Bone Mineral Density of Lumbar Spine: A Comparison between Active and Inactive Postmenopausal Women

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Abstract: Background & Objectives: The studies indicate that environmental, genetic, environmental, nutrition and physical activity can factors affect bone status. In this study, bone mineral density (BMD) of lumbar spine in active and in-active women post menopause was compared. **Materials and Methods:** This study was of comparative post-occurrence type. 24 of active and in-active postmenopausal women from Bojnourd city were volunteered in this study that at least 3 years and/or maximum 7 years have passed from their last menstruation. 12 of Active women with mean age: 54/58±1/93 years and BMI: 26/45±1/77 kg/m^2) and 12 in-active women with mean age: 54/83±2/21 years and BMI: 25/41±1/46. Active women were involved in walking training program, 3 sessions per week (1 hour per session) for at least 3 years. Subjects BMD of lumbar spine were measured by the DEXA device. SPSS software ver-16 was used to analyze data. Independent t-test performed at significant level ($P \leq 0.05$). **Results**: The results of this study showed that BMD of the lumbar spine in active postmenopausal women was significantly higher than in-active postmenopausal women ($P<0.05$). **Conclusion:** Regular walking as the body weight bearing activity contributes to increasing BMD of the lumbar spine by increasing work load on bone. Thus, walking as low–cost and most effective exercise can be used to prevent osteoporosis at the time of menopause.

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1. Introduction

Osteoporosis, as one of the prevalent diseases in current century, has afflicted millions of people throughout the world. It reduces bone mineral density (BMD) and consequently damages the infrastructure of bone tissue [1]. As bone infrastructural changes and bone mass decrease are almost irreparable after adulthood, it is preferable to prevent rather than to treat osteoporosis. The most effective preventive measure, however, may be taken in youth, adolescence and even childhood, during skeletal growth, to help increase peak bone mass [2]. Since osteoporosis entails no external or alarming symptoms and remains almost latent until a fracture occurs, it is called the silent epidemic of the century [3]. Osteoporosis is less prevalent in men than in women so that bone mass decrease begins much later and progresses slowly in men [4]. Studies have shown that osteoporosis afflicts many women even before their menopause while it afflicts almost all postmenopausal women due to decreased estrogen secretion [5]. Guéguen (2000) reported BMD decreases in 40-45 year-old adults to be as much as 0.2-0.3 percent per year while the decrease amounts to 2-4 percent per year in the first five years following the menopause [6].

Research conducted by Rheumatology Research Center of Iran shows that 2.5 million postmenopausal women are vulnerable to severe osteoporosis and bone fracture. The disease has significantly developed among the women over 50 years of age so that about 28 percent of Iranian postmenopausal women are afflicted by osteoporosis and 53 percent by osteopenia [7]. The most severe complication of osteoporosis, however, is the effect its induced fractures exert on death toll as well as the financial costs. A study reported that thigh fractures would increase from 50000 instances in 1997 to 150000 instances in 2050, of which 75 percent occurs in women. However, using a bone densitometer (DEXA scan), as one of the systematic methods of detecting bone diseases [8], may help diagnose osteoporosis early so that bone fractures may be reduced by 30-50 percent through medication [9]. Further, exercise training and physical activity, as a non-pharmacologic method, seems to provide a better measure to prevent osteoporosis though research has brought about variable findings as to the effect of physical activity on bone tissue.

Recent research shows that the athletes doing weight-bearing exercise have higher BMD values than their non-athlete counterparts [10,11]. Still, it seems that non-weight-bearing exercise is less contributive to bone synthesis [12]. Indeed, non-weight-bearing athletes have similar [13, 14] or lower BMD values comparing with their non-athlete counterparts [15-18]. On the other hand, research findings suggest that training intensity is more a significant factor than the stimulation time. Sports such as weightlifting, which entail short-term pressure bearing, contribute to bone synthesis to a greater degree than do endurance sports such as swimming, cycling and walking [19]. In this regard, Nicholas et al (2003) reported that physical activity increased BMD by 5 percent in female athletes comparing with their non-athlete counterparts [20]. Puntila observed that both inactive young and postmenopausal women were vulnerable to decreased bone density [21]. On the other hand, Cavanaugh and Kohn (1997) reported that walking training did not influence bone density in postmenopausal women or prevent their bone density decrease [22]. On the contrary, Borer et al. (2007) found that walking training significantly improved lumbar spine BMD in obese postmenopausal women [23].

Considering the cited studies, various researchers have already reported contradictory findings as to the effect of physical activity such as walking on BMD so that there is no consensus among the researchers. Furthermore, walking is highly popular as a simple, viable exercise that helps prevent osteoporosis in postmenopausal women (an effective non-pharmacologic method). The present study aims to compare lumbar spine BMD between active and inactive postmenopausal women in Bojnord province. The results may hopefully provide revealing insights into the effect of physical activity on BMD for both postmenopausal women and health officials (Ministry of Health and Treatment, Sports Ministry and Ministry of Education).

2. Methodology

This is an applied study with a cross-sectional (ex post facto) approach. The population of the study consisted of both active and inactive postmenopausal women, aged 50-58 years old, in Bojnord province. As an inclusion criterion, the subjects should have experienced their last menstrual period at least 3 and at most 7 years before. There are two reasons why this time interval was selected; first, estrogen secretion dramatically decreases following menopause; and second, the decreased estrogen secretion affects BMD. Therefore, the minimum three years and the maximum seven years following the last menstrual period were considered as the inclusion criterion to restrict the range of study and achieve a relative homogeneity in the subjects.

The participants of the study consisted of 12 active postmenopausal (Age=54.58±1.93 years; Height=160±0.06 cm; Weight=67.92±4.35 kg; BMI=26.45±1.77 kg/m^2) and 12 inactive postmenopausal (Age=54.83±2.21 years; Height=159±0.05 cm; Weight=64.25±3.33 kg; BMI=25.41±1.46 kg/m^2) women. The active subjects had a history of regular walking training for at least three years (three sessions a week, one hour per session). The control subjects, however, had no regular exercise training though they were similar to the active subjects in terms of calendar and menopausal ages.

To select the participants, a questionnaire was administered to the volunteers, through which they both gave their consent to participate in the study and reported on their history of alcohol and tobacco use, smoking and specific diseases such as diabetes, renal failure, anticonvulsant use, cardiovascular diseases and so on.

A bone densitometer (DEXA or Dual-Energy X-ray Absorptiometry) was used to measure BMD of lumbar spine. To this end, the subjects lied down on the examination table and kept their hands stretched along their bodies. Then a box was placed under the subjects' shins and knees so that their waistline touched the bed and their knees stood at the right angle to their body (see Figure 1). Afterwards, a technician made adjustments to the device arm and the lumbar spine scan was made. Before the scan was done, the subjects were informed of the method of BMD scan and the likely risks it might have posed to them. SPSS 16 was used to do the statistical analysis of the data. Considering the data analysis, Kolmogorov-Smirnov test was first run to examine the normality of the data. Then independent t test was run to compare BMD of lumbar spine between active and inactive postmenopausal women ($P \leq 0.05$).

3. Results

Tables 1 have showed subjects` anthropometric characteristics and table 2 compares lumbar spine BMD between the two groups of participants.

As has shown in Table 2, active women BMD was significantly higher across all the scanned areas comparing with the inactive women ($p<0.05$).

Table 1. The Anthropometric characteristics in active & inactive women (df: 22).

Variable	Group	Mean ± SE	Differences of mean	t	P-Val
Age (yr)	active	54.58±1.93	0.24±0.01	1.502	0.206
	inactive	54.83±2.21			
Height (cm)	active	160.0±0.06	01.0±0.03	1.831	0.104
	inactive	159.0±0.05			
Weight (kg)	active	67.92±4.35	03.67±0.08	3.651	0.034*
	inactive	64.25±3.33			
BMI (kg/m^2)	active	26.45±1.77	01.04±0.05	1.826	0.093
	inactive	25.41±1.46			

*=significant in 0.05

Table 2. The Comparison of BMD in postmenopausal active & inactive women (g/cm^3), (df: 22).

Variable	Group	Mean ± SE	Differences of mean	t	P-Val
First L. V.	active	0.944±0.18	0.117±0.08	2.279	0.033*
	inactive	0.827±0.13			
Second L. V.	active	0.963±0.11	0.104±0.04	2.554	0.018*
	inactive	0.859±0.09			
Third L. V.	active	1.032±0.13	0.195±0.09	3.981	0.001*
	inactive	0.837±0.10			
Fourth L. V.	active	1.011±0.15	0.196±0.12	3.69	0.001*
	inactive	0.805±0.10			
First-fourth L. V.	active	0.987±0.12	0.156±0.06	3.502	0.002*
	inactive	0.831±0.11			
Total V.	active	1.062±0.13	0.168±0.07	3.516	0.002*
	inactive	0.894±0.10			

L. V: lumbar vertebrae *=significant in 0.05

4. Discussion

The present findings showed that active postmenopausal women had significantly higher lumbar spine BMD across all the measured lumbar area comparing with their inactive counterparts ($p<0.05$), which may account for the effect of exercise on increased BMD. Studies have long been conducted on the effect of exercise and physical activity on BMD. For example, Slemenda et al. (2001) conducted a study entitled role of physical activity in the development of skeletal mass in children. They reported that a combination of physical activity and adequate nutrition (particularly vitamin D and calcium) played the central role in maximized skeletal mass during growth. Besides, physical activity during puberty and before the age of eleven contributed to skeletal mass increment as much as 4-7 percent, which still continued for a few years following the cessation of physical activity [24]. Carlson observed that physical activity led to increased bone size (due to the replacement of cartilage with bone) and bone density (due to the variations induced by intramembranous transformations that produce a thicker mass) [25]. Considering the effect of physical activity on BMD, it should be noted that the type and intensity of physical exercises exert an independent and incremental effect on BMD so that more intense physical exercises lead to higher BMD as a result of higher stimulation of bone cells [26].

Some researchers have already reported contradictory findings. For instance, Borer et al. (2007) investigated the effect of 30-minute fast walking per session (for 3 months, 4 sessions per week) in obese postmenopausal women and reported that the training protocol significantly increased lumbar spine BMD in the subjects [23]. Vainionpaa et al. (2005) reported that 30-minute fast walking per session (for 4 months, 3 sessions per week) increased lumbar spine BMD as much as 2.2 percent in obese premenopausal women (35-40 years old) comparing with a control group. In this regard, the subjects' serum estrogen increased as much as 7.3 percent but their weight decreased as much as 3.1 percent [27].

However, Gusin et al. (2006) came up with findings inconsistent with the above-cited studies. They used an outdoor fast walking training protocol for two months (3 sessions per week, 30 minutes per session) and found that walking, as an effective physical activity to be used by postmenopausal women, did not influence their bone density but significantly decreased their weights [28].

Korpelaninen et al (2006) observed that a 35-minute walking training (for 3 months, 3 sessions per week) did not increase lumbar spine BMD in middle-aged women. However, it significantly increased both their estrogen level and muscular mass, either which I think contributed to maintaining bone density in the subjects [29]. It is worth noting that BMD begins to decrease early in the fourth decade of life, but physical activity (weight-bearing exercises) may help slow down this process [30]. Studies on Iranian women show that they reach their maximum lumbar spine BMD at the age of 25-35 years, but then bone degeneration exceeds bone production resulting in the increased risk of osteoporosis [31]. As the cited findings suggest, physical activities such as walking did not exert consistent effects on BMD in the subjects, which may relate to differences in the exercise duration, intensity and distance in training protocols [32] as well as training location [33].

As decreased BMD (osteoporosis) does not pose a serious problem to human per se, it is considered as a silent disease that is only heard of with fractures. Research has shown that BMD is an important predictor of osteoporotic fractures [34] often occurring after the ages of 60-70 years [35]. The more important point, however, is the death toll associated with these fractures. Research findings suggest that spine osteoporosis ends up with vertebral compression fractures in which middle and lower chest as well as upper back is more involved so that an acute pain begins in the back and extends over to the sides and front. The patients may also feel a chronic pain in their back, which intensifies as they stand up. In some cases, vertebral fractures may result in decreased body height and bring about dorsal kyphosis and cervical lordosis. Nevertheless, research has shown that BMD may be increased through muscular stretch during muscle contraction as well as the body shocks induced by the ground. The latter factor seems to be more effective in increased BMD and contributes to calcium absorption by bone marrow [29].

In the end, it should be noted that estrogen secretion, as one of the most important hormones affecting BMD, significantly decreases after menopause so that 0.2-0.3 percent BMD decrease per year during 40-45 years of age amounts to 2-4 percent BMD decrease per year in the first five years after menopause. As the present study were conducted on the postmenopausal women, higher BMD in active/sports women accounts for the positive effects of exercise training on bone tissue density. Therefore, it is recommended that postmenopausal women do such exercises as jugging to prevent sharp decreases in BMD so that they may maintain their skeletal mass to old age.

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