Bahrain Medical Bulletin Vol. 26, No. 2, June 2004

Effect of Exercise Program on the Bone Mineral Density in Sedentary Females

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Background: Osteoporosis is a widespread disorder, which affects postmenopausal women, causing fractures after simple trauma. Exercise is long being known to reduce the risk of osteoporosis.

Objective: A prospective study was carried out to scientifically assess the effect of exercise in sedentary Saudi Women.

Methods: The study was carried out on 100 women with clearly defined criteria of inclusion in the study. The height, weight, abdomen, and thigh girth was measured pre and post exercise. Women in the age range of 25-50 years were included in the study. They were randomly divided into two groups. Both groups had Bone Mineral Density (BMD) measurement of the lumbar spine and hip region before the start of the study. One group was subjected to a structured exercise program within the hospital confines, three times a week for three months. At the end of the three months the measurements were repeated.

Results: The average age of the subjects studied was 39 years (ranges 27.5 -50 years). The mean bone mineral density (BMD) of the lumbar spine and hip prior to exercise was 1.115 gm/cm^2, with a range of 0.94gm/cm^2 and 1.53 gm/cm^2. Post exercise the BMD was 1.32 gm/cm^2 (range 0.97 and 1.720 gm/cm^2) with statistical significance of p Value <0.0001. The mean BMD in women with more than 5 children was 1.2 gm/cm^2 as compared to the women with less than 5 children was 1.1gm/cm^2 , with a P value <0.05. The age and sex matched BMD showed that Saudi women had significantly lower BMD as compared to western women of the same age P value <.0001.

Conclusions: This prospective study confirms that the average bone mineral density of the Saudi Arabian women is much lower as compared with the western women and there was a statistical significance between the post and pre-exercise groups. We believe it is advisable for Saudi women who are sedentary to participate in some type of exercise so as to reduce the risk of osteoporosis and osteoporosis related fractures.

Bahrain Med Bull 2004;26(2):

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Osteoporosis has now become a major health care problem in the World and the World Health Organization (WHO) believes that we are heading for a major epidemic the years to come. Osteoporosis afflicts over 24 million people in USA alone costing $10 billion and accounts to over 300,000 hip fractures alone[1]. It was estimated that in the years to come 20,000 to 30,000 new cases would be added yearly to the existing ones. Emphasis was tabled long time back on preventing or slowing the process of osteoporosis.

It is known that regular exercise particular due to walking can slow the down osteoporosis and preserve trabecular bony architecture in the body[2]. Exercise as a method of reducing osteoporosis was not given its due importance and other prophylactic interventions were studied at length. It is known since long that the attainment of peak bone mass depend 80% on the genetic factors[3], and 20% it depends on the environmental factors such as exercise, other habits and calcium intake[4]. Controversy still exists about the role of exercise in the prevention of osteoporosis[5] and on the other hand reports in the literature suggest the beneficial effect of exercise in reducing osteoporosis[6-8].

This prospective study was conducted to assess the effect of exercise on the BMD among sedentary Saudi Arabian women.

METHODS

One hundred Saudi females, who are healthy, married or previously married and living in the eastern Saudi Arabia (Dammam and Al-Khobar) formed the study group. The inclusion criteria were as follows:

1. Married or previously married women in the age of 25-50 years.
2. Should have no disease or on hormonal therapy.
3. Non-smoker.
4. Sedentary life style at least for the last one year.
5. Not on a diet.
6. Permanent resident of eastern province of Saudi Arabia.

The study sample of 50 females was subjected to exercise program under the supervision of the investigators thrice a week for three months. Pre and post exercise BMD measurement of the lumbar spine and the hip region before and after the study was completed.

The Exercise Schedule

The exercise program included two main activities; Non-walking activities and walking activities. The non-walking activity consisted of stretching exercises, quadriceps strengthening and breathing exercises. The walking activity included warming-up phase for 5 minutes at normal walking speed of 1.5 km/hour, working-out phase of brisk walk for 20 minutes at 3 km/hour and cooling-down phase for 5 minutes with the return at 1.5 km/hour.

The data were subjected to analysis to achieve Ch-Square, paired t-test to assess the change in body weight, BMI, before and after the exercise intervention. Multiple linear regression was used to find the important factors affecting the changes in BMI and Bone mineral density. Comparison among the groups with respect to changes of quantitative variables by

ANOVA/Kruskal Wallis test. The final level of significance was accepted as <0.05 throughout the study.

RESULTS

The average age of the subjects studied was 39.0 years (range 27.5 -50 years). Figure 1 gives the details of the age distribution. The combined mean bone mineral density (BMD) of the lumbar spine and the hip prior to exercise was 1.115 gm/cm^2 with a range of 0.94gm/cm^2 and 1.55 gm/cm^2 and post exercise the mean was 1.320 gm/cm^2 with statistical significance of p Value <0.0001 (Table 1). The mean BMD of the lumbar spine in women with more than 5 children was 1.2 gm/cm^2 as compared to the women with less than 5 children was 1.1gm/cm^2. There was statistical significance of Pvalue <0.05.

Table 1. **Effect of Exercise on the Bone Mineral Density**

	Minimum	Maximum	Mean	P value
Pre-Exercise (BMD)gm/cm^2	0.94	1.53	1.1150	<0.001
Post Exercise (BMD) gm/cm^2	0.97	1.720	1.3200	<0.001
Z-Score (Lumbar Spine)	-0.59	-9.42	0.346	
Z-Score (Hip)	-0.44	-6.47	-0.19	
T-Score (Lumbar Spine)	-0.22	0.197	-1.60	
T-Score (Hip)	-0.346	0.142	-0.102	

The overall age and sex matched BMD showed that the Saudi women had significantly lower BMD compared to the western women of the same age P value <.0001. The average loss of total body weight after the exercise was 1.69 Kg with the mean pre and post exercise was 76.34±16.18 and 74.65±15.26 P value <0.001. There was a statistical significant gain in the lean body weight of 0.49 Kg. The mean pre and post exercise was 50.82±7.70 to 51.25±7.42 (P value <0.001) (Table 2).

Table 2. Effect of Exercise on the Body

Parameter	Pre-Exercise	Post-Exercise	P value
Body Fat	26.60	24.24	<0.001
Total Body Water	35.72	34.90	<0.001
Total Weight	76.34	74.65	<0.001
Lean Body Weight	50.82	51.25	<0.001
BMD Lumbar Spine	1.15	1.24	<0.001
BMD Hip	1.06	1.13	<0.001

DISCUSSION

Osteoporosis is defined as decrease in bone mass per unit volume with increased susceptibility to fractures. Osteoporosis results from loss of estrogen in women after 50 years of age and

followed by a complex interaction between the diet, habits, and physical exercise. It appears that the factors which could reduce osteoporosis stay neglected among the Saudi Arabian population. In spite of the development in the diagnosis of osteoporosis, still the preventive measures of osteoporosis is neglected. Patients are treated for the fractures once they occur rather than attempting to prevent osteoporosis initially. One report on the basis of plain radiographs found that 89% of their patients were osteoporotic even though plain radiographs indicate osteoporosis once 30 percent of the body bone is lost[9]. Further reports confirmed that BMD of the postmenopausal women was much lower compared to the international standards[10-12]. These studies indicate that young Saudi Arabian women have low BMD in comparison to the western woman of the same age.

Many research reports have convincingly shown that exercise is effective in maintaining and increasing the BMD. It was shown that walking over 7.5 miles weekly increases the BMD[13]. Retrospective studies confirmed the benefits of physical exercise. The present study have shown that exercise does increase the BMD and slows down the bone loss. Regular exercise and non-smoking is important in reaching maximal peak bone mass in young adults[3]. The National Institute of Health Consensus Development Panel on Osteoporosis, Prevention and Therapy (2001) suggested that regular exercise can contribute to development of high peak bone mass and may reduce fractures in older women.

The World Health Organization (WHO) believes that we are heading for a major epidemic in the years to come. Researchers studying osteoporosis have placed emphasis on preventing or slowing down the process of osteoporosis in the postmenopausal age group. One way to do was by promoting weight bearing exercise. It was noticed that the effect of exercise was by increasing of BMD of the lumbar spine in the pre-menopausal women whereas in the postmenopausal women the increase of BMD was more in the hip region. It was further confirmed that in conjunction with dietary calcium, exercise plays a significant role in reducing fractures in later life[15].

All the exercises are not good for the human body an example of such a scenario is in young women strenuous exercise could be harmful by causing amenorrhea, decrease in body weight. The degree and the extent of any exercise should be adapted to the age, the physical ability and the skeletal condition of the individual. In young people, sporting activities are beneficial in storing up a bone reserve and should be encouraged. Along with the exercise, children should be advised to take oral calcium to build up the skeletal mass. In our patients a simple 30 minutes exercise of walking at 1.5km/hour was enough to positively change the BMD, decreased the total body weight and increase in the lean body weight making them healthier.

Despite numerous studies and case reports of the changes which occur during pregnancy and lactation, controversy existed whether pregnancy made a positive impact on the BMD. The role of pregnancy and gain of BMD have not been reached in depth. Report from a prospective study from King Faisal University showed that a difference of BMD in women who had less than five compared to those who had more than five children[11] and this was confirmed by a large scale study of 1855 multiparous women that the repeated pregnancies appear to have a protective factor against the development of osteoporosis[16]. In this study The BMD of women who had more than 5 children was more than in those less than 5 children.

CONCLUSION

This study confirms the earlier apprehensions that the BMD in Saudi Arabian women is lower as compared to the western women of the same age. Secondly weight bearing exercise has a positive influence in increasing the BMD. It is strongly recommended that women in this part of the world who have sedentary life style should participate in some sort of weight bearing exercise programs to increase the BMD and reduce the risk of fractures.

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