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Evaluation of Osteoporotic Fractures in a Group of Turkish Women*

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Aims: The frequency of osteoporotic fractures varies from one country to another. Epidemiologic data related to osteoporotic fractures is limited in Turkey. In this study, we aimed to explore the frequency of osteoporotic fractures in osteoporotic women on the basis of our outpatient clinic data. Additionally, we aimed to define the relationship between osteoporotic fractures and age, menopause status, bone mineral density (BMD), and body mass index (BMI).

Materials and Methods: This is a retrospective chart review of 934 osteoporotic women, older than 50 years of age, seen from March 1998 through July 2005 at a musculoskeletal disease outpatient clinic of a tertiary-care center. The data related to osteoporotic bone fractures and the relation with age, menopause status, BMD (spine and femur neck), and BMI were evaluated.

Results: Osteoporotic fractures were observed in 194 patients (20.8%). Vertebral fractures were the most common form of osteoporotic fracture in our patient group (107 patients). The fracture rate seems to be increased with age and menopausal state; however, such a relationship was significant only in vertebral and hip fractures. There was no significant difference in terms of BMI between the patients with or without any fractures.

Conclusions: Osteoporotic fracture frequency in our study group was found to be relatively low as compared to the previous reports. It can be claimed that tendency towards osteoporotic fracture is relatively low in our study population.

Key Words: Osteoporosis, fracture, hip, vertebrae, Turkish

Bir Grup Türk Kadınında Osteoporotik Kırıkların Değerlendirilmesi

Amaç: Osteoporoza bağlı kırıkların sıklığı ülkeden ülkeye değişmektedir. Türkiye'de osteoporotik kırıklarla ilgili epidemiyolojik veriler sınırlıdır. Bu çalışmada poliklinik verileri temelinde osteoporozlu kadınlarda görülen osteoporoza bağlı kırıkların sıklığını, bunun yanı sıra osteoporoza bağlı kırıklar ile yaş, menapoz, kemik mineral yoğunluğu ve vücut kitle indeksinin ilişkisini ortaya koymayı amaçladık.

Yöntem ve Gereç: Mart 1998 ile Haziran 2005 yılları arasında, kas ve iskelet hastalıkları polikliniğinde 50 yaş üzeri 934 osteoporozlu kadın, poliklinik kayıt bilgileri üzerinden retrospektif olarak incelendi. Osteoporotik kırıkların yaş, menapoz, kemik mineral yoğunluğu (lomber ve femur boynu) ve vücut kitle indeksi ile olan ilişkileri değerlendirildi.

Bulgular: Osteoporoza bağlı kırık 194 hastada saptandı (% 20.8). Hasta grubumuzdaki en sık görülen kırık şekli, vertebral kırıklardı (107 hasta). Kırık sıklığı yaş ve menapozla artış göstermekle birlikte bu artış sadece vertebral ve kalça kırıklarında anlamlı düzeylerdeydi. Kırıklı ve kırıksız hastalar arasında VKİ yönüyle anlamlı bir ilişki yoktu.

Sonuç: Çalışma grubumuzda osteoporoza bağlı kırık sıklığı, bildirilmiş kırık oranlarına göre düşük bulundu. Bu durum çalışma grubumuzda osteoporoza bağlı kırıklara yatkınlığın az olması şeklinde yorumlanabilir.

Anahtar Sözcükler: Osteoporoz, kırık, kalça, vertebra, Türk

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Introduction

Osteoporosis is a global health concern. It is a chronic and asymptomatic condition characterized by low bone mass, bone structure deterioration, and an increased risk of fracture (1). Fragility fractures are the most important and disabling consequence of osteoporosis. They result in loss of functional ability, increased morbidity, and mortality. The incidence of osteoporotic fractures has increased in the greater proportion of the world population (2). The financial and human burdens associated with osteoporotic

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fractures are expected to multiply exponentially. As predicted by the International Osteoporosis Foundation, in Europe, more than 40% of middle-aged women will suffer one or more osteoporotic fracture(s) during their remaining lifetime (3). The most typical fracture due to osteoporosis occurs at the spine, and hip fractures are thought to occur in the most severe osteoporotic patients (4). Other forms of osteoporotic fractures occur at the forearm, humerus, pelvis, tibia and fibula, ribs, clavicle, scapula, and sternum (5). Attention has focused on hip fracture morbidity since epidemiological information is more widely available for the hip than for the other sites of osteoporotic fracture. Today, about half of the hip fractures occur in Europe and North America; in 2050, this proportion will fall to one-quarter due to the greater increase in population size in the other regions (6).

Risk factors for osteoporotic fractures may be classified into two groups: bone-related factors and non-bone factors. Bone-related risk factors are strongly associated with bone density, and traditionally risk assessment studies have focused on these factors (7). These variables increase the risk of fracture by affecting bone mineral density (BMD) and include age, gender, race, geographical region, genetics, diet, lifestyle, hormonal status, and medical co morbidities. Some factors cannot be modified due to their intrinsic nature, but modification is possible in others. Non-bone risk factors are variables not related to bone density. These factors may increase fracture risk irrespective of osteoporosis diagnosis. The most important non-bone risk factor is falls due to lack of physical activity, muscle weakness, gait and balance problems, neuromuscular diseases, disability of the lower extremities, or impaired proprioception (7-9).

Several studies have suggested a wide geographic variation in fractures both between and within countries. For example, the highest rates of hip fracture are seen in Caucasians living in northern Europe, especially in the Scandinavian countries (10). The rates are intermediate in the populations of Asia, China, and Kuwait and lowest in black populations (11-14). It has also been estimated that the prevalence of vertebral fractures in Hispanic American or Japanese American women is approximately one half that of Caucasian women and it is even lower in African Americans (15). It was reported in the Mediterranean Osteoporosis Study (MEDOS) that the hip fracture rate in Turkey is relatively low; however, there are no sequential studies on the fracture frequency in osteoporotic patients in Turkey. Therefore, we aimed to describe the frequency of osteoporotic fractures in women with osteoporosis on the basis of our outpatient clinic data.

Materials and Methods

Patients

Between March 1998 and July 2005, 3170 female patients were registered in the musculoskeletal outpatient clinic of Gülhane Teaching Hospital, Ankara, Turkey. A total of 1268 women, with osteoporosis and age older than 50 years, were recruited and evaluated retrospectively for their eligibility to be included in this study. Three hundred and thirty-four patients were found to be ineligible and were excluded. Exclusion criteria included presence of metabolic bone disease, malignancy, renal disease, liver disease, enzyme abnormalities, and previous fracture due to severe trauma (such as traffic accident). Accordingly, the data obtained from 934 women were analyzed.

Fracture types were categorized in four groups according to their localization: vertebral, hip, wrist-forearm, and other site fractures. Other site fractures were further sub-grouped as: humerus, pelvis, tibia and fibula, ribs, clavicle, scapula, and sternum fractures.

The diagnosis of osteoporosis was established regarding lumbar spine and hip BMD measurements. Patients were considered to have osteoporosis if they had a BMD T-score less than –2.5 at any site.

Data Collection

All patients were examined by one of the two physicians (MT, EO). Demographic data and disease characteristics of the patients were recorded. Body mass index (BMI) of each patient was also calculated and recorded.

Assessment of Vertebral Fractures

Vertebral fractures were evaluated using direct X-rays. All radiographs were of good quality, with good visibility and reliable identification of all vertebrae. Lateral roentgenograms of the thoracic and lumbar spine (T4-L4) were evaluated by the same radiology specialist and the authors. Vertebral fractures were identified by direct visualization using Genant's semiquantitative method

(16). The reproducibility of the method for diagnosis of prevalent and incident vertebral fractures was found to be high, with intraobserver agreement of 93-99% and interobserver agreement of 90-99% (17). This method grades vertebrae on a scale of 4. Grade 0 refers to normal, grade 1 to 20-25% reduction, grade 2 to >25-40% reduction, and grade 3 to >40% reduction in vertebral height. A vertebral fracture was defined as a reduction of at least 20% of the vertebral body height.

BMD Measurements

Bone mineral density measurements of the hip (femoral neck) and the lumbar spine (L1-L4; anteroposterior view) were performed by a trained technician using the same DXA equipment (Hologic QDR-4500, USA) in all patients. The results were expressed in grams per square centimeter. The reference range estimation was made using our own data obtained from a Turkish population of normal healthy women.

Statistical Analysis

All statistical analyses were performed using a commercially available statistical software package, SPSS for Windows ver. 13.0 (SPSS Inc., USA). Chi-square, Student's-t, and Mann-Whitney U tests were used for analyses. A calculated P value of less than 0.05 was considered as significant.

Results

The clinical and demographic characteristics of the study population are shown in Table 1. The majority of the patients with osteoporotic fractures were postmenopausal. The average age was significantly higher in patients with fractures. There was no significant difference in terms of menopausal age and BMI between those with and without osteoporotic fractures. Patients with fractures had significantly lower spine and neck BMD measurements. Of 934 patients with osteoporosis, 194 (20.8%) of them had at least one osteoporotic fracture. Fracture frequency was found to be related to both chronological age and menopausal age (Table 2). The majority of the fractures were found to be vertebral (n=107, 11.5%), followed by wrist-forearm fractures (n=54, 5.8%), other site fractures (n=20, 2.1 %), and hip fractures (n=13, 1.4 %). The details are summarized in Table 3.

Vertebral Fractures

Vertebral fracture was diagnosed in 107 patients (11.5%), and was the most frequently observed osteoporotic fracture. Distribution of fractures along the spine showed three peaks at T12, L1, and L2 (Figure 1). Fifty-nine percent of the vertebral fractures were found to be on the thoracic spine, while 41% were on the lumbar spine. The number of patients with only one vertebral fracture (n=55, 54.7%) was higher than those having multiple vertebral fractures (n=52, 45.3%). Most of the vertebral fractures were categorized as grade 2 fractures, followed by grade 1 and grade 3 fractures (Table 4). The total number of fractured vertebrae was 174, since some of the patients had several fractures.

BMD

Spine BMD measurements in patients with vertebral (P=0.01) or hip (P=0.01) fractures were significantly lower than in those without fractures, as expected. Nevertheless, spine BMD measurements of patients with forearm or other site fractures were not different than in those without fracture, as shown in Figure 2. Neck BMD measurements in patients with vertebral (P=0.001), hip (P=0.001), or wrist-forearm (P=0.01) fractures were

Table 1. Demographic and clinical variables in the study patients.

Variable	Fracture group (n=194)	Non-fracture group (n=740)	P*
Age (years)	67.8 ± 7.5	63.4 ± 7.5	0.001
Premenopause (n)	0	17	
BMI (kg/cm^2)	28.4 ± 5.6	27.9 ± 4.0	0.64
Spine BMD (g/cm^2)	0.668 ± 0.084	0.692 ± 0.068	0.01
Neck BMD (g/cm^2)	0.640 ± 0.094	0.686 ± 0.093	0.001

BMI: Body mass index; BMD: Bone mineral density.
Data are expressed as mean ± SD, with exception of premenopause status
* Student's-t test

Table 2. Frequency of osteoporotic fractures in the study population according to age, menopause, and BMI.

Characteristics	Fracture group		Non-fracture group		Total		P***
	n	%*	n	%*	n	%**	
N	194	20.8	740	79.2	934	100.0	
Age group (years)							
50-54	8	7.8	94	92.2	102	10.9	
55-59	16	10.3	140	89.7	156	16.7	
60-64	38	15.6	205	84.4	243	26.0	0.001
65-69	51	27.6	134	72.4	185	19.8	
70-74	47	33.3	94	66.7	141	15.1	
≥ 75	34	31.8	73	68.2	107	11.5	
Years since menopause							
0-9	15	9.4	144	90.6	159	17.0	
10-19	73	18.8	316	81.2	389	41.6	0.001
20-29	69	25.9	197	74.1	266	28.5	
≥ 30	35	34.4	68	66.0	103	11.0	
BMI (kg/cm^2)							
<19.0	3	21.4	11	78.6	14	1.5	
19.0-24.9	50	20.6	193	79.4	243	26.0	0.846
25.0-29.9	74	18.4	329	81.6	403	43.1	
≥ 30.0	57	20.8	217	79.2	274	29.3	

BMI: Body mass index.

* Percentage of the corresponding line

** Percentage of the corresponding column

*** Chi-square test

Table 3. The distribution of osteoporotic fractures depending on age and sites.

	Vertebra		Wrist-forearm		Hip		Other		P***
	n	%*	n	%*	n	%*	n	%*	
Age group (years)									
50-54	2	25.0	4	50.0	0	0.0	2	25.0	
55-59	4	25.0	8	50.0	0	0.0	4	25.0	
60-64	20	52.6	9	23.7	4	10.5	5	13.2	
65-69	29	56.9	15	29.4	1	2.0	6	11.8	
70-74	31	66.0	9	19.1	5	10.6	2	4.3	
> 75	21	61.8	9	26.5	3	8.8	1	2.9	0.001
Total (n) (%)**	107	11.5	54	5.8	13	1.4	20	2.1	

* Percentage of the corresponding line.

** Fracture percentage for all patients.

*** Chi-square test.

Other fractures: Humerus, pelvis, tibia and fibula, ribs, clavicle, scapula, and sternum

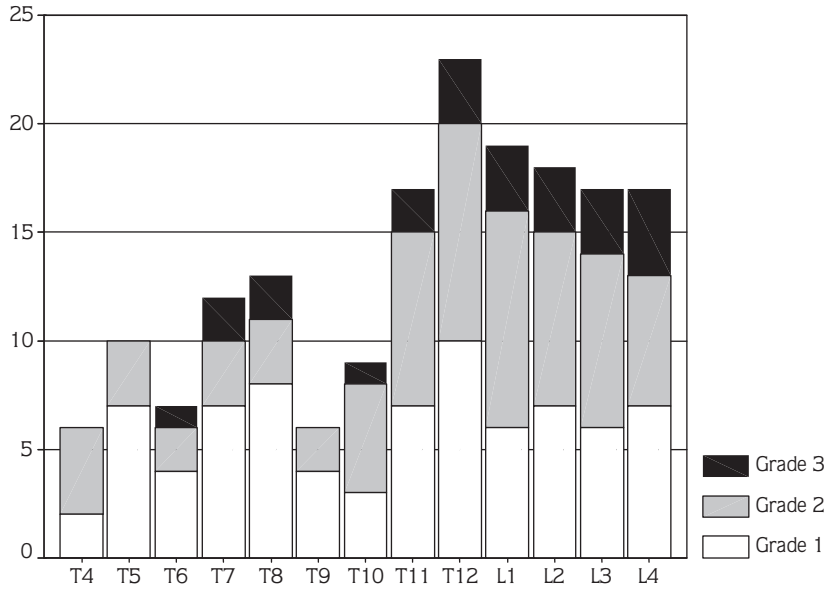

Figure 1. Distribution of vertebral fractures along the spine according to site and severity.

Table 4. The properties of vertebral fractures.

Characteristics	N	%
One fracture	55	54.7
Two or more fractures	52	45.3
Grade*		
1	72	41.4
2	78	44.8
3	24	13.8

* Given number represents the fractured vertebrae.

significantly different than in those with no fractures; however, there was no statistical difference in terms of other site fractures. As summarized in Figure 3, the lowest neck BMD values were seen in patients with hip fractures, as expected.

Age

Frequency of vertebral fractures and hip fractures was significantly increased with age. This relation was more clear in the age group 60 and above (P = 0.001). On the other hand, this relationship was not true for wrist-forearm or other site fractures (Table 3).

BMI

Body mass index measurements were found to be similar in patients with or without any fractures (P = 0.846).

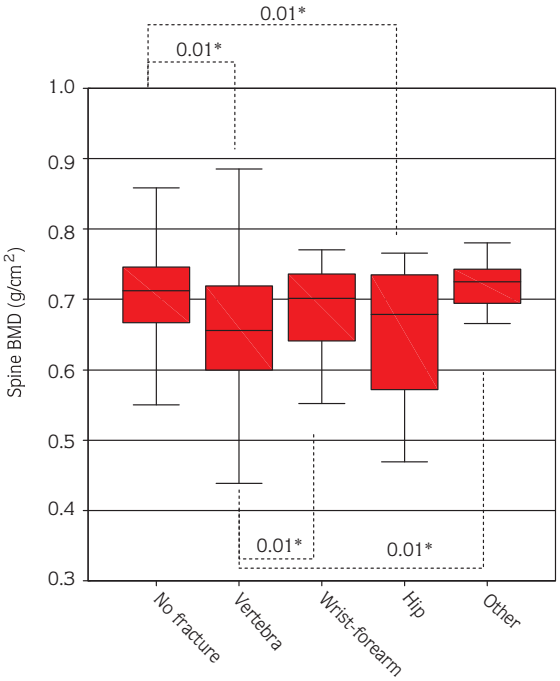

Figure 2. Comparison of spine BMD values from various sites in patients.
* Mann-Whitney U test.

Discussion

Other than MEDOS (18) and the European Vertebral Osteoporosis Study (EVOS) (19), the frequency of osteoporotic fractures in Turkey has not been evaluated

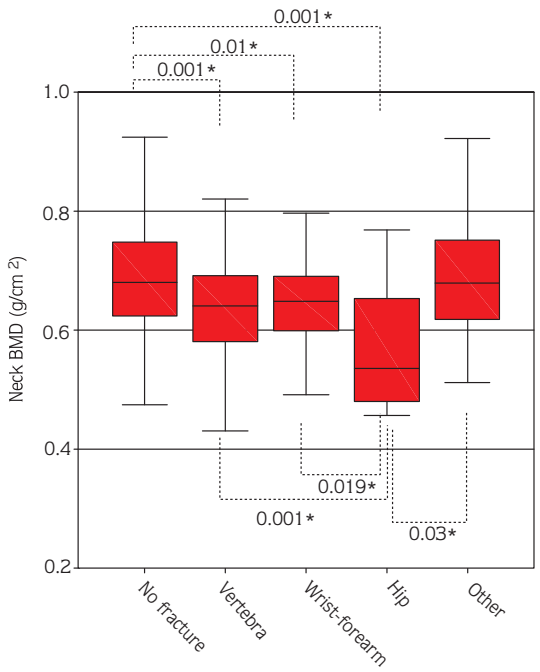

Figure 3. Comparison of neck BMD values from various sites in patients.
* Mann-Whitney U test.

in large samples. It is certain that this study can not be regarded as an epidemiological study; however, we believe that it may help to estimate the frequency of osteoporotic fractures in Turkish women. This study was carried out in a hospital with more than 900,000 patient admissions per year. This number represents roughly 1% of our general population.

Vertebral fractures (11%) were found to be the most frequent type of osteoporotic fractures in our study population. The relationship between geographical area and the frequency of osteoporotic fractures is well known. Referring to EVOS, prevalence of vertebral fractures among randomly recruited, 50-79 year-old postmenopausal women varied from 12 to 20.2 according to diagnostic methods, and 11.1 to 20% according to geographical differences in Europe (20). Recent data from the Epidemiology of Osteoporosis Study (EPIDOS) have yielded estimates of prevalence of vertebral fractures as 19% among women aged 75 to 79 years, 21.9% among those aged 80 to 84 years, and 41.4% among those aged 85 years and older (21). In Canada, prevalence of vertebral deformity is 23.5% in women (22). Considering the rates referred to above, the frequency of vertebral fractures in our study population is rather low.

We found the frequency of forearm fractures as 5.8%, other site fractures as 2.1%, and hip fractures as 1.4% in our study population, and these frequencies are significantly lower than those reported in the relevant literature. For example, in Sweden, hip fractures accounted for 3.8% of all osteoporotic fractures in women aged between 50 and 54 years. This ratio rises progressively with age, so that between the ages of 80 and 85 years, hip fractures account for 35.6% of all osteoporotic fractures in women (23). In studies from the United States (US), Sweden, and the United Kingdom (UK), the proportion of hip, forearm, and humerus fractures has shown a similar pattern (6). Among the total fractures of male and female groups, hip fracture was estimated to account for 18.2%, forearm 18.5%, and other site fractures 39.6% worldwide (5). In other words, female to male ratio was seen as 2.3, 4.0 and 0.9 for hip fracture, forearm and other site fractures, respectively. As reported in MEDOS, the hip fracture incidences were relatively low in Turkey as compared to the other Mediterranean countries, including France, Greece, Italy, Portugal, and Spain (18). It was reported recently that the 10-year probability of hip fractures varies more than 15-fold from one region to another. Categorization of countries into very high-, high-, medium-, and low-risk based on 10-year hip fracture probabilities showed that the UK, Australia, Canada, Germany, Greece and Singapore are at high risk. Very high-risk countries are Denmark, Iceland, Norway, Sweden and the US, whereas Korea, Turkey and Venezuela are considered as low-risk countries (24).

Sub-analysis of patients with vertebral fractures regarding the grade of fracture revealed that more than half of the vertebral fractures were grade 2 or grade 3. Since grade 1 fractures may not be related to osteoporosis, but to other diseases such as osteoarthritis, these deformities more likely occurred as a result of osteoporosis.

Our results corroborate the findings of population-based studies in women showing that vertebral fractures are clustered at the thoracolumbar regions of the spine. The thoracolumbar junction consists of an articulation between the relatively rigid thoracic spine and the freely mobile lumbar segments, maximizing compression stresses. It has been suggested, on theoretical grounds, that endplate deformities occur more frequently in the lumbar spine due to a posterior center of gravity in this region (25).

Almost half of our patients with vertebral fractures had multiple vertebral fractures, which confirms the existence of possible new vertebral fractures as previously reported (26).

In our study population, frequency of vertebral fractures and hip fractures significantly increased with age, as previously reported (20,27). On the contrary, no similar relation was found among wrist-forearm and other site fractures. They typically occur at a younger age than hip fractures, mostly in women, and do not show the same exponential increase with age as hip fractures do. According to the studies from the US, it was reported that the fracture incidence in women rises more rapidly to a plateau, whereas the studies from the UK reported a more gradual increase with age (28). In Sweden, however, the incidence still increases progressively with age after the age of 65 as well (6). Although there are only limited studies both in the US and the UK regarding other site fractures, the existing studies draw a slight increase with age (28).

We have confirmed the role of a well-established risk factor, years since menopause, in any osteoporotic fracture. However, we could not expose a relationship between fracture frequency and BMI. Such a relationship is indicated in some studies and only a few against it (29-33). Sixty-eight percent of the patients with fractures and 72% of the patients with no fractures had BMI of more than 25. Considering this, the low frequency of osteoporotic fractures in our study group might be explained by the fact that most of our patients were overweight.

Bone mineral density is the most frequently used marker for bone strength and fragility fractures. It is estimated that BMD accounts for approximately 70% of bone strength and correlates well with fracture risk. For every 1 SD decline in femoral-neck BMD, it is estimated that the risk of an osteoporotic fracture at the hip increases by 2.5-fold. While BMD measurements provide valuable information on fracture risk, it should be noted that a significant portion of bone strength may be derived from other sources (e.g., genetics) (7,34).

It was first suggested by Marshall et al. (35) that relative risk values are approximately the same for all BMD sites to predict any fracture. This hypothesis was confirmed by the publication of 10-year follow-up data of the Study of Osteoporotic Fractures (SOF) reporting the relative risk value as around 1.4 for six different BMD sites (36). Our study results revealed a relationship between vertebral and hip fractures and spine BMD, whereas vertebral, hip and wrist-forearm fractures correlated with neck BMD. A similar relationship, however, was not observed for the other types of fractures. This discrepancy can be explained by our relatively small sample size.

This study has several limitations. First of all, radius measurement for BMD evaluation is not used in routine practice in our center. Thus, the radius BMD measurements are not included in this current study. Secondly, information derived from our study group about the frequency of patients with multiple osteoporotic fractures is not helpful. Since the number of patients with fractures was relatively low in our study population, we could not examine the relationship in-depth, such as between severe vertebral fractures and the increased rate of new fracture occurrence.

In summary, the rate of osteoporotic fractures was found relatively low in our study population regarding vertebral, wrist-forearm, hip, and other site fractures. It can be claimed that tendency towards osteoporotic fracture is relatively low in our study population.

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