

Original Research Article

## Osteoporosis- Do We Need to Think Beyond Bone Mineral Density?

Dr Preeti Soni<sup>1</sup>, Dr Shipra Chaudhary<sup>2</sup>, Dr U Singh<sup>3</sup>

<sup>1</sup>Senior Resident, Delhi State Cancer Institute, Dilshad Garden, New Delhi, India. 110095

<sup>2</sup>Assistant Professor, PGIMER and Dr RML Hospital, New Delhi, 110001

<sup>3</sup>Professor and Head, Department of PMR, AIIMS, New Delhi, 110029

Corresponding Author: Dr Preeti Soni

### ABSTRACT

**Introduction-** Fracture is the most concerned clinical outcome of osteoporosis, but recently it has been found that most fragility fracture occurs in patients with either normal or osteopenic Bone Mineral Density (BMD) scans. This warrants us to look for factors beyond BMD alone for bone strength. Country specific WHO-Fracture Risk Assessment Tool (FRAX) has emerged as a promising and validated tool to assess probability of fragility fracture.

**Materials and Methods-** In this Cross sectional study, eighty patients with BMD prescribed elsewhere or in our OPD were recruited. Ten were excluded on the basis of age being less than 40 years. Demographic data, BMD test report measured by DXA scan and risk factors included in WHO-FRAX tool were recorded for the remaining 70 patients. Ten year probability of major osteoporotic fracture and hip fracture was assessed using country specific WHO-FRAX tool.

**Results-** Excel 2007 and STATA 14 were used for data analysis and curve comparison. Mean age was  $61.37 \pm 11.06$  years and male to female ratio was 1:3. Mean T score at Spine was  $1.86 \pm 1.72$  and Mean T score at Hip was  $1.8 \pm 1.12$ . Out of 15 patients showing normal BMD at hip, 4 (26.7%) had low BMD at spine and out of 55 subjects with low BMD at hip (osteopenia and osteoporosis), FRAX picked up only 2 cases at risk of major osteoporotic fracture in coming ten years.

**Discussion-** To our knowledge, this is the first gender unbiased report of FRAX score of native Indian population. We found that FRAX is more sensitive to predict treatment threshold in osteoporotic hip rather than osteopenic hip and FRAX under-estimates ten year major osteoporotic fracture risk (including spine fracture) in Indian population.

**Conclusion-** FRAX has a major role in predicting fracture risk but it has its inherent flaws. It does not replace good clinical judgment by health care practitioner. Besides FRAX, We should always look for other Clinical Risk Factors (CRFs) and guide our treatment accordingly.

**Key words-** Osteoporosis, Bone mineral density, DXA Scan, India, WHO Fracture Risk Assessment tool.

### INTRODUCTION

Osteoporosis is defined as a skeletal disorder characterized by compromised bone strength predisposing to an increased risk of fracture. <sup>(1)</sup>

WHO classified osteoporosis based on Bone Mineral Density (BMD) T score of Dual energy X ray Absorptiometry (DXA) machine, where T score more than -1 is considered as normal, between -1 to -2.5 is

osteopenia or low bone mass and less than -2.5 is considered as osteoporosis. <sup>(2)</sup>

Asian audit of International Osteoporosis Foundation had estimated that in 2013, fifty million Indians were either osteopenic or osteoporotic with incidence rate of osteoporotic fracture was around 34.3 per one lakh population. <sup>(3)</sup> The Delhi Vertebral Osteoporosis Study (DeVOS) (2012) estimated prevalence of vertebral

fracture 17.1% in 415 females subjects age 50 years and above. <sup>(4)</sup> In a Rohtak based study (2013), hip fracture rates in women above 50 years of age were found around 159 per one lakh. <sup>(5)</sup> Though we have not come across any nationwide Indian epidemiological data on fracture prevalence, with increasing longevity, osteoporotic fractures could be a major cause of morbidity and mortality in elderly Indians. <sup>(6)</sup>

Cut off limit set in WHO classification for osteoporosis is actually not the cut off limit for osteoporotic fractures as studies have shown that most osteoporotic fractures occurred in individuals with T score well above WHO operational threshold for osteoporosis. <sup>(7)</sup> Besides low bone density, there are many other risk factors for osteoporosis. National Osteoporotic Foundation (NOF) has given a long list of osteoporotic risk fractures, a few of them are genetic, hypogonadal, endocrinal, rheumatological and life style risk factors including low calcium intake, Vitamin D deficiency, high caffeine intake, smoking, falling, thinness and alcohol intake etc. <sup>(8)</sup>

WHO Fracture Risk Assessment Tool (FRAX) was developed by WHO metabolic disease group in 2008 to improve fracture prediction rate by adding clinical risk factors with bone mineral density measured by DXA. FRAX is a web based algorithm. Country specific FRAX tools are available on <http://www.shef.ac.uk/FRAX>, that computes the 10-year probability of hip fracture and major osteoporotic fracture, here major osteoporotic fracture is defined as a clinical spine, hip, forearm, and proximal humerus fracture. <sup>(9)</sup>

Besides femoral neck BMD, risk factors included in FRAX are Current age, rheumatoid arthritis, Secondary osteoporosis, prior osteoporotic fracture (including morphometric vertebral fracture), parental history of hip fracture, current smoking, low body mass index, alcohol intake (3 or more drinks per day), oral

glucocorticoids ( >5 mg/day of prednisone for >3 months).

National Osteoporosis Foundation (NOF) recommended indication of use of FRAX tool are- when there are uncertainty to start treatment for osteoporosis, post menopausal women or men 50 years or older, T score between -1 to -2.5, patients who are not on treatment for osteoporosis and who do not have any spine or hip fracture. Drug treatment for osteoporosis is recommended when 10 year probability exceeds 20% for major osteoporotic fracture and 3% for hip fracture. <sup>(8)</sup>

FRAX performance characteristics have been studied and validated in many independent studies but most of these cohorts concerned only elderly women and have mainly focused on hip fracture. <sup>(10,11)</sup> There are only a few Indian studies on use of FRAX tool. <sup>(12,13)</sup>

We aimed to study ten years probability of major osteoporotic and hip fracture using WHO FRAX tool in urban tertiary care center in India and also to evaluate performance characteristics of WHO FRAX tool in comparison to DXA BMD in Indian scenario at our tertiary care hospital setting.

## **MATERIALS AND METHODS**

We conducted this cross sectional observational study in the department of Physical Medicine and Rehabilitation, AIIMS, New Delhi in patients with BMD prescribed elsewhere or in our department. We excluded patients who already had any spine or hip fracture, patients below 40 years of age, those who were already on anti-resorptive drugs for osteoporosis and who were non- Indian in origin.

We initially recruited 80 subjects, of which ten were excluded based on exclusion criteria (seven were below forty years and three were already on treatment for osteoporosis). Demographic data (age, gender, height and weight), hip BMD test report and clinical risk factors (CRFs) included in FRAX tool were recorded for remaining seventy patients.

### Statistical analysis

Excel 2007 and STATA 14 were used for data analysis. Chi square or Fischer exact tests were used to find factors associated between qualitative variables. P value <0.05 was considered significant.

### RESULTS

We analyzed the data of seventy men and women aged 41 to 83 years. Mean age was 61.37± 11.6 years with male to female ratio 1:3 (17 male and 53 female). Twenty five patients had normal Body Mass Index (BMI < 25), twenty eight were overweight (BMI between 25 to 29.9) and seventeen patients were obese (BMI >30).

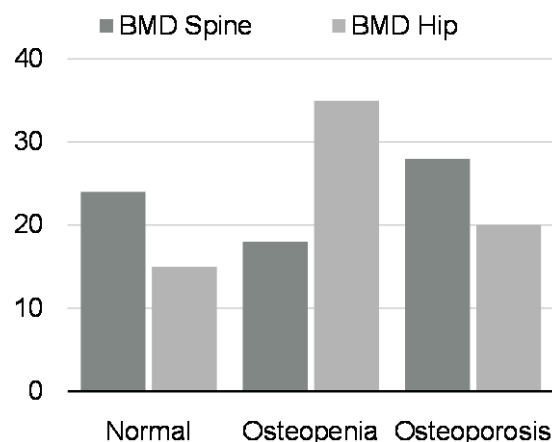
Mean T score recorded at spine was -1.86±1.72 and at hip -1.8±1.12 with minimum T score at spine was -6.1 and at hip it was -4.2.

Out of seventy, twenty four subjects had normal BMD at spine and fifteen subjects had normal BMD at hip. Out of these fifteen, eleven subjects also had normal BMD at spine and of remaining four, three showed osteopenia and one showed osteoporosis at spine. These four subjects draws our special attention as despite having low BMD, these were not included in fracture risk assessment in FRAX tool as it consider only hip BMD.

FRAX hip and BMD at hip were highly associated (p<0.001) with ten year probability of fracture prediction in FRAX at hip (>3%) increased with decreasing BMD in DXA, and we found that FRAX effectively predicted fracture risk in osteoporotic BMD rather than osteopeniac BMD as FRAX scored >3% in 15 subjects out of 20 in osteoporotic BMD and only one out of 35 osteopeniac BMD. This may be contrary to the NOF recommendation which stated that FRAX is the most useful tool in osteopenia. (8)

When association between hip BMD and FRAX major osteoporotic fracture was plotted, we found that out of 55 patients who had low BMD (35 Osteopenic and 20 osteoporotic), FRAX considered only two

subjects at ten years risk of osteoporotic fracture.



Graph 1- BMD distribution

Table1- BMD hip versus BMD spine

BMD spine	BMD Hip			Total
	Normal	Osteopenia	Osteoporosis	
Normal	11	11	2	24
Osteopenia	3	11	4	18
Osteoporosis	1	13	14	28
Total	15	35	20	70

Table 2- BMD Hip versus FRAX Hip

BMD Hip	FRAX Hip		Total
	<3%	>3%	
Normal	15	0	15
Osteopenia	34	1	35
Osteoporosis	5	15	20

Table3- BMD hip versus FRAX major osteoporotic fracture

BMD Hip	FRAX Major Osteoporotic Fracture		Total
	<20%	>20%	
Normal	15	0	15
Osteopenia	35	0	35
Osteoporosis	18	2	20

### DISCUSSION

To our knowledge, this was the first gender unbiased study of use of WHO FRAX tool in native Indian population, as previous reports included either elderly women or men and were not on native Indian patients. (12, 13)

In this study, we found some interesting results with the use of FRAX tool - FRAX may be sensitive to predict treatment threshold in osteoporotic hip but not in osteopenic hip and FRAX underestimates ten year probability of major osteoporotic fracture (including spine fracture) in Indian population.

Our results were similar to the study done by Daswani et al. in 506 apparently healthy postmenopausal Indian women, who found that out of 152 osteoporotic women, only 19 were eligible for medical therapy, based on their FRAX score, with only one woman had major osteoporotic fracture (MOF) risk >20% and 19 had hip fracture risk >3%. They also concluded that FRAX based fracture threshold were specific but not sensitive for Indian women and suggested that threshold for medical treatment for osteoporosis need to be recalibrate in Indian population. (12) Japanese committee also noted that FRAX underestimate fracture risk in Japanese population and recommended a cut off value of 15% instead of 20% as treatment threshold. (14)

Discrepancy may be attributed to high prevalence of other risk factors in Indian population that are not included in Clinical Risk Factors (CRF) in WHO FRAX, of which calcium and vitamin D deficiency is the major contributing factor to poor bone health in India. Other risk factors such as low peak bone mass in adulthood, poor nutrition may also present.

BMD reports included in our study were from different DXA machines including both Hologic and Lunar, as we included all the patients who already had BMD reports or were advised in our institute, but this could be acceptable as it was not a longitudinal study and we had clearly mentioned the type of DXA machine for each patient while calculating FRAX score.

## CONCLUSION

Based on previous literature and our results, we can conclude that FRAX has major role in predicting osteoporotic fracture risk but it has some inherent flaws and it does not replace a good clinical judgement by health care practitioner. Besides FRAX, we should always look for other clinical and laboratory risk factors and guide our treatment accordingly.

Though it was a cross sectional study with small sample size, we look forward for some multi centric longitudinal studies with bigger sample size to evaluate validity of FRAX tool in the Indian scenario.

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How to cite this article: Soni P, Chaudhary S, Singh U. Osteoporosis- do we need to think beyond bone mineral density? *Int J Health Sci Res.* 2017; 7(10):97-101.

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