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The Effect of 12 Weekes Weight Bearing Water Training on the Bone Density of Middle Age Sedentary Women

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Osteoporosis is a bone disease common among women and it constitutes one of the dominate factors reducing quality of life and even shortening life. Physical activity and especially activity that increases muscles tension or loads on bones, helps to prevent the process of bone density loss. So the aim of the present study was to examine the effect of 12 week weight bearing water exercise program on bone mineral density in 50-70 years old women. The number of 20 women with the adage 50-75 years admitted in this study and randomized into water exercise group(n=10) and control group (n=10). The exercises group participated 12week in weight bearing water exercise program 3 times per weeks consist 10 minute warm up,20 minute weight bearing water exercise program and 10 minute active recovery .the period of each part increase gradually to 15 minute for warm up and recovery part and 45 minute for main part. While the control group was asked to do not engaged any physical activity and maintain their sedentary life. Bone density for all women was measured before and after the training program. Using the sample t- test (ad 0.05) indicates that water exercised program have a positive effect on bone density in Comparison to the control group which showed a loss.

Key word: Osteoporosis, Bone density, Water exercise.

Osteoporosis is the most common type of bone disease among women, in which bones become fragile and more likely to fracture due to low bone density, resulting an increased risk of skeletal fractures, chronic pains and functional disabilities.

According to international osteoporosis foundation (IOF)(1), women over the age of 50 which have experienced bone fracture at least once in their lifetime or those women who are over 65 have the greatest risk of developing osteoporosis. Among the several types therapeutic intervention in osteoporosis, hormone replacement therapy (HRT) has traditionally been seen as the standard method of preventing osteoporotic fractures among postmenopausal women which, definitely has got clear side effects including breast and endometrial cancers.

Estrogens replacement therapy (ERT) has been shown to prevent bone loss, increase bone mass, and prevent bone fractures. It is useful in both preventing osteoporosis in postmenopausal women and in treating women who already have developed osteoporosis.

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Most hormone specialists (endocrinologists) now believe the benefits of ERT in postmenopausal women outweigh the risks of endometrial cancer and vein thrombosis, in addition(kampstone)[2], studies have shown that those patients who are diagnosed renal complications are not allowed to consume a high level of calcium supplements as a treatment or prevention of osteoporosis[2]. Preliminary studies suggest that regular exercise could be used as a treatment in patients whose bone mass is already reduced[3]. Physical activity may have a contribution to reducing fracture risk; it may enhance bone strength by optimising BMD and improving bone quality by promoting adaptive changes in bone geometry and architecture[4].

According to international osteoporosis foundation (IFO) weight bearing exercises including tennis, mountain climbing, volleyball and aerobic are by far the best type of physical activities in confronting to osteoporosis. The review of 20 different studies (Zehnacer 2009)[5] shown, the increases in BMD were site-specific and required high loading with a training intensity of 70% to 90% of 1 RM for 8 to 12 repetitions of 2 to 3 sets performed over one year duration, Because weight training exercises with high intensity have more effect on the BMD[6-8]. Furthermore, the vast majority of osteoporotic patients are reluctant to take part in these types of physical activities because of greatly increasing the possibility of a fall and fractured bone(1). Thus, it is quite obvious that in order to stimulating bone density and formation or even reduction of bone density another type of physical activity is needed in which the risk of falling and fracture to be decreased. Although the exact mechanism by which exercise increases bone mass is not fully understood, it is widely accepted that impact forces are required for the bone to respond to physical activity. Aquatic exercise has been less considered as a viable method to combat bone loss and osteoporosis. In general, water could produce a degree of weight-bearing comparable to that induced by ground-based exercises causing muscular activity and requitement of bigger muscle groups by which increases the bone mechanical loading and simulates the process of ossification[9]. In contrast to other types of physical activity, aquatic exercises can also cause upper and lower limbs involvement with an appropriate range of motion reducing joints loading. Moreover, aquatic exercise can improve function and balance in elderly people, thus ultimately decreasing fall risk and the potential for hip fractures[9]. So the aim of the present study was to examine the effect of 12 week weight bearing water exercise program on bone mineral density in 50-70 years old women.

METHODS

Women participating in the study were volunteers recruited through advertising strategy in one Tehran's pool. All met the following criteria: None smoker females aged between 50 and 70 years; postmenopausal for at least 12 months; not institutionalized; and having no contraindication to undertaking physical exercises without close medical supervision, hormone therapy and calcium consumption and without cardiovascular and thyroid history and randomized into water exercise group(n=10) and control group (n=10).

The exercises group participated 12 weeks in weight bearing water exercise program 3 times per weeks consist 10 minute warm up,20 minute weight bearing water exercise program and 10 minute active recovery. All exercise sessions were divided into three parts. They began with a 10-minute warm-up period consisting of a succession of moderate stretching and flexibility exercises involving all the joints and muscles. The second part of the session, which lasted 40 minutes, consisted of periods of walking, jogging, dynamic jumping, kicking and aerobic step test in the water, interspersed with muscular exercises according to brook model. Each exercise consisted of a series of 10 to 11 repetitions. The exercise session ended with a 10-minute cool-down period. In the second week, aerobic exercise lasted for 45 minutes and 15 minutes warm up and 15 minutes active recovery. The following progression was used regarding the intensity and duration of the weight-bearing exercises. The intensity of the jumps was adjusted to approximately 60% of the heart rate reserve (HRR). Maximum heart rate used to determine HRR was estimated by the well-known equation, 220 - age. During the second week, the intensity was increased to 80% of the HRR. Blood pressure was measured by sphygmomanometer before and after exercise. While the control group was asked to do not engaged any physical activity and maintain their sedentary life. Bone density, weight, height and functional fitness being were measured before and at the end of the exercise program to assess the program's effectiveness. Participants were required to be at the bone density centre in the morning and recommended to eat the breakfast two hours before the measurement. BMD of the lumbar spine (L2 to L4) and BMD of the femoral neck were measured by dual energy X-ray absorptiometry (DEXA). Since all outcome variables were

Normally distributed, paired and independent t tests were employed to assess the impact of the exercise program.

RESULTS

The characteristics of subjects involved in the analysis of the program are presented in table 1.

Table 2 summarizes the impact of the program in terms of the percentage improvement in bone density observed between the beginning and end of the 12 weeks program. The conclusion that can be drawn from these data shows that there was no significant difference in bone density between two groups before 12 weeks exercise program which means that participants were divided into two groups by random distribution. Lastly, the data also reveal that there was a significant difference in BMD at the lumbar spine and the femoral neck in exercise group indicating increased significantly over the 12 weeks aquatic exercise program, whereas no change was noted at the femoral neck and lumbar spine in control group, though there was insignificant reduction in BMD at the lumbar spine (-0.14) and the femoral neck (-0.23) respectively in control group.

Table 1. Summary of the participant's characteristics

Exercise group	Control group	Variable
average	Average	-
60±6.34	61.2±6.15	Age
158.3±4.7	158.1±5.66	Height (cm)
68.4±3.5	69±3.94	Weight (kg)
29.64±0.03	30.2±0.04	BMI

Table 2. Summary of the Impact of the Exercise Program on Outcome variables in two groups for 12 weeks before and after

BMD	Phase	Control group	Exercise group	P value
0.580	0.965±0.143	0.912±0.119	before	Lumbar spine
0.041*	1.293±0.112	0.898±0.104	after	
(0.872)p=control *0.048 p=exercise	0.328	-0.14	Difference between before and after	
0.742	0.951±0.141	0.958±0.098	before	Femoral neck
0.033*	0.328±0.119	0.935±0.076	after	
(0.725)p= control (0.024*)p=exercise	0.677	-0.23	Difference between before and after	

*Data are presented as MEAN ±SD, P < 0.05
*(-) signifies that there was a reduction in BMD

DISCUSSION

The objective of this study was to evaluate the effects of 12 weeks weight-bearing, water-based exercise program on the bone density of 50-70 women with low bone mass. The results of this study have shown that water exercised program have a positive effect on bone density in comparison to the control group which have showed a loss.

The result of the present study is consistent with the finding of Zehnacer's review study indicating the effect of weighted exercises on bone mineral density in post menopausal women with a training intensity of 70% to 90% of 1 RM for 8 to 12 repetitions of 2 to 3 sets, but the environment and the duration of exercise are not the same. Torsviet and et all (2004)(6) showed that high intensity physical activity in comparison to low or medium intensity physical activity has a greatest impact on bone density, which is consistent with the finding of the current study. In the present study weight bearing water exercise has been performed. In terms of exercise movements, the same association has been observed with the finding of other studies like Suaminen (1993)[7], Snow (2000)[8], Magkors (2007)[10], just the only difference is that in the current study the majority of exercise movements have been performed into water in which the possibility of fall and fracture bone was minimised. Although, there are only a few studies that evaluate the effects of weight bearing water exercise on the bone density, the finding of this study is quite consistent with the result of Tania and et all's study[9]. Tania demonstrated that the level of bone density at femoral head in postmenopausal women has been increased by 12 months weight bearing water exercise. In addition, the same observation has been observed in other studies such as, Goldstein[11] and Tskuahara[12]. Goldstein had investigated the effects of 5 months weigh bearing water exercise on bone density in postmenopausal women, concluding significant difference between the groups pre and post treatment. On the other hand, bone density in weight bearing water exercise in comparison to weight bearing exercise in the land was improved significantly. The effects of water exercise on bone loss in healthy Japanese postmenopausal women have been cross-sectionally and longitually investigated from the view point of preventing osteoporosis by Tsukahara and *et al.,* (1994), demonstrating consistently participating in water exercise for approximately 35 months is a crucial factor in preventing bone loss. In contrast, in Bravo's study (1997)[13] such similarity has not been found. It is supposed that the main reasons for differences are the type and intensity of exercise including 45 minutes different types of jumps and endurance and strength exercise increasing bone structural.

It is north worthy to point that there are many contributors in bone response to mechanical and dynamic loading including the duration, intensity, frequency and optimum type of physical activity in increasing BMD[14-15].Frost (1992) suggested that bone structure has been protected through feedback system by which an increased mechanical and dynamic loading has a huge impact on stimulating of bone growth and formation. This theory is known as mechanostat theory. According to this theory, mechanical loading should be precisely determined to increase the rate of bone remodelling compare with bone resorption.

This mechanical loading is known as minimum effective strain threshold[16]. It seems likely that in Bravo's study the intensity and load of exercise was less than minimum effective strain threshold to improve BMD at femoral head. Furthermore, the result of this study is consistent with the finding of Aya et al (2003)[17]. They showed that aquatic exercise has caused anabolic changes on bones in sedentary people. Shojayee and et al (1997)[18] had conducted an investigation on the effect of three kinds of special exercise with medicine on the bone mineral density of postmenopausal. The main finding of Shojayee's study demonstrate that there was no significant difference in bone density at lumbar spine after and before weight bearing water exercise with medicine, while there was a significant difference in bone density at femoral neck after weight bearing water exercise with medicine. Taken together, we can conclude that that study was conducted on osteoporosis patient who had taken medicine, besides the type and intensity of exercise was quite different. Harush (2009)[19] had conducted a study on the effect of a water exercise program on bone density of postmenopausal women for 7 months, supporting the hypothesis that it is possible to plan a water exercise program that has a positive effect on bone density in postmenopausal women who lost 1-2% bone density annually. Frenando fronza et al (2013)[20] evaluated the efficiency of a high-intensity, 6-month aquatic exercise program according to vertebral parameters, anthropometry and physical fitness of post menopausal women with and without fractures. He concluded that the high intensity aquatic exercise proved to be for the exercised groups, benefiting postmenopausal women with and without fractures. The protocol provided improvements in the BMD of the femoral head and lumbar spine for those with and without fractures, which is consistent with our finding, but all women in Fernando's study received oral daily diet supplements with one capsule containing 500 mg elemental calcium and 100 IU cholecalciferol (vitamin3) to be taken after breakfast, in the present study no medicine or hormone therapy has been taken. Moreover, the result of the current study is consistent with the study of Sundrobalsamo (2013)(21) indicating the positive effect of weight bearing exercise on bone density at lumbar spine and femoral neck.

CONCLUSION

In conclusion, the exercise program evaluated in this study has the positive effect on skeletal system and bone density in postmenopausal women aged 50-70. It can be sighted that weight bearing water exercise is by far the best way of exercise in terms of safety and efficacy to improve bone density in preventing osteoporosis.

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