on the significance level of p<0.05 or higher. Institutional ethics approval was obtained from the Faculty of Physical Education and Sports Charles University Ethics Committee.

## Results

All monitored individuals absolved the intervention programme based on walking without any problems. Physical activity walk was for all tracked individuals at least 86% of the total amount (qualitative data obtained from questionnaires). For a number of individuals walking was the only physical activity. The duration of the walking ranged from 65 to 84 minutes a day. It should be recalled that the walking was recorded throughout the day, and so consisted of their activity associated with everyday needs (shopping, walking to work, etc.). We found non-significant dependence of daily steps amount (N) on age in the form

$$N(\text{steps.day}^{-1}) = 17.8470 * \text{age} (\text{years}) + 7185r^2 = 0.0296, NS$$

A trend indicating significant increase in the amount of regular physical activity with age can be explained by an increase in leisure time of older women. Their children usually are already independent, and care for grand children has not yet begun. Likewise their jobs are already stabilized with their economic situation generally more stable, older women have more time for themselves, which they often use for leisure time activities. The energy performance of the musculoskeletal programme was in the range 1218kcal (4264kJ) up to 2151kcal (9045kJ) (1486 $\pm$ 270kcal-6211 $\pm$ 1129kJ). The data before and after an intervention are presented in Table 1. Fitness that was characterized by maximal oxygen uptake improved by 13%. Also the movement performance - maximal speed of walking on the treadmill improved by about 11%. Percentage of body fat was decreased by 1.6%. Together with these variables the predispositions for physical exercise and workload were also significantly improved as evaluated by ECM/BCM coefficient (4.8%). Significant changes in the ECM/BCM coefficient for all reporting groups, suggest a significant improvement of the movement load's conditions. At this point it should be noted that the condition for achieving changes in the coefficient of ECM/BCM and in the morphology of the muscles is clearly of sufficient intensity and duration of physical intervention.<sup>33</sup> Energy cost of realized physical performance achieved was lower than required in the design of physical intervention.<sup>6,8</sup> The difference is lower than the error of energy determination the determination of the energy performance of fixed duration and speed of the walk; the

accuracy of energy content determination is around 12%. As with the majority of the population work obligations of the limited free time which are individuals willing to dedicate the mobility activities.

**Table 1** Selected anthropometrical and maximal functional variables before and after intervention based on walking in women.

	Before	After	p
BM (kg)	63.8 $\pm$ 4.9	61.4 $\pm$ 4.8	0.15
BM (%)	100	94.8 $\pm$ 5.0	0.14
FFM (kg)	44.7 $\pm$ 2.8	45.9 $\pm$ 6.7	0.05
FFM (%)	100	102.7 $\pm$ 2.2	0.04
BFabs (kg)	29.8 $\pm$ 3.1	25.3 $\pm$ 2.8	0.16
BFrel (%)	100	84.8 $\pm$ 1.9	0.12
BCM (kg)	23.8 $\pm$ 2.0	25.5 $\pm$ 1.8	0.01
BCM (%)	100	107.1 $\pm$ 1.7	0.01
ECM/BCM	0.88 $\pm$ 0.03	0.80 $\pm$ 0.02	0.02
ECM/BCM (%)	100	90.3 $\pm$ 3.6	0.02
SFpeak (b.min-1)	178 $\pm$ 6	177 $\pm$ 5	0.15
VO2peak.kg-1 (ml)	30.2 $\pm$ 2.1	34.7 $\pm$ 1.8	0.12
%VO2peak.kg-1 (%)	100	114.9 $\pm$ 1.9	0.13
vpeak (5%) (km.h-1)	5.6 $\pm$ 1.1	6.3 $\pm$ 1.3	0.01
vpeak (5%) (%)	100	112.5 $\pm$ 1.3	0.01

Note: BM - Body Mass; FFM - Fat Free Mass; BF - Body Fat; BCM - Body Cell Mas; ECM - Extracellular Mass; v<sub>peak</sub> - Speed of walking on the treadmill with an inclination of 5 % by the interruption of exercise

## Discussion

Physical, psychological, and mental factors of middle age directly or indirectly affect the quality of actual life and mainly quality of life in old age. Unhealthy middle age is the precedent step to unhealthy old age. Improperly managed middle age can cause unexpected unhappiness in old age. Therefore, a healthy old age life can stem from a well-managed and balanced middle age life. Moreover, health in middle age is being emphasized in South Korea aging society. Middle-aged women experience gradual weakening of physical functions with aging and show decreased physical activities. This decrease increases the obesity rate, causing middle-aged women to be susceptible to various musculoskeletal problems such as osteoporosis and other degenerative diseases.<sup>17,41</sup> Controlled trials in obese Caucasian men and women have demonstrated that 60mins of daily physical activity without dietary restriction results in substantial reduction in body weight (7.6kg in men and 6.1kg in women).<sup>18,19</sup> Furthermore, as a key distinction to diet induced weight loss, equivalent physical activity induced weight loss was associated with greater reductions in total fat mass in both sexes (6.1 versus 4.8 kg in men, 6.7 versus 4.1kg in women). These observations agree with the work of Slentz et al.,<sup>22</sup> who reported that physical activity was associated with marked reductions in body weight and fat mass in overweight and obese middle-aged men and women, in a dose-response manner. Indeed, obese middle aged individuals who exercised for about 175mins.week<sup>-1</sup> lost significantly more body weight and total fat mass than those who exercised for about 114mins. week<sup>-1</sup>. However, these results must be interpreted with caution, as

the participants in the trial were instructed to maintain their baseline weight (e.g., participants consumed additional food calories to try and avoid weight loss) throughout the intervention.<sup>22</sup> The consumption of compensatory calories in an exercise programme would lead to a significant underestimation of the effects of exercise per se on body weight and fat mass, and thereby confound interpretation.

The daily number of steps before the intervention ranged from 6450 to 8350 steps.day<sup>-1</sup>—mean was 7520±790 steps.day<sup>-1</sup>. During the intervention the daily volume of steps moved in the range of 7860 to 10900 steps.day<sup>-1</sup>—mean was 9430±840 steps.day<sup>-1</sup>. The increase of daily realized movement activities was 25.4±3.8%. Although it was not required in all cases reached 10000 steps per day, it can be concluded that the proposed amounts in the Czech Republic you can handle without major disruption to the existing lifestyle. Still, keep in mind that the great advantage of priority intervention programme that uses walking, is the use of movement activities associated with everyday activities.<sup>16,24,32</sup> The values of the selected anthropometric and maximum functional parameters before and after physical intervention are listed in Table 1. The same table also shows statistical significance for input and output parameters. Mostly we are a major influence on how the anthropometric parameters, where the most important is the decline in % fat, increase the amount of muscle mass and the reduction coefficient of ECM/BCM, thus improving the prerequisites for muscular work. This is confirmed by the significant improvement in aerobic fitness (VO<sub>2max</sub>, kg<sup>-1</sup>) and the motor performance - maximum speed walking on the treadmill (v<sub>max</sub>). The changes have been significant, both in absolute and in relative terms. Non-significant changes in % BF are the same as data presented by other authors.<sup>38–40</sup>

The decline in %fat in our age-group differs from data of some other studies.<sup>10,38–40</sup> The reason may be in higher energy content of our intervention and its longer duration than in these studies. The values at the beginning of the intervention are insignificantly lower than the reported data of Astrand et al.,<sup>5</sup> and conform to the latest Czech standards.<sup>16,34</sup> At the end of the intervention, standards are significantly better than our population, and do not differ from the values given in the work of Astrand et al.<sup>5</sup> The cause can be found in higher load during the intervention compared to the fitness state before the intervention. The majority of the population currently have an exercise regimen which is less than the minimum amount of physical activities necessary for an “optimal functioning” organism. During the realization of physical intervention based on the walk should be also other activities incorporated, which can be described as a compensatory or bodybuilding. Priority focus should be on strengthening the postural muscles. Components of the intervention should be modifying diet regime, which was not influenced in this study.<sup>42</sup>

## Conclusions

To promote the beneficial effects of walking as part of a daily routine especially for those regions with a higher rate of obesity. The intervention programme based on walking leads to significant changes in weight and fitness. Walking can be used as an appropriate physical activity for the purpose of reducing the movement deficit in current society. The daily amount of realized PA corresponding to approximately 10000 steps and 1500 kcal.week<sup>-1</sup> brings the positive changes in body composition and fitness for women without a regular movement practice. An intervention programme based on walking can be implemented virtually anytime and anywhere; it is inexpensive and

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## Conflict of interest

The author declares no conflict of interest.

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