Physical Activity Review vol. 4, 2016

Original Articles

DOI: http://dx.doi.org/10.16926/par.2016.04.06

Obesity - causes and remedies

Authors' Contribution:

A – Study Design
B – Data Collection
C – Statistical Analysis
D – Manuscript Preparation
E – Funds Collection

Václav Bunc

Charles University Prague, Faculty of Physical Education and Sports, Czech Republic

Abstract

Obesity is blamed for over 2.8 million annual deaths all over the world with increasing prevalence of related comorbidities, including metabolic (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.) The aim of the study was to describe the causes and remedies of obesity. There are two primary causes for the increase in obesity: lack of an active lifestyle and poor nutrition. Fortunately, inactivity and poor nutrition are causes that can be altered through intervention. The PA based on walking in duration of 5 months were used in subjects with BMI>30kg.m^{-1}. The PA was controlled in 192 middle age women, 67 men of the same age, and 58 women seniors with help the pedometer Omron HJ720IT and energy content was controlled by Caltrac, and by relationship between speed of walking and VO_2. VO_{2peak} was improved from 13.2±2.1% in women to 15.1±2.4% in men, and by 13.0±2.7% in senior women. Similarly was altered the motor performance – maximal speed of walking on the treadmill about 11.3±2.6% in women and16.2±3.1% in men, and by 10.8±2.6% in senior women. %BF was decreased by 7.2±1.9% in women and by 6.5±2.0% in men, and by 6.7±2.4% in senior women. Together with these variables were significantly improved the predispositions for physical and workload evaluated by ECM/BCM coefficient (6.8±2.5% in women, 7.9±3.1% in men, and 8.5±3.0% in senior women). We may concluded that walking with the mean energy content of 1500kcal.week^{-1} (9430 ± 840steps.day^{-1})in females and men of middle age, and energy content about 1000 kcal.week^{-1} (6930 ± 610steps.day^{-1}) in senior women is able to significantly reduce the overweight and/or obesity and an improve actual fitness state in subjects without regular movement regime. Therefore, the chance of success in reducing the effects of hypokinesia have only those PA, which are cheap, safe, well manageable and easily available for sale in the times and conditions, complying with the intervened individuals.

Key words: *obesity, active life style, movement intervention, walking*

INTRODUCTION

Obesity is one of the basic medical and social problems of today's world. In recent decades, obesity has dramatically increased worldwide (e.g. in the United States more than 35 % and in Europe more than 20 % of adults are obese) [1,2,3]. It is a problem in both developing and developed countries. Obesity is a multifactorial disease caused mainly by the interaction of genetic and environmental factors. Obesity, in the absence of disease, can only occur as a result of a chronic positive mismatch between energy intake and energy expenditure resulting in fat accumulation. This storage of excess calories as adipose tissue is a normal biological response to a positive caloric balance. Conversely, weight loss, in the absence of disease or surgical intervention, can only occur as the result of a chronic negative mismatch of energy intake and expenditure. These basic facts are why the study of energy balance is a significant scientific are with important public health implication. Deficits in motivation, self-efficacy, and self-esteem, sedentary life-styles, and psychosocial problems complicate treatments for obesity. Thus, a comprehensive management approach needs to address these issues as well. However, conservative weight-reduction programs often fail or patients regain weight initially lost because motivation for weight maintenance decreases [4].

The increasing prevalence of overweight youth in the western countries and the associated increase in medical comorbidities has created a growing need for effective weight-management interventions. Overweight subjects are likely to have hyperinsulinemia, high-density lipoprotein cholesterol, high triglycerides, and hypertension, which are components of the metabolic syndrome [5]. Beside the medical problems the overweight and/or obesity means the decrease of work performance, decrease of leisure time activities realization and thus decrease of human rehabilitation, rehabilitation of work predispositions. Obesity impacts on humans can be divided into two areas [6,7,8]:

1. Objective:
   - 80% probability of diabetes,
   - 80% probability of high blood pressure,
   - Metabolic syndrome,
   - Cancer,
   - Stroke,
   - Depression,
   - Polycystic ovary syndrome,
   - Fat liver disease,
   - Glomerulopathy,
   - Bone fragility
   - Dermatological complications
   - Sight impairment and blindness
   - Overload the musculoskeletal system,
   - Premature fatigue, and often lower working efficiency.
2. Subjective:
   - Inaesthetic "look",
   - Lack of interest in physical activity,
   - Often reduced self-esteem, ridicule.

There are two primary causes for the increase in world obesity: lack of an active lifestyle and poor nutritional habits [5, 7, 8, 9]. Fortunately, inactivity and poor nutrition are causes of obesity that can be altered through intervention. If no intervention takes place, subjects could suffer many of the physical and emotional side effects of obesity. Causes of adulthood obesity can be found in an inappropriate lifestyle of contemporary adult population. Lifestyle is undergoing substantial changes. Recent times have seen a continuous decrease in the performance of physical activities, both spontaneous and organized [9, 10]. Research has shown that the amount of physical activities performed by adults of both sexes has decreased by approximately 15% in the last two decades, while energy intake during the same period virtually stagnant [8, 9, 11]. The volume of realized PA is also dependent on the age, and decrease with growing age [9,11]. This stems in unsuitable conditions for the implementation of PA adult and the lack of knowledge about prevention of obesity. Obesity is up to about 5% of cases the problem of education and not medicine. For an effective intervention is necessary in the first place timely identify its initial stages and simultaneously identify the variables that can be affect by the external interventions. To assess the early stages of obesity in population studies, which include a large number of monitored individuals, most commonly use the BMI determination [6]. Because BMI is calculated from the total weight is preferable to identify the early stages of obesity with help of the body composition evaluation - mainly body fat content [12]. To determine obesity state can be used the 95 percentile of the BMI population data and/or percent body fat content [13].

The increase in the prevalence of overweight and obesity cases worldwide is occurring against a background of a progressive reduction in the energy expended for work and occupational activities as well as for the accomplishment of personal chores and daily necessities. In contrast, the energy expenditure of leisure time activities, the most important discretionary component of total daily energy expenditure, may have increased slightly, but not enough to keep pace with changes brought about the actual life style. The contemporary dietary habits are playing a sufficient role in energy balance. In western countries the energy intake during the last decade staying practically constant and/or slightly decrease.

For the identification of variables that can be used for obesity management can we use the so-called energy balance equation that characterizes energy intake and energy expenditure

$$\Delta E = E_{input} - E_{output}$$

E_{input} may be calculated by a multiple of BMR, where size is determined by the constant current lifestyle, specifically implemented motion mode, gender and body dimensions [13]. E_{output} is energy demand of actual movement regimen.

Body weight is a function of energy and nutrient balance over an extended period of time. Energy balance is determined by macronutrient intake, energy expenditure, and energy nutrient partitioning.

Positive energy balance over weeks and months will result in weight gain while negative energy balance will have the opposite effect. From the energy balance equation then clear that modifiable variable to the reduction of obesity are diet and exercise regimen.

METHODS

The PA based on walking in duration of 5 months were used in groups of subjects with BMI>30$kg \cdot m^{-2}$ by the reduction of energy intake about 10%. The PA was controlled in 192 middle age women, 67 men of the same age, and 58 women seniors with help the pedometer Omron HJ720IT and energy content was controlled by Caltrac, and by relationship between speed of walking and oxygen uptake. Selected somatic and functional variables are presented in Table 1.

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 5 $km \cdot h^{-1}$ with zero inclination of the treadmill. Graduated on load speed of 3 $km \cdot h^{-1}$on the inclination of 5% was incremented by 1 $km \cdot h^{-1}$ 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.

Table 1. Somatic and selected functional variables in the followed groups of subjects (W – women of middle age, M – men of the same age, SW – senior women).

	W (n=192)	M (n=67)	SW (n=58)
Age [years]	48.7±3.9	49.7±4.1	69.5±4.4
Body mass [kg]	83.9±4.9	96.5±7.9	79.6±6.7
Height [cm]	163.9±5.6	173.1±5.0	158.5±2.6
BMI [$kg \cdot m^{-2}$]	31.2±3.3	32.2±3.7	31.7±2.6
FFM [kg]	52.2±2.8	62.6±3.8	47.4±3.4
BF rel [%]	37.8±3.1	35.1±2.7	40.5±5.1
ECM/BCM	0.88±0.03	0.82±0.03	1.12±0.05
$VO_{2peak} \cdot kg^{-1}$ [ml]	27.8±2.3	32.1±5.3	22.5±3.2
v_{peak} (5%) [$km \cdot h^{-1}$]	5.6±1.1	6.5±1.3	4.8±1.6

Manageable long-term reduction of energy intake during a body mass reduction is around 10%. It follows that decreases energy intake must be gradual, step by step. After reaching of sub-weight it is possible in a further step continue again with 10% reduction in energy intake. The same procedure must be used by the reduction in body mass, in determining the energy intake directly derived from BMR [14].

Basic descriptive statistics was calculated for somatic and functional parameters. The differences were assessed firstly according factually significance and secondly with help of Student t-test for paired values.

The reproducibility 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 ± SD. 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.

RESULTS

Changes of selected somatic and functional variables are collected in Table 2.

Table 2. Selected somatic and functional variables before (B) and after the movement intervention based on walking in followed groups of subjects together with their changes in percentages of starting values (W – women of middle age, M – men of the same age, SW – senior women).

	%BF [%]	ECM/BCM	$VO_{2peak} \cdot kg^{-1}$ [ml]	v_{peak} (5%) [$km \cdot h^{-1}$]
W (n=192) B	37.8±3.1	0.88±0.03	27.8±2.3	5.6±1.1
W (n=192) A	35.3±2.9	0.82±0.03	31.5±2.5	6.2±1.4
Δ (%)	7.2±1.9*	6.8±2.5*	13.2±2.1**	11.3±2.6**
M (n=67) B	35.1±2.7	0.82±0.03	32.1±5.3	6.5±1.3
M (n=67) A	32.8±2.9	0.76±0.04	36.6±4.6	7.4±1.4
Δ (%)	6.5±2.0*	7.9±3.1*	14.1±2.5**	13.2±3.1**
SW (n=58) B	40.5±5.1	1.12±0.05	22.5±3.2	4.8±1.6
SW (n=58) A	37.8±3.1	1.03±0.04	25.4±3.1	5.3±1.5
Δ (%)	6.7±2.4*	8.5±3.0**	13.0±2.7**	10.8±2.6**

* $p<0.05$, ** $p<0.01$

DISCUSSION

All monitored individuals absolved the intervention program based on walking without any problems. Walking like a dominant physical activity was for all women tracked at least 86% of the total volume of (qualitative data were obtained from questionnaires), then walking 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 walking was recorded throughout the day, therefore, consisted of their activity associated with everyday needs (shopping, walk to work, etc.).

Physical activity is now admitted as being an integral element of adult obesity treatment, but it is not clear which intervention is the most efficient [7,15,16]. Physical activity is an extremely complex behavior that requires active involvement of the subjects and his nearly environment as well. It is influenced by personal, family and environmental factors and each of these elements can be a potential barrier in preventing active participation of the subject, therefore compromising a successful implementation of a program. These limitations are obvious for moderate-to-vigorous physical activity which is usually recommended for treating obese persons [3,16].

A large amount of literature on the physical environment, physical activity, and obesity addresses several aspects of the neighborhood physical environment. Studies that used ecological models showed that several aspects of the physical environment had an effect on obesity in adults [17]. For example, residents of a mixed-land-use neighborhood (i.e., both residential and commercial) or a high-density neighborhood were likely to be more active because of opportunities to walk to stores and other destinations. However, the empirical evidence on land use and density and adult obesity is mixed [18].

Fitness - peak oxygen uptake was improved from 13.2±2.1% in women to 15.1±2.4 % in men, and by 13.0±2.7 % in senior women. Similarly was altered the motor performance – maximal speed of walking on the treadmill about 11.3±2.6% in women and16.2±3.1 % in men, and by 10.8±2.6 % in senior women. %BF was decreased by 7.2±1.9% in women and by 6.5±2.0% in men, and by 6.7±2.4 % in senior women. Together with these variables were significantly improved the predispositions for physical and workload evaluated by ECM/BCM coefficient (6.8±2.5 % in women, 7.9±3.1 % in men, and 8.5±3.0 % in senior women). Detailed changes of selected somatic and functional variables are collected in Table 2.

According to our results the full job subjects are able to realize daily number of steps from the 6900 to 9100 steps. Although it was not required in all cases reached 7000 to 10000 steps a day respectively [19,20,21], 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 [15,19,22].

The energy performance of the musculoskeletal program was in the range from 1192 kcal (4264 kJ) up to 2198 kcal (9045 kJ) (mean was 1486 ± 270 kcal-6211 ± 1129 kJ) per week in both men and women of middle age. This energy content was realized by walking with the mean steps amount of 9430 ± 840 steps $\cdot day^{-1}$. In senior women we found the weekly energy content of imposed physical activities in the range of 856 kcal (3578 kJ) to 1540 kcal (6437 kJ) (mean was 986 ± 240 kcal - 4122 ± 1003 kJ). The mean daily amount of steps was 6930 ± 610 steps $\cdot day^{-1}$.

The weighted evidence suggests that physical activity is associated with a marked reduction in total and abdominal obesity and thus is a useful strategy for the treatment of obesity. The quantity of physical activity required to the obesity reduction across gender and race is not firmly established; however, evidence to date suggests that for most individuals, an increase of daily exercise amount [5,10]. An exercise energy expenditure of 6.5-8.5 MJ·week^{-1}, corresponding for example to walking 50-70 min·day^{-1}, seems to be associated with stable weight after weight reduction [23]. There is a dose response between the amount of completed physical activity and weight-loss maintenance. Decisive is next to the duration of exercise and intensity of the applied load, which must be in the range 75 to 85% of the maximum heart rate [9,14]. This activity must be realized with help of exercise for which is subject perfectly adapted. In majority cases the most suitable activity for obesity reduction seems to be walking [11,12]. Walking during weight reduction leads to modest weight loss, abdominal fat loss, and total fat loss. The walking can be split into shorter (10-20 min) periods. There is a dose response between the amount of completed physical activity and weight-loss maintenance. A smaller amount of walking may slow down, although not prevent, weight regain.

CONCLUSIONS

Obesity management is highly creative long-term activity that requires access for all who are involved in these processes. It should be clearly defined partial and final objectives of the intervention. It is also necessary to define where it can be reliably demonstrated the effect of the intervention. It should be noted intervened that achieving success will need his cooperation and that weight reduction will need to expend considerable effort and funds. For the success of the intervention should always respect individual state - the degree of obesity, health status, previous physical and dietary experience, knowledge intervened, the potential of his or her free time, his or her motivation, relationship environment to the obesity and to applied interventions, family anamnesis, financial and material terms and conditions where an intervention is implemented. At the same time the success of intervention is necessary mutual trust and continuously if possible - daily contact with intervening intervened. Only subject to a substantial part of the above can be expected positive effect of implemented interventions.

We may concluded that walking with the mean energy content of 1500 kcal.week^{-1} (9430 ± 840 steps.day^{-1}) is able to significantly reduce the overweight and/or obesity and an improve actual fitness state in subjects without regular movement regime of middle age. In seniors women the movement program based on walking with energy content about 1000 kcal.week^{-1} (6930 ± 610 steps.day^{-1}) is able significantly influent their body composition and physical fitness state.

ACKNOWLEDGEMENTS

The study was established with the support of the Czech Ministry of Education research project MSM 0021620864, and project of Charles University P38.

REFERENCES

1. Catenacci VA, Hill JO, Wyatt HR: The obesity epidemic. Clin Chest Med, 2008, 30(3): 415–444. doi:10.1016/j.ccm.2009.05.001
2. Ogden CL, Yanovski SZ, Carroll MD, and Flegal KM: The epidemiology of obesity. Gastroenterology, 2007, 132(6), 2087–2102. doi:10.1053/j.gastro.2007.03.052
3. Tsigos C, Hainer V, Basdevant A, Finer N, Fried M, Mathus-Vliegen E, et al.: Management of obesity in adults: European clinical practice guidelines. Obesity facts, 2008, 1(2): 106–116

4. Teufel M, Stephan K, Kowalski A, Kaesberger S, Enk P, Zippfel S, Giel K: Impact of Biofeedback on Self-efficacy and Stress Reduction in Obesity: A Randomized Controlled Pilot Study. Applied Psychophysiology [online], 2013, 38(3): 177-184
5. Ross R, Janssen I: Physical activity, total and regional obesity: dose-response considerations. Medicine and Science in Sports Exercise, 2001, 33: S521–S527
6. Stevens J, Erber Oakkar EE, Cui Z, Jianwen CJ, Truesdale KP: US adults recommended for weight reduction by 1998 and 2013 obesity guidelines, NHANES 2007-2012. Obesity (19307381) [online]. 2015, 23(3): 527-531
7. Bouchard C: Physical activity and obesity. Champaign: Human Kinetics. 2000.
8. Brettschneider WD, Naul R, (Eds.): Obesity in Europe. Frankfurt am Main: Peter Lang, 2007.
9. Bunc V, et al.: Role pohybových aktivit v životě dětí a mládeže. (The role of physical activities in the adolescents and children life). Final report of the Czech Ministry of Education grant VZ MSM 115100001, Praha: UK FTVS, 2004
10. Haskell WL, Lee IM, Pate RR, Powell KE, et al.: Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Circulation, 2007, 116: 1081-1093
11. Bunc V, Skalská M: Using Walking as a Tool for Fitness and its Influence on Obesity and Overweight Individuals. Jacobs J Obesity. 2015, 1(1): 010
12. Bunc V, Skalská M: Effect of walking on body composition and aerobic fitness in non-trained men of middle age. Antropomotoryka, 2011, 21(55):39-46
13. Herrmann SD, Willis EA, Honas JJ, Lee J, Washburn RA, Donnelly JE: Energy intake, nonexercise physical activity, and weight loss in responders and nonresponders: The Midwest Exercise Trial 2, 2015, 23(8): 1539-1549
14. Bunc V, Hráský P, Skalská M: Body Composition and Aerobic Fitness like a Result of 6 Months Walking Program in Senior Women. JMED Research, 2014, 14, Article ID 950910, pp. 10, DOI: 10.5171/2014.950910
15. Bunc V: Walking like a tool of physical fitness and body composition influence. Antropomotoryka, 2012, 22(57):63-72
16. Bunc V: Nadváha a obezita dětí – životní styl jako příčina a důsledek. (Overweight and obesity in children – lifestyle like a cause and consequence). Česká kinatropologie, 2008, 12(3): 61-69
17. Papas M, Alberg A, Ewing R, Helzlsouer K, Gary T, Klassen A: The built environment and obesity. Epidemiol Rev, 2007, 29:129-143
18. Rutt CD, Coleman KJ: Examining the relationships among built environment, physical activity, and body mass index in El Paso, TX. Preveventive Mededicine, 2005, 40(6);831-841
19. Choi BC, Pak AW, Choi JC, et al.: Daily step goal of 10,000 steps: a literature review. Clin Invest Med, 2007, 30(3): E146-E15l
20. LeMasurier GC, Sidman CL, and Corbin CB: Accumulating 10,000 steps: does this meet current physical activity guidelines? RQSE, 2003, 74(4): 389-394
21. Marshall AL: Should all steps count when using a pedometer as a measure of physical activity in older adults? Journal of Physical Activity and Health, 2007, 4: 305-314.
22. Mori N, Armada F, Willcox DC: (2012). Walking to school in Japan and childhood obesity prevention: New lessons from an old policy. American Journal of Public Health, 2012, 102(11): 2068–2073
23. Bunc V, Dlouhá R: Energy cost of treadmill walking. J Sports Med Phys Fitness, 1997, 37:103-109

Address for correspondence:

Václav Bunc, Faculty of P.E. and Sports Charles University, J.Martího 31, 162 52 Prague 6, Czech Republic, email: bunc@ftvs.cuni.cz

Recevied: 23.05.2015; Accepted: 25.05.2016; Published online: 31.05.2016