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Bone Mineral Status Response to Treadmill Walking Exercise in Postmenopausal Women

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Abstract: The early postmenopause is a period in which fast bone loss in women's lifespan occurs. postmenopausal years of life at least. Even in later life initiation of physical activity can reduce fracture risk, but it must be maintained in order to preserve its benefits on bone health. The aim of this study was to detect the changes in bone mineral status after 6 months of walking training in postmenopausal women. Methods: Forty postmenopausal women participated in this study and divided into two equal groups; the first group (A) received treadmill walking exercise training, where the second group (B) received no exercise training. The program consisted of three sessions per week for six months. There was a significant increase in mean values of bone mineral density, serum calcium, parathyroid hormone and grip strength of group (A), while the results of group (B) were not significant. There was a significant difference between both groups. So, treadmill walking exercise training is an effective treatment policy to improve bone density and prevent bone loss in postmenopausal women.

Key words: Walking · Bone Mineral Density · Postmenopausal women

INTRODUCTION

In Europe and North America about 6% of men and 21% of women aged 50-84 years are classified to have osteoporosis. Osteoporosis causes an increase in bone fragility. Its clinical significance mainly refers to (hip) fractures secondary to (low or moderate) trauma. Although it is well accepted that exercise is essential for the management of osteoporosis [1].

The level of bone marrow density in later life is a function of the maximum bone mass attained in early adulthood and of subsequent age-related bone loss, which starts after entering the fourth decade of life and accelerates in early postmenopausal years in women. The clinical significance and (economic) burden of osteoporosis mainly refers to hip fractures and fractures of the forearm, the proximal humerus and vertebrae secondary to low to moderate trauma in postmenopausal women. Worldwide, approximately 200 million women suffer from osteoporosis[2].

In postmenopausal women, simultaneous age-related declines of muscle force and bone loss have been reported. It has been suggested that the maximum muscle force, as estimated by grip strength, should be taken into consideration as a strong determinant of the mechanical characteristics of the bone. It is known that changes in the muscle force measured with grip strength are associated with menopausal bone loss and future fractures[3].

MATERIALS AND METHODS

Subjects: Forty women were enrolled in this study, their age ranged from 60 to 65 years. All volunteers were asked to read and sign an informed consent document prior to participation. Women who were smokers, having any endocrine, orthopedic, renal, liver, cardiac disorders, obesity, diabetes, chest diseases, any medication likely to influence bone metabolism or other pathologic processes were excluded. All participants were tested for bone mineral density, serum calcium and parathyroid hormone before the treatment and after 6 months at the end of the study.

Following pre-training testing, a randomized block procedure was used to assign qualified participants into 2 equal groups; group (A) received treadmill walking

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exercise training.The second group (B) was asked to refrain from participating in any structured exercise program for the duration of the study. All participants were free to withdraw from the study at any time. If any adverse effects had occurred, the experiment would have been stopped, with this being announced to the Human Subjects Review Board. However, no adverse effects occurred and so the data of all the participants were available for analysis.

METHODS

Evaluated Parameters

Bone Marrow Density: Bone marrow density measurements were performed at the lumbar spine (L2-L4) and the radius (Lunar Prodigy, GE, Madison, WI, USA).

Parathyroid Hormone (PTH) and Serum Calcium: Intact PTH was measured in serum with an ELISA (Diagnostics Systems Laboratories, Inc., Webster, TX). The intra-assay CV was 5.0% and the inter-assay CV was 6.0%.

Grip Strength: Grip strength of the dominant hand was measured using three successive repetitions with a Jamar hand dynamometer (Sammons Preston Rolyan, Cedarburg, WI, USA). The elbow was flexed at a 90° angle and not allowed to contact any body part. Resting time between subsequent measurements was 30 s [3].The mean value of the two best performances was used in the analyses. The intraclass correlation coefficient (ICC) of the grip strength measurements has been shown to be 0.87 for absolute grip strength values.

The Physical Training Programme: The aerobic treadmill-based training programme (Enraf Nonium, Model display panel Standard, NR 1475.801, Holand) was set to 60% of the maximum heart rate (HRmax) for one month and increased gradually for 80% of maximal heart rate during the second month of the program achieved in a reference ST performed according to a modified Bruce protocol. This rate was defined as the training heart rate (THR). After an initial, 5-minute warm-up phase performed on the treadmill at a low load, each endurance training session lasted 30 minutes and ended with 5-minute recovery and relaxation phase. All patients performed three weekly sessions over a 6-month period.

Statistical Analysis: The mean values of bone mineral density, serum calcium, parathyroid hormone and grip strength were measured and calculated before and after 6 months for both groups. Then the data were compared using paired "t" test to determine the level of significance. Comparison between both groups was done by using the independent "t" test. The significance level was fixed at $P< 0.005$.

RESULTS

Forty postmenopausal women participated in this study and divided into two equal groups; the first group (A) received treadmill walking exercise training. The second group (B) received exercise training.

Measurement of bone mineral density, serum calcium, parathyroid hormone and grip strength were taken before the starting of the study (pre-test) and after six months at the end of the study (post-test). The mean bone mineral density, serum calcium, parathyroid hormone and grip strength values were significantly higher statistically in group (A), while the results of group (B) were not significant (Table 1 and 2). There was a significant difference between both groups after treatment (Table 3). So, walking exercise training is an effective treatment modality to prevent bone loss and decrease the risk of osteoporosis in postmenopausal women.

Table 1: Comparison of mean value, standard deviation and p-value of bone marrow density, serum calcium, parathyroid hormone and hand grip strength of group (A) before and after treatment

	Mean±SD			
	Before	After	t. value	Significance
BMD of lumber spine (mg/cm)	121.167±11.41	152.75±16.103	3.762	P <0.05
BMD of radius (mg/cm)	271.917±24.26	316.083±26.89	2.843	P <0.05
Serum Calcium (ng/dl)	8.767±1.23	10.517±1.24	2.753	P <0.05
Parathyroid Hormone (ng/dl)	14.933±2.517	12.367±2.208	-2.61	P <0.05
Hand grip strength (mmHg)	146.73±6.58	163.25±4.78	5.82	P <0.05

BMD = Bone Marrow Density

Table 2: Comparison of mean value, standard deviation and p-value of bone marrow density, serum calcium, parathyroid hormone and hand grip strength of group (B) before and after treatment.

	Mean±SD			
	Before	After	t. value	Significance
BMD of lumber spine (mg/cm)	121.167±12.06	119.917±11.48	-1.465	P >0.05
BMD of radius (mg/cm)	279.917±25.79	278.583±26.19	-1.732	P >0.05
Serum Calcium (ng/dl)	8.866±1.276	8.783±1.391	-0.431	P >0.05
Parathyroid Hormone (ng/dl)	14.367±2.636	14.988±2.078	0.843	P >0.05
Hand grip strength (mmHg)	148.34±6.42	152.76±4.5	1.97	P >0.05

BMD = Bone Marrow Density

Table 3: Comparison of mean value, standard deviation and p-value of bone marrow density, serum calcium, parathyroid hormone and hand grip strength of group (A) and group (B) after treatment

	Mean±SD			
	Group (A)	Group (B)	t. value	Significance
BMD of lumber spine (mg/cm)	152.75±16.103	119.917±11.48	3.765	P <0.05
BMD of radius (mg/cm)	316.083±26.89	278.583±26.19	2.543	P <0.05
Serum Calcium (ng/dl)	10.517±1.24	8.783±1.391	2.642	P <0.05
Parathyroid Hormone (ng/dl)	12.367±2.208	14.988±2.078	2.651	P <0.05
Hand grip strength (mmHg)	163.25±4.78	152.76±4.5	5.42	P <0.05

BMD = Bone Marrow Density

DISCUSSION

The aim of this study was to detect the effect of walking training exercise on bone mineral density, serum calcium, parathyroid hormone and grip strength in postmenopausal women. Participants in this study were divided into two equal groups; the first group (A) received treadmill walking exercise training, where the second group (B) received no exercise training. The program consisted of three sessions per week for six months. There was a significant increase in mean values of bone mineral density, serum calcium, parathyroid hormone and grip strength of group (A), while the results of group (B) were not significant. There was a significant difference between both groups.

The results of this study agreed with the previous studies in similar cases. Lester etal., stated that training interventions of longer duration (6-36 months) have consistently reported positive bone mineral density increases, whereas those of shorter durations (< 6 months) have failed to show similar adaptations[4].Also, Nordstrom etal., reported that athletes who participate in weight-bearing activities have higher bone mineral density (BMD) than sedentary controls [5] and [6].

Bonaiuti *et al*., stated that all prescribed exercise programs, including aerobic exercise, resistance exercises or walking are effective at 1 year or more in slowing loss of bone marrow density. Fast walking is recommended as the best prevention and treatment strategy for osteoporosis in postmenopausal women as it is most similar to activities of daily living and may produce the greatest compliance [7]. However, Minematsu etal. said that treadmill running was more effective than swim in the pool in prevention of bone loss. Especially, trabecular thickness was kept in treadmill running rats. It was suggested that bone loss was inhibited by exercise and this differs by the loading situation [8].

The possible mechanism by which exercise maintains the skeletal integrity are: changes in the biochemical structure of the blood by altering the level of its component which has a role in the integrity of normal skeletal and mechanical load of the exercise which can modify and increase bone mass. The rise in serum calcium is mainly die to the effects of exercise induced acidosis. So, when the PH falls the excess hydrogen ions reversibly displace calcium ions from imidazole groups of the albumin molecule, this causing the serum calcium to rise [9]. The increase in bone mineral density after exercise may be due to increase in serum calcium associated with decreased parathyroid hormone following exercise

training [10].The deposition of bone at the points of compressional stress has been suggested to be caused by piezoelectric effect as continual physical stress stimulates osteoblastic deposition of bone causes a negative potential at the compressed site and a positive potential elsewhere in the bone. So minute quantities of current flowing in bone cause osteoblastic activity at the negative end of the leads to increase in bone deposition and as a result increase in bone mineral density [11,12].

CONCLUSION

This study clearly indicated that walking exercise improves bone integrity and in order to reduce the great public health burden of osteoporosis in postmenopausal women.

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REFERENCES

1. Bonaiuti, D., B. Shea, R. Iovine *et al.*, 2002. Exercise for preventing and treating osteoporosis in postmenopausal women (review), The Cochrane Database of Systematic Reviews, The Cochrane Library, Oxford issue 2 (Art. No.: CD000333).
2. Grimston, S., K. Tanguay, C. Gundberg and D. Hunely, 1998. The caliotropic hormone response to changes in serum calcium during exercise in female. J. Clin. Endocrinol. Metab., 76: 867-872.
3. Guyton, A., 1993. Human Physiology and Mechanisms of disease, 7th ed., W.B. Saunders Company, Tokyo, 610-612, 1993.
4. Kanis J.A., N. Burlet, C. Cooper *et al.*, 2008. European guidance for the diagnosis and management of osteoporosis in postmenopausal women, Osteoporos Int., 19: 399-428.
5. Lester, E. Mark, L. Urso Maria Urso, K. Evans Rachel, R. Pierce Joseph, A. Spiering Barry, M. Maresh Carl *et al.*, 2009. Influence of exercise mode and osteogenic index on bone biomarker responses during short term. Bone, 45: 768-776.
6. Ligunghall, S., H. Joborn and L. Benson, 1999. Effects of physical exercise on serum calcium and parathyroid hormone. Eur. Clin. Invest., 14: 469-473.
7. Menkes, A., S. Mazei and R. Redmond, 2002. Strength training increases regional bone mineral density and bone remodling in middle aged and older women. J. Appl. Physiol., 74: 2478-2484.
8. Minematsu, A., Y. Nakamori, K. Hayakawa and Y. Nishii, 2009. Effect of treadmill running and swimming exercise on bone microstructure in rats with overiectomy. Bone, 44: S423.
9. Nordstrom, A., T. Olsson and P. Nordstrom, 2006. Sustained benefits from previous physical activity on bone mineral density in males, J. Clin. Endocrinol. Metab., 91: 2600-2604.
10. Nordstrom, P., M. Neovius and A. Nordstrom, 2007. Early and rapid bone mineral density loss of the proximal femur in men. J. Clin. Endocrinol. Metab., 41: 995-1004.
11. Schmitt, M. Natalie, Schmitt Jochen and Dören Martina, 2009. The role of physical activity in the prevention of osteoprosis in postmenopausal women-An update. Maturitas, 63: 34-38
12. Sirola, J., T. Rikkonen, M. Tuppurainen, J.S. Jurvelin and H. Kroger, 2006. Association of grip strength change with menopausal bone loss and related fractures: a population-based follow-up study, Calcif. Tissue Int., 78: 218-226.