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The effect of group exercise on postmenopausal osteoporosis and osteopenia

Menopoz sonrası osteoporoz ve osteopenide grup egzersizlerinin etkinliği

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Amaç: Menopoz sonrası osteoporoz ve osteopeni tanısı konmuş kadınlarda grup egzersizinin kemik mineral yoğunluğu (KMY), ağrı ve yaşam kalitesi üzerindeki etkileri incelendi.

Çalışma planı: Çalışmaya, DEXA (Dual Energy X-ray Absorptiometry) yöntemi ile sırasıyla osteoporoz (T-skoru < -2.5) ve osteopeni (T-skoru -1 ile -2.5 arası) tanısı konan 16 osteoporotik (ort. yaş 55.2) ve 17 osteopenik (ort. yaş 55.4) kadın alındı. Katılımcılar ortopedik, nörolojik, respiratuvar, vasküler, metabolik veya mental sorunları olmayan bireylerden seçildi. Her bir gruba 21 hafta süreyle, haftada üç gün bir saat süre ile, fizyoterapist eşliğinde, solunum, ısınma, germe, kuvvetlendirme, denge, stabilizasyon ve soğuma egzersizlerini kapsayan grup egzersiz programı uygulandı. Tüm olgularda tedavi öncesi ve sonrasında ağrı şiddeti görsel analog skala ile, femur boynunda ölçülen KMY, DEXA ile ve yaşam kalitesi QUALEFFO-41 (Quality of Life Questionnaire of the European Foundation for Osteoporosis) anketi ile değerlendirildi.

Sonuçlar: İki grup arasında, osteopeni grubunda vücut ağırlığının daha fazla ($p<0.05$) olması dışında, yaş, boy ve beden kütle indeksi açısından fark bulunmadı ($p>0.05$). Her iki grupta egzersiz sonrasında T-skoru, KMY ve yaşam kalitesi anketinin tüm parametrelerinde artış, ağrı şiddetinde ise azalma görüldü ($p<0.05$). Osteoporoz ve osteopeni gruplarında ortalama T-skoru egzersiz öncesinde sırasıyla -2.7±0.2 ve -1.8±0.5, egzersiz sonrasında -2.4±0.5 ve -1.4±0.5 ölçüldü. Egzersiz sonrasında osteoporoz grubunda olguların %43.8'inde osteopeni için geçerli T değerlerine; osteopeni grubunda ise olguların %23.5'inde sağlıklı kişiler için kabul edilen T değerlerine ulaşıldı. Tedavi sonrası değişimler açısından gruplar arasında anlamlı farka rastlanmadı ($p>0.05$).

Çıkarımlar: Bu pilot çalışma, hem osteoporoz hem de osteopeni gruplarında fizyoterapist eşliğinde yapılan grup egzersizlerinin ağrının azaltılması, KMY ve yaşam kalitesinin artırılmasında etkin olduğunu göstermektedir.

Anahtar sözcükler: Kemik yoğunluğu; egzersiz tedavisi; osteoporoz, menopoz sonrası/önleme ve kontrol; yaşam kalitesi; anket.

Objectives: We investigated the effects of group exercise on bone mineral density (BMD), pain, and quality of life in postmenopausal women with osteoporosis and osteopenia.

Methods: The study included 16 osteoporotic (mean age 55.2 years) and 17 osteopenic (mean age 55.4 years) postmenopausal women whose diagnoses were made by dual energy X-ray absorptiometry (DEXA) showing T-scores of less than -2.5 and in a range of -1 to -2.5, respectively. Subjects having orthopedic, neurological, respiratory, vascular, metabolic, or mental problems were excluded. Each group received the same group exercise program for one hour three times a week for 21 weeks, supervised by a physiotherapist, and including breathing, warm-up, stretching, strengthening, balance, stabilization, and cooling exercises. All participants were evaluated before and after the exercise program by a visual analog scale for pain severity, by DEXA for BMD, and by QUALEFFO-41 (Quality of Life Questionnaire of the European Foundation for Osteoporosis) for quality of life.

Results: The two groups were similar with respect to age, height, and body mass index ($p>0.05$), but osteopenic women had a higher body weight ($p<0.05$). After the exercise program, both groups exhibited significant improvements in T-score, pain score, BMD, and all parameters of the QUALEFFO-41 ($p<0.05$). The mean T-scores before and after exercise were -2.7±0.2 and -2.4±0.5 in osteoporotic women, and -1.8±0.5 and -1.4±0.5 in osteopenic women, respectively. Following exercise, 43.8% of osteoporotic women had a T-score showing osteopenia, and 23.5% of osteopenic women had a T-score falling within the normal range. The two groups did not differ significantly with respect to the differences between the mean improvements obtained after the exercise program ($p>0.05$).

Conclusion: This pilot study demonstrates the effectiveness of physiotherapist-supervised group exercise programs in decreasing pain and increasing BMD and quality of life of both osteoporotic and osteopenic women.

Key words: Bone density; exercise therapy; osteoporosis, postmenopausal/prevention & control; quality of life; questionnaires.

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According to the World Health Organisation, osteoporosis is the second widespread public health problem after cardiovascular diseases. Osteoporosis creates major clinical outcomes, negatively affecting life quality; frequently bringing about pain, deformity, function loss (apraxia) and fracture risks, in addition to major functional inadequacies.[1,2] Each year, more than 1.5 million people face the problem of osteoporosis. Furthermore, each year, osteoporosis is causing more than 700 thousand vertebral fractures and 300 thousand hip fracture cases. Fractures related to osteoporosis not only bring about life threatening results but they constitute a major public health issue with serious economical and social dimensions.[3]

Preventive measures regarding skeletal health are becoming more significant as they are getting ahead of its treatment means and early diagnosis of osteopenia upon the consideration of risk factors is especially becoming more important. Measures intended to maintain bone density in post menopausal women are being targeted.[4,5]

Recent researches have clearly revealed the importance of exercise and physical activity in the rehabilitation of osteoporosis. Literature reviews on osteoporosis show that in most of the studies life quality is being observed, that exercise programs are mostly individual and that they are intended for specific muscle groups.[4,6,7]

Currently, group exercises, which allow persons with the same pathology to exercise together, are commonly being used for various purposes as a treatment method that increases motivation and provides social togetherness. In rehabilitation approaches that target public health, group exercises have a significant role. Studies that examine the effects of group exercise training in post menopausal women, on bone mineral density, pain and quality of life, with a comparative approach between osteoporosis and osteopenia groups, are quite inadequate. In this study, the effects on bone mineral density (BMD), pain and quality of life, of physiotherapist guided group exercises, which took place three times a week for 21 weeks, with post menopausal women that were diagnosed with osteopenia and osteoporosis were explored. The degree of effectiveness of the assigned group exercises in pre osteoporosis (osteopenia) or osteoporosis cases in post menopausal women and the differences in effect between groups were studied.

Patients and method

Thirty-three women of ages between 46 and 67, diagnosed with osteoporosis and osteopenia according to BMD measures were included in the study.

The necessary permit and approval for the study was obtained from the Medical, Surgical and Pharmacological Researches Ethics Board and patients who accepted the explanatory consent form, stipulated by the ethics board were included in the research.

Women who (i) were diagnosed with osteoporosis with the DEXA (Dual Energy X-ray Absorptiometry) method (T Score < -2.5) and with osteopenia (T Score between -1 and -2.5); (ii) did not experience vertebral fractures or fractures at the lower extremity and does not have endoprosthesis and fixation materials; (iii) are over 40 years of age and post-menopausal; (iv) would be able to join the exercise program regularly and (v) did not use pharmaceuticals that affected the bone metabolism were included in the study.

Women with diagnosed heart diseases and those who were found to have kidney, liver and inflammatory diseases at the laboratory tests were excluded. Those who were diagnosed with restrictive and obstructive lung diseases and those with serious visual, speech or hearing ailments were also excluded from the study.

To create homogeneity within the group, women who did not regularly exercise within the past year, who did not take part in a sports activity on a regular basis and were sedentary were included in the programme. Two separate groups were created based on the diagnoses that formed the basis for the study. The first group consisted of 16 women who were diagnosed with osteoporosis and the second group consisted of 17 women, diagnosed with osteopenia. Both groups received the physiotherapist guided group exercise training program we have developed for one hour, three times a week for 21 weeks (Table 1).

The demographic variables of the subjects were recorded and the below evaluations were made:-

Pain: The intensity of the pain the subjects felt while resting and in the course of movement was measured with a visual analogue scale (VAS) that varied between 0 and 10 cm.

Table 1. The applied exercise programme

Respiratory Exercises
- Deep chest respiration
- Deep diaphragmatic respiration

Warm-up Exercises
- Mark time exercise
- Clenching the hands into a fist then relaxing while marking time and the shoulders are flexed
- Clenching the hands into a fist then relaxing while marking time and the shoulders are abducted
- Clenching the hands into a fist then relaxing while marking time and the shoulders are besides the body
- While standing straight up, double sided knee flexion and extension
- Mark time while standing up, hips at 90° while flexing the knee

Stretching Exercises
- Stretching hip/thigh flexors
- Stretching Hamstrings
- Stretching limber extensors
- Pectoral stretching
- Stretching the vertebral colon

Posture Exercises
- Rotating the shoulders upwards and backwards
- Scapular adduction by bringing the elbows together while hands rest on the waist
- Scapular adduction by pushing the shoulders backwards while hands are loose

Strengthening exercises on the mattress
- Abdominal strengthening while lying on the back, hips and knees at flexion
- While hip is at 90° flexion, knee flexion and extension
- Hip abduction adduction while lying on the side
- Hip flexion extension while lying on the side
- Hip extension at the facedown position
- Shoulder and back extension at the facedown position – elbow straight
- Shoulder and back extension at the facedown position – elbow flexed
- Contra-lateral arm and leg extension at the facedown position
- Back extension while hands are clamped together on the hips at the facedown position
- Push-ups while hands are on the floor at the facedown position (without lifting the pelvis)
- Cat-camel exercise at all on fours position
- Bridging while hips and knees are flexed while lying on the back

Afoot exercises
- Shoulder flexion- extension
- Shoulder abduction – adduction
- Elbow flexion –extension
- Shoulder horizontal abduction – adduction
- Mini squat while the back and the waist are straight up
- Shoulder abduction at the mini squat position
- Shoulder flexion at the mini squat position

Balance exercises
- Standing still on one foot and transferring weight
- Raising at the toe tips on both legs
- Mini squat on single leg
- Raising at the toe tips on one leg

Cooling Exercises
- Flexing exercise
  1. Upwards
  2. Frontwards
  3. Sideward while sitting cross-legged
- Stretching hip/thigh flexors
- Stretching Hamstrings
- Stretching limber extensors
- Respiratory exercises
  1. Deep chest respiration
  2. Deep diaphragmatic respiration

The course of the exercises

For 21 weeks, the breathing, warm-up, stretching, posture and cooling exercises were applied the same way.

No of repeats: For the first 4 weeks, all exercises were repeated 10 times. Later, between the 4th and the 8th weeks they were repeated 15 times. Between the 8th and 12th weeks, 20 times and between the 12th and 21st weeks, 25 times.

Exercises that were included in the program on the 8th week:
- The balance exercises were done eyes closed.
- Hip and knee flexion afoot
- Hip abduction afoot

Exercises that were included in the program on the 12th week:
- Mark time exercises were converted to jumping exercises where the patients raised about 10cm above the ground.
- The strengthening exercises that were done on the mattress included 1 kg weights

Exercises that were included in the program on the 16th week:
- Balance exercises were done with 1 kg weights
- With the use of 55 cm exercise balls, stabilization and strengthening exercises were commenced

Quality of Life: QUALEFFO-41 (Quality of Life Questionnaire of the European Foundation for Osteoporosis), which is a life quality questionnaire developed especially for women with osteoporosis, was used. [8] Parameters regarding pain, daily life activities, housework, mobility, social activities, general health and mental functions were evaluated.

Bone mineral density measure: With DEXA, the T-score and the BMD value of the femur neck were measured in gr/cm2 units and the same me-

Table 2. The distribution of the demographic features of the subjects according to the groups (Mann-Whitney U-test)

	Osteoporosis (n=16) (Mean±SS)	Osteopenia (n=17) (Mean±SS)	U	*p*
Age (years)	55.2±5.5	54.5±6.1	125.50	0.705
Height (cm)	158.8±6.1	163.1±4.8	82.50	0.053
Body Weight (kg)	62.5±11.2	67.8±5.4	66.50	**0.012**
Body Mass Index (kg/m2)	24.5±3.6	25.4±3.0	117.50	0.505
The age that the patient went through menopause (years)	46.6±2.4	48.0±2.4	135.00	0.971
No of given births	1.6±1.4	2.0±1.1	112.50	0.372

asurements were made at the end of the 21st week, post-treatment. The analysis of the data obtained from the research group was executed via SPSS for Windows 14.0 statistics package program. For intra-group pre and post-treatment comparisons the Wilcoxon test was used and for inter-group comparisons the Mann-Whitney U-test was used.

Results

The demographic features of the subjects are as shown in Table 2. When the subjects are studied in terms of demographic features as age, height, body weight and body mass index (BMI), no differences were observed between groups except for body weight ($p<0.05$). It was observed that in the osteopenia group, the body weight is more when compared with the osteoporosis group ($p<0.05$).

In both groups, increases have been observed in T-scores, BMD and all the parameters of the life quality questionnaire and decrease in the intensity of pain after the exercise ($p<0.05$; Table 3). In terms of changes after the treatment, a significant difference between the two groups was not observed ($p<0.05$; Table 4).

In the osteoporosis group, while all subjects had T values -2.5 or less, which is the accepted value for osteoporosis, before the exercise, T values acceptable for osteopenia were observed in 43.8% of the subjects after the exercise.

In the osteopenia group, while all subjects had T values between -1 and -2.5, which is the accepted value for osteopenia, before the exercise, T values acceptable for healthy people were observed in 23.5% of the subjects after the exercise.

Table 3. Comparison of pre and post exercise values of the subjects (Wilcoxon test)

	Osteoporosis (n=16)				Osteopenia (n=17)			
	Before	After	Z	*p*	*Before*	After	Z	*p*
T-Score	-2.7±0.2	-2.4±0.5	-2.74	**0.006**	-1.8±0.5	-1.4±0.5	-3.35	**0.001**
BMD (gr/cm^2)	0.67±0.03	0.72±0.06	-2.84	**0.004**	0.77±0.07	0.81±0.07	-3.35	**0.001**
VAS								
Resting	3.7±2.0	1.0±1.2	-3.52	**0.000**	3.7±2.2	0.9±1.2	-3.18	**0.000**
Movement	5.1±1.7	2.3±1.2	-3.52	**0.000**	4.4±2.1	1.2±1.1	-3.62	**0.000**
QUALEFFO-41								
Pain	78.8±8.7	62.8±16.7	-3.31	**0.001**	79.1±11.8	62.4±16.6	-3.63	**0.000**
Daily life activities	88.3±7.9	83.6±9.1	-2.39	**0.017**	89.7±6.2	78.5±20.0	-2.85	**0.004**
Housework	72.8±1.0	61.6±15.4	-3.20	**0.001**	75.3±12.3	64.4±16.1	-3.44	**0.001**
Mobility	86.1±5.7	76.4±12.1	-3.30	**0.001**	87.1±6.8	78.1±12.2	-3.30	**0.001**
Social activities	63.6±12.2	40.2±15.5	-3.52	**0.000**	62.6±14.1	41.5±20.7	-3.41	**0.001**
General health	51.0±9.4	33.9±12.7	-3.54	**0.000**	56.4±10.9	39.7±15.2	-3.43	**0.001**
Mental functions	61.3±12.2	52.1±16.4	-3.42	**0.001**	65.5±6.1	56.5±8.0	-3.57	**0.000**

BMD: Bone Mineral Density; VAS: Visual Analogue Scale; QUALEFFO-41: Quality of Life Questionnaire of the European Foundation for Osteoporosis.

Table 4. Comparison of average values of post and pre exercise differences (Mann-Whitney U)

	Osteoporosis	Osteopenia	U	*p*
T-score	-0.36±0.46	-0.33±0.30	131.5	0.871
BMD (gr/cm^2)	-0.04±0.05	-0.04±0.04	132.5	0.900
VAS				
Resting	2.7±1.6	2.2±1.6	121.0	0.588
Movement	2.7±1.46	3.2±1.8	121.5	0.600
QUALEFFO-41				
Pain	16.0±12.2	16.8±10.3	126.0	0.715
Daily Life Activities	4.7±6.2	11.2±19.3	110.5	0.326
Housework	11.3±8.1	10.9±8.2	131.0	0.855
Mobility	9.8±9.8	9.0 ±7.9	135.0	0.986
Social activities	23.3±16.0	21.1±13.6	131.0	0.857
General health	17.1±13.3	16.7±11.8	121.0	0.585
Mental function	9.2±9.6	9.0±3.9	97.5	0.159

BMD: Bone mineral density; VAS: Visual analogue scale; QUALEFFO-41: Quality of Life Questionnaire of the European Foundation for Osteoporosis.

Discussion

Relieving the risks causing osteoporosis and those related with osteoporosis carry an important role regarding public health. Although it is stated that obesity has a preventive effect against osteoporosis, various opinions are put forward as to the mechanism of this protective effect. It has been stated that the protective effect can be a combination of hormonal and mechanic factors. [10] It is also stated that in women older than forty years of age, bone depletion is affected from age, number of given births, and the duration of menopause and that obesity has a significant bone protection effect.[11]

In our study, while the average BMI values of the cases in the osteoporosis group are normal, the osteopenia group was classified as overweight. Although the difference in body mass indices is not significant, the fact that the body weight in the osteoporosis group is less than that in the osteopenia group supports the view in the literature in this respect. There is need for a healthy control group and wider groups with more individuals so as to make a better interpretation of the results. It is generally found that osteoporosis results with a decrease in height and an increase in lordosis and kyphos due to vertebral deformation. In our study, the average height of osteoporotic cases is less than that in the osteopenia group; however the difference is not significant. Since osteopenia is the preceding stage of osteoporosis, this finding can be considered as important and concordant with the literature. The results could be better interpreted through studies whereby the postural problems are also examined and compared with control groups.

DEXA and BMD measures are still considered the most reliable methods in efforts to explore the effects of osteoporosis treatment. Various durations are noted as the most appropriate imaging frequency. The durations vary from about 6 months to two years and according to patients' risk factor and the treatment applied. [3,12] One of the two fundamental basis of bone mineral density measurement indications is the correct estimation of fracture risk and the second is the availability of therapeutic options capable of increasing the BMD. Clinical studies indicate a substantial increase in BMD in the vertebrae during measurements carried out after the third month of bisphosphonate treatment and also in the pelvis one year after the treatment.[12] On patients with high risk levels, measurements should be carried out twice a year. [12]

According to Lewiecki[13] the BMD test must be repeated every six months on patients who carry the risk for bone depletion, until the bone mass proves stable.

Crilly and associates[14] looked into the responses from BMD measures to drug treatment on the 6th and the 12th months; they observed an increase in the BMD measures made both on the 6th and the 12th months of treatment and concluded in determining the efficacy of treatment, imaging the lumbar vertebra with DEXA on the 6th or 12th months is sufficient. Chien and associates,[15] as well as Yamazaki and associates[16] have manifested effects of an exercise program on the BMD with the help of DEXA on the 6th month.

In our study, BMD measurements are repeated every six months with a view to determine the efficiency of group exercises. As also mentioned in the literature, this study aimed at putting objectively the efficiency of exercise treatment in improving BMD. For the continuation of early stage positive effects on bone mineral density, there is need for studies where long term follow-ups are carried out and patients continue doing their exercises. Osteoporotic hip bone fractures are very widespread. Since osteoporosis

has such a clinical importance, in our study, effects of exercises on the trochanter BMD are evaluated. In both groups post exercise T-score and BMD values have increased. Changes in the T percentages are considered a significant finding indicating the efficacy of group exercises. We are of the opinion that, the fact that the women under survey who were diagnosed with osteoporosis and osteopenia immediately joined group exercises, increased the success of our treatment. We believe that, the fact that the exercises were guided by a physiotherapist, group motivation and social interaction also significantly contributed to the results.

According to the studies mentioned in the literature, physical activities and exercises have positive effects on BMD. However, there is no accord of viewpoints on the type, severity, duration and frequency of the exercise programs.[17,19] Recent studies show that Tai Chi is an efficient and reliable physical activity in improving BMD in post menopausal women.[17,18]

Chien and associates[15] found that 24 weeks of aerobics increased the BMD in femur neck in osteopenic women. The exercise was performed three times a week for 24 weeks. Each exercise session lasted 50 minutes. The program also included using of a walking band and step. Walking exercise started with 5-minute warm-up exercises and ended with another 5-minute cooling exercises. In the second part of the exercise program, a 20cm high platform was used for a period of 10 minutes. Similarly, our exercises were performed three times a week for 21 weeks. Each session lasted 60 minutes. In both programs, warm-ups, respiration, balance, coordination, strengthening, stretching, stabilisation and cooling exercises were performed.

Kemmler and associates[6] studied the effects of physical exercise on BMD, physical capacity and the quality of life in post-menopausal osteopenic women comparing their results with the control group. They applied exercise programs to groups of 12 -15 persons twice weekly for a period of one year. The programs which included warm-up, endurance, jumping, strengthening and stretching concentrated mainly on weight transfer exercises. Jumping exercise was performed only in the fifth month of the program. Although the types of exercises differed from the ones used in our studies, they were all intended to achieve the same objective. They found, in particular, that BMD and the quality of life increased in the exercise group. Although we do not have control groups in our study, our results are concordant with those of the abovementioned study. It is observed that, both in osteoporosis and osteopenia exercising had significant positive effects. During studies performed on pre and post-menopausal women, it is demonstrated that long term weight transfer and strengthening exercises positively contributed to the BMD of lumbar vertebrae, femur neck and trochanter in particular.[6,19] In literature, generally, studies indicate positive effects of walking on the BMD, while on the other hand there are some studies which do not consider this sufficient.[16] It is shown that walking is more effective than cycling or swimming in increasing the bone density.[20] As is also stated in literature, in our exercise program weight transfer exercises were emphasised. In our study, balance exercises and exercises realised in standing position constituted weight transfer and weight bearing on lower extremity bones. We have shown that aerobic exercises performed with normal body weight and walking and running prevented osteoporosis and falling, by increasing muscle strength, coordination and balance.[20] Barnett and associates[21] studied the effects of group exercise program supplemented by home exercise program to be engaged in for a year, on balance, muscle strength, reaction period, physical function, fitness and prevention of falling in geriatrics and found that the program improved the balance and decreased the risks of falling. Gusi and associates[22] examined effects of low frequency vibration exercises and walking on decreasing the risk of fracture and found that 8-week long vibration exercises are more effective than walking in decreasing the risk of bone fracture.

The chronic pain identified in osteoporosis not only causes postural deformities, but it also restricts daily life activities, cause mental disorders and decrease the physical capacity and the quality of life. In researches on osteoporosis, pain is an important monitoring parameter.[23,24] Yavuzer and associates[24] have evaluated the features of pain in patients with osteoporosis with McGill pain score form, body diagram and VAS. The intensity of pain was reported to be 6.9 ± 1.9 cm. This value is similar to the VAS values of active cases in the osteoporosis group of our study. Lombardi and associates,[25] related the pain in osteoporosis with fracture. Unlike this study, in the study we carried out, neither of the treatment groups

in our study, experienced fracture or serious orthopaedic problems. This induces the opinion that the pre exercise pains in our cases are due to osteoporosis and other factors caused by postural reasons resulting from osteoporosis. The decrease in pain intensity in both groups of our study might be based on the general fitness and psychological influence that exercising creates on the whole body.

Today, the increased life span and improvements in current health conditions have made osteoporosis-related fractures an important health issue. Erhan and Gunduz[26] examined by means of SF-36, effects of a fracture in post menopausal women with osteoporosis, with or without osteoporotic fracture on the quality of life, however they did not find any difference between the two groups in this respect. Such a result indicates that in women with osteoporosis, the quality of life decreases regardless of an eventual fracture.

Adiguzel and associates[1] have examined effects of osteoporosis on the quality of life by means of the Nottingham Health Profile (NHP) which is similar to the SF-36 scale, and indicated that the quality of life is related with BMD. Through QUALEFFO-41, a survey on quality of life that we had also used in our study, Oleksis and associates[27] evaluated the quality of life on 751 post menopausal women with osteoporosis (449 of who had vertebrae fracture). They found significant differences between the groups with and without vertebrae fraction in terms of pain, physical function, social function, general health and total scores except for mental function. There are studies showing a decrease in quality of life in connection with the increase in age and the number of fractures.[27,28] Since we do not have any cases with fracture, we enjoy no possibility to make a comparison with this study; nevertheless, long term observations may provide us with valuable information.

Post exercise BMD values of almost half of the cases with osteoporosis reached T values at the limits normally acceptable in osteopenia, while 25% of cases with osteopenia have reached T values that are considered to be within normal limits. Besides underlining the importance of exercise for both patient groups, these results lay bare the benefits of exercise as a preventive measure.

In eliminating problems like osteoporotic pain, depression, functional deficiencies to arise from deformities and psychosocial problems, as well as decrease in the quality of life, exercise training is the most important approach towards rehabilitation.[29]

The findings of this study establish that well organised group exercises for osteoporosis can provide benefits of utmost importance for the public health in general.

In our study post menopausal women diagnosed with osteoporosis and osteopenia are treated as two separate groups and their post treatment results are compared; this is how our study distinguishes itself from other studies in the literature. In addition, in the physiotherapist guided group exercise programs which we had designed as three times weekly for a period of 21 weeks prove our study different from other researches.

1. We are of the opinion that bringing together individuals with the same pathology by means of group exercise programs is effective in decreasing the pain and increasing the quality of life.

2. Physical activity and exercise is paramount in treating and preventing osteoporosis. The fact that we had applied a comprehensive exercise program contributed to the success of our study. We believe that, particularly strengthening and weight transfer exercises, that are carried out in a progressive manner for a period of 21 weeks in the guidance of a physiotherapist have created these results.

3. We have achieved significant improvement in both the osteoporosis and the osteopenia group through our exercise program; though no differences were recorded between the groups. Consequently, we can conclude that at any stage of osteoporosis, exercise training is equally important. However, participation of patients in the exercise groups at the earliest stage of the illness, as well as the content of the exercise program is material.

We believe that the findings of our study will orient future studies on osteoporosis and act as guidance in this field.

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