An evaluation of the 10-year major osteoporotic and hip facture risk using the FRAX score in Erzurum

Using the FRAX score in Erzurum

Ahmet İmerci[1], Nevres Hurriyet Aydoğan[1], Ali Aydın[2]
[1]Department of Orthopaedics and Traumatology, Mugla Sitki Kocman University, Faculty of Medicine, Mugla,
[2]Atatürk University, Faculty of Medicine, Turkey

This was presented as a poster presentation at the 26th Bone Joint Congress, Antalya. 2015; 83-84. Turkey.

Abstract

Aim: The aim of this prospective study was to provide an estimation of the 10-year probability of the four major osteoporotic fractures using fracture risk evaluation scale (FRAX) and to review the risk factors for osteoporosis in males and females aged over 50 years in Erzurum, Turkey. Material and Method: An evaluation was made 1254 patients who presented at the Outpatient Clinics of State Hospital in 2013. Taking the risk factors and bone mineral density (BMD) values into consideration, and using the FRAX risk evaluation scale, the 10-year major osteoporotic (MO) and hip fracture risks were evaluated for all the participants. Results: While a significant difference was seen between the genders in respect of measurements of the osteoporosis (OP) major risk fracture with BMD determined as mean 7.4% in females and 5.77% in males, and without BMD, as 8.27% in females and 4.59% in males and without BMD, the hip fracture risk was 2.92% in females and 1.91% in males (p=0.016, p<0.001, p<0.001, respectively), no significant difference was determined in the hip fracture risk with BMD at 2.62% in females and 3.05% in males (p=0.517). With an increase in body mass index (BMI), there was a decrease in the OP risk (p<0.001). With BMD, the MO fracture risk groups were formed of 84.5% low risk, 10.5% moderate risk and 5% high risk. Discussion: If BMD values were taken as the basis for medical treatment in Turkey, the use of scanning tests and fracture risk evaluation scales such as FRAX would be useful. However, to be able to better determine the extent of OP and the fracture risk in the general population and maybe to be able to determine threshold values which may be different in our population, there is a need for further multi-center studies including greater numbers of patients.

Keywords

Osteoporos; Bone Mineral Density; Fracture; Frax; Erzurum

Introduction

Osteoporosis (OP) is a systemic skeletal disease, characterised by low bone mineral density (BMD) and destruction of the micro-structure of the bone tissue, which causes increased bone fragility and risk of fracture [1]. In most people, the disease shows no symptoms until the development of a fracture and therefore, early diagnosis is extremely important. BMD measurements are used in diagnosis and follow-up and to obtain these measurements, the Dual X-ray absorptiometry (DEXA) method is accepted as the gold standard [2].

The fracture risk evaluation scale (FRAX) is a fracture evaluation tool developed by the World Health Organisation (WHO) [2]. FRAX allows clinicians to calculate a definite 10-year risk for the patient of a hip or 'major' fractures (hip, wrist, humerus or spinal fractures). In a comparison of BMD alone, a higher differentiation has been shown at least 13% in the prediction of females suffering a future fracture [4]. The possibility is calculated using risk factors such as age, body mass index (BMI), previous fragility fracture, familial history of hip fracture, cigarette smoking, long-term use of oral glucocorticoid, rheumatoid arthritis, excessive alcohol consumption and other secondary OP causes. Individuals at high risk of OP and osteoporotic fractures can be identified with the determination of the risk factors. Thus, fractures can be prevented with modification of the risk factors [3, 5].

Early diagnosis of OP, identification of risk groups for early treatment and prevention, and determination of the risk before a fracture all play an important role in the prevention of morbidity and mortality associated with OP and in the reduction of healthcare costs. Therefore, the aim of this study was to determine cases of osteopenia and OP in the early stages by measuring BMD and to determine the 10-year fracture risk using the FRAX scale in patients presenting at our hospital.

Material and Method

In the study period of 2013, a total of 1254 patients aged over 50 years, with no previous OP treatment underwent a DEXA scan at State Hospital. BMD measurements were taken with a DEXA Hologic Q 2000 device of the posteroanterior lumbar spine (L1- L4) and hip (femoral neck). The machine calibrations, tests, controls, and phantom measurements were applied routinely by certified technicians. The participants removed outer clothing and were weighed and measured, then DEXA scanning was applied. The BMD values were evaluated with the T-scores defined according to the peak young adult bone density value. According to the WHO classification, patients with a T-score of ≤-2.5 were accepted as osteoporotic, those with scores of -1- -2.5 as osteopenic and those with a score of> -1 as normal [2]. Approval for the study was granted by the Research Ethics Committee of Ataturk University. Informed consent was obtained from all patients prior to inclusion.

Fracture Risk Evaluation Tool

The 10-year probability fracture can be automatically calculated using FRAX® scoring. Therefore, for the evaluation of fracture risk according to FRAX®, the required data was recorded on a questionnaire administered face-to-face. These data included age, gender, height, weight, previous fracture, hip fracture of a parent, smoking, glucocorticoid treatment, rheumatoid arthritis, secondary osteoporosis, alcohol intake and related clinical data. The web-based algorithm at http://www.shef.ac.uk/FRAX® was applied as the FRAX® algorithm (version 3.6) adapted for

Turkey [3]. In this way, by entering and not entering the femoral neck (FN) T-score value for each patient, four different scores were obtained for major osteoporotic (MO) fracture risk and hip fracture risk. According to the National Osteoporosis Foundation in the USA (NOF) criteria, a FRAX® score of ≥20% for MO fracture or ≥3% for hip fracture is defined as a patient at high risk and these values are accepted as the threshold for intervention [5].

Statistical Analysis

The study data were analysed using SPSS for Windows version 20 (SPSS Inc, Chicago, IL, USA) statistics software. Continuous variables were stated as mean ± standard deviation (SD) and categorical variables as percentage (%). The relationships were compared between gender and demographic characteristics, and between T-scores and fracture risk. The relationship between BMI and the fracture risk with and without the BMD value was evaluated with the Pearson and Spearman tests. A value of p<0.05 was accepted as statistically significant.

Results

The mean age was determined as 64.97 years for females and 68.54 years for males. The BMI was calculated as 29.33 ± 5.19 for females and 25.70 ± 4.15 for males, and the difference was statistically significant (p<0.001).

The distribution of risk factors of the patients was previous fracture (37), parent hip fracture (22), current smoking (25), current glucocorticoid use (12), alcohol consumption (2), rheumatoid arthritis (8), and secondary OP (34). The most common cause of secondary OP was diabetes mellitus (32).

Of the total cases, 513 (40.9%) were determined as osteoporotic, 496 (39.5%) as osteopenic and 246 (19.6%) as normal. No statistically significant difference was determined between the genders in respect of the femoral neck T-scores (p=0.784). The lumbar 1-4 T-scores were statistically significantly lower in females than in males (p<0.001). While a significant difference was seen between the genders in respect of measurements of the OP major risk fracture with BMD determined as mean 7.4% in females and 5.77% in males, and without BMD, as 8.27% in females and 4.59% in males and without BMD, the hip fracture risk was 2.92% in females and 1.91% in males (p=0.016, p<0.001, p<0.001, respectively), no significant difference was determined in the hip fracture risk with BMD at 2.62% in females and 3.05% in males (p=0.517) (Table 1). With an increase in BMI, a decrease in the OP risk was determined both with and without BMD measurements (p<0.001) (Table 2).

With BMD, the MO fracture risk groups were formed of 84.5% low risk, 10.5% moderate risk and 5% high risk. For hip fracture risk with BMD, the rates were 88.2% low risk, 7.4% moderate risk and 4.4% high risk.

Discussion

Early diagnosis of OP, identification of risk groups for early treatment and prevention, and determination of the risk before a fracture all play an important role in the prevention of morbidity and mortality associated with OP and in the reduction of healthcare costs [2, 4].

In a study by Kutlu et al. [6], the frequency of OP and osteopenia were determined as 14.9% and 39.2% respectively. In another study, 57% of patients were determined as osteoporotic and 42% as osteopenic [7]. According to the results of the FRAK-TURK study in Turkey by the Turkish Osteoporosis Association,

Table 1. Characteristics of the study population

	Female (n=1094)	Male (n=161)	p-value
Age (years)	64.97±9,29	68.54±8,25	<0,001
Weight (kg)	72.81±14,10	75.45±13,69	0,025
Height (cm)	157.43±6,11	170.99±6,79	<0,001
BMI	29.33±5,19	25.70±4,15	<0,001
Femoral Neck T score	-1.47±1,01	-1.49±1,25	0,784
Lumbar 1-4 T score	-2.24±1,19	-1.70±1,14	<0,001
BMD with MO fracture probability	%7,4±7,80	%5,77 ±8,07	0,016
BMD without MO fracture probability	% 8,27±6,67	% 4.59±2,11	<0,001
BMD with hip fracture probability	%2,62±6,76	%3,05±8,06	0,517
BMD without hip fracture probability	% 2.92±4,35	% 1.91±1,74	<0,001
Normal	198	48	
Osteopenia	421	75	
Osteoporosis	475	38	

BMI: Body Mass Index, BMD: bone mineral density, MO: major osteoporotic

Table 2. Relationship between fracture probability and Body Mass Index

	Pearson	Spearman
BMD with MO fracture probability	-0,178 <0,001	-0,191 <0,001
BMD without MO fracture probability	-0,20 <0,001	-0,233 <0,001
BMD with hip fracture probability	-0,178 <0,001	-0,274 <0,001
BMD without hip fracture probability	-0,274 <0,001	-0,334 <0,001

which included participants aged 50 years and over in 12 regions, including Erzurum, osteopenia was determined in 50% of the participants and OP in 25% [8]. In a study conducted in the region of Thrace, OP was revealed to be a significant health problem as 1 in 4 individuals over the age of 55 years were osteoporotic. The prevalence in females was determined as 15.1% and in males over the age of 40 years, 10.7% [9]. Ipek et al. [10] determined the OP rate with DEXA as 31.8% in the L1-L4 vertebrae region, as 40.2% in the femoral neck and as 34.3% in at least one area of the L1-L4 vertebrae and/or the femoral neck. In the current study, 513 (40.9%) patients were determined as osteoporotic, 496 (39.5%) as osteopenic and 246 (19.6%) as normal.

In a previous study in Turkey, the probability of MO fracture was determined as 0.5%-12 % with BMD and as 0.1%-7.1% without BMD, and the risk of hip fracture as 0%-10% with BMD and as 0%-5.6% without BMD [6]. In another study evaluating the risk of fracture with FRAX, a high risk of MO fracture was determined in 9.5% of patients and a high risk of hip fracture in 30.4% (11). The fracture risk in females aged over 50 years was estimated with FRAX and the 10-year MO fracture, and hip fracture risk with and without BMD measurement was found to be 1.7%, 16.4%, and 2.3%, 16% respectively [12]. Tuzun et al. [8] found the mean 10-year MO fracture probability to be 6.0% and the hip fracture to be 2%. In another study in Turkey, the MO and hip fracture was determined as 5.5% andd 0.9% with BMD measurements and as 5.7% and 1.1% without BMD measurements [13].

The validity and reliability of the FRAX fracture risk scoring system have been investigated in studies made in different countries. In a multi-center retrospective study by Pedrazzoni et al. [14], the actual 10-year risk in postmenopausal females was reported to be 7.5% of the median value and 1.7% for the femoral

fracture risk. Czerwinski et al. [15] reported the MO fracture probability as 9.9% when calculated without BMD measurements and 10.2% with BMD. In a study in Japan, Fujiwara et al. [16] reported that fracture risk was 5% in patients over the age of 50 years, and more than 20% in those aged over 80 years. Etinger et al. [17] calculated the 10-year hip fracture risk using the FRAX USA Model in patients aged younger than 65 years and the risk was reported as <40%. Leslie et al. [18] found a greater risk in females than males of both MO fracture and hip fracture. These results were similar to the findings of the current study. In the current study population, the fracture risk with both measurement methods was determined as 4.59%-8.27% for MO fracture risk and as 1.91%- 3.95% for hip fracture risk. As expected, the probability was higher in females than males. One of the risk factors of OP is body structure [19]. A significant relationship was found between BMI and OP in a study by Pinar et al. [20] of females aged >45 years. Similarly, Kutlu et al. [6] determined a statistically significant relationship between BMI and OP. However, Robitaille et al. [21] reported OP in 11% of cases with BMI <18.5 and 7.5% of those with BMI of ≥30. A statistically significant correlation was determined in the current study between BMI and OP, and as BMI increased, so the OP risk decreased (p<0.001). In a prospective study of males aged >50 years, Burger et al. [22] showed a strong relationship between an increase in BMI and high BMD. Obese patients were compared with those of normal values in a study by Mesci et al. [23], and it was reported that the T-scores of the obese patients were higher and the FRAX fracture risk was lower.

Bastos-Silva et al. [24] identified high fracture risk (≥20%) as 0.75% using BMD and as 1% without the use of BMD values. In relation to hip fractures, a high fracture risk (≥3%) was determined in 5.22% with BMD, and in 11.44% without BMD. In the current study, according to the NOF threshold criteria (≥20%), this group constituted 5% MO fracture risk and 4.4% hip fracture risk with FRAX with BMD [25]. Demir et al. [19] found high risk to be <1% with and without BMD measurements for both fracture risks.

That some significant fracture risk factors are not included (falls, bone turnover, style of dressing, lifestyle), that BMD is limited to the femoral neck, that the fracture risk may be over or underestimated, and that it is not used in patients who have been treated, are some of the disadvantages of the FRAX model [26-28]. Despite low BMI values in Turkey, OP is widespread, and there is a great risk of osteoporotic fractures. Taking into consideration that the BMD and T-score can be affected by many factors, it has been reported that as the data used in the FRAX model in Turkey are insufficient and out-of-date, there is a need for it to be revised [8, 27, 29].

To provide a simple calculation of the risk factor with the use of the FRAX risk evaluation scale, which has been developed for each country with specially prepared data and consideration of the risk factors, patients at high risk can be identified in the early stages and appropriate OP treatment will be cost-effective. If medical treatment in Turkey were based on BMD values, fracture risk evaluation scales such as FRAX and the use of scan tests would be beneficial.

Scientific Responsibility Statement
The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding
None

Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

References

1. Kanis JA, Melton LJ, Christiansen C, Johnston CC, Khaltaev N. The diagnosis of osteoporosis. J Bone Miner Res. 1994; 9(8):1137-41.
2. Kanis JA, McCloskey EV, Johansson H, Cooper C, Rizzoli R, Reginster JY, et al. European guidance for the diagnosis and management of osteoporosis in postmenopausal women. Osteoporos Int. 2013; 24(1):23-57.
3. Unni S, Yao Y, Milne N, Gunning K, Curtis JR, LaFleur J. An evaluation of clinical risk factors for estimating fracture risk in postmenopausal osteoporosis using an electronic medical record database. Osteoporos Int. 2015;26(2):581-7.
4. Kanis JA, Oden A, Johansson H, Borgström F, Ström O, McCloskey E. FRAX and its applications to clinical practice. Bone. 2009;44(5):734-43.
5. Donaldson MG, Cawthon PM, Lui LY, Schousboe JT, Ensrud KE, Taylor BC, et al. Estimates of the proportion of older white men who would be recommended for pharmacologic treatment by the new US National Osteoporosis Foundation guidelines. J Bone Miner Res. 2010; 25(7):1506-11.
6. Kutlu R, Civi S, Pamuk G. Frequency of osteoporosis and calculation of 10-years fracture probability by using FRAX TM Tool in postmenopausal women. Turk J Phys Med Rehab. 2012; 58: 126-35.
7. Beyazal MS, Çapkın E, Karkucak M, Guler M, Çakırbay H, Tosun M. The Relationship of Osteoporosis Risk Factors with Bone Mineral Density in Patients Admitted Our Outpatient Clinic in Trabzon. Turk J Osteoporos. 2016; 22: 17-23.
8. Tuzun S, Eskiyurt N, Akarirmak U, Saridogan M, Johansson H, McCloskey E, et al. The impact of a FRAX-based intervention threshold in Turkey: the FRAX-TURK study. Arch Osteoporos. 2012; 7: 229-35.
9. Keskin Y, Çekin MD, Gunduz H, Luleci NE, Giray E, Sur H, et al. The Prevalence of Osteoporosis in the Thrace Region of Turkey: A Community-Based Study. Türk Fiz Tıp Rehab Derg. 2014; 60: 335-40.
10. Ipek A, Gafuroglu U, Bodur H, Yılmaz O. Osteoporoz Riskinin Değerlendirilmesi. Türk Fiz Tıp Rehab Derg. 2012; 58: 212-9.
11. Gultekin SS, Arslan MS, Topaloğlu O, Delibaşı T. Postmenopozal Kadınlarda Güncel Yöntemler ile Kırık Riski Analizi. J Clin Anal Med. 2015; 6(5): 541-4.
12. Gokmen NE, Kandemirli GC, Basbug E, Avsaroglu B, Ok N, Unal ST, et al. FRAX ile Yapılan Kırık Riski Değerlendirmesi ve Geleneksel Risk Faktörleriyle İlişkisi. Uludağ Üniversitesi Tıp Fakültesi Dergisi. 2014; 40(2): 69-73.
13. Olmez Sarikaya N, Kapar Yavasi S, Tan G, Satiroglu S, Yildiz AH, et al. Agreement between FRAX scores calculated with and without bone mineral density in women with osteopenia in Turkey. Clin Rheumatol. 2014; 33(12): 1785-9.
14. Pedrazzoni M, Girasole G, Giusti A, Barone A, Pioli G, Passeri G, et al. Assessment of the 10-year risk of fracture in Italian postmenopausal women using FRAX®: a North Italian multicenter study. J Endocrinol Invest. 2011; 34: 386-91.
15. Czerwinski E, Kanis JA, Osieleniec J, Kumorek A, Milert A, Johansson H, et al. Evaluation of FRAX to characterise fracture risk in Poland. Osteoporos Int. 2011; 22(9): 2507-12.
16. Fujiwara S, Nakamura T, Orimo H, Hosoi T, Gorai I, Oden A, et al. Development and application of a Japanese model of the WHO fracture risk assessment tool (FRAX). Osteoporos Int. 2008; 19: 429-35.
17. Ettinger B, Black DM, Dawson-Hughes B, Pressman AR, Melton LJ. Updated fracture incidence rates for the US version of FRAX®. Osteoporos Int. 2010; 21: 25-33.
18. Leslie WD, Morin S, Lix LM, Johansson H, Oden A, McCloskey E, Kanis JA; Manitoba Bone Density Program. Fracture risk assessment without bone density measurement in routine clinical practice. Osteoporos Int. 2012; 23(1): 75-85.
19. Demir A, Kutlu R, Çivi S. Assessment of 10-Year Major Osteoporotic and Femur Fracture Risk of Postmenopausal Women Using FRAX®. Turk J Phys Med Rehab. 2014; 60(Supp. 1): S11-S18.
20. Pınar G, Pınar T, Doğan N, Karahan A, Algier L, Abbasoglu A, et al. Kırk beş yaş ve üstü kadınlarda osteoporoz risk faktörleri. Dicle Tıp Dergisi. 2009; 36: 258-66.
21. Robitaille J, Yoon PW, Moore CA, Liu T, Irizarry-Delacruz M, Looker AC, et al. Prevalence, family history, and prevention of reported osteoporosis in U.S. women. Am J Prev Med. 2008; 35: 47-54.
22. Burger H, de Laet CE, van Daele PL, Weel AE, Witteman JC, Hofman A, et al. Risk factors for increased bone loss in an elderly population. Am J Epidemiol. 1998; 147: 871-9.
23. Mesci E, Mesci N, İçağasıoğlu A, Madenci E. Postmenopozal Dönemde Obezitenin Ön Kol Kırıkları, Kemik Mineral Yoğunluğu ve Kırık Riski (FRAX®) ile İlişkisi. Turk J Osteoporos. 2016; 22: 80-4
24. Bastos-Silva Y, Aguiar LB, Pinto-Neto AM, Baccaro LF, Costa-Paiva L. Correlation between osteoporotic fracture risk in Brazilian postmenopausal women calculated using the FRAX with and without the inclusion of bone densitometry data. Arch Osteoporos. 2016; 11: 16.
25. Imerci A, Yalın Kılınç C, Aydogan NH, Karalezli MN, Savran A. Fracture Risk Assessment Tool (FRAX®) Results Calculated With and Without Bone Mineral Density Values for the Evaluation of Fracture Risk in Postmenopausal Women With Osteopenia. J Clin Densitom. 2017;3: S1094-6950(16)30259-1.
26. Silverman SL, Calderon AD. The utility and limitations of FRAX: A US perspective. Curr Osteoporos Rep. 2010; 8: 192-7.
27. Atik OS. Osteoporotic fracture risk assesment. Eklem Hastalık Cerrahisi. 2008; 19: 1.
28. Atik OS. Is DXA the gold standard? Eklem Hastalık Cerrahisi. 2011; 22: 63
29. Aslan A, Konya MN, Yağcı S, Karakoyun Ö. FRAX® Türkiye Modeli Yeterli mi? Türk Toplumunda FRAX® ile Osteoporotik Kırık Riski Analizi. Türk Osteoporoz Dergisi. 2014; 20: 21-5.