

## Correlation of FRAX Risk Score and Severity in Osteoporotic Vertebral Fracture

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Yes

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None

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# Correlation of FRAX Risk Score and Severity in Osteoporotic Vertebral Fracture

**Author(s):** Jung M

## Abstract

**Objectives:** To identify the correlation between FRAX risk score and severity of osteoporotic vertebral fracture

**Methods:** The study subjects were 214 in-patients who had osteoporotic vertebral fracture. The subjects were divided into 2 groups according to whether or not they had a BMD score (BMD, non-BMD group). Fracture severity index was calculated from lateral vertebral x-ray film with Genant's semiquantitative method. The correlation between FRAX risk score and fracture severity index were analyzed.

**Results:** Significant correlation was detected between FRAX risk score (major osteoporotic & hip fracture) and fracture severity index in the BMD group ( $r=0.463$ ,  $p < 0.001$ ,  $r=0.446$ ,  $p < 0.001$ ) as well as between FRAX risk score and BMD ( $r=-0.322$ ,  $p < 0.001$ ). There was no correlation in the non-BMD group

**Conclusions:** This study demonstrates a correlation between FRAX risk score and osteoporotic vertebral fracture severity in BMD group.

**Keywords:** FRAX, Osteoporosis, Bone mineral density, Osteoporotic fracture, Compression fracture

## Introduction

Osteoporosis is a progressive bone disease characterized by a decrease in bone mass with microarchitectural change. When bone strength is reduced, it can lead to an increased risk of osteoporotic fracture. Osteoporotic fracture is an important disease in terms of health and economic aspects as it can deteriorate the quality of life by disabling the individual but also can increase the risk of early death [1-4].

Osteoporosis is diagnosed by measuring BMD. Commencement of treatment is also based on the T-score of BMD. However, the absolute frequency of osteoporotic fracture is higher in patients with osteopenia than in patients with osteoporosis, therefore starting treatment based on T score (T-score < -2.5) is problematic because the treatment

timing may be delayed for many patients with fractures. This delay likely increases individual prevalence as well as mortality in addition to increasing the medical cost of the whole society [5]. To this end, new standards have been required for early detection and treatment of osteoporotic fracture.

The WHO fracture risk assessment tool (FRAX tool) is an Internet-based fracture prediction tool developed by the World Health Organization Collaborating Centre for Metabolic Bone Diseases at Sheffield University, UK. FRAX is used to calculate the 10-year probability of hip fracture risk as well as the 10-year probability of a major osteoporotic fracture. The calculation can be performed by entering 12 risk factors including nationality, gender, age, weight, height and BMD into the FRAX web site (<http://www.shef.ac.uk/FRAX>). However, the diagnostic threshold has not yet been established and the study is still in progress. [6].

In this study, we investigated the correlation between FRAX risk score and the severity of osteoporotic fracture. We also examined the correlation of the FRAX model by investigating whether the model can be the prognostic prediction factor of osteoporotic fracture.

## Study Objective

The objective of this study was to observe the statistical significance between FRAX risk score and fracture severity in patients with osteoporotic vertebral fracture and thereafter to identify whether the FRAX model can be used to predict the prognosis of fractures.

## Study Subjects and Methods

**1. Study Population:** The study was conducted as a retrospective study based on medical records of 419 patients who had been hospitalized with osteoporotic vertebral fracture from 2002 to 2012. The age range of the subjects was between 40 and 90 years. The cases with factors likely to affect fracture severity such as those with past history of major trauma, past history of vertebral surgery, and those with suspected vertebral metastasis lesion caused by malignant tumor were excluded from the study. In addition, subjects with

incomplete medical records or illegible images caused by deterioration of quality were excluded, leaving a total of 212 subjects to participate in the study.

**2. Calculation of FRAX Risk Score:** Information was collected for calculation of the FRAX risk score, including gender, age, weight, height, past history of fracture, parental history of hip fracture, current smoking status, history of using steroid agent, rheumatic arthritis, secondary osteoporosis, alcohol consumption  $\geq 3$  units/day and the femoral BMD score. The collected data was entered into the calculation page of the Sheffield University (<http://www.shef.ac.uk/FRAX>) website to determine the FRAX risk score, i. e. the 10-year probability of a major osteoporotic fracture and the 10-year probability of hip fracture risk. Because information on parental history of hip fracture was missing in the medical records of many subjects, the calculation for those subjects was performed with the assumption that there was no parental history of hip fracture.

**3. Classification of Study Subject Group:** Of the 214 subjects, 133 had records on the results of BMD while 81 subjects lacked that information. The study groups were therefore divided in accordance with availability of bone density test results, and the two groups were named BMD group (Group that had calculated FRAX risk scores with information on bone density) and Non-BMD group (Group that had calculated FRAX risk scores without information on bone density).

**4. Assessment of Fracture Severity:** The severity of fracture was assessed by using Genant's semiquantitative method. This method determines the reduction of spinal height visually, assigning a rating of 0 points for no reduction, 1 point (Minimal fracture) for a 20-25% reduction, 2 points for a 25-40% reduction (Moderate fracture) and 3 points for reduction  $\geq 40\%$  (Severe fracture). The points assigned to each spinal bone are aggregated and divided by the number of spinal bones measured. The resulting value is the spinal deformity index used as the severity index of fracture [7]. The measurement range was set from the 4<sup>th</sup> thoracic vertebra down to the 4<sup>th</sup> lumbar vertebra. For subjects with incomplete imaging record for the whole range, the severity index was calculated using only the available portions.

**5. Statistical Analysis:** Among the basic characteristics of the BMD group and Non-BMD group, the continuous variables (age, weight, height, BMI, severity index of fracture, FRAX risk score) were compared with each other using the Student's t-test. Discrete variables were compared with each other using the chi-square test. Severity of fracture, FRAX

risk score, and the correlation between the severity index of fracture and BMD was assessed using Pearson correlation analysis. SAS ver. 5.1 (SAS Institute, Cary, NC, USA) was used for statistical analysis.

## Study Results

**1. Baseline Characteristics of Study Subjects:** The baseline characteristics for a total of 214 subjects are as follows: the mean ages of the BMD and Non-BMD groups were  $74.5 \pm 8.5$  and  $72.5 \pm 9.4$  years old respectively, the mean body weights were  $53.0 \pm 9.5$ kg and  $54.9 \pm 10.4$ kg, BMI were  $22.7 \pm 3.5$ kg/m<sup>2</sup> and  $22.8 \pm 3.8$ kg/m<sup>2</sup>, and the severity indices of fractures were  $0.75 \pm 0.52$  and  $0.73 \pm 0.43$  respectively. These factors presented no significant differences between the two groups. Risk factors also did not significantly differ in both groups. The factors that presented differences in the two groups were height, FRAX risk score (major osteoporotic fractures) and FRAX risk score (hip fracture). The height was  $152.7 \pm 8.0$  cm in the BMD group and  $155.0 \pm 7.3$  cm in the Non-BMD group, FRAX risk score (major osteoporotic fractures) was  $14.3 \pm 7.7\%$  in the BMD group and  $9.2 \pm 4.4\%$  in the Non-BMD group, and FRAX risk score (hip fracture) was  $7.6 \pm 5.7\%$  in the BMD group and  $4.4 \pm 3.1\%$  in the Non-BMD group, presenting significant differences (Table 1).

**2. Analysis of Correlation:** The r value between the severity index of fracture for the BMD group and the FRAX risk score (major osteoporotic fractures) was 0.463 ( $p < 0.001$ ), definite indication of a positive linearity relation, whereas the r value between the severity index of fracture and major FRAX risk scores (hip fracture) was 0.446 ( $p < 0.001$ ), also a definite indication of a positive linearity relation. On the other hand, the r value between the severity index of fracture and BMD was  $-0.322$  ( $p < 0.001$ ), showing a definitely negative linearity relation. There were no significant correlations between the severity index of fracture and FRAX risk score of the Non-BMD group.

## Discussion

Osteoporotic fracture refers to fractures that result from mechanical forces as little as minor compression that would not ordinarily result in fracture. Fragility fractures that are osteoporotic fractures occur most commonly in the spinal vertebrae, hip, femur, and distal radius. They may also occur in the humerus,

pelvis, and other bones. Among these, hip fracture is the most clinically important type of fracture due to high morbidity and mortality. In addition, osteoporotic fracture is associated with limited walking, depression, decreased independence, chronic pain and increased mortality. It is an important condition in terms of health and economic aspects because it increases total medical expenditures [8].

The risk factors of osteoporotic fracture include old age, previous history of fracture, use of steroids, parental history of hip fracture, low weight, excessive alcohol intake, rheumatic arthritis, and secondary osteoporosis. Among them, age, past history of fracture and BMD are known as the strongest risk factors for the likelihood of fracture.

FRAX model is a diagnostic tool used to predict the 10-year probability of bone fracture risk and its usefulness had been verified by several studies so far. However, the intervention threshold for osteoporosis is not yet established [9-10].

In this study, an assessment on the severity index of fracture was performed. The assessment of fracture was limited to spine because the degree of fractures can be measured unlike many other types of osteoporotic fractures. The Genant's semiquantitative method used in this study to assess the severity of fracture is a method widely used in clinical studies due to its simplicity compared to other quantitative methods, high level of precision and lower level of inter-observers errors [11].

We investigated whether there was any correlation between the severity of osteoporotic fracture and FRAX risk scores in this study. From the results, the severity of fracture showed an increase with increasing FRAX risk scores (Definite positive linear relation, osteoporotic fracture and hip fracture,  $r=0.463(p< 0.001)$ ,  $0.446(p< 0.001)$ ), indicating that severity of fracture was related to risk factors for incurrance of fracture to a certain extent. The results also indicate that FRAX risk scores may be a prediction factor for the severity of fracture. Nevertheless further study is required to identify how much the risk factors contribute, which risk factor is related to the severity of fracture, what the risk factors must be to exacerbate the existing fracture and what the risk factors must be to increase the prevalence of new fractures.

FRAX risk scores of the Non-BMD group did not show any correlation with the severity of fracture, in direct conflict with existing study results suggesting that even if calculated without BMD, FRAX risk scores is meaningful on prediction of the probability of fracture

[12]. In addition, the results of this study may suggest that distribution of bone density differs between fracture and the non-fracture patients and therefore bone density must be closely associated with the severity of fracture.

The study was conducted as a retrospective study based on prior medical records of patients and patients were selected as study subjects only if they had detailed disease history records and fracture-related image data. However, this study was partly limited in terms of study design. In the process of selecting study subjects, the selection of patient groups could be likely biased. Also, the fracture sites as well as the number of fractured sites investigated were not all uniform across patients and sometimes, or partial data (parental history of hip fracture, BMD test results) was missing.

## Conclusion

Osteoporotic fracture is a disease involving several simultaneous risk factors. The FRAX model is a predictive probability of fracture calculated using those risk factors. In this study, bone density and FRAX risk scores showed a correlation with the severity of spinal fracture. In conclusion, the bone density and FRAX risk scores appear to be very closely related to the prognosis of osteoporotic fracture, therefore, taking FRAX risk scores into consideration would be more useful in predicting the severity of fracture than the bone mineral density. However, given the limitations in terms of study design, a large scale prospective study may be required.

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## Illustrations

### Illustration 1

Table 1: Basic characteristics and risk factors of study groups

Variables(n=214)	FRAX with BMD (n=133)		FRAX without BMD (n=81)		p-Value
	Mean $\pm$ SD	Range(Min to Max)	Mean $\pm$ SD	Range(Min to Max)	
Age (Yr)	74.5 $\pm$ 8.5	50-90	72.5 $\pm$ 9.4	44 – 90	0.121
Weight (Kg)	53.0 $\pm$ 9.5	34.5 – 80.0	54.9 $\pm$ 10.4	35.0 – 80.2	0.176
Height (Cm)	152.7 $\pm$ 8.0	135.0 – 173.0	155.0 $\pm$ 7.3	140.0 – 180.9	0.036
BMI (Kg/m <sup>2</sup> )	22.7 $\pm$ 3.5	16.0 – 33.4	22.8 $\pm$ 3.8	15.4 – 33.3	0.854
Femoral neck (g/cm <sup>2</sup> )	0.61 $\pm$ 0.11	0.32 – 1.07	NA	NA	NA
Fracture Severity Index	0.75 $\pm$ 0.52	0.08 – 2.67	0.73 $\pm$ 0.43	0.08 – 2.50	0.723
FRAX Risk Score(%) major osteoporotic	14.3 $\pm$ 7.7	2.7 – 37.0	9.2 $\pm$ 4.4	2.6 – 24.0	0.000
FRAX Risk Score(%) hip	7.6 $\pm$ 5.7	0.4 – 29.0	4.4 $\pm$ 3.1	0.2 – 16.0	0.000
Risk factors osteoporosis	No. (%)		No. (%)		p-Value
Sex (Female: Male)	110:23 (82.7 : 17.3 )		61:20 (75.3 : 24.7)		0.190
Previous Fracture	57(42.9)		24(29.6)		0.053
Parent Fractured hip	0 (0)		0 (0)		0.000
Current Smoking	13 (9.8)		13 (16.0)		0.173
Glucocorticoids	6 (4.5)		1 (1.2)		0.191
Rheumatoid arthritis	1 (0.8)		0 (0)		0.434
Secondary osteoporosis	1 (0.8)		1 (1.2)		0.722
Alcohol 3 or more units/day	4 (3.0)		5 (6.2)		0.263

NA: Not Available

## Illustration 2

Table 2. Correlation analysis of fracture index with FRAX risk scores

	Group A			Group B	
	FRAX risk score (major osteoporotic)	FRAX risk score (hip)	BMD	FRAX risk score (major osteoporotic)	FRAX risk score (hip)
r	0.463	0.446	-0.322	0.110	0.106
p-value	<0.001	<0.001	<0.001	0.326	0.344

## Reviews

### Review 1

#### Review Title: Review on Correlation of FRAX Risk Score and Severity in Osteoporotic Vertebral Fracture

Posted by Prof. Kulvinder K Kaur on 01 Feb 2014 05:59:00 AM GMT

1	Is the subject of the article within the scope of the subject category?	
2	Are the interpretations / conclusions sound and justified by the data?	
3	Is this a new and original contribution?	
4	Does this paper exemplify an awareness of other research on the topic?	
5	Are structure and length satisfactory?	
6	Can you suggest brief additions or amendments or an introductory statement that will increase the value of this paper for an international audience?	
7	Can you suggest any reductions in the paper, or deletions of parts?	
8	Is the quality of the diction satisfactory?	
9	Are the illustrations and tables necessary and acceptable?	
10	Are the references adequate and are they all necessary?	
11	Are the keywords and abstract or summary informative?	

**Rating:** 5

**Comment:**

The author has used Genants semi quantitative method to assess the severity of fracture and even other authors like Nayal et al prefer semiquantitative which is easy to replicate than the other methods.

The author has not taken into account the affect of any treatment taken by patients which may affect these scores and in future prospective study it should be taken into account .

**Competing interests:** None

**Invited by the author to make a review on this article? :** Yes

**Experience and credentials in the specific area of science:**

I have been managing postmenopausal women over last 30yrs under the heading gynaecological neuroendocrinology and deal with all sorts of old postmenopausal women with any kind of endocrine problems.

**Publications in the same or a related area of science:** No

**References:**

None

**How to cite:** Kaur K.Review on Correlation of FRAX Risk Score and Severity in Osteoporotic Vertebral Fracture[Review of the article 'Correlation of FRAX Risk Score and Severity in Osteoporotic Vertebral Fracture ' by Jung M].WebmedCentral Obstetrics And Gynaecology 1970;5(2):WMCRW002941

## Review 2

### Review Title: Correlation of FRAX Risk Score and Severity in Osteoporotic Vertebral Fracture

Posted by Prof. Tae-Hee Kim on 30 Jan 2014 01:22:46 AM GMT

1	Is the subject of the article within the scope of the subject category?	
2	Are the interpretations / conclusions sound and justified by the data?	
3	Is this a new and original contribution?	
4	Does this paper exemplify an awareness of other research on the topic?	
5	Are structure and length satisfactory?	
6	Can you suggest brief additions or amendments or an introductory statement that will increase the value of this paper for an international audience?	
7	Can you suggest any reductions in the paper, or deletions of parts?	
8	Is the quality of the diction satisfactory?	
9	Are the illustrations and tables necessary and acceptable?	
10	Are the references adequate and are they all necessary?	
11	Are the keywords and abstract or summary informative?	

**Rating:** 8

**Comment:**

No

**Competing interests:** None

**Invited by the author to make a review on this article? :** Yes

**Experience and credentials in the specific area of science:**

I Won the prize about the ASBMR award in Korea about

**Publications in the same or a related area of science:** Yes

**References:**

Evaluation of the Osteoporosis Health Belief Scale in Korean Women J Bone Metab 2013;20:25-30

**How to cite:** Kim T. Correlation of FRAX Risk Score and Severity in Osteoporotic Vertebral Fracture [Review of the article 'Correlation of FRAX Risk Score and Severity in Osteoporotic Vertebral Fracture' by Jung M]. WebmedCentral Obstetrics And Gynaecology 1970;5(1):WMCRW002925