

# The impact of a 12-week walking program on the bone mass density, serum estrogen, and body composition of overweight girl students

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**ABSTRACT:** Osteoporosis and overweight are two important hygienic disorders which influence the health and the body composition of a person, and they are becoming more and more widespread in modern societies. The present paper studies the impact of hiking on a number of selected factors in a group of female students. Subjects: 40 overweight female high school students who participated in this research voluntarily. Subjects were randomly placed in two groups of 20 (BMI control group:  $28.4 \pm 2.6$  Kg/m<sup>2</sup> and BMI experimental group:  $29.2 \pm 1.8$  Kg/m<sup>2</sup>). Before and after 12 weeks of hiking, the estrogen serum, bone mass density and body composition of all subjects were measured. A hiking program was defined for the experimental group which consisted of three 30-minute hiking sessions per week, with 50% to 75% of heart rate, and for a total of three months period. Statistical methods: the gathered data were analyzed through independent t-test at the significance level of  $p \leq 0.05$ . The results: the findings showed that there was no significant change in bone mass density at the thighs and the spine in experimental and control groups ( $p \geq 0.05$ ), however, the body composition and serum estrogen level were significantly different between the two groups ( $p = 0.001$  and  $p = 0.035$  respectively). Conclusion: it can be concluded that long-term hiking with above specifications effects estrogen and body composition, however, any effects on bone mass density possibly requires more time or more severity in the experiment.

**Keywords:** Bone mass density, Estrogen, Overweight, Female students.

## INTRODUCTION

nowadays, osteoporosis, less physical activity, and inappropriate diet, are a serious threat to human health, resulting in more and more yearly deaths than any type of cancer. Accordingly, World Health Organization has declared that future years will face a significant public health problem. Osteoporosis has no clinical signs, and if not prevented, shows itself in side effects such as several bone fractures (1). Women are usually prone to osteoporosis after 20 years of age, nevertheless, it can be prevented in them using a few simple methods. Medical experts believe that the best time to prevent osteoporosis is youth, since, at this age the most amount of bone mass is produced and the more the bone mass density, the less the risk of developing osteoporosis at an older age. Some harmful factors in this disease are low physical activity, inappropriate diet, underweight, overweight especially at the center of the body, and drinking too much coffee (2). Those whose Body Mass Index is above 30 are considered fat. In general, from medical expert's point of view, obesity and overweight open the way for other disorders such as diabetes, high cholesterol, irregular menstruation cycles, joint pains, and different types of cancer (3).

Lower body organs and bones in fat people suffer many harms, especially at central parts like stomach, and it has been observed that overweight can result in cracking and fracture in thigh and pelvis bones. Instead of muscular tissue which is a determining factor in the extent of bone mass and the strength of bones against mechanical stress, fat people have an extra fat mass which acts as an extra ineffective load on bones in lower organs, resulting in wear-

out and friability of them. This is in turn because of a high level of fat synthesis in these people and a prevention of osteoblast synthesis and formation of new bones (4).

According to the above, Hsu (2006) and Zhao (2007), have reported a negative relation between high level of fat and bone mass in different areas of the body (5, 6). Researchers believe that changing the life style from having low physical activity to having regular aerobic physical activity like 30 minutes of daily walk can reduce the risk of developing osteoporosis in women (7). The most appropriate way of reaching a desired weight is exercising regularly and receiving the required amount of calories according to weight, height, age, and physiological conditions (8). Physiologically, physical activity leads to better blood circulation and better bones and joints nutrition. More blood flow, transfers more oxygen and nutrients to bone cells, and suitable amount of stress by physical activity, enlarges and strengthens the bones, as well as increasing calcium absorption in them (9). In addition, bone formation hormones like estrogen increase by exercising. Estrogen produces collagen and thus, strengthens the bones. It activates vitamin D in the body and cause bones to absorb more calcium and therefore become stronger (10).

Duntilla (2001) showed that active young and postmenopausal women show lower risk of decrease in bone mass density. The most popular exercise among these women is hiking, as mentioned by this study (11). On the contrary, Cavanaugh and Can(1997) argued that hiking has no positive effect on bone mass density in postmenopausal women, neither does it prevent its decrease (12). Based on these and other similar studies, we can conclude that hiking programs have different effects on women bone mass density, however, it is important to note that few studies have considered hiking effects solely on young women and female students, especially with a focus on overweight. Most studies on prevention and treatment of osteoporosis have been conducted with an emphasis on postmenopausal women. In addition, most medical advices and medical and exercise programs are offered for women at this age. The present study is an attempt to cover young overweight women regarding the physiological effects of 12 weeks of hiking on the aforementioned factors in preventing bone mass decrease and osteoporosis.

Subjects: the statistical population in the present study is consisted of fat non-exercising female students. 40 overweight girl students between 16 and 18 years of age and with BMI between 26 and 30 participated in the study voluntarily through public announcement. They were then randomly placed in two control and experimental groups of 20. During selection, subjects were thoroughly informed of the study and its required steps through a guide sheet and were personally interviewed by the test giver. The subjects were not consuming hormones or any other type of medication and not under any type of medical treatment; they had no family record of osteoporosis, no cardiorespiratory diseases and no joint problems. Also, they had no irregularity in the menstruation cycle during the previous year.

## MATERIALS AND METHODS

after filling out a consent form, the subjects were taken for the required measurements. Their weights and heights were measured in kilograms and centimeters using Seca weight and height scales made in Germany. Body Mass Index (BMI) was measured in terms of  $\text{Kg/m}^2$ . Different parts of body composition (muscular mass, fat mass, and the percentage of fat mass) for every subject was evaluated through Bioelectric Impedance method (BIA-106, RJL Systems) using the body composition analyzer made in South Korea. Bone Mass Density (BMD) was measured through Dual Energy X-ray Absorptiometry in terms of  $\text{gr/cm}^2$  using Lunar Densitometry device made in USA.

In order to measure the level of serum estrogen, biochemical analysis of blood was conducted using Radio Immunoassay (RIA) method in a pathobiology laboratory. Sampling was done at 8 in the morning in FBS conditions and on the fifth day of menstruation cycle (the follicular phase) for every subject.

In order to implement the exercise protocol and to determine its severity, the subjects were given a Rockport Walk Test based on heart rate. The experimental group, then, went hiking 3 sessions a week and 30 minutes each session in a track for 12 weeks. There were 5 to 10 minutes of warm-up and cooling before and after each session consisting of body movement and stretching exercises. The severity of exercise in every session was controlled by Polar Heart Rate Monitor made in Finland.

After 12 weeks, all measurements were repeated. No specific activity was defined for the control group, except participating in the two stages of anthropometrics and lab measurements.

Statistical methods: to describe quantitative variables, the present study used descriptive statistical methods, mean, and standard deviation, and the mean score of experimental and control groups were compared through t-test. The findings were analyzed at the statistical level of  $P \leq 0.05$  (table 1).

## RESULTS AND DISCUSSION

in the present study, the control group was consisted of 20 overweight female students with the average age of  $17.2 \pm 1.5$  and the average height of  $159 \pm 8.4$  cm, and the experimental group was consisted of 20 overweight female students with the average age of  $17.6 \pm 1.0$  and the average height of  $160.2 \pm 7.3$  cm.

Data analysis showed that the two groups did not differ much in the primary anthropometric specifications and blood variables (table 1). The findings also showed that Bone Mass Density in thighs and the spine in both groups did not render significant change after 12 weeks; although both groups showed more BMD in both areas at the end, the increase was not significant ( $p > 0.05$ ). However, all components of body composition and the level of serum estrogen was significantly changed in the experimental group ( $p=0.001$  and  $p=0.035$  respectively), so that the fat mass, the percentage of the fat mass and the overall weight of the body were decreased and the non-fat mass was increased. Such changes were not observable in the control group.

Discussion: the findings of the study showed that BMD in overweight girls did not change significantly after three months of regular hiking. On the other hand, their overall weight was decreased and their level of serum estrogen was increased. Estrogen plays an important role in the maintenance and reinforcement of bone mass density, reducing osteoporosis, and strengthening pelvis and spine bones. It helps the body to produce collagen which in turn strengthens the bones (15).

The findings of the present study matches those of Gusi (2006), in which a two-month brisk walking exercise program, consisting of three 30-minute sessions per week, did not affect BMD of thighs and spine bones (L4-L2) in postmenopausal overweight women, but decreased their weight significantly (16). The present findings also support Korpelaninen (2006) in which 35 minutes of walking three times a week for three months did not affect BMD of thighs and spine bones in middle-aged women but changed the level of serum estrogen of the subjects significantly and increased their muscular mass. These researchers asserted that an increase in muscular mass and the level of serum estrogen can maintain the subjects' BMD (17). Nonetheless, not all walking exercises were ineffective on bone mass density; Borer (2007) showed that walking for 30 minutes to 88 % of severity for four times a week in the course of three months results in a significant increase in thigh and spine bones density in fat postmenopausal women (19). In addition, Vinionpa (2005) implied that a 30-minute walk, 3 times a week, for 4 weeks results in a 1.1% increase in thigh BMD, a 2.2% increase in spine BMD, a 7.3% increase in serum estrogen level, and a 3.1% decrease in the overall weight in fat middle-aged women (20). The inconsistency between the findings of these studies and those of the present research seems to be a result of higher exercise severity and more sessions in the former, which resulted in an increase in their subjects' BMD.

It can be inferred from the aforementioned findings that, in order for the exercises to be effective on BMD, a number of different factors need to be considered, such as: severity of exercises, duration, speed, age, number of sessions, and nutrition. The present study, however, showed that a hiking program in short term can effectively decrease the weight and increase the level of serum estrogen in overweight female students, but is not significantly effective on their BMD. It can be suggested that a long term more severe program might have a positive effect on bone mass density and its influencing factors in young overweight or fat girls. Further studies in this regard are still needed.

Table 1. Values of variables before and after intervention

Variable	Control group Pre-test	Control group Post-test	Experimental group Pre-test	Experimental group Post-test	P.V <sup>1</sup>
Thighbone density (gr.m <sup>2</sup> )	$1.0 \pm 0.1$	$1.0 \pm 0.1$	$0.8 \pm 0.1$	$0.9 \pm 0.1$	0.67
Spine density (gr.m <sup>2</sup> )	$1.1 \pm 0.2$	$1.2 \pm 0.1$	$1.1 \pm 0.3$	$1.12 \pm 0.3$	0.59
Serum estrogen (picogram/mililiter)	$43.3 \pm 4.2$	$43.5 \pm 16.2$	$30.7 \pm 16.5$	$61.1 \pm 17.5$	0.035*
Weight (Kg)	$74.3 \pm 11.0$	$74.1 \pm 10.1$	$76.0 \pm 10.1$	$74.1 \pm 5.7$	0.001*
Fat mass weight (Kg)	$31.2 \pm 7.4$	$30.4 \pm 7.9$	$28.9 \pm 5.3$	$26.8 \pm 6.7$	0.001*
Fat mass percentage (%)	$39.0 \pm 3.5$	$38.0 \pm 4.2$	$37.8 \pm 3.0$	$35.6 \pm 5.8$	0.001*
Muscular mass weight (Kg)	$42.7 \pm 7.0$	$43.9 \pm 7.6$	$43.8 \pm 5.2$	$44.6 \pm 7.2$	0.001*

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