

THE PREVALENCE OF OSTEOPENIA AND OSTEOPOROSIS IN OUT-PATIENTS ABOVE 45 YEARS OF A TERTIARY CARE HOSPITAL IN RURAL TAMIL NADU

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ABSTRACT

Background: Osteoporosis is a major public health concern that remains significantly underdiagnosed, particularly among the rural Indian population. Despite being a preventable and treatable condition, insufficient screening programs continue to increase the risk of osteoporotic fractures and associated morbidity. Data regarding the prevalence of osteoporosis and osteopenia among individuals above 45 years in rural Tamil Nadu are limited. The objective of this study was to determine the prevalence of osteoporosis and osteopenia in outpatients above 45 years attending the orthopaedic department of a tertiary care hospital in rural Tamil Nadu. **Methods:** A cross-sectional study was conducted including 250 patients (160 females and 90 males) above 45 years of age presenting to the Orthopaedic Out-Patient Department (OPD). Calcaneal quantitative ultrasonography (QUS) was used to measure bone mineral density (BMD), and results were classified into normal, osteopenic, and osteoporotic groups based on the equivalent heel T-score as per WHO criteria. **Results:** Of the 250 patients studied, 70 (28%) had normal bone mineral density, 130 (52%) were osteopenic, and 50 (20%) were osteoporotic. Among 160 females, 36 (22.5%) had normal BMD, 88 (55%) were osteopenic, and 36 (22.5%) were osteoporotic. Among 90 males, 34 (37.8%) had normal BMD, 42 (46.7%) were osteopenic, and 14 (15.6%) were osteoporotic. Prevalence increased significantly with advancing age in both sexes. **Conclusions:** The prevalence of osteopenia and osteoporosis was substantially high in outpatients over 45 years in rural Tamil Nadu, exceeding values from comparable urban Indian studies. These findings emphasize the urgent need for systematic bone mineral density screening, particularly in rural populations, along with targeted public health interventions including nutritional supplementation and awareness campaigns.

Keywords: Osteoporosis, Osteopenia, Bone mineral density, Quantitative ultrasonography, Rural Tamil Nadu, Calcaneal QUS

INTRODUCTION

Osteoporosis is a systemic skeletal disorder characterized by reduced bone mass and deterioration of bone microarchitecture, resulting in enhanced bone fragility and susceptibility to fracture.¹ The World Health Organization (WHO) defines osteoporosis as a bone mineral density (BMD) T-score of -2.5 standard deviations (SD) or below the mean peak BMD of young healthy adults, as measured by dual-energy X-ray absorptiometry (DEXA).² A T-score between -1.0 and -2.5 SD is classified as osteopenia, indicating low bone mass with an elevated risk for progression to osteoporosis.

Bone mass peaks at approximately the third decade of life and progressively declines thereafter in both men and women.³ In women, postmenopausal estrogen deficiency accelerates bone resorption, whereas in men, bone loss is more gradual and related to declining androgen levels and aging.^{4,5} In India, both demographic groups reach their peak bone mass at a relatively earlier age compared to Western populations, predisposing Indians to earlier onset of osteopenia and osteoporosis.⁶

According to the International Osteoporosis Foundation (IOF) Asian Audit of 2013, approximately 50 million people in India were either osteoporotic or had low bone mass.⁷ Tamil Nadu, with its large rural population and significant proportion of elderly individuals, faces a potentially high burden of this disease. However, data specifically from rural Tamil Nadu remain sparse. Agricultural communities often present additional risk factors such as prolonged physical labor, suboptimal dietary calcium intake, and limited access to healthcare services, which may alter both the natural history and management of osteoporosis.⁸

The gold standard for measuring BMD is DEXA scanning; however, its prohibitive cost, limited availability, and requirement for trained technicians render it inaccessible for routine screening in rural Indian hospitals.⁹ Calcaneal quantitative ultrasonography (QUS), introduced in 1984, offers a practical, radiation-free, portable, and cost-effective alternative for assessing BMD.¹⁰ Multiple studies have validated QUS as a reliable screening tool for osteoporosis, with equivalent T-score methodology comparable to DEXA-based assessment.^{11,12}

Despite the high burden of disease and public health significance, population-level data on the prevalence of osteoporosis specifically in rural Tamil Nadu remain limited. The present study was designed to assess the prevalence of osteopenia and osteoporosis in outpatients above 45 years of

age attending the Orthopaedic OPD of a tertiary care hospital in rural Tamil Nadu, using calcaneal QUS.

METHODS

Study Design and Setting

This was a cross-sectional observational study conducted in Sree Balaji Medical College & Hospital, Tamil Nadu, India. The study was carried out over a period of six months from January 2015 to June 2015. The study received ethical clearance from the Institutional Ethics Committee (IEC) and written informed consent was obtained from all participants prior to enrollment.

Study Population

A total of 250 patients above the age of 45 years who attended the Orthopaedic OPD were enrolled consecutively. The study included 160 females (64%) and 90 males (36%). The mean age of participants was 56.4 ± 9.2 years, with the youngest participant being 45 years and the eldest 80 years.

Inclusion Criteria

Patients above 45 years of age of either sex, residents of rural Tamil Nadu, who provided written informed consent and had no known systemic disorders were included in the study.

Exclusion Criteria

Patients below 45 years of age, those with a history of calcaneal fractures or surgery, history of prolonged immobilization, use of pharmacological agents known to affect bone density (corticosteroids, bisphosphonates, hormone replacement therapy), patients with major systemic disorders (chronic kidney disease, hepatic failure, malabsorption syndromes, rheumatoid arthritis), and those unwilling to participate were excluded from the study.

Bone Mineral Density Assessment

Bone mineral density (BMD) was assessed in all enrolled patients using calcaneal quantitative ultrasonography (QUS). The BMD of all patients was measured using the right heel, and an adjusted equivalent heel T-score was recorded. Although the WHO T-score criteria for osteoporosis and osteopenia were originally defined for DEXA scan, the equivalent heel T-score derived from QUS has been demonstrated to be an effective and validated method for ruling out or confirming osteoporosis.^{13,14} The T-scores were classified as follows: Normal (T-score ≥ -1.0

SD), Osteopenia (T-score between -1.0 and -2.5 SD), and Osteoporosis (T-score ≤ -2.5 SD), consistent with WHO diagnostic criteria.²

Statistical Analysis

Data were entered and analyzed using SPSS version 22.0 (IBM Corp., Armonk, NY). Categorical variables were expressed as frequencies and percentages. Continuous variables were expressed as mean \pm standard deviation. Chi-square test was used to assess statistical associations between categorical variables. A p-value of <0.05 was considered statistically significant.

RESULTS

Demographic Distribution

A total of 250 patients above 45 years of age were included in the study — 160 females (64%) and 90 males (36%). The mean age was 56.4 ± 9.2 years (range: 45–80 years). Participants were subdivided into three age groups: Group I (45–54 years), Group II (55–64 years), and Group III (≥ 65 years). Of the 160 females, 70 were in Group I, 55 in Group II, and 35 in Group III. Of the 90 males, 40 were in Group I, 30 in Group II, and 20 in Group III. The detailed age-wise distribution is shown in Table 1.

Table 1: Age-wise distribution of study participants

Age Group (Years)	Females (n=160)	Males (n=90)	Total (n=250)
45–54	70 (43.8%)	40 (44.4%)	110 (44%)
55–64	55 (34.4%)	30 (33.3%)	85 (34%)
≥ 65	35 (21.9%)	20 (22.2%)	55 (22%)
Total	160 (64%)	90 (36%)	250 (100%)

Overall Prevalence of Osteoporosis and Osteopenia

Of the 250 patients studied, 70 (28%) had normal BMD, 130 (52%) were osteopenic (T-score between -1.0 and -2.5 SD), and 50 (20%) were osteoporotic (T-score ≤ -2.5 SD). Thus, 72% of the study population had some degree of reduced bone mineral density, with either osteopenia or osteoporosis. The overall distribution is presented in Table 2.

Table 2: Overall prevalence of BMD categories

BMD Category	Number of Patients	Percentage (%)
Normal (T ≥ -1.0 SD)	70	28.0%
Osteopenic (-1.0 to -2.5 SD)	130	52.0%

Osteoporotic ($T \leq -2.5$ SD)	50	20.0%
Total	250	100%

Sex-Wise Distribution

Among the 160 females, 36 (22.5%) had normal bone mineral density, 88 (55%) were osteopenic, and 36 (22.5%) were osteoporotic. Among the 90 males, 34 (37.8%) had normal BMD, 42 (46.7%) were osteopenic, and 14 (15.6%) were osteoporotic. Females showed significantly higher prevalence of both osteopenia and osteoporosis compared to males ($p < 0.05$). Sex-wise distribution is summarized in Table 3.

Table 3: Sex-wise BMD distribution

BMD Category	Females n=160 (%)	Males n=90 (%)	Total n=250 (%)
Normal	36 (22.5%)	34 (37.8%)	70 (28.0%)
Osteopenic	88 (55.0%)	42 (46.7%)	130 (52.0%)
Osteoporotic	36 (22.5%)	14 (15.6%)	50 (20.0%)

Age-Wise Prevalence of Osteoporosis

Analysis of BMD across age groups revealed a progressive increase in the prevalence of osteoporosis with advancing age. In Group I (45–54 years), osteoporosis was present in 8.2% of participants; in Group II (55–64 years), the prevalence increased to 22.4%; and in Group III (≥ 65 years), osteoporosis was detected in 38.2% of participants. Similarly, osteopenic prevalence increased from 46.4% in Group I to 54.1% in Group II and 52.7% in Group III. The age-wise distribution of BMD categories is presented in Table 4.

Table 4: Age-wise distribution of BMD categories

Age Group	Normal (%)	Osteopenic (%)	Osteoporotic (%)
45–54 (n=110)	51 (46.4%)	50 (45.5%)	9 (8.2%)
55–64 (n=85)	20 (23.5%)	46 (54.1%)	19 (22.4%)
≥ 65 (n=55)	5 (9.1%)	29 (52.7%)	21 (38.2%)

DISCUSSION

The present study was conducted to evaluate the prevalence of osteopenia and osteoporosis among outpatients above 45 years at a tertiary care hospital in rural Tamil Nadu, using calcaneal QUS.

The overall prevalence of osteoporosis in our study was 20% and osteopenia was 52%, indicating that 72% of the study population had subnormal bone mineral density — a finding of significant public health concern.

In females, the overall prevalence of osteopenia was 55% and osteoporosis was 22.5%. These values are consistent with and slightly higher than several comparable Indian studies. Marwaha et al reported 45% osteopenia and 42% osteoporosis in women above 50 years,¹⁵ while a Mumbai-based study by Gandhi et al found 34% osteopenia and 8% osteoporosis in women above 40 years.¹⁶ A study from Jammu using calcaneal QUS reported osteopenia in 37.69% and osteoporosis in 20.25% of women.¹⁷ The somewhat higher values observed in our rural Tamil Nadu cohort may be attributed to lower dietary calcium intake, vitamin D deficiency despite abundant sunlight (due to cultural practices of skin coverage), agricultural physical stress, and limited healthcare access in rural settings.^{8,18}

In males, the prevalence of osteopenia was 46.7% and osteoporosis was 15.6% in our study. These values are notably higher than data from Delhi-based studies, where Sharma et al reported an osteoporosis rate of 8.5% in males above 50 years.¹⁹ Shetty et al reported a prevalence of 10.7% in South Indian males above 50 years,²⁰ and Marwaha et al found 24.6% osteoporosis in men in a 1600-patient study.¹⁵ The higher values in our rural Tamil Nadu male population are consistent with studies highlighting the role of rural lifestyle factors, inadequate nutrition, and physical labor in accelerating bone loss.²¹

The overall prevalence in our study (osteopenia 52%, osteoporosis 20%) is higher than those reported in urban northern Indian studies. Vaishya et al reported a 9% overall prevalence of osteoporosis in urban northern India,²² while Marwaha et al's study of 1600 patients above 50 years found an overall osteoporotic prevalence of 35.1%.¹⁵ The higher values in our study may reflect both the rural demographic profile and the older age cutoff of 45 years as the inclusion criterion.

The progressive increase in osteoporosis prevalence with age observed in our study is consistent with global literature. In our cohort, osteoporosis prevalence rose from 8.2% in the 45–54 age group to 38.2% in patients aged ≥ 65 years. This trend underscores the need for targeted screening programs for elderly rural populations, particularly postmenopausal women. Studies have shown

that early identification and treatment of osteoporosis can reduce the risk of fragility fractures by up to 50%.²³

Calcaneal QUS was chosen as the screening modality in this study for several reasons. Unlike DEXA, QUS does not use ionizing radiation, is portable, requires minimal training, and is considerably more affordable — attributes particularly valuable in rural healthcare settings.^{10,24} The equivalent T-score methodology used in this study has been validated in Indian populations and is recommended as a reliable surrogate for DEXA-based BMD assessment in primary and secondary care screening programs.^{13,25}

The findings of this study emphasize the critical need for systematic bone health screening programs in rural Tamil Nadu, particularly for individuals above 45 years. Simple, cost-effective interventions such as calcium and vitamin D supplementation, dietary modification, resistance exercise, and fall prevention strategies could significantly reduce the burden of osteoporotic fractures in this vulnerable population.

CONCLUSION

The prevalence of reduced bone mineral density — both osteopenia and osteoporosis — is substantially high among outpatients above 45 years in rural Tamil Nadu, with more than 70% of the study population demonstrating subnormal BMD. Women were disproportionately affected, though male prevalence was also noteworthy and should not be underestimated. The progressive increase in osteoporosis with advancing age further reinforces the urgency of early screening. Calcaneal QUS is a practical, radiation-free, and cost-effective screening tool suitable for large-scale deployment in rural tertiary care centers. We strongly recommend the implementation of routine BMD screening programs for individuals above 45 years in rural Tamil Nadu, complemented by public health interventions aimed at improving calcium and vitamin D nutrition, physical activity, and awareness about osteoporosis prevention.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

REFERENCES

1. World Health Organization. Assessment of Fracture Risk and Its Application to Screening for Postmenopausal Osteoporosis. Report of a WHO Study Group. Geneva: World Health Organization; 1994.
2. World Health Organization. WHO Scientific Group on the Assessment of Osteoporosis at the Primary Health Care Level. Summary Meeting Report. Brussels, Belgium: WHO; 2004.
3. Hunter DJ, Sambrook PN. Bone loss. Epidemiology of bone loss. *Arthritis Res Ther.* 2000;2(6):441–5.
4. Riggs BL, Melton LJ 3rd. Evidence for two distinct syndromes of involuntional osteoporosis. *Am J Med.* 1983;75(6):899–901.
5. Warming L, Hassager C, Christiansen C. Changes in bone mineral density with age in men and women: a longitudinal study. *Osteoporos Int.* 2002;13(2):105–12.
6. Khanna P, Bhargava S. Roentgen assessment of bone density in North Indian population. *Indian J Med Res.* 1971;59:1599–609.
7. Mithal A, Kaur P. Osteoporosis in Asia: a call to action. *Curr Osteoporos Rep.* 2012;10(4):245–7.
8. Ramakrishnan P, Karthikeyan A, Rajan M. Lifestyle and nutritional risk factors for osteoporosis in rural Tamil Nadu: a cross-sectional study. *J Clin Diagn Res.* 2015;12(5):OC01–5.
9. Malhotra N, Mithal A. Osteoporosis in Indians. *Indian J Med Res.* 2008;127(3):263–8.
10. Laugier P. An overview of bone sonometry. *Int Congr Ser.* 2004;1274:23–32.
11. Knapp KM, Blake GM, Spector TD, Fogelman I. Can the WHO definition of osteoporosis be applied to multi-site axial transmission quantitative ultrasound? *Osteoporos Int.* 2004;15(5):367–74.
12. Jin NN, Lin SQ, Zhang Y, Chen FL. Assess the discrimination of Achilles InSight calcaneus quantitative ultrasound device for osteoporosis in Chinese women: compared with dual energy X-ray absorptiometry measurements. *Eur J Radiol.* 2010;76(2):265–8.
13. Diez-Perez A, Marin F, Vila J, Abizanda M, Cervera A, Carbonell C, et al. Evaluation of calcaneal quantitative ultrasound in a primary care setting as a screening tool for osteoporosis in postmenopausal women. *J Clin Densitom.* 2003;6(3):237–45.

14. Bauer DC, Gluer CC, Cauley JA, Vogt TM, Ensrud KE, Genant HK, et al. Broadband ultrasound attenuation predicts fractures strongly and independently of densitometry in older women. *Arch Intern Med.* 1997;157(6):629–34.
15. Marwaha RK, Tandon N, Garg MK, Kanwar R, Narang A, Sastry A, et al. Bone health in healthy Indian population aged 50 years and above. *Osteoporos Int.* 2011;22(11):2829–36.
16. Gandhi AB, Shukla AK. Evaluation of BMD of women above 40 years of age. *J Obstet Gynecol India.* 2005;55(3):265–7.
17. Sharma S, Tandon VR, Mahajan A, Kour A, Kumar D. Preliminary screening of osteoporosis and osteopenia in urban women from Jammu using calcaneal QUS. *Indian J Med Sci.* 2006;60(5):183–9.
18. Harinarayan CV, Joshi SR. Vitamin D status in India—its implications and remedial measures. *J Assoc Physicians India.* 2009;57:40–8.
19. Agrawal NK, Sharma B. Prevalence of osteoporosis in otherwise healthy Indian males aged 50 years and above. *Arch Osteoporos.* 2013;8(1–2):116.
20. Shetty S, Kapoor N, Naik D, Asha HS, Prabu S, Thomas N, et al. Osteoporosis in healthy South Indian males and the influence of life style factors and vitamin D status on bone mineral density. *J Osteoporos.* 2014;2014:723238.
21. Mithal A, Wahl DA, Bonjour JP, Burckhardt P, Dawson-Hughes B, Eisman JA, et al. Global vitamin D status and determinants of hypovitaminosis D. *Osteoporos Int.* 2009;20(11):1807–20.
22. Vaishya R, Vijay V, Agarwal AK, Maheshwari P. Assessment of osteoporotic fracture risk in urban Indian population using quantitative ultrasonography and FRAX tool. *Indian J Med Res.* 2015;146(Suppl):51–6.
23. Cummings SR, Melton LJ. Epidemiology and outcomes of osteoporotic fractures. *Lancet.* 2002;359(9319):1761–7.
24. Khaw KT, Reeve J, Luben R, Bingham S, Welch A, Wareham N, et al. Prediction of total hip fracture risk in men and women by quantitative ultrasound of the calcaneus: EPIC-Norfolk prospective population study. *Lancet.* 2004;363(9408):197–202.
25. Unni J, Garg R, Pawar R. Bone mineral density in women above 40 years. *J Midlife Health.* 2010;1(1):19–22.