Introduction

Osteoporosis, the most common bone disorder affecting humans, is a progressive, asymptomatic skeletal disease characterized by low bone density and deterioration of bone microarchitecture, resulting in a loss of bone strength, increased bone fragility and an increased risk of fractures[1,2]. Osteoporotic fractures typically occur at the hip, forearm and vertebrae[3]. The risk of fracture increases exponentially with age, with a doubling in risk for every 7-8 years beyond the age of 50 years[1,2].

Reduction in the biomechanical competence of the axial skeleton can result from the parallel decline in bone and muscle mass with aging. Inactivity also may contribute to this decline[4]. Osteoporosis may be asymptomatic until a vertebral fracture occurs. Furthermore, a micro-fracture, spinal extensor weakness, and generalized activity reduction can result in progressive kyphotic deformity and pain[5]. In a study done by Itoi et al.[5] strengthening exercises for back extensor muscles in healthy postmenopausal women determined a significant increase in back extensor muscle strength and improvement of posture, but not in bone mineral density (BMD).

Exercise, whether for prevention or treatment, is one of the major alternatives for the management of bone loss. The purpose of exercise in the treat-
ment of osteoporosis is to improve axial stability and locomotion through safe strengthening of muscles. Spinal extensor resistive exercises can decrease the risk of vertebral fractures if performed properly\(^6\). Aging and immobility result in loss of muscle strength. The loss of muscle strength is more gradual and is not substantially affected by a sudden decline in hormone levels, as occurs with bone loss\(^3\). However, to the best of our knowledge, the relationship between paraspinal muscle thickness and bone loss in humans have not been studied yet. Therefore, the objective of this study was to measure the paraspinal muscle thicknesses in postmenopausal osteoporotic patients.

Materials and methods

Ninety-five postmenopausal women were enrolled in this study. Demographic and clinical characteristics, body mass index (BMI) and exercise habits were recorded. Subjects with a history for other systemic diseases were excluded if they had malignancy, chronic hepatitis, renal disease, rheumatoid arthritis, parathyroid dysfunction, hyperthyroidism, diabetes mellitus, or other possible disorders affecting bone metabolism. In addition, patients with neurological deficit or those with chronic low back pain were excluded. All subjects were informed about the study procedure, and they gave written consent to participate. This study was approved by the Research Ethics Committee of University and conducted in accordance with the Declaration of Helsinki.

Back pain was evaluated by Numerical Rating Scale (NRS). BMD was measured with dual-energy X-ray absorptiometry (DXA) at the lumbar spine and femoral neck. The diagnosis of osteopenia and osteoporosis was determined on the basis of the World Health Organization criteria [defined by BMD T-score < 1 and T-score < 2.5 standard deviations (SD) of the mean for young adults], with or without prevalent vertebral fractures. Postmenopausal women were classified into 3 groups as osteopenia, osteoporosis and normal BMD. Quality of life was assessed by using Quality of Life Questionnaire of the European Foundation for Osteoporosis (QUALEFFO-41). The Turkish version of the QUALEFFO-41 was administered to all study participants\(^6\). QUALEFFO is a self-assessment instrument that has been developed to measure the quality of life patients with osteoporosis.

Ultrasound has been shown to be a convenient imaging tool for muscle measurements. A linear probe (7.5 MHz, Acuson-Siemens Inc., Mountain View, California) was used for measuring erector spinae muscle thicknesses. A single technologist performed all scans. Each subject was scanned in the prone position. For the thoracic spine, the skull base was palpated and the spinous process of the 10th thoracic spine was identified in the midline. Paraspinal muscle thickness was measured transversely with the probe, 4 cm lateral from the midline of the 10th thoracic spine. In a prone position, three ultrasound images of erector thickness were obtained on each side at the 10th thoracic spine and average value was recorded (Figure 1).

![Figure 1](image.png)

**Figure 1:** Transverse ultrasonographic view showing the erector spinae muscle at the level of the 10th thoracic spine (4 cm lateral to the midline)

Statistical analysis

Statistical analysis was performed by using SPSS 13.0 (SPSS Inc., Chicago, IL, USA). Data were expressed as mean ± standard deviation. Kruskal-Wallis test was used to compare the mean paraspinal muscle thickness values between the groups. Correlations between patients' characteristics and paraspinal muscle thicknesses were analyzed using Pearson correlation coefficients. Statistical significance was set at p<0.05.

Results

A total of 95 patients were included. Demographic and clinical characteristics of postmenopausal women are presented in Table 1. There was no significant difference in age, BMI, mean menopause duration, duration of weekly exercises, NRS for back pain and QUALEFFO-41 values between groups (all p>0.05) (Table 1).

Twenty patients (21.0%) had osteoporosis and 34 (35.7%) had osteopenia 41 postmenopausal patients (43.1%) showed normal BMD.
In present study, we compared paraspinal muscle thickness in cases with osteoporotic, osteopenic and normal, to the best of our knowledge, for the first time in the literature. The results of our study showed that there were significant differences in paraspinal muscle thickness among the groups. We have found that osteoporotic patients had thinner paraspinal muscle thickness when compared to those in osteopenia and normal BMD group. In addition, paraspinal muscle thickness was found to be lower in osteopenia when compared to normal BMD group.

<table>
<thead>
<tr>
<th>Patients (n=95), mean (SD)</th>
<th>p value</th>
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<tbody>
<tr>
<td>Age, years</td>
<td>53.56 (5.45)</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>31.69 (5.20)</td>
</tr>
<tr>
<td>Menopause duration, years</td>
<td>7.63 (2.58)</td>
</tr>
<tr>
<td>Duration of weekly exercise, hour</td>
<td>0.30 (1.15)</td>
</tr>
<tr>
<td>Back pain, NRS</td>
<td>41.70 (28.25)</td>
</tr>
<tr>
<td>Lumbar BMD, g/cm²</td>
<td>1.08 (0.35)</td>
</tr>
<tr>
<td>Femur BMD, g/cm²</td>
<td>0.98 (0.10)</td>
</tr>
<tr>
<td>QUALEFFO-41</td>
<td>43.68 (10.95)</td>
</tr>
</tbody>
</table>

*p<0.05, * Bold p values denote significance. BMI Body Mass Index, BMD Bone Mineral Density, NRS Numeric Rating Scale, QUALEFFO Quality of Life Questionnaire of the European Foundation for Osteoporosis.

Table 1: Characteristics of the participants.

Discussion

In present study, we compared paraspinal muscle thickness in cases with osteoporotic, osteopenic and normal, to the best of our knowledge, for the first time in the literature. The results of our study showed that there were significant differences in paraspinal muscle thickness among the groups. We have found that osteoporotic patients had thinner paraspinal muscle thickness when compared to those in osteopenia and normal BMD group. In addition, paraspinal muscle thickness was found to be lower in osteopenia when compared to normal BMD group.

Sinaki et al. (8) studied a less demanding non-loading exercise program for the back extensor muscles in postmenopausal women who were not on estrogen therapy. They concluded that postmenopausal bone loss is unaffected by a modest exercise program despite an increase in muscle strength. Nonloading muscle exercise may be ineffective in retarding vertebral bone loss in ambulatory, healthy postmenopausal women (9). Therapeutic exercise should address osteoporosis-related deformities of axial posture, which can increase risk of fall and fracture. Strengthening of the major appendicular muscles decreases fragility. Thus, the role of a therapeutic exercise program is to increase muscle strength safely, decrease immobility-related complications, and prevent fall and fracture in patients with osteoporosis (10).

Acutely, the pain and edema associated with vertebral compression fracture can be decreased with isometric contractions of the paraspinal muscles (back extensors). In our study, there was no significant difference among groups regarding back pain. Chronically, the use of spinal extension exercises in combination with pelvic tilt exercises can decrease the compensatory lumbar lordosis that occurs in association with thoracic hyperkyphosis (11).

Miyakoshi et al. (12) showed that back extensor strength, which is mainly exerted by lumbar extensors, and lumbar spinal mobility are the most important factors for improving quality of life. Crepaldi et al. (13) and Mika et al. (14) have shown a reduction in muscle strength in the dorsolumbar region of women with osteoporosis, and have reported a correlation between this condition and BMD in the lumbar spine, possibly aggravating postural abnormalities associated with the disease. Sinaki et al. (15) reported that greater back extensor strength contributed to the smaller degree of thoracic kyphosis but not to the degree of lumbar lordosis in American subjects. Also, the risk of falls has been shown to increase in patients with thoracic hyperkyphosis (16). X.

Back strength is lower in osteoporotic women than in healthy women and has shown a negative correlation with thoracic kyphosis. Back strength is a significant contributor to spinal mobility and QOL. Therefore, back exercise is recommended for patients with osteoporosis (16-19). Cunha-Henriques et al. (20) compared musculoskeletal alterations in postmenopausal women with or without osteoporosis.
One of the alterations observed in the participants studied was a reduction in muscle strength. Back flexor and extensor strength was poorer in women with osteoporosis. This finding is in agreement with data published by other authors showing a significant correlation between reduced back muscle strength and a decrease in the BMD of the vertebral column.

In present study, we did not find significant difference in quality of life (QUALEFFO) among 3 groups. QUALEFFO can be considered as scale to assess general health status, although it is specific to osteoporosis. It allows assessing pain, physical and mental activities as well as social activities. We found no significant difference between normal and osteoporotic women included to our study, when we assessed total of all these activities. Osteoporosis does not cause marked impairment in mental and social activities before onset of complication, although osteoporosis causes pain and limitation in physical activities. It may have an indolent course for years.

There are a few important limitations of this study. First, the number of postmenopausal patients was small. Second, effect of exercises on back extensors in osteoporotic patients was not investigated. Third, our method of muscle assessment may also be disputed. Although there are studies which suggested volumetric measuring by using MRI, a validity and reliability study for measuring paraspinal muscles by US has not been previously administered.

Conclusion

Paraspinal muscle thickness was found to be lower in postmenopausal osteopenic and osteoporotic women. This finding indicates that reduction in bone mass is related to reduction in muscle mass. According to the results of this study, it could be thought that strength exercises for back extensors would have beneficial effect on bone health in osteoporotic patients.

References


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