International Journal of Medicine Research
ISSN: 2455-7404
www.medicinesjournal.com
Volume 3; Issue 3; July 2018; Page No. 58-65

A study of WHO FRAX score to predict Fracture risk in Indian type 2 diabetics

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Abstract
Objectives: The present study was done to evaluate the bone mineral density and calculate the WHO FRAX score in type 2 diabetic patients.
Methods: The present study comprised of a total of 120 diagnosed cases of type-2 Diabetes Mellitus (68 males and 52 females), who were evaluated by detailed history, clinical examination, biochemical parameters (including VIT. D levels), and finally screened for Bone mineral density by DEXA SCAN. These cases were then analyzed for the FRAX SCORE available online.
Results: The mean age of the study group was 59.15 years and the mean duration of Diabetes Mellitus was 8.55 years. 19.16% and 25% of the cases were smoker and alcoholic respectively. The mean HbA1c of males was 8.36 and that of females was 7.87 while for the overall study group was 8.14, poor glycaemic control (HbA1c≥9.5) was seen in 19.16% of the total cases. Strict glycaemic control (HbA1c<7%) was seen in only 30% of the study population.
The mean cholesterol, serum triglycerides serum HDL, serum LDL and serum VLDL were 148.90, 133.14, 41.94, 72.3, 29.34 mg/dl respectively. The mean serum vitamin d level for males was 30.58nmol/L and for females was 29.25nmol/L while for the overall was 30nmol/L. 3% had optimal serum VIT D levels, 68% were having insufficiency while 29% were deficient.
The mean BMD was 0.682 gm/cm^2 and the mean T score was -1.63. 34(28.33%) cases out of 120 had T score ≥-1(NORMAL BMD) while 58(48.33%) cases had T score between -1 and -2.5(OSTEOPENIA) and 28(23.33%) cases had T score ≤-2.5(OSTEOPOROSIS).When FRAX score was calculated using the Indian calculator , major osteoporotic fracture had a mean value of 5.485 and hip fracture had a mean of 2.01.
VIT.D level was having a significant positive correlation with BMD. BMD was having a significant positive correlation with total cholesterol level.
Conclusion: Type 2 diabetics are prone to increased fracture risk as measured by the FRAX score. Only 3% of the total cases in the present study had optimal serum VIT D levels and 28% had their BMD in the normal range. Serum vitamin D levels have positive correlation with BMD and hence their maintenance in the normal range is essential. Type 2 Diabetics should also take measures to contain their serum cholesterol levels as higher levels are associated with decreasing BMD.

Keywords: type 2 diabetics, fracture risk, WHO FRAX score

Introduction
Diabetes Mellitus (particularly type 2) and osteoporosis are two very common disorders, and both are increasing in prevalence. Adolescents with type 1 Diabetes Mellitus may not reach potential peak bone mass, putting them at greater fracture risk. In adults with type 2 Diabetes, fracture risk is increased and is not explained by the bone mineral density measured by dual-energy X-ray absorptiometry, still considered the gold standard predictor of fracture[1]. In women over 45, osteoporosis accounts for more days spent in hospital than many other diseases, including diabetes, myocardial infarction and breast cancer [2]. It is estimated that only one out of three vertebral fractures come to clinical attention [3]. The prevalence of Diabetes Mellitus has increased exponentially over the past years, with 200 million people currently suffering from Diabetes Mellitus. It is estimated that the prevalence worldwide will exceed 360 million patients in 2030.The major contribution to this population is by type-2 Diabetes Mellitus [4]. According to the World Health Organization estimates (2004), India had 32 million diabetic subjects in the year 2000 and this number would increase to 80 million by the year 2030. The International Diabetes Mellitus Federation (2006) also reported that the total number of diabetic subjects in India was 41 million in 2006 and that this would rise to 70 million by the year 2025. This means by that time India will contribute to more than one fifth (20%) of the total diabetic population of the world [5].
Even though the majority of diabetic population is presently from urban population; the scenario is changing rapidly due to socio-economic transition occurring in the rural areas. Also decreased physical activities and better economic conditions have produced changes in diet habits. The conditions are more favourable for expression of Diabetes Mellitus in Indians, who already have a racial and genetic susceptibility for the disease [6].
Although patients with type 2 diabetes (T2DM) have an increased risk of hip fracture as concluded in many studies, risk of vertebral fracture (VF) and its association with BMD are still unclear. T2DM patients may have an increased risk of VFs independent of BMD or diabetic complication status,

suggesting that bone quality may define bone fragility in T2DM[7].

The BMD of hip is lower in diabetics compared with age and BMI-matched non-diabetic men, and its level is similar in age and BMI-matched diabetics and non-diabetic men with metabolic syndrome. This suggests that both diabetes and metabolic syndrome are associated independently with higher osteoporosis and lower BMD of hip and are risk factors for increased incidence of hip fractures in men [8].

The relationship between diabetes and osteoporosis is complex and, although it has been investigated extensively, the subject remains controversial. While low bone mineral density (BMD) is consistently observed in type 1 diabetes, the relationship is less clear in type 2 Diabetes, with some studies reporting modestly increased or unchanged BMD. Both type 1 and type 2 diabetes have been associated with a higher risk of fractures. Despite discrepancies between BMD and fracture rates, clinical trials uniformly support the fact that new bone formation and bone microarchitecture and, thus, bone quality, are altered in both types of diabetes. Although a causal association between diabetes and osteoporosis cannot be established on the basis of existing data, it is possible to conclude from many studies and from a better understanding of the physiopathology of diabetes that it can increase the risk of fractures through skeletal (decreased BMD and bone quality) and extraskeletal (increased risk of falls etc) factors[9].

The most widely used tool in osteoporosis diagnosis and follow-up is bone mineral density (BMD) measured by dual-energy X-ray absorptiometry (DEXA) which has a strong correlation with the fracture risk [10]. In attempt to better estimate fracture risk the World Health Organization (WHO) developed the FRAX tool which calculates a 10 year probability of osteoporotic fracture 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 status and alcohol consumption with or without BMD measurements [11].

So by predicting the fracture risk, appropriate therapy can be instituted in the high risk group.

Materials and Methods

Study was conducted at department of Medicine, Radiodiagnosis, Biochemistry, at PGIMER (Post graduate institute of medical education and research), Dr RML Hospital New Delhi.

Study Period: November 2011 to February 2013

Study Design: cross sectional observational study

Study Group: The study group included 120 consecutive cases of type 2 Diabetes mellitus {according to WHO criterion}of >50 years of age attending OPD ,Emergency Dept. or admitted in Medicine Wards of Dr.RML Hospital, New Delhi

Inclusion Criteria

- Age > 50 yrs.
- All the patients of type 2 Diabetics for more than 1 year duration were enrolled into the study after informed consent.

Exclusion Criteria

- Osteoporotics taking bisphosphonates, teriparatide, calcitonin and hormonal therapy were excluded.
- 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 were discarded from the data.
- Patients with skeletal deformities.
- Uncooperative patients.

Methodology

The patients were evaluated as per the standard protocol specially concentrating on history, physical examination, baseline routine investigations like Hemogram (ESR, Hb, TLC, DLC, Platelet count, TRBC count, PCV) ,FBS,PPBS 2 hrs after 75 g of glucose load, LFT, KFT, Serum Proteins, Chest X-Ray, USG Abdomen, lipid profile, ECG, Vitamin D levels

HBA_{1C} levels using High Performance Liquid Chromatography Dexa Scan (manufacturer-HOLOGIC INC.) was done of the lumbar spine, radius bone and neck of the femur and 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.

Definitions for the present study-

Diabetes

- Case definition of type 2 DM was based on the WHO guidelines.

Criterion for the diagnosis

Diabetes Mellitus was diagnosed by demonstrating any one of the following:

- Fasting plasma glucose level $\geq$ 7.0 mmol/L (126 mg/dL).
- Plasma glucose $\geq$ 11.1 mmol/L (200 mg/dL) two hours after a 75 g oral glucose load as in a glucose tolerance test.
- Symptoms of hyperglycemia and casual plasma glucose $\geq$ 11.1 mmol/L (200 mg/dL).
- Glycated hemoglobin (Hb A1C) $\geq$ 6.5%.

HbA1c-

Strict glycaemic control- <7%
Good glycaemic control- $\leq$ 8.5%
Fair glycaemic control- 8.5% - 9.5%
Poor glycaemic control- $\geq$ 9.5%

Serum 25 Hydroxy Vit D Levels- As mentioned in the table 1 below.

Table 1: Classification of Vitamin D status by 25(OH)D Concentration [a, b]

25(OH)D Concentration	Classification
≤ 10 ng/ml	Deficient
11-20 ng/ml	Insufficient
>20 ng/ml	Optimal

a: 25(OH)D = 25-hydroxyvitamin D.
b: To convert from ng/ml to nmol/L, multiply by 2.496

Bone mineral density

- World Health Organization criteria for classification of patients with bone mineral density measured by dual-energy X-ray absorptiometry-

Table 2: Classification of patients as per T score

Classification	T-score
Normal	-1.0 or greater
Low bone mass (osteopenia)	Between - 1.0 and -2.5
Osteoporosis	-2.5 and below
Severe osteoporosis	-2.5 and below + fragility fracture

Results

The data obtained was analyzed to look for the clinical risk factors, VITAMIN D levels and BMD in type 2 Diabetic cases of over the age of 50 years. FRAX SCORE was calculated to predict the fracture risk. The mean, standard deviation of the common variables and other descriptive data are mentioned in the table 3 given below, while the co-relation was done between different variables namely as given in table 4-

Table 3: Descriptive data of the study group (Sex wise 1= Male; 2=Female)

		N	Mean	Std. Deviation
Age(years)	1	68	59.76	7.440
	2	52	58.37	6.499
	Total	120	59.16	7.053
Duration of diabetes(years)	1	68	8.03	5.800
	2	52	9.23	7.006
	Total	120	8.55	6.351
HbA1c(%)	1	68	8.360294	2.0261823
	2	52	7.871154	2.0595389
	Total	120	8.148333	2.0465993
Total cholesterol(mg/dl)	1	68	146.75	48.303
	2	52	151.73	43.206
	Total	120	148.91	46.042
Triglyceride(mg/dl)	1	68	130.31	52.898
	2	52	136.85	54.821
	Total	120	133.14	53.611
LDL(mg/dl)	1	68	77.485	22.8692
	2	52	65.531	26.0188
	Total	120	72.305	24.8995
VLDL (mg/dl)	1	68	26.500	11.9132
	2	52	33.065	27.6060
	Total	120	29.345	20.4252
HDL(mg/dl)	1	68	42.21	11.996
	2	52	41.60	11.141
	Total	120	41.94	11.589
Vit.D(nmol/L)	1	68	30.586765	9.2728766
	2	52	29.250000	10.7857113
	Total	120	30.007500	9.9353554
BMD(gm/cm^2)	1	68	.696074	.1265320
	2	52	.665038	.1528801
	Total	120	.682625	.1388144
T score	1	68	-1.554412	.9047856
	2	52	-1.750000	1.2052988
	Total	120	-1.639167	1.0454620
Major Osteoporotic fracture(china)	1	68	4.563235	3.7837005
	2	52	4.757692	2.9994997
	Total	120	4.647500	3.4533618

Hip fracture (china)	1	68	1.720588	2.5586003
	2	52	1.444231	1.7881323
	Total	120	1.600833	2.2527852
Major osteoporotic fracture (india)	1	68	5.125000	4.2755597
	2	52	5.955769	4.2686460
	Total	120	5.485000	4.2746202
Hip fracture(india)	1	68	2.169118	3.1852860
	2	52	1.801923	2.1155345
	Total	120	2.010000	2.7683809

Table 4: Co-relational analysis

Correlations							
		Total Cholesterol	**Triglyceride**	**LDL**	**VLDL**	**HDL**	**Vit.D**
Total Cholesterol	Pearson Correlation	1	.422**	.443**	.352**	.481**	.014
	Sig. (2-tailed)		.000	.000	.000	.000	.876
	N	120	120	120	120	120	120
Triglyceride	Pearson Correlation	.422**	1	.394**	.263**	.078	-.053
	Sig. (2-tailed)	.000		.000	.004	.396	.568
	N	120	120	120	120	120	120
LDL	Pearson Correlation	.443**	.394**	1	-.147	.180*	.035
	Sig. (2-tailed)	.000	.000		.109	.049	.704
	N	120	120	120	120	120	120
VLDL	Pearson Correlation	.352**	.263**	-.147	1	.120	-.020
	Sig. (2-tailed)	.000	.004	.109		.192	.829
	N	120	120	120	120	120	120
HDL	Pearson Correlation	.481**	.078	.180*	.120	1	.071
	Sig. (2-tailed)	.000	.396	.049	.192		.444
	N	120	120	120	120	120	120
Vit.D	Pearson Correlation	.014	-.053	.035	-.020	.071	1
	Sig. (2-tailed)	.876	.568	.704	.829	.444	
	N	120	120	120	120	120	120
BMD	Pearson Correlation	-.190*	-.006	.112	-.108	-.099	.406**
	Sig. (2-tailed)	.038	.948	.225	.241	.283	.000
	N	120	120	120	120	120	120
Family history of Diabetes Mellitus	Pearson Correlation	.107	.149	.056	-.036	-.005	-.024
	Sig. (2-tailed)	.245	.103	.547	.695	.960	.795
	N	120	120	120	120	120	120
Duration of Diabetes Mellitus	Pearson Correlation	.158	-.085	-.161	.107	.133	.147
	Sig. (2-tailed)	.086	.358	.080	.244	.149	.109
	N	120	120	120	120	120	120

*. Correlation is significant at the 0.05 level (2-tailed)
**. Correlation is significant at the 0.01 level (2-tailed).

4 patients out of 120 had optimal VIT D levels (>50 nmol/L), 81 had insufficiency (>25 – 50 nmol/L) and 35 patients were deficient (≤25 nmol/L).

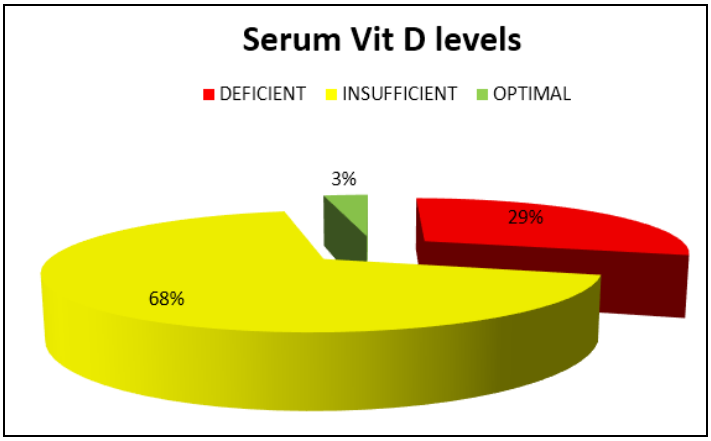

Fig 1: Classification of study group as per Vitamin D levels

The minimum height of the cases was 143cm and the maximum was 180 cm with the mean height of 161.02cm and standard deviation of 8.382 cm. The minimum weight of the subjects was 38 kg and maximum weight was 85 kg with the mean weight of 63.825 kg and standard deviation of 10.361 kg

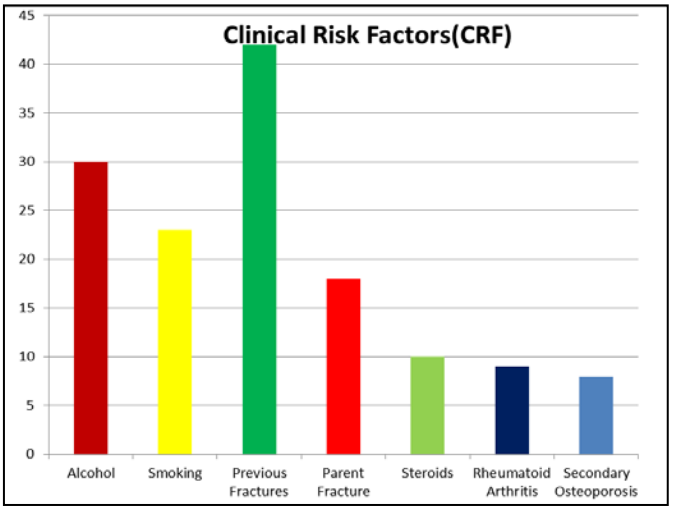

Fig 2: Prevalence of Clinical Risk Factors in the study group

The minimum serum vitamin D level was 3.7nmol/L and the maximum level was 65.3 nmol/L with the mean value of 30.007nmol/L and standard deviation of 9.93 nmol/L. The minimum BMD in gm/cm^2 was 0.426 while the maximum was 1.14.The mean was 0.682 and the standard deviation was 0.138.

The minimum of T score was -3.8, while the maximum was 2.6 and the mean value of T score was -1.63. 34(28.33%) cases out of 120 had T score ≥-1 while 58(48.33%) cases had T score between -1 and -2.5 and 28(23.33%) cases had T score ≤-2.5.

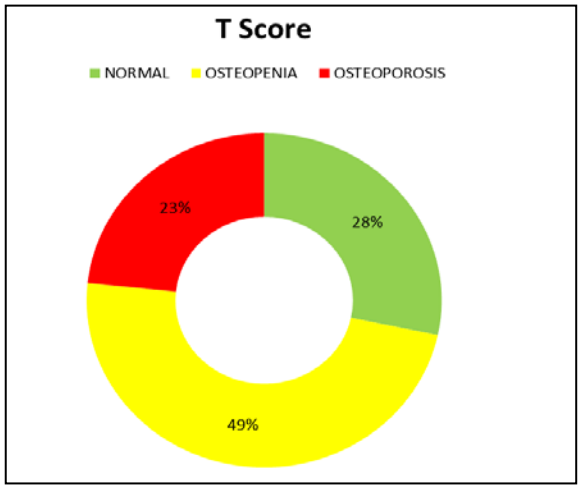

Fig 3: Classification of BMD in the study group

FRAX score was calculated using the Indian calculator online by using the same variables and the values were-

- Major osteoporotic fracture had a minimum value of 1.1, while the maximum value was 26.The mean value was 5.485.
- Hip fracture had a minimum value of 0, maximum value of 21 and the mean was 2.01.
- For the 28 patients who had their T score in the osteoporotic range, the mean value of FRAX SCORE (Indian)was –
  Major osteoporotic – 9.02
  Hip – 4.9

Total cholesterol level was having a significant positive correlation with triglyceride, LDL levels, VLDL levels, HDL levels and negative correlation was significant with BMD levels.

Triglyceride level was having a significant positive correlation with total cholesterol, LDL levels and VLDL levels. LDL level was having a significant positive correlation with total cholesterol , triglycerides and HDL levels VLDL level was having a significant positive correlation with total cholesterol and triglyceride levels HDL level was having a significant positive correlation with total cholesterol and LDL levels.

VIT.D level was having a significant positive correlation with BMD and BMD was having a significant positive correlation with total cholesterol level.

Discussion

Osteoporotic fractures are associated with excess mortality. Effective treatment options are available, which reduce the risk of vertebral and non-vertebral fractures, but the identification of patients with high fracture risk is problematic. Several clinical risk factors are know that operate partially or completely independently of BMD, and affect the fracture risk. These include age, a prior fragility fracture, a 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 value, and calculates the 10-year absolute risk of hip and major osteoporotic (hip, vertebral, humerus and forearm together) fracture probabilities. Although the use of data is not yet uniform, the FRAX is a promising opportunity to identify individuals with high fracture risk [14].

Type 2 diabetes is associated with higher bone density (BMD) and, paradoxically, with increased fracture risk. It is not known if low BMD, central to fracture prediction in older adults, identifies fracture risk in diabetic patients. However, because T2DM is, paradoxically, associated with higher BMD and increased fracture risk, there is concern that these established methods for predicting fractures may not perform adequately in patients with T2DM.There is a need to clarify the utility of standard methods for assessing fracture risk in this expanding population of older adults.

There are no prospective studies available on prediction of fracture in those with T2DM using BMD T-scores or FRAX.

In a study done by Shwartz *et al.* they utilized data from three prospective observational studies with adjudicated fracture outcomes, the Study of Osteoporotic Fractures, the Osteoporotic Fractures in Men study, and the Health, Aging and Body Composition Study, to assess the associations of BMD T-score and FRAX with hip and non-spine fracture risk in older adults with T2DM. Those using insulin are reported to have a higher fracture risk, so their results were stratified by

insulin use. In this first study to prospectively examine the relationship between BMD and fracture in older adults with type 2 diabetes, they found that lower Femoral Neck BMD and higher FRAX score were associated with hip and non-spine fracture risk. The ability of Femoral Neck BMD T-score or FRAX score to predict fracture is similar in those with and without diabetes. However, for a given T-score and age, those with diabetes had a higher risk of fracture than those without diabetes, consistent with previous reports. Diabetic participants also experienced higher fracture rates at a given FRAX score than non-diabetic participants.

However, interpretation of T-score or FRAX score in an older diabetic patient must take into account the higher fracture risk associated with diabetes. FRAX has been incorporated into U.S. guidelines for prevention and treatment of osteoporosis.

The FRAX algorithm does not currently include T2DM as a risk factor for fracture, and the study results indicated that use of the FRAX score in diabetic patients will likely underestimate risk. The results were most consistent for women, but also indicated that FRAX tends to underestimate risk in diabetic men, particularly in those using insulin.

The reasons for increased fracture risk at a given BMD in older adults with diabetes are not clearly understood. Bone strength may be compromised through changes that are not captured with DXA, such as higher levels of advanced glycation end products in bone collagen. More frequent falls in those with diabetes could also increase fracture risk for a given BMD.

The study did not find an increased risk of non-spine fracture in diabetic men who were not using insulin.

Men may be relatively protected from the negative skeletal effects of diabetes due to less rapid bone loss with aging. [13].

In pre-menopausal Dutch women, the prevalence of osteopenia was 27.3 %, and 4.1% of the women were osteoporotic; and in Canadian women, the prevalence of osteoporosis was 20%. [15, 16]. In Vietnamese adult women, the prevalence of osteoporosis was found to be relatively higher compared with that in nearby countries. High osteoporosis in the age group 50-70 years was comparable to Japanese women and this was postulated to be due to pre-World War exposure and poor nutrition at that time [17]. In another study, the prevalence was thought to be less among rural premenopausal women as compared to urban due to high outdoor physical activity in this population.

Results from the National Osteoporosis Risk Assessment (NORA) reported that osteoporosis was associated with a fracture rate approximately four times that of normal BMD and osteopenia was associated with a 1.8-fold higher rate. The same study affirms the immediacy of risk posed by the finding of low BMD; the risk of fracture is not a decade or more in the future, but rather exists at the time of diagnosis [18] .One intriguing observation has emerged in study population, that significantly less women were postmenopausal among those having low BMD, but then it was a small study involving only 200 women. Of major interest is the finding that almost every alternate woman in the peri and postmenopausal group was found to have low BMD. Similar prevalence of osteoporosis after the age of 50 years has been seen in previous studies by Babu and Vestergaard *et al.* [19, 20] Prevalence of osteoporosis in healthy ambulatory postmenopausal South Indian women was found to be 48%, and a significant positive correlation between BMI and BMD at the lumbar spine and femoral neck was established in this study (r=0.4; P=0.0001). [21]. Many of the published data from India have shown lower BMD among young Indian women as compared to those established by the NHANES III reference database in women aged 20-29 years. [22,23] There is a suggestion that lower BMD values in Asians may be a size related artifact and there may be a need among the Indian women to measure bone mineral apparent density (BMAD), which is an estimation of volumetric density. [24]

In a study done by Aggarwal N *et al*. at PGI ,Chandigarh ,the prevalence of osteoporosis in their study was found to be high (53%) in peri- and postmenopausal women. There was a significant positive correlation between increasing age, low BMI, low calcium intake, lack of exercise, and low BMD. Thus, high prevalence of osteoporosis in peri and postmenopausal women is a major health concern. Although no symptoms occur prior to fracture, BMD and other risk factors can be used to identify high-risk patients, and because effective interventions exist, many of these fractures are now preventable. The launch of the WHO technical report, assessment of osteoporosis at primary health care level, and the related web-based FRAX tool are the major milestones toward helping health professionals worldwide to improve identification of patients at high risk of fractures. [25]

A risk assessment tool for osteoporosis developed by Sharma and Khandelwal can be effective in a resource-poor nation like India, where they used a combination of questionnaire and ultrasonic measurement of BMD. Although DEXA scan is considered as a gold standard for BMD assessment, most of the Indian women cannot afford it due to the cost involved [26].

In a study to evaluate the effect of BMD on fracture risk prediction using FRAX among Asian Indian men when used in conjunction with clinical risk factors done by kuruvilla k *et al.*

Forty four Asian Indian men (mean age 64.9 (±8.4) years) who had lived in the United States for an average of 33.6 (±10.6) years underwent BMD measurement at the proximal femur. Subjects were subjected to a general physical exam and history of fracture, hip fracture in a parent, current smoking and alcohol use, and diagnosis of inflammatory arthritis was obtained. Thirteen subjects (29.5%) had femur neck T-scores $\geq$ -1.0, 28 (63.6%) T-scores between -1.0 and -2.5, and three (6.8%) T scores < -2.5. The 10-year probability of a major osteoporotic fracture based on a combination of clinical risk factors and femur neck T-scores was significantly higher than the fracture probability based on clinical risk factors alone ($t(43) = 2.58$, $p = 0.01$)[12].

In the study by Aggarwal N *et al.*, the prevalence of low BMD was found in more than half of this population (53%). The mean age in group I (normal BMD) was found to be 50.56 ± 5.74 years as compared to 52.50 ± 5.94 in group II with low BMD (P=0.02). The two groups were similar with respect to parity, education, socio -economic status, family history of osteoporosis, hormone replacement therapy, and thyroid disorders. 46.8% of the women in group I and 33% of the women in group II had low physical activity and there was no statistically significant difference in sunlight exposure between the groups. Parity or the number of children and type of menopause was not seen to have much association with low

BMD in their study. Lack of exercise and low calcium diet were significantly associated with low BMD. Multiple logistic regression analysis showed that age, exercise, menopause, and low calcium diet acted as significant predictors of low bone density [27].

While in our study-- The study group included 120 cases of type 2 DM with a minimum age of 50 years and maximum of 86 years, the mean age was 59.16 years with the standard deviation of 7.053.

The study included 68 males and 52 females. The minimum BMD in gm/cm^2 was 0.426 while the maximum was 1.14.The mean was 0.682 and the standard deviation was 0.138.

The minimum of T score was -3.8, while the maximum was 2.6 and the mean value of T score was -1.63

- 31(25.8%) cases out of 120 had T score ≥-1 (normal)
- 63(52.5%) cases had T score between -1 and -2.5 (osteopenia)
- 26(21.7%) cases had T score <-2.5(osteoporosis)

When FRAX score was calculated using the Indian calculator online, the values were-

- Major osteoporotic fracture had a minimum value of 1.1, while the maximum value was 26.The mean value was 5.485.
- Hip fracture had a minimum value of 0, maximum value of 21 and the mean was 2.01.

Laboratory studies have suggested a role for cholesterol in the pathogenesis of both osteoporosis and atherosclerosis. The purpose of this prospective study was to assess whether cholesterol levels, repeatedly measured over three decades in young and middle-aged adult women and men, predicted bone mineral density (BMD) at advanced age. No significant association between total cholesterol and BMD was found in women for any of the bone sites considered. For example, adjusted mean BMD at the lumbar spine was similar in women from the lowest to highest quartile of total cholesterol, respectively, 1.07, 1.08, 1.06, 1.07 g/cm2; P for trend=0.98. Similarly, the findings in men largely showed no association between cholesterol and BMD, although there was an isolated finding of a statistically significant trend in decreasing mean radial shaft BMD with increasing total cholesterol, 0.73, 0.72, 0.72, 0.70 g/cm2, lowest to highest quartile, P for trend=0.02. Cholesterol levels in women and men from young adulthood to middle age years do not appear to have long-term clinical implications for osteoporosis later in life [28].

But in our study Total cholesterol level was having a significant negative correlation with BMD levels with p value <0.05.

Conclusion

In the end, on the basis of present study, we conclude that type 2 diabetics are prone to increased fracture risk as measured by the FRAX score. Diabetes, itself is a risk factor and can be considered for inclusion in one of the clinical risk factors in Frax Score. Only 3% of the total cases in the present study had optimal serum VIT D levels and 28% had their BMD in the normal range. Serum vitamin D levels have positive correlation with BMD and hence their maintenance in the normal range is essential. Type 2 Diabetics should also take measures to contain their serum cholesterol levels as higher levels are associated with decreasing BMD. There is an urgent need for realization that there is high prevalence of fracture risk in type-2 Diabetes Mellitus and these patients should be put to regular screening to detect the same so as to prevent the morbidity and mortality associated with it.

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