

Assessment of Osteoporotic Fracture Risk in Patients above 50 Years Using Quantitative Ultrasonography and Fracture Risk Assessment Tool: A Cross-sectional Study

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Learning Point of the Article:

Accessible pre-screening with QUS and the FRAX tool offers a practical and cost-effective method for the early detection of osteoporosis in resource-limited settings, enabling timely intervention among high-risk populations.

Abstract

Introduction: To investigate the prevalence of osteoporosis and its association with age, sex, body mass index (BMI), and bone mineral density (BMD) in a sample of individuals from South India. To assess the risk of major osteoporotic fractures (MOF) and hip fractures among study participants.

Materials and Methods: This cross-sectional study was conducted in a tertiary care hospital in Southern India. A sample of 453 participants both male and female above 50 years of age was included. BMD measurements were assessed using the ultrasound bone densitometer. BMI and fracture risk assessment (FRAX) score were calculated for all patients.

Results: The average age of the participants was 60 years. The mean t-score was -1.57 . 306 (68%) had osteopenia, and 45 (9.9%) participants had osteoporosis. A higher number of females (73%) had osteoporosis than males (27%). There was no significant difference between the BMI in the normal (28.16) versus the osteopenia (27.67) and the osteoporotic group (26.92). Mean MOF risk was 4.03 (2.81 SD).

Conclusion: Decrease in BMD was associated with increased fracture risk, particularly among older female participants. The findings underscore the need for targeted public health interventions and clinical strategies to improve bone health and reduce fracture risk.

Keywords: Prevalence, bone mineral density, body mass index, fracture risk assessment score, osteoporosis.

Introduction

Osteoporosis is a metabolic bone disease that is marked by a low bone mass and deterioration of bone microarchitecture, which increases bone fragility and susceptibility to fractures (World Health Organization, 1994) [1]. In 2006, osteoporosis was estimated to have caused more than 89 lakh fractures annually worldwide, resulting in an osteoporotic fracture occurring every 3 s [2]. As per the report of the International Osteoporosis

Foundation, osteoporosis-related fractures affect about 1 in 3 women and 1 in 5 men aged 50 years or above during their lifetime [3]. The significant risk factors include age of the individual, gender, body mass index (BMI), and bone mineral density (BMD) [4,5]. In South Asia, the burden of non-communicable diseases is rising, and there is a need to understand the epidemiology of osteoporosis [6,7]. Early diagnosis by BMD assessment and the prediction of fracture

Author's Photo Gallery



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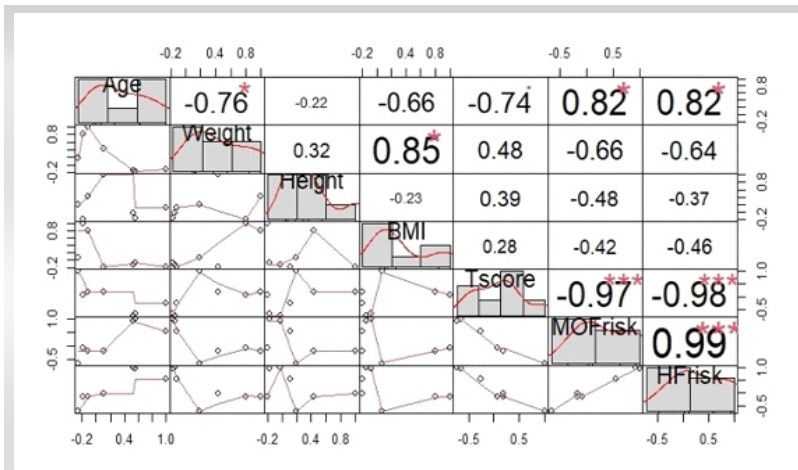


Figure 1: Correlation plot between variables in the study.

risk are important because it can decrease morbidity and can significantly reduce the burden on the Indian health care system. A study conducted in the urban population of New Delhi, utilizing quantitative ultrasound (QUS) for BMD assessment, reported the prevalence of osteoporosis to be 8.9% and that of osteopenia to be 59.55%. They also found that 20 (0.04%) individuals had a significant osteoporotic fracture risk exceeding 20% [8].

A cross-sectional study in southern India in patients above 50 years of age reported a high prevalence of osteoporosis (50%) and osteopenia (36%) [9]. There is a need to investigate further and fully characterize the prevalence and risk factors of osteoporosis within diverse populations in South India. These studies' findings unveil the regional variations and further accentuate the importance of more focused research to address the specific needs.

Yen et al. conducted a study comparing QUS to DXA for pre-screening of osteoporosis. They found a meaningful correlation between QUS and DXA and concluded that pre-screening for osteoporosis with calcaneus QUS is useful [10].

Through this study, we investigated the prevalence of osteoporosis and its association with age, sex, BMI, and BMD in a specific sample of individuals from South India. In addition, we assessed the risk of major osteoporotic fractures (MOF) and hip fractures (HF) among study participants using the fracture risk assessment (FRAX) tool.

Materials and Methods

This study was a cross-sectional design, conducted at a tertiary care hospital in Southern India, including 453 men and women aged above 50 years who presented to the Orthopaedic department. Female patients on hormonal replacement therapy, post-hysterectomy patients, patients

on corticosteroid therapy, bedridden patients, and immunocompromised patients were excluded from the study. Ethics approval was obtained from the AIIMS Mangalagiri Institutional Ethics Committee. The approval number is AIIMS/MG/IEC/2022-23/182.

Participants' demographic information, including age, sex, height, weight, and place of residence (rural or metropolitan), was collected. For each participant, the BMI was calculated using an established formula and was categorized according to the South Asian BMI guidelines [11].

BMD measurements were assessed using the ultrasound bone densitometer (Furuno CM-300). The QUS measurements were done at the level of the mid-calcaneum. Quality assurance tests and calibration for the machine were performed by a single trained technician on each screening day. The overall median t-score was calculated, and participants were classified into 3 categories: Normal bone density, osteopenia, and osteoporosis, based on the established diagnostic criteria [1,12].

A well-validated risk assessment tool, namely FRAX[®], was used to estimate each participant's risk of MOF and HF [1].

Participants showing a significant osteoporotic fracture risk of $\geq 20\%$ or a HF risk of $\geq 3\%$ were considered for the treatment [8].

The patients were then informed and explained about their BMI, BMD score, and the fracture risk, and appropriate advice and treatment were given to the patients by the treating doctor.

The statistical analysis was performed, including the correlation, Chi-square, analysis of variance, and regression analyses to examine the significant associations between bone health, fracture risk, age, sex, BMI, and BMD. The data

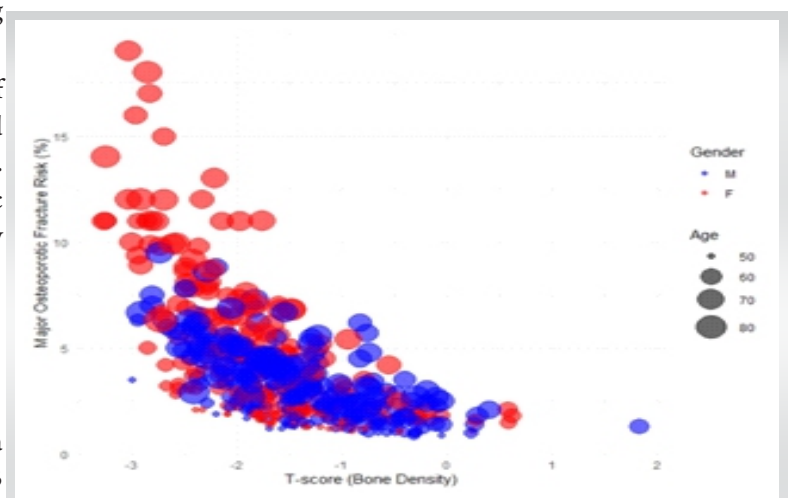


Figure 2: T-score versus major osteoporotic fractures risk by gender and age.

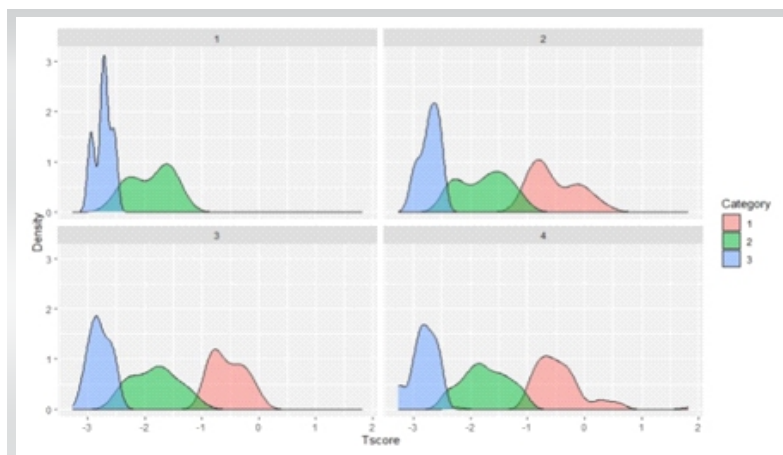


Figure 3: Distribution of t-score among various bone mineral densities.

collection procedure followed high-quality clinical protocols and adhered to the data privacy policies. Statistical analyses were conducted to examine the relationship between the participants' bone health status, fracture risk, age, sex, BMI, and BMD.

Results

453 participants were examined to determine the prevalence of osteoporosis and its relationship with age, sex, residence, BMI, and BMD. Majority of the participants 49% were in the 50–59 age range (Table 1). The average age of the participants was 60 years (interquartile range [IQR], 55–65 years). The study included 226 females (49.9%) and 227 males (50.1%). The median height was 156 cm (IQR: 149–163), and the median total weight was 67 kg (IQR: 58–76). As per BMI categories for South Asians, the data showed that 71 % of the participants were obese, 13% were overweight, and only 14% were normal weight (Table 1). The overall median t-score was -1.67 (IQR: -2.11 to -1.09). The mean t-score was -1.57 (Table 2). 306 (68%) participants were classified as having osteopenia. 45 (9.9%) participants had osteoporosis (Table 1).

The median age of participants with osteopenia was 60 years (IQR: 55–66), those with osteoporosis were 65 years (IQR: 60–70), and those with normal bone density were 58 years (IQR: 54–62) and this was significant ($P < 0.001$) (Table 2).

Of the total 161 participants (36%) in the 60–69 age group, 29 (18%) were in the normal group, 110 (68.3%) had osteopenia, and 22 (13.6%) had osteoporosis.

A higher number of females (73%) had osteoporosis than males (27%). A higher number of males (64%) had a normal BMD than females (36%) ($P < 0.001$) (Table 2).

51% of participants were from rural areas and 49% were from metropolitan areas. There was no significant difference with regard to osteoporosis among the rural (53%) and urban (47%)

participants in our study ($P = 0.4$) (Table 2).

From our study, we found that the average BMI was 27.71. There was no significant difference between the BMI in the normal (28.16) versus the osteopenia (27.67) and the osteoporotic group (26.92), and the $P = 0.405$. In the age group of 70 years and above, there were 7 (9.7%), 52 (72.2%), and 13 (18.1%) participants who were normal, had osteopenia, and had osteoporosis, respectively (Table 3).

Among the obese, 78 (24.37) were normal, 215 (67.18) had osteopenia, and 27 (8.43%) had osteoporosis. In the overweight individuals, 10 (16.945) were normal, 43 (72.8%) had osteopenia, and 6 (10.16%) had osteoporosis. Among the individuals with normal BMI, 13 (21%) were normal, 41 (66%) had osteopenia, and 8 (13%) had osteoporosis. In the underweight BMI, 7 (58%) had osteopenia and 4 (33%) had osteoporosis. The percentage of participants who were normal or underweight had a higher incidence of osteoporosis.

The average t-score was the lowest in the underweight group (-2.04) and was highest in the obese group (-1.52). This difference was significant, $P = 0.049$ (Table 3).

Significant differences were observed in the risk of MOF across the groups ($P < 0.001$). The mean MOF risk was 4.03 (2.81 SD). Individuals with osteopenia or osteoporosis had mean risks of 3.97 (2.06 SD) and 8.76 (4.14 SD), respectively, whereas participants with normal bone health had a significantly reduced risk, at 2.14 (1.2 SD). The risk increased by almost 4 times when comparing patients with normal bone health to patients with osteoporosis. This difference was significant ($P < 0.001$) (Table 2).

Similarly, there was a significant difference ($P < 0.001$) in the risk of HF among the groups. The normal group had the lowest risk, at 0.31 (0.35 SD), while the overall mean HF risk was 1.25 (1.27 SD). The risk categories for osteoporosis and osteopenia had mean values of 3.83 (1.7 SD) and 1.19 (0.82 SD), respectively. Both MOF risk and HF risk were higher in the underweight group, 5.03 and 2.015 compared to the overweight group, 3.96 and 1.16, respectively, and this was significant ($P = 0.02$ and 0.005) (Table 3). The mean t-score among the obese was -1.52 , and among the underweight was -2.04 , showing a decreasing trend of BMD with weight, and the association was significant ($P = 0.05$) (Table 3).

Fig. 1 depicts the negative correlation ($r = -0.74$) between age and bone t-score. Notably, with correlation values of -0.97 and -0.98 , respectively, bone t-score showed a very substantial negative connection with both MOF risk and HF risk. Age

Table 1: Description of the study participants

Characteristic	$n^1=453$ (%)
Age (years)	
50–59	220 (49)
60–69	161 (36)
70 and above	72 (16)
Gender	
Male	227 (50.1)
Female	226 (49.9)
BMI	
Underweight	12 (2.6)
Normal	62 (14)
Overweight	59 (13)
Obese	320 (71)
T-score	-1.67 (-2.11, -1.09) ²
BMD	
Normal	102 (23)
Osteopenia	306 (68)
Osteoporosis	45 (9.9)
¹ n (%); ² Median (IQR). IQR: Interquartile range, BMI: Body mass index, BMD: Bone mineral density	

Discussion

The study's findings emphasize the importance of awareness, screening, and early intervention to prevent osteopenia and osteoporosis in this population, with significant implications for clinical practice and public health. The identification of age, gender, and BMI as significant risk factors amplifies the need for the development of targeted prevention and management programs, tailored to the specific needs of different demographic groups [13,14,15,16]. Furthermore, the strong association between bone density and fracture risk emphasizes the importance of incorporating FRAX into the clinical evaluation of patients, particularly those with known risk factors [17]. These facts influence the need for timely interventions, such as lifestyle modifications, pharmacological treatments, and fall prevention strategies, to reduce the burden of osteoporosis-related fractures in this population [18,19]. This cross-sectional study provides valuable insights into the epidemiology of osteoporosis and its associated risk factors in a sample of individuals in South India.

The prevalence of osteoporosis in our study was found to be 9.93%, which was similar to a study conducted by Vaishya et al., in New Delhi, which showed a prevalence of 8.99% [8]. In a large population-based study of perimenopausal women, the prevalence of osteopenia and osteoporosis was 27.3% and 4.1%, respectively [13]. Agrawal and Sharma reported the prevalence of osteoporosis as 8.5% in Indian men above 50 years [20]. In our study, the prevalence of osteoporosis in men was 5.28% and in females was 14.6%.

Age and bone health

In our study, the mean age of the study population was 60.58 years. The results showed a clear association between age and bone health. Older participants, particularly those in the 60–69 and 70+ age groups, had a higher prevalence of osteopenia and osteoporosis, 13.66% and 18.05%, respectively. Kaushal et al., found the prevalence of osteoporosis in age groups 50–59 years, 60–69 years, and ≥ 70 years to be 14.3%, 18.6%, and 36.4%, respectively, among females, and 6.5%, 4.3%, and 5.6%, respectively, among males [21].

Sex difference

The proportion of females was higher in the osteoporosis group than in the male group, while the proportion of males was higher in the normal bone density group. Women generally have a higher prevalence of osteoporosis and a lower BMD than men because of the role of hormonal changes and other sex-specific factors in the pathogenesis of this condition. De Martinis et al. reported that out of 2,376 subjects screened for osteoporosis,

correlated negatively with weight ($r = -0.76$) as well, which gave a negative correlation between weight and BMI ($r = -0.66$). As the age increased, there was a significant increase ($r = 0.82$) in both MOF risk and HF risk.

As demonstrated in the multivariable scatter plot (Fig. 2), MOF risk exhibited an inverse relationship with t-score, which was negatively correlated with increasing age and was more pronounced among female subjects. Younger individuals seemed to gravitate down in terms of (MOF risk) as evidenced by the smaller circles at the bottom of the plot. T-score was much lower in females and with increase age, also the MOF was higher in females with increasing age.

The distribution of t-scores for the four BMI categories – underweight, normal, overweight, and obese – is shown in Fig. 2 classified into normal, osteopenic and osteoporotic groups. The data indicate a discernible pattern of declining osteoporotic t-score prevalence with rising BMI. There are almost no individuals in the underweight category who have normal BMD, even though the numbers of participants are quite less in this category (Fig. 3).

Table 2: Demographic and anthropometric details of the study participants by bone mineral density

Characteristic	Overall, <i>n</i> =453 ¹ (%)	Normal, <i>n</i> =102 ¹ (%)	Osteopenia, <i>n</i> =306 ¹ (%)	Osteoporosis, <i>n</i> =45 ¹ (%)	<i>P</i> -value ²
Age	60.5 (7.62)	58.49 (6.01)	60.6 (7.81)	65.11 (7.71)	<0.001
Age group					<0.001
50–59	220 (49)	66 (65)	144 (47)	10 (22)	
60–69	161 (36)	29 (28)	110 (36)	22 (49)	
70 and above	72 (16)	7 (6.9)	52 (17)	13 (29)	
Gender					<0.001
F	226 (49.9)	37 (36)	156 (51)	33 (73)	
M	227 (50.1)	65 (64)	150 (49)	12 (27)	
Residence					0.4
Rural	232 (51)	46 (45)	162 (53)	24 (53)	
Urban	221 (49)	56 (55)	144 (47)	21 (47)	
Weight	67.36 (13.38)	70.89 (12.76)	66.91 (13.17)	62.42 (14.41)	0.001
Height	155.97 (9.33)	158.94 (9.01)	155.5 (9.16)	152.44 (9.58)	<0.001
BMI	27.71 (5.2)	28.16 (5.31)	27.67 (4.98)	26.92 (6.31)	0.405
BMI					
Underweight	12 (2.6)	1 (1.0)	7 (2.3)	4 (8.9)	0.096
Normal	62 (14)	13 (13)	41 (13)	8 (18)	
Overweight	59 (13)	10 (9.8)	43 (14)	6 (13)	
Obese	320 (71)	78 (76)	215 (70)	27 (60)	
T-score	-1.57 (0.77)	-0.47 (0.47)	-1.76 (0.39)	-2.78 (0.19)	<0.001
MOF risk	4.03 (2.81)	2.14 (1.2)	3.97 (2.06)	8.76 (4.14)	<0.001
HF risk	1.25 (1.27)	0.31 (0.35)	1.19 (0.82)	3.83 (1.7)	<0.001

¹ Mean (SD); *n* (%) ²ANOVA; Pearson's Chi-squared test. ANOVA: Analysis of variance, SD: Standard deviation, MOF: Major osteoporotic fractures, HF: Hip fractures, MOF: Major osteoporotic fractures, BMI: Body mass index

94.5% were women and only 5.4% were men. Women exhibited lower BMD compared to men (t-score values: -2.33 ± 1.14 vs. -1.31 ± 1.55 ; $P < 0.001$) [22]. Sharma et al. found that the maximum number of both osteoporotic and osteopenic women was recorded in the age group of 55–64 years and observed that almost all women (100%) over 65 years of age had either of these conditions [23]. In our study, the prevalence in participants aged 70 years and above was found to be approximately 3 times higher in females (10, 76.9%) than in males (3, 23.1%). In a study conducted among the South Indian population by Chitten and James, the overall prevalence of osteopenia and osteoporosis was found to be 48.4% and 6.6%, respectively, in all the age groups [24].

BMI and bone health: Data revealed a complex relationship

between BMI and bone health. While obesity was highly prevalent in the study population, obese participants had a lower median t-score than the underweight group. This inverse association between BMI and BMD has been reported in other studies. It may be attributed to factors such as the mechanical loading effects of excess weight, as well as the potential influence of adipokines and other metabolic factors on bone metabolism. The link between BMI and bone health is heterogeneous, yielding inconsistent results. While some studies suggest that obesity may be protective against osteoporosis, longitudinal data paint a different picture. A cross-sectional study had found that 37% of overweight and obese patients had significantly lower lumbar BMD than expected, with obesity (BMI >30) associated with low bone

Table 3: Distribution of variables by body mass index

Characteristic	Overall, <i>n</i> =453 ¹ (%)	Underweight <i>n</i> =12 ¹ (%)	Normal <i>n</i> =62 ¹ (%)	Overweight <i>n</i> =59 ¹ (%)	Obese <i>n</i> =320 ¹ (%)	<i>P</i> -value ²
Age	60.58 (7.62)	66.17 (10.61)	61.13 (8.29)	63.19 (7.67)	59.78 (7.17)	0.001
Age group						
50–59	220 (49)	3 (25)	29 (47)	18 (31)	170 (53)	
60–69	161 (36)	4 (33)	21 (34)	26 (44)	110 (34)	
70 and above	72 (16)	5 (42)	12 (19)	15 (25)	40 (13)	
Gender						0.001
F	226 (50)	6 (50)	18 (29)	25 (42)	177 (55)	
M	227 (50)	6 (50)	44 (71)	34 (58)	143 (45)	
Residence						0.8
Rural	232 (51)	7 (58)	30 (48)	33 (56)	162 (51)	
Urban	221 (49)	5 (42)	32 (52)	26 (44)	158 (49)	
Weight	67.37 (13.38)	40.5 (5.05)	53.15 (6.64)	59.31 (7.28)	72.62 (11.35)	<0.001
Height	155.36 (9.33)	152.67 (8.44)	158.52(8.19)	157.29 (9.49)	155.36 (9.46)	0.034
BMI	27.71 (5.2)	17.32 (0.77)	21.08 (1.25)	23.89 (0.63)	30.09 (4.12)	<0.001
T score	–1.57 (.77)	–2.04 (0.72)	–1.63 (0.76)	–1.7 (0.71)	–1.52(0.79)	0.049
Category						
Normal	102 (23)	1 (8.3)	13 (21)	10 (17)	78 (24)	
Osteopenia	306 (68)	7 (58)	41 (66)	43 (73)	215 (67)	
Osteoporotic	45 (9.9)	4 (33)	8 (13)	6 (10)	27 (8.4)	
MOF risk	4.03 (2.81)	5.03 (3.48)	3.46 (2.18)	4.88 (3.08)	3.96 (2.82)	0.022
HF risk	1.25 (1.27)	2.15 (1.67)	1.25 (1.15)	1.63 (1.4)	1.16 (1.24)	0.005

¹ Mean (SD); *n* (%) ²ANOVA; Pearson's Chi-squared test. ANOVA: Analysis of variance, SD: Standard deviation, MOF: Major osteoporotic fractures, HF: Hip fractures, MOF: Major osteoporotic fractures, BMI: Body mass index

mass compatible with osteoporosis [25]. Studies found that obese older adults experienced greater loss of bone density in the femoral neck over time compared to those with normal weight, contradicting the idea that obesity protects bones [26]. A systematic review by Turcotte et al. of 121 studies found that obesity is associated with higher bone mass and favorable bone structure, with bone turnover rates being lower or similar to those without obesity [27]. Reports are suggestive that obesity was associated with reduced HF in men and postmenopausal women, and reduced wrist fractures in postmenopausal women, but increased ankle fractures in postmenopausal women [19]. In our study, the majority of our participants belonged to the obese category, 320 (70.6%). The mean BMI was 27.71 kg/m². In our study, osteoporosis was maximum in

the underweight, 33.3% followed by normal, 12.9%, and overweight, 10.2%. It was least in the obese (8.43%). Kumar et al., found a positive association between BMI and BMD among females [28]. They evaluated 255 healthy pre- and postmenopausal females. They found that with the increase in BMI, the BMD values also increased in premenopausal females, but the association was lost in postmenopausal females. Karunanayake et al., also found that low BMI (odds ratio 3.1) was positively associated with osteoporosis incidence [29].

Urban and rural population

When comparing the prevalence of osteoporosis among the urban and rural populations, we found no significant difference. The mean t-score among females living in rural areas was found



to be -1.72 SD, and it was -1.54 SD among males, and the overall mean t-score was -1.63 SD. Similarly, among the Urban population, it was found to be -1.72 SD among females, -1.31 SD among males, and the overall mean t-score was -1.50 SD. 80.17% of the rural population had either osteopenia or osteoporosis compared to 74.66% seen in the urban population. Matsuzaki et al., in their meta-analysis, found opposing evidence on urban-rural BMD differences, with high-income countries showing higher BMD in rural areas. At the same time, findings were inconsistent in low- and middle-income countries [30]. Zheng et al. concluded from their study that the prevalence of osteoporosis in rural populations was higher than that in urban populations, and the factors associated with the risk of osteoporosis were similar in urban and rural populations [31]. Raj et al., in their study, concluded that females, the elderly, and urban residents have an increased chance of low BMD [32]. Overall, on studying the literature, we found that there is no clear difference in BMD in rural and urban populations.

Fracture risk

The study found a strong negative correlation between the bone t-score and the risk of MOF and HF. Individuals with lower bone density had a notably higher fracture risk, which emphasizes the need for early identification and treatment. Multiple studies confirmed that lower BMD correlates with increased fracture risk [33,34,35,36]. In the study done by Vaishya et al., of the 445 participants, the number of individuals with $>20\%$ MOF risk was 20 (0.04%), and the number of individuals with HF risk $>3\%$ was 93 (20.89%) [8].

The limitations of this study must be acknowledged. Primarily, the cross-sectional design limits the ability to establish definitive causal relationships between BMD, BMI, and fracture risk, and the lack of longitudinal follow-up prevents the assessment of actual long-term fracture outcomes. Furthermore, as a single-center, hospital-based study, the sample may not fully represent the general population, inherently introducing selection bias and limiting generalizability to broader regions. Our strict exclusion criteria, while necessary for controlling variables, excluded key demographic groups (such as patients on corticosteroid or hormone replacement therapies), which may restrict the applicability of these findings to real-world clinical populations. The sample size was also relatively small for specific subgroup analyses, notably within the underweight cohort, which reduces statistical power for those specific groups.

Methodologically, while quantitative ultrasonography (QUS) is accessible for pre-screening, the use of QUS instead of the gold-standard DEXA scan may reduce overall diagnostic

accuracy. In addition, QUS measurements were restricted to the calcaneum and may not accurately reflect axial skeletal BMD (such as the hip or spine), which are the most clinically relevant sites for MOF. Relying on the FRAX tool without direct DEXA inputs also carries the limitation of potentially underestimating or overestimating fracture risk. We must also consider that self-reported variables utilized in the FRAX calculation (e.g., prior fractures, smoking, alcohol use) are inherently subject to recall bias. Possible inter-observer or device variability, despite daily calibration, could still influence QUS measurements. Furthermore, our analysis did not evaluate important potential confounders such as dietary calcium intake, vitamin D status, sunlight exposure, physical activity levels, or fall risk factors, all of which are critical determinants of fracture risk. Comorbidities known to influence bone health, including diabetes and thyroid disorders, were also not factored into the final analysis. Finally, the high prevalence of obesity within our specific study population may skew the observed associations between BMI and BMD.

Conclusion

This study highlights the significant burden of osteoporosis and its associated risk factors in the South Indian population, emphasizing the importance of increasing awareness and implementing targeted preventive measures. Reduced BMD was strongly associated with a higher risk of fractures, particularly among older female participants. No significant differences were observed in the prevalence of osteopenia and osteoporosis between urban and rural populations. These findings underscore the need for focused public health initiatives, early screening programs, and effective clinical management strategies to improve bone health, reduce fracture incidence, and enhance the quality of life of individuals at risk of osteoporosis in this region.

Clinical Message

Routine bone health screening using accessible tools such as QUS and the FRAX is strongly recommended for individuals aged 50 years and above, particularly females and those with a low BMI. Reduced BMD is significantly associated with an increased risk of major osteoporotic and HF, making early detection essential. Proactive screening facilitates the timely implementation of appropriate pharmacological interventions, lifestyle modifications, and fall-prevention strategies, thereby reducing fracture risk, minimizing associated morbidity, and improving overall quality of life.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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