Effect of Exercise on Lumbar Bone Density in Osteoporotic Postmenopausal Women

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ABSTRACT

This study was done to investigate the effect of exercise on osteoporotic postmenopausal women. Thirty asymptomatic osteoporotic postmenopausal women were selected from outpatient Clinic of Dar-El-Shefaa Hospital. Their age ranged from 53 to 60 years old, they were postmenopausal for at least three years, body mass index did not exceed 30 Kg/m^2 and parity not more than three times. They were assigned randomly into two groups equal in number, study and control group. Study group performed weight bearing exercise plus specific exercise program for lumbar spine and Control group maintain the ordinary life style. Both groups received the same regimen of calcium supplementation (1000 mg/day) for 6 months of treatment. Evaluation was done by measuring bone mineral density (BMD) at lumbar spine (L_{1-5}) and serum alkaline phosphatase for both groups before and after 6 months of treatment. Results revealed that BMD at lumbar spine (L_{1-5}) statistically significantly increased and serum alkaline phosphatase statistically significantly decreased in the study group and did not change in the control group. According to the previous results of the present study weight-bearing exercise for lumbar spine can be considered as an effective treatment in osteoporotic postmenopausal women.

Keyword: *Bone mineral density, Exercise, Menopausel, Alkaline phosphatase.*

INTRODUCTION

Postmenopausal osteoporosis is a major community health problem in terms of medical, social and economic costs[15]. It is a significant cause of women's morbidity and mortality leading to fractures of the hip, spine and wrist. Osteoporosis is a primary metabolic bone disease[3].

Maximum bone mineral density (BMD) usually occurs early in the third decade of life. Osteoclastic and osteoblastic activities achieve the balance in BMD. Beyond the 30 to 40 years old age, the osteoblastic activity fails to completely balance osteoclastic activity, resulting in an increase in the absorption of bone. The increased resorption results in an increased size of the resorption cavities and ultimately in decreased bone mass[7.] In the aging skeleton however there is an imbalance between the restorptive and formative process[9].

There are two types of osteoporosis, type I due to a decrease in cumulating estrogens which affects trabecular bone –especially vertebral bone- and affects females more than males in a ratio of 1:6. Type II, senile osteoporosis, which is age related and occurs in cortical and trabecular bone, affects females and males in a ratio 2:1[21].

Although there is no cure for osteoporosis, therapy should be directed primarily toward increasing physical activity, reducing the risk of falling and secondarily toward stabilizing bone mass. Reversing the osteoporotic process require therapy in the form of hormonal replacement[19]. Calcitonin, which is peptide hormone mediator for estrogen action, produce inhibition of osteoclastic activity and therefore decrease the bone resorption [6]. Also, maintaining a high

dietary intake a calcium, vitamin D, reduction of excessive consumption of protein and phosphorous are indicated as therapeutic options[21]. Calcium must be given with sodium fluoride to allow mineralization of the new osteoid. Problems with this modality, include the questions of abnormal bone architecture and the high incidence of side effects[14].

Today, physical therapy can be used widely for preventing and treating osteoporosis. Exercise is beneficial in dealing with such disease as it affects the skeleton in several ways[23].

Exercises are very important for slowing the progression of osteoporosis weight bearing exercises apply tension to muscle and bone that encourages the body to compensate for the added stress by increasing bone density as much as 2% to 8% per year[11].

Smith et al. (1989)[17] demonstrated reduced bone loss in postmenopausal women after 4 years of a walking and jogging program. Also, study of Eisman (1993)[2] showed an increase in neck femur BMD after skeletal loading.

It has generally been presumed that for exercises to be effective in preventing bone loss with aging, it must be weight bearing in nature to generate enough mechanical stress. While the study of Bloomfield Et al (1993)[1] provided evidence of a prospective nature that non-weight bearing exercise may be effective in reversing bone loss in postmenopausal women.

This study was conducted to investigate the effect of exercise on BMD of lumbar vertebrae in osteoporotic postmenopausal women.

SUBJECTS MATERIAL AND METHODS

I – Subjects

Thirty asymptomatic osteoporotic postmenopausal women were recruited from Dar-El-Shefaa Hospital between 2005-2006.

The Criteria for inclusion were as follow:

a. DXA diagnosis of osteoporosis in Lumbar vertebrae (L_{1-5}) with no evidence of vertebral compression fractures.
b. Age between 53 to 60 years.
c. No history of other bone diseases, as well as renal, liver and endocrinal disorders or cardiac affection.
d. Body mass index did not exceed 30 Kg/m^2 and parity not more than 3 times.
e. No intake of any medications associated with accelerated bone loss (Steroids).
f. Had natural menopausal at least 3 years before entry in this study.
g. No history of low back pain.

Subjects were assigned randomly into two groups equal in number:

Study group: participated in weight bearing exercises on treadmill in addition to specific exercise for the lumbar spine muscles.

Control group: followed their ordinary life style.

Both groups received the same regular regimen of calcium bicarbonate supplementation (1000 mg/ day) all through the study period (6 months).

II- Instrumentation

1- Dual x-ray absorptiometry (DXA) was used measure BMD at lumbar spine (L_{1-5}).
2- Treadmill was used to perform weight bearing exercise in Study group.

III- Procedures

1. Evaluative procedures:

a. Bone mineral density at lumbar (L_{1-5}) was measured by DXA for both study and control groups.
b. Blood samples were taken to measure alkaline phosphatase for both study and control groups.

Evaluations for both groups were done before entry in this study and after 6 months of treatment.

2. Treatment procedures:

All women in both groups received the same calcium supplementation (1000 mg/ day) calcium bicarbonate all through the study period.

Study group

Each woman in this group participated in a weight bearing exercise program on treadmill plus specific exercises for the muscles around the lumbar spine for 6 months, 3 sessions per week.

1. Weight bearing exercise program for 30 minutes started by 5 minutes warming up and ended by another 5 minutes cooling down in the form of walking with no resistance and no inclination at the walk way of the treadmill and in between 20 minutes of active stage of walking with 15° inclination at the walk way of the treadmill and resistance to make the woman walked at her training heart rate (moderate work load).
   - Training heart rate = [(0.6 to 0.75) x (maximal attained heart rate – resting heart rate) ± resting heart rate][5].
2. Specific exercise training program: To strength erectrospinae muscles which performed from:
   - Prone lying position with pillow under the abdomen and arms beside the body. By tightening the back extensors, lifting the head off the bed then relax.
   - Crock lying position by lifting the pelvis off the bed making a bridge, and then relax.
   - Sitting position by adducting both scapulae, so decreasing the space in between and then relax.
   - To decrease the lumbar lordosis (posterior pelvic tilt), which performed from: crock lying position by contracting the abdominal muscles, pressing lumbar region down against bed, then relax.
   - Sustained muscle contraction for each specific exercise training was maintained for 5 seconds followed by 10 seconds of relaxation. Each woman performed 3 sets of 10 repetitions for each of the four exercises. Therefore, each specific exercise session consisted of 120 repetitions.
3. Data analysis: Data collection, presentation and analysis of the results were used student –t- test and percentages of changes were used. The data were considered significant when P was less than 0.05.

RESULTS

The results of the study are presented under the following headings:

1. Physical characteristics

At this study age, years of menopause, height, weight and BMI showed a statistically non significant difference ($P > 0.05$) between both study and control groups (Table 1).

Table (1): Statistical summary of the physical characteristics of both groups.

Variables	Groups		Levels of significance
	Study group	Control group	
Age (years)	55.31 ± 5.67	53.55 ± 4.04	0.63
Menopausal years	4.78± 1.2	3.9 ± 1.6	0.72
Height (cms)	156.33 ± 5.51	158 ± 4.14	0.93
Weight (Kgs)	64.07 ± 6.48	63.45 ± 4.62	0.82
BMI (Kg/ m2)	26.15 ± 2.26	25.61 ± 1.81	0.40

2. Bone mineral density at lumbar spine (L_{1-5})

Results of this study showed that the increase in lumbar BMD in response to exercise in Study group was statistically significant (P < 0.03) at the lumbar spine when comparing between before and after 6 months of exercise training, whereas in control Control group, the change in BMD at lumbar spine was statistically non- significant (P < 0.74) after 6 months of starting the study, (Table 2).

Table (2): Total BMD at lumbar spine (L1-5) for both groups.

Groups	Total BMD of L1 – 5 (gm/ cm2)		Level of significance
Study group	Pre ttt	0.757	P < 0.03
	Post ttt	0.821	
Control group	Pre ttt	0.765	P < 0.74
	Post ttt	0.774	

Prior to study, there was a statistically non significant differences (P < 0.59) among both groups, while there was a statistically significant increase (P < 0.05) in the post results of Study group when compared to that results of Control group, (Figure 1).

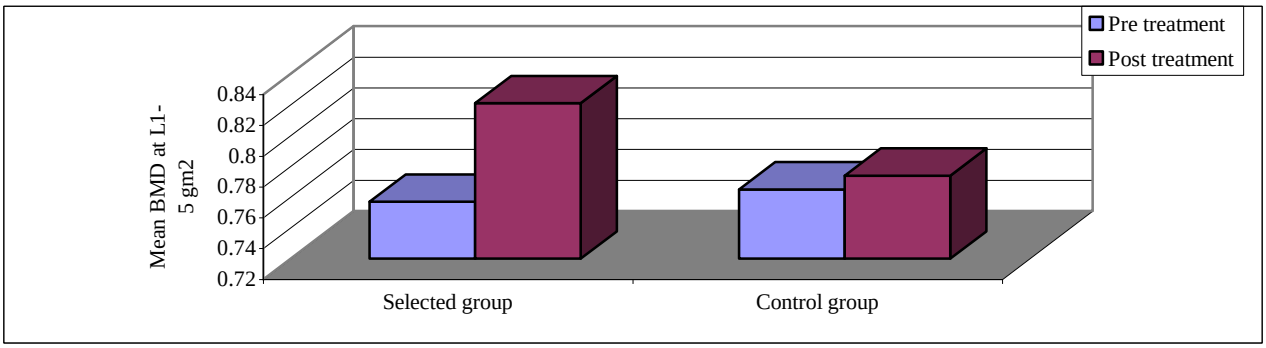

Fig. (1): Mean values of BMD at (L1-5) in Study group & Control group.

3. Serum alkaline Phosphatase

Initial values of serum alkaline phosphatase were nearly similar among both study and control groups, while after 6 months of treatment the difference was statistically significant (P<0.05).

Results of this study showed that the decrease in serum alkaline phosphatase in Study group was statistically significant (P<0.05), where as in Control group, there was statistically non-significant difference (P<0.33) between, before and after 6 months of treatment (Table 3).

Table (3): Serum alkaline phosphatase (IU/Liter) for both groups.

Groups	Serum alkaline phosphatase (IU/Liter)		Level of significance
Study group	Pre ttt	156.92 ±35.23	P < 0.05
	Post ttt	150.60 ± 35.96	
Control group	Pre ttt	157.03 ± 35.66	P < 0.33
	Post ttt	156.43 ± 34.52	

DISCUSSION

Osteoporosis is a common medical problem that occurred without warning. It causes bones to become weak and brittle that even mild stresses like bonding over can cause fracture[20]. The effect of physical exercise in postmenopausal women received considerable attention because data regarding the effect of physical training in postmenopausal women with normal patterns of physical activity are controversial.

The major finding of the present study is the significant increase in BMD of the lumbar spine (L_{1-5}) and decrease in alkaline phosphatase in response to structured exercise regimen that is traditionally considered weight bearing in nature (treadmill) and local action physical activity (specific exercises for the back extensor muscles).

These results confirmed with that of wolfgang and Johannes (2004) who found that women which participated in a weight bearing exercises increase their BMD at the lumbar spine.

Also, Swezey et al. (2000) reported that postmenopausal women who regularly participated in a regular weight bearing exercise for one hour undertaken three times a week have increased their bone content and slowed the amount of bone loss.

Also, several studies revealed a significant in BMD of lumbar spine in exercise subjects without significant change in non-exercise subjects[13].

On the other hand, Sinaki et al, (1989) concluded that postmenopausal bone loss is unaffected by modest exercise training program despite an increase in muscle strength.

The previous results can be explained by McGarry & Kiel (2000), who demonstrated that walking produce stress. This stress creates electric charge that attracts a matrix of minerals to the location that's being stressed where they add to the bone mass density and essentially build bigger and stronger bone.

Another explanation for the effect of exercise on bone was resulted from its simulative effects for the osteoblastic cells to deposit more bone. The deposition of bone at points of compress ional stress has been suggested to be caused by a piezoelectric effect[4].

Conclusion

As a conclusion, weight bearing exercise on treadmill plus specific exercises for the lumbar region is an effective method for preventing and treating osteoporotic postmenopausal women.

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الملخص العربي

تأثير التمرينات الرياضية على كثافة العظام في المنطقة القطنية لدى السيدات المصابات بهشاشة العظام بعد انقطاع الدورة الشهرية

تهدف هذه الدراسة لبحث تأثير التمرينات الرياضية على السيدات المصابات بهشاشة العظام بعد انقطاع الدورة الشهرية. وقد تم اختيار عينه من ثلاثين سيدة بالعيادة الخارجية لمستشفى دار الشفاء ممن تتراوح أعمارهن بين 53 – 60 سنة ، مرت بعد انقطاع الدورة الشهرية لديهن ثلاث سنوات على الأقل ، ولا تزيد نسبة الوزن إلى الطول لدى كل منهن عن 30كجم/م^2 ولم تلد أىّ منهن أكثر من ثلاث مرات . وقد تم تقسيم السيدات عشوائياً إلى مجموعتين متساويين في العدد (مجموعة دراسية – مجموعة ضابطة). شاركت المجموعة الدراسية في برنامج التمرينات الهوائية على جهاز سير الجري بالإضافة إلى إتباع برنامج تمرينات خاصة لمنطقة الفقرات القطنية بينما استمرت المجموعة الضابطة في إتبّاع نمط حياتها العادي . وتناولت السيدات في المجموعتين نفس الجرعة من الكالسيوم 1000مجم/اليوم لمدة 6 شهور (فترة العلاج)، وتم تم التقييم للمجموعتين عن طريق قياس كثافة العظام في المنطقة القطنية بالإضافة إلى قياس الفوسفاتيز القاعدية للمجموعتين قبل وبعد 6 شهور من الدراسة . وأثبتت النتائج أن كثافة العظام في المنطقة القطنية كانت زيادتها فعّالة وأيضاً نقص الفوسفاتيز القاعدية بشكل ملحوظ إحصائياً في المجموعة الدراسية على عكس ما حدث بالمجموعة الضابطة . وبناءاً على النتائج السابقة للدراسة يمكن اعتبار أن التمرينات الهوائية على جهاز سير الجري وبرنامج التمرينات للمنطقة القطنية علاج فعّال للسيدات المصابات بهشاشة العظام بعد انقطاع الدورة الشهرية .

الكلمات الدالة : كثافة العظام – التمرينات – انقطاع الدورة الشهرية – الفوسفاتيز القاعدية .