

Research Article

Using Walking as a Tool for Fitness and its Influence on Obesity and Overweight Individuals

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Abstract

This study summarizes the use of walking (as a tool) and how it relates to influencing health, fitness, body composition, well-being and other psychological variables. It followed an intervention program that lasted 5 months using 1000 kcal of energy intensity in senior women, 1500 kcal in middle-aged men and 2000 kcal for children and composed of at least 85% walking, pointing to significant changes in fitness and body composition. Fitness, which was characterized by maximal oxygen uptake, was improved by 13% (in senior women and obese children) and 17% (middle age men). Similarly, the motor performance – maximal speed of walking on the treadmill was increased by about 11% in senior women and obese children and by about 15% in middle aged men. The percentage of body fat was decreased by 1.6% in senior women and by about 16.8 in men of middle age, and by about 14% in children. Together with these variables were significantly improved the predispositions for physical and workload evaluated by ECM/BCM coefficient. The lowest mean change was found in middle age men (4.8%) and the highest in senior women (10.8%). It may be concluded that walking in the range of 7000 to 10000 steps per day is able to remove the movement deficit in the contemporary population, which is due to present lifestyle and may be used in majority population for improvement of health predispositions and for an improved physical fitness state.

Keywords: Walking; Hypokinesia; Body Composition; Physical Fitness; Intervention Programs

Introduction

Movement belongs to the basic biological needs of man, its deficiency can cause a number of problems whether health or employment [1-3]. 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 activities all contribute to and are cited as the most frequent reasons for the rise of an overweight form and obesity in the populace [eg. 2,4,5].

Global increases in the number of children and/or adults who are overweight or obese are attributable to a number of factors including increased intake of energy-dense foods that are high in fat and sugars but low in vitamins, minerals, and other healthy micronutrients, and decreased physical activity levels due to increasingly sedentary lifestyles, changing modes of transportation as well as increasing urbanization [2,4,6].

Lack of an exercise regimen in adulthood is most commonly the result of inappropriate way then and especially inappro-

appropriate forms of physical activities offered to children and the resulting lack of physical experience. Another possible cause can be economic and skill demands of the commonly recommended physical activities [2,4,7]. Therefore, the chance of success in reducing the effects of hypokinesia have only those physical activities (PA), which are cheap, safe, well manageable and easily available for sale in the times and conditions, complying with the intervened individuals [2,7,8].

Obesity has increased alarmingly in all social groups and age groups in the world population [2,4] as determined by genetic, metabolic, sociocultural, 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 the usual level 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, including in obese children and adolescents [2,7].

Obesity is one of the basic medical and social problems of today's world. It is a problem in both developing and developed countries. The latest scientific data has concluded that obesity reduces life by approximately 7 years. We'll add more to the fact that the obesity demotivated in the implementation of the individual physical activities that affect their physical prowess, then there is evidence that the reduction in fitness means further shortening of life expectancy of the next 2 years [9].

Most current publications concur that growing obesity is clearly the result of the current populace lifestyle [eg., 4,10]. There is evidence that the number of individuals with weight problems today have already exceeded the number of people suffering from malnutrition [5]. Being overweight or obese is the cause of a series of health complications, but no less essential to the lifestyle of the individual, is the deterioration of the conditions for the implementation of PA and the resulting deterioration of the quality of life. An accompanying phenomenon is reduced aerobic capability, the reduced ability of regeneration after a work load, decreasing the possibilities of use still increasing the volume of leisure time and increased the risk of certain diseases, which have cause in hypokinesia [11,12].

From a number of forms of PA meets the above requirements and activities based on it. In the literature is illustrated by the effect of movement-based programs on walking in influencing the muscular strength (Neptune et al. 2008), weight [11,13], physical fitness [8,10,12,14,15,16,17]. The intensity and volume of the musculoskeletal load can be evaluated by using the number of steps per day. We find often the recommendation that, for the positive influence of fitness or weight, it is necessary to implement, in seniors, at least 7 000 steps a day [18] or 10 000 steps in children and adults [8, 19]. Evaluation of the intensity of the load then you need to know the time, that was the appropriate number of steps implemented [10].

The benefits of walking as compared with running the can be summarized as follows [10]:

- Walking is physical activity, which is one of the most adapted
- Lower probability of injury
- When walking is not a flight phase
- Contact with the surface while walking, is about 1.8 times the weight of the
- Contact with the surface forces, at run time, are approximately 3 times the weight of the
- While walking you can communicate with the outside world
- Walking can be practically implemented at any time and in any weather
- Energy intensity is to walk at a speed of less than 7 km/h lower than the run time; at speeds higher than 7 km/h higher.

Active travel to a job and/or to school, such as walking and cycling, has been identified as an important source of physical activity in children and adults. Many developed countries are now promoting walking to job or school as a way to increase a physical activity amount, aiming to tackle the epidemic of childhood and/or adult obesity [6].

When you use walking as a possible means of affecting fitness, being overweight or obese is part of the encounter with the caveat that the walk is not sufficiently intense PA, which could cause their persistent changes. Because when walking are loaded with muscle groups of the lower limbs and postural muscles, its energy intensity similar to the run-time performance, of course, everything is dependent on the intensity of the applied PA [6,20].

Energy intensity of walking and running, expressed as the quantity of energy required to transfer a 1 kg in weight after track 1 m is given in Figure 1. For the use of walking to cultivate a man can successfully take advantage of the fact that the energy intensity of walking depending on the rising intensity of the load, shows a clear minimum. This dependency can be described using a parabolic curve [20]. The curve describing this dependence shows a minimum at a speed of movement in the range of 3-3.5 km/h. This fact can be successfully used in physical rehabilitation of persons with a high health risk when there is a need to make an impact on an individual's PA was as small as possible. For example, when it is used, this fact is the rehabilitation of cardiac patients [1,12].

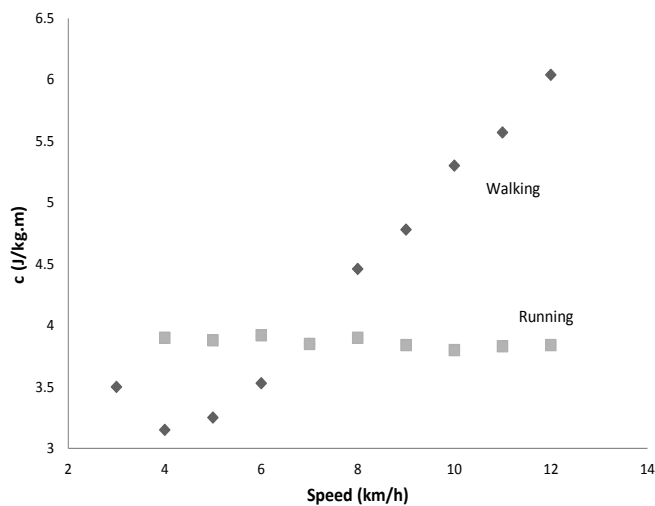


Figure 1. Dependence of walking and running energy cost coefficient c in dependence on speed of movement.

The basic cause of being overweight or obese is currently receiving its energy non adapted issue [2,4]. This definition is of major practical importance, since individuals with low output energy is easier to edit than to change the diet significantly partially their exercise regimen.

Based on our investigation shows that the weekly volume of physical activities for the last two decades have decreased by about 30% compared to the values of the eighties [2,21]. Currently, dropping in the total volume of the imposed PA in children (including school PE too) from the values around 7.7 hours in children under ten years of age to a value of around 2.1 hours for older children [22].

From the foregoing, that the current exercise regimen as children so the adult population does not match their biological needs [2,14] It is therefore possible to conclude that the exercise regimen a substantial part of the population is inadequate to the needs of the organism needs for its seamless function. The movement is one of the basic biological needs of human, unfortunately we are not currently able to his lack of a key.

The regular implementation of the PA is clearly influenced by the positive experience with mobility activities [14]. The basic problem (especially in children) is the way and the form of the supply of appropriate physical activities. The offer must correspond to their current physical fitness, the previous motion experience, must be understandable and interesting intervened subjects. It is a form of PA. Currently, 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 [2].

Another problem that is associated with the lack of movement load type is still declining fitness of the population [22]. Fitness is not currently understood only as a prerequisite for the realization of the performance, but is increasingly emphasized its preventive effect. Therapeutic it is an important prerequisite for the active lifestyle. We understand it as the ability of the organism to cope or resist external stress [22].

You can only influence proportionate to the prowess of the PA, a suitably designed mobility program. Fitness affects both the working performance, then, not only the physical, but also mental and therefore affects the application of the individual in society [1, 9].

The aim of the study was to verify whether the exercise program based on walking, is able to induce positive changes in body composition and fitness for children, adults and seniors.

Subjects and methods

The group of 339 children (179, with normal weight – the mean age of 12.2 ± 2.1 years, 95 overweight - 12.5 ± 2.3 , and 65 obese – 12.3 ± 2.2), 68 men of middle age (45.7 ± 3.6 years), and 53 senior women (68.7 ± 5.0 years) participated in this study. Seniors and men participated in the monitoring on the basis of the challenges. The children were selected from schools in Prague region. All were without objective health problems, which have been checked, together with an examination of the information when you can, and without regular locomotive program. Seniors and middle-aged men were before functional tests examined cardiologist. None from our subjects were systematically trained.

Functional parameters were evaluated in an open system using appliance Cortex Metalyzer II. The load was carried out on treadmill. Walking speed in warm up loads was 3 and 5 km/h with zero inclination of the treadmill. Graduated on load speed of 3 km/h and the inclination of 5% was incremented by 1 km/h up to the moment of subjective exhaustion.

Body composition was determined for the whole-body bioimpedance by lying position. The electrodes were in tetrapolar configuration in the places recommended by the manufacturer (BIA 2000, Datainput, Germany). Predictive equations for calculation of body composition variables (BC, BCM – body cell mass, ECM – extracellular mas) were modified for the Czech population according to verification by DEXA method.

Current physical activity guidelines [12,23] recommend 150 to 250 minutes 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 (WHO 2010). However, randomized controlled trials suggest that brisk walking inter-

ventions (≥ 12 weeks) elicit only a small beneficial effect on body weight and adiposity outcomes in overweight and obese adults [24-26]. Hence, this modality of exercise, despite being recommended [7,12,23], may not be particularly effective for inducing clinically meaningful reductions in body fat.

The proposed movement program 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 5 months.

Weekly energy intensity (energy expenditure) of the proposed intervention program of the seniors was 1000 kcal (4180 kJ), for men of middle age 1500 kcal (6270 kJ), for children with normal weight 2000 kcal (8360 kJ) overweight 2100 kcal (8778 kJ) and obese then 2300 kcal (9614 kJ).

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 $\text{VO}_2 \cdot \text{kg}^{-1}$ and walking speed gained from walking on the treadmill in the laboratory for children ($n = 320$), men of middle age ($n = 154$), middle-aged women ($n = 86$) and senior women ($n = 106$). The equation is used to estimate the energy intensity of the walk after the plane in the speed walk 3-9 km/h has the following form

$$\text{VO}_2 \cdot \text{kg}^{-1} (\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}) = 5.7488 \cdot v (\text{km} \cdot \text{h}^{-1}) - 6.0561$$

$$r = 0.872, p < 0.005, S_{\text{EE}} = 1.49 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}, T_{\text{EE}} = 1.74 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$$

The number of steps was evaluated for selected individuals using the pedometer Omron HJ 720IT and energy intensity among men and senior women was controlled by Caltrac. Qualitative data on realized PA were collected using a questionnaire. Recorded were all PA that lasted at least 5 minutes or longer.

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 $\pm s_p$. The significance of differences was assessed by t-test for pair values. We consider to be significant differences 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 and discussion

Before the intervention, all participants were informed in detail on the objectives of the study, the potential risks, as well as on the overall arrangement of the study. In the framework of this information were also basic information about how the creation and design of the intervention program and the explanation of basic p.e. and health concepts.

All monitored individuals absolved the intervention program based on walking without any problems. Physical activity walk was for all tracked at least 86% of the total volume of (qualitative data obtained from questionnaires), then walk for a number of individuals was the only physical activity. The duration of the walk ranged from 65 to 84 minutes a day. It should be recalled that the walk was recorded throughout the day, therefore, consisted of their activity associated with everyday needs (shopping, walk to work, etc.).

The energy performance of the musculoskeletal program seniors ranged from 650 kcal (2675 kJ) in 1780 kcal (7740 kJ) (better mean of 950 ± 230 kcal- 3970 ± 960 kJ). Energy intensity intervention for adults was in the range 1020 kcal (4264 kJ) up to 2250 kcal (9045 kJ) (1500 ± 290 kcal- 6270 ± 1212 kJ). In children with normal weight with energy intensity ranged from 1360 kcal (5685 kJ) to 2620 kcal (10952 kJ) (1980 ± 310 kcal- 8276 ± 1296 kJ) for overweight children in the 1650 kcal (6897 kJ) it 2310 kcal (9656 kJ) (2020 ± 230 kcal- 8444 ± 960 kJ) and obese children with the energy intensity ranged in the 1940 kcal (8109 kJ) up to 2550 kcal (9045 kJ) (2260 ± 290 kcal- 9447 ± 1212 kJ).

Fitness that was characterized by maximal oxygen uptake was improved from 13% (in senior women and obese children) to 17% (middle age men). Similarly was altered the motor performance - maximal speed of walking on the treadmill about 11% in senior women and obese children and about 15% in middle aged men. Percentage of body was decreased by 1.6% in senior women and about 16.8% in men of middle age, and about 14% in children. Together with these variables were significantly improved the predispositions for physical and workload evaluated by ECM/BCM coefficient. The lowest mean change was found in middle age men (4.8%) and the highest in senior women (10.8%).

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 [14].

Energy performance was achieved with the senior women and children insignificantly lower than was required in the design of physical intervention [2,4]. The difference is lower than the error is the determination of the energy performance of fixed duration and speed of the walk, which is around 12%. This is

lower than the exercise regimen recommended. As with the majority of the population work obligations of the limited time which are individuals willing to dedicate the mobility activities.

For about 15% of all observed subjects we evaluated the total abolition of the daily number of steps. The senior women moved in the range of 6900 to 9100 steps for men in the 8500 to 10800 steps and for children up to 12800. Although it was not required in all cases reached 7000 to 10000 steps a day respectively, 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 program that uses walking, is the use of movement activities associated with everyday activities [6,8,10].

The values of the selected anthropometric and maximum functional parameters before and after physical intervention are listed in Tables 1 to 4. In the same tables are also shown statistical significance for input and output parameters.

	Before	After
BM (kg)	69.9±7.9	70.4±7.8
BM (%)	100	100.7±5.9
FFM (kg)	43.7±6.8	45.9±6.7*
FFM (%)	100	105.0±5.2*
BF _{abs} (kg)	37.5±5.1	36.9±4.8
BF _{rel} (%)	100	98.4±3.9
BCM (kg)	22.8±5.0	25.1±4.8**
BCM (%)	100	110.0±2.7**
ECM/BCM	0.92±0.03	0.82±0.02**
ECM/BCM (%)	100	89.2±3.6**
SF _{max} (b.min ⁻¹)	134±6	133±5
VO _{2max} .kg ⁻¹ (ml)	20.5±3.2	23.0±3.3**
%VO _{2max} .kg ⁻¹ (%)	100	113.1±3.7**
v _{max} (5%) (km.h ⁻¹)	4.4±3.1	4.9±3.4**
v _{max} (5%) (%)	100	111.4±3.3

* p<0,05, ** p<0,01

Table 1. Selected anthropometrical and maximal functional variables before and after walking intervention based on walking in senior women, BM – body mass, FFM – fat free mass, BF_{abs} – absolute values of body fat, BF_{rel} – relative value of body fat in percentages of body mass, BCM – body cell mass, ECM – extracellular mass, SF_{max} - maximal heart rate,

v_{max} (5%) – maximal speed of running with the 5% of the treadmill inclination.

	Before	After
BM (kg)	79.1±7.9	75.6±7.8*
BM (%)	100	95.6±4.6*
FFM (kg)	64.0±3.8	65.4±6.7*
FFM (%)	100	102.0±5.2* *
BF _{abs} (kg)	19.1±3.1	15.9±2.8**
BF _{rel} (%)	100	83.2±3.1**
BCM (kg)	35.2±3.7	37.0±2.8*
BCM (%)	100	105.1±2.7**
ECM/BCM	0.82±0.03	0.78±0.02**
ECM/BCM (%)	100	95.2±3.2**
SF _{max} (b.min ⁻¹)	178±7	176±6
VO _{2max} .kg ⁻¹ (ml)	33.1±5.3	38.7±4.8**
%VO _{2max} .kg ⁻¹ (%)	100	117.0±3.3**
v _{max} (5%) (km.h ⁻¹)	6.8±1.1	7.8±0.9**
v _{max} (5%) (%)	100	115.0±1.5**

* p<0,05, ** p<0,01

Table 2. Selected anthropometrical and maximal functional variables before and after walking intervention based on walking in senior women, BM – body mass, FFM – fat free mass, BF_{abs} – absolute values of body fat, BF_{rel} – relative value of body fat in percentages of body mass, BCM – body cell mass, ECM – extracellular mass, SF_{max} - maximal heart rate,

v_{max} (5%) – maximal speed of running with the 5% of the treadmill inclination

	NBM		OW		OB	
	before	after	before	after	before	after
BM (kg)	44.0±3.8	45.4±3.7*	52.6±3.0	48.4±2.3**	63.2±3.6	54.3±2.8**
BM (%)	100	103.2±5.2*	100	92.1±2.0**	100	83.6±2.7**
ECM/BCM	0.89±0.03	0.84±0.02**	0.90±0.02	0.83±0.02**	0.91±0.04	0.84±0.02**
ECM/BCM (%)	100	94.3±3.2**	100	92.2±3.1**	100	92.3±4.3**
BF _{abs} (kg)	19.7±3.9	17.0±3.0**	24.6±3.1	20.8±2.5**	28.3±3.1	23.9±2.9**
BF _{rel} (%)	100	86.3±3.6**	100	84.6±2.4**	100	84.4±3.1**
v _{max} (5%)(km/h)	12.5±1.8	13.9±1.7*	11.8±1.1	12.8±0.9*	9.8±0.3	10.4±0.4*
v _{max} (5%)(%)	100	111.2±4.2**	100	108.5±0.9*	100	106.1±2.2*
VO _{2max} /kg (ml)	44.6±3.9	51.2±3.0**	33.1±5.3	38.7±4.8**	24.5±3.2	27.7±3.3**
VO _{2max} /kg (%)	100	114.8±3.6**	100	116.9±1.5**	100	113.1±3.6**

* p<0,05, ** p<0,01; NBM – normal body mass, OW - overweight, OB - obesity

Table 3. Selected anthropometrical and maximal functional variables before and after walking intervention based on walking in senior women, BM – body mass, FFM – fat free mass, BF_{abs} – absolute values of body fat, BF_{rel} – relative value of body fat in percentages of body mass, BCM – body cell mass, ECM – extracellular mass, v_{max} (5%) –

maximal speed of running with the 5% of the treadmill inclination

Mostly we are a major influence on how the anthropometric parameters, where the most important is the decline in % fat, increase the amount of fat 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_{2max} , kg^{-1}) and the motor performance – maximum speed walking on the treadmill (v_{max}). The changes have been significant, both in absolute and in relative terms.

Non-significant changes in %BF in senior women are practically the same like a data presented by other authors [eg. 24- 26].

The decline in %fat in our groups of children and men of middle age are differing from data of some other studies [7,24-26]. The reason may be in higher energy content of our intervention and its longer duration according to these studies.

The values in the beginning of the intervention are insignificantly lower than the reported data are Astrand and Rodahl [1] and conform to the latest Czech standards [10,22]. At the end of the intervention are significantly better than our population standards and do not differ from the values given in the work of Astrand and Rodahl [1]. The cause can be search in higher load during the intervention compared to the fitness state before the intervention. The majority of the population already exercise regimen is currently less than the minimum amount of physical activities necessary for the “optimal functioning” organism.

During the realization of physical intervention using the walk is to be paid in addition to other activities, 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 in this study was not influenced.

Conclusions

Promote the beneficial effects of walking to school and/or as a part of the daily routine especially for those prefectures with a higher rate of obesity.

The intervention program based on a walking exercise occurs with significant changes in weight and fitness. Walking can be used as an appropriate physical activity for the purposes of the movement deficit reducing in the current society.

The daily amount of realized PA corresponding to approximately 7000 steps a day and 950 kcal/week at senior women, about 10 000 steps and 1500 kcal/week for adults and about 11 000 steps and 2000 kcal/week raises the positive changes in body composition and fitness for people without a regular locomotive practice.

Intervention program based on walking, you can implement virtually anytime and anywhere, is inexpensive and available for everyone.

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