

Original Research Article

A study on WHO Frax score to predict fracture risk in predialysis patients of chronic kidney disease

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ABSTRACT

Background: Disturbances in mineral and bone metabolism are prevalent in chronic kidney disease (CKD) and are an important cause of morbidity and decreased quality of life. These disturbances include renal osteodystrophy and CKD-Mineral and Bone Disorder (CKD-MBD). The Frax tool developed by WHO is an attempt to better estimate the fracture risk. It calculates a 10 year probability of osteoporotic fractures of spine, forearm, hip or shoulder based on clinical risk factors with or without BMD measurements.

Methods: It is a Cross sectional observational study which was done from 01 November 2013 to 31 March 2015. The study group included 60 cases of pre dialysis Chronic Kidney Disease attending OPD, Emergency or admitted in medicine wards of Dr. RML Hospital, New Delhi. Bone mineral density measured by dual-energy X-ray absorptiometry and all patients were classified according to World Health Organization criteria. DEXA SCAN (manufacturer-Hologic INC.) was done of the lumbar spine, radius bone and neck of the femur. Frax score was calculated as per WHO guidelines.

Results: On using the Indian Frax calculator the average 10 year probability for major osteoporotic fractures in stage 4 ($9.47 \pm 2.62\%$) was found to be significantly higher ($p < 0.0001$) than that in stage 3 ($1.92 \pm 0.8\%$). Similarly, the average 10 year probability for hip fracture in stage 4 ($4.61 \pm 1.45\%$) was also found to be significantly higher ($p < 0.0001$) than that in the stage 3 ($0.75 \pm 0.49\%$).

Conclusions: The study confirmed the high incidence of low BMD in patients of CKD. The 10 year fracture risk in these patients as predicted by Frax score was significantly higher in CKD patients irrespective of whether the Chinese or the Indian calculator was used.

Keywords: Bone mineral density, Chronic kidney disease, Dual energy X ray absorptiometry, World health organization

INTRODUCTION

Chronic Kidney Disease (CKD) is a major cause of global morbidity and mortality in developing countries. The approximate prevalence of CKD is 800 per million populations (pmp), and the incidence of end-stage renal disease (ESRD) is 150-200 pmp.¹ Chronic kidney disease (CKD) is now a public health problem affecting an estimated 10-13% of the world population.^{2,3}

The prevalence of CKD in India has been estimated to range between 0.78% and 0.87%.^{4,5} Disturbances in mineral and bone metabolism are prevalent in chronic kidney disease (CKD) and are an important cause of morbidity and decreased quality of life. These disturbances include renal osteodystrophy and CKD-Mineral and Bone Disorder (CKD-MBD).⁶ Pathogenesis of decreased bone strength in CKD includes several metabolic and hormonal abnormalities, including

decreased renal synthesis of 1,25(OH)2D3, hyperphosphatemia, hypocalcaemia, increased secretion of PTH, chronic metabolic acidosis, premature hypogonadism, and 25(OH) vitamin D deficiency.

All of these adversely affect the bone remodelling process in one or more of the following ways increasing bone resorption, decreasing bone formation or impairing mineralization of osteoid leading to osteoporosis.⁷

Osteoporosis is a disorder characterized by a reduction in bone mass and micro architectural deterioration of bone tissue with an increased risk of fractures.⁸

The disease is considered to be a silent thief as it usually does not become clinically apparent until fracture occurs. Hence, screening of high risk populations is essential.

The Frax tool developed by WHO is an attempt to better estimate the fracture risk. It calculates a 10 year probability of osteoporotic fractures based on clinical risk factors such as (body mass index, fracture history, parental fracture history, presence of secondary causes of osteoporosis, use of glucocorticoids as well as smoking and alcohol consumption) with or without BMD measurements at the femoral neck to give the 10-year probability of a hip fracture and the 10-year probability of a major osteoporotic fracture (clinical spine, forearm, hip or shoulder fracture).⁹

Frax have overall improved the ability of clinicians and researchers to identify individuals at high risk of fragility fractures. However, the performance of this tool in specific subpopulations needs further examination.¹⁰

METHODS

After taking ethical approval from the Institutional Review Board, this study was conducted at the Department of Medicine and Radio diagnosis at PGIMER (Post graduate institute of medical education and research), Dr. RML Hospital New Delhi, India.

It is a Cross sectional observational study which was done from 01 November 2013 to 31 March 2015. The study group included 60 cases of pre dialysis Chronic Kidney Disease attending OPD, Emergency or admitted in medicine wards of Dr. RML Hospital, New Delhi, India.

Inclusion criteria

Pre dialysis patients of Chronic Kidney Disease (GFR <60 mL/min/1.73 m² for 3 months) of Age >40 years with USG findings suggestive of chronic renal disease, Structural abnormalities as markers of kidney damage detected by imaging like Polycystic kidneys, Dysplastic kidneys, Hydronephrosis due to obstruction, Cortical scarring due to infarcts, pyelonephritis or associated with vesicoureteral reflux, Renal masses or enlarged kidneys

due to infiltrative diseases, Renal artery stenosis, Small and hyper echoic kidneys, Duration >3 months, based on documentation or inference, Duration is necessary to distinguish chronic from acute kidney diseases, Creatinine clearance calculated by MDRD formula.

Exclusion criteria

Includes Patients already diagnosed osteoporosis on treatment, Secondary changes in the lumbar area (L1-L4) that produce false BMD measurements, Such as degenerative sclerotic changes, the presence of osteophytes, aortic calcifications, collapsed compression fractures and lumbar prosthesis will be discarded from the data, Patients with skeletal deformities.

After taking thorough history, complete routine and essential investigations of all patients were done. Bone mineral density measured by dual-energy X-ray absorptiometry and all patients were classified according to World Health Organization criteria.

Table 1: WHO working definition of osteopenia and osteoporosis.

Classification	T- Score
Normal	-1 or greater
Osteopenia (low bone mass)	Between -1 and -2.5
Osteoporosis	-2.5 and below
Severe osteoporosis	-2.5 and below + fragility fracture

Body mass index (BMI) was calculated based on the following formula

$$BMI = \frac{\text{Weight (kg)}}{\text{Height (meter)}^2}$$

Blood glucose was determined by the enzymatic method using the reagent kit (Randox, Gluc-PAP, and HITACHI). 25 hydroxy VIT D levels were measured by ELISA. DEXA scan (manufacturer-HOLOGIC INC.) was done of the lumbar spine, radius bone and neck of the femur. Frax score was calculated as per WHO guidelines

Statistical analysis

The analysis was carried out in Microsoft Excel and SPSS software version 17. A p-value of ≤0.05 was taken as level of statistical significance.

RESULTS

The study group included 60 cases of chronic kidney disease with a minimum age of 41 years and maximum of 80 years. The mean age in cases was 57.68±11.32 years. The cases consisted of 27 males and 33 females. The minimum height of the cases was 135cm and the maximum was 168 cm with a mean height of 154.1±6.8cm.

The minimum weight of the cases was 35 kg and maximum weight was 92 kg with a mean weight of 56.08±10.2 kg (Table 2, Figure 1). Majority of patients

(70%) belong to lower middle class and 30% of patients belong to upper middle class based on kuppuswamy's modified scale.

Table 2: Descriptive data of the study group.

	No. of patients	Male	Female	p- value
	60	27	33	>0.05
Age (years)	57.68±11.32	55.03±11.32	59.84±11	>0.05
BMI (Kg/m ²)	23.58±3.87	23.24±4.25	23.93±3.57	>0.05

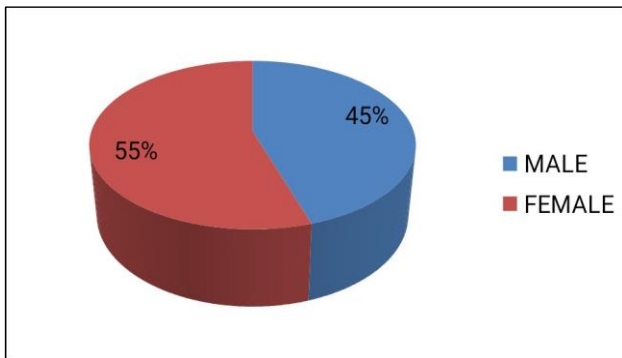


Figure 1: Sex distribution in cases.

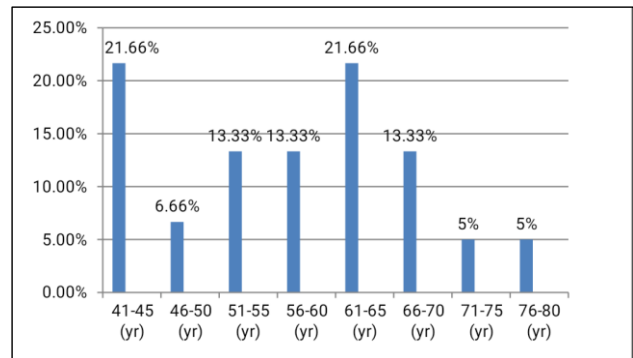


Figure 2: Age distribution of cases.

Table 3: Frax Score WHO calculator (Indian calculator).

		Stage 3 (n=30)	Stage 4 (n=30)	p- value
Major osteoporotic fracture risk %	5.82±4.61	1.92±0.8	9.47±2.62	<0.0001
Hip fracture risk %	2.68±2.55	0.75±0.49	4.61±1.45	< 0.0001

On using the Indian Frax calculator the average 10 year probability for major osteoporotic fractures in stage 4 (9.47±2.62%) was found to be significantly higher (p<0.0001) than that in stage 3 (1.92±0.8%).

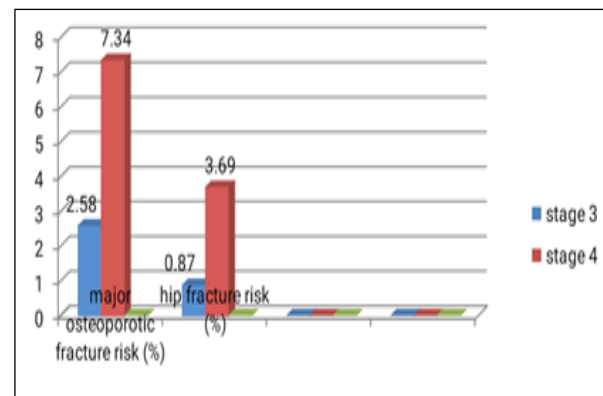


Figure 4: Frax Score WHO calculator (Indian).

Similarly, the average 10 year probability for hip fracture in stage 4 (4.61±1.45%) was also found to be significantly higher (p<0.0001) than that in the stage 3 (0.75±0.49%) (Table 3).

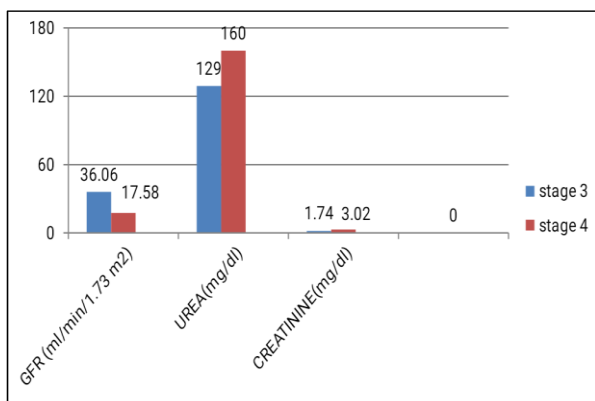


Figure 3: Renal parameters in the study group.

DISCUSSION

Our present study is a cross sectional study performed over duration of one year, on 60 CKD patients (27 males and 33 females) above the age of 40 years. The patients were analysed for various clinical risk factors of Frax SCORE and BMD. Frax SCORE was calculated using the WHO guidelines.

Osteoporotic fractures are associated with excess mortality. Low bone mineral density (BMD) is the basis for the diagnosis of osteoporosis. It is an important determinant of fracture risk. Several other clinical risk factors are known that operate partially or completely and independent of BMD and affect the fracture risk. These include age, prior fragility fractures, and parental history of hip fracture, use of corticosteroids, excess alcohol intake, rheumatoid arthritis, and different types of diseases which can cause secondary bone loss.

The Frax tool integrates the weight of above mentioned clinical risk factors for fracture risk assessment with or without BMD values and calculates the 10-year absolute risk of hip and major osteoporotic (hip, vertebral, humerus and forearm together) fracture probabilities.

In this present study, 45% of CKD patients had osteopenia and 48.33% patients had osteoporosis. The prevalence of osteopenia in our study is similar to study done by Taal MW et al, at Boston, USA and by A. Polymeris et al, at UK and by Z. Jabbar et al, at Postgraduate Institute of Medical Education and Research, Chandigarh, India.¹¹⁻¹³

The prevalence of osteoporosis was higher in our study which could be attributed to the higher age group of our study population and more female patients in our study.

Mean BMD in this study was 0.596 ± 0.115 which was similar to found in study done by Z. Jabbar et al and by Marianne Rix et al.¹⁴

In this study vitamin D deficiency and insufficiency were seen in 93.33% and 6.66% patients respectively which were very similar to a study by Beena Bansal et al, in which vitamin D deficiency and insufficiency were seen in 88.9% and 6.7% respectively. The mean vitamin D level was found 14 ± 4.19 which was close to a study by B. Ghosh, et al, and by Mohd Rozita et al.¹⁵⁻¹⁷

In this study BMD and T-score in stage 3 and stage 4 were significantly different. While Previously conducted study done by Z. Jabbar et al had similar view.

Authors observed a good correlation of BMD with iPTH, vitamin D, GFR, Frax score. This is consistent with previous studies and supported the biological significance of these results. In this study authors observed a good correlation of GFR with iPTH, Serum calcium and phosphorus. This was consistent with other studies.

In this study on using the Indian Frax calculator the average 10 year probability for major osteoporotic fractures in CKD stage 4 ($9.47 \pm 2.62\%$) was found to be significantly higher ($p < 0.0001$) than that in CKD stage 3 ($1.92 \pm 0.8\%$). Similarly, the average 10 year probability for hip fracture in CKD stage 4 ($4.61 \pm 1.45\%$) was also found to be significantly higher ($p < 0.0001$) than that in the CKD stage 3 ($0.75 \pm 0.49\%$).

Limitations of the study number of subjects included in the study was only sixty. Moreover, they were all patients attending the same hospital. Hence, the study population may not be representative of the general population.

Some of the clinical risk factors for osteoporosis included in the Frax calculator also contribute to disease severity in CKD patients (e.g. Rheumatoid arthritis, steroids use). This could have led to confounding.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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