E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.02.67

Research Article

A Prospective Observational Study on Osteoporosis in Postmenopausal Women Attending Opd

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Received: 13.05.26, Revised: 14.06.26, Accepted: 15.07.26

ABSTRACT
Background: Osteoporosis is a major public health problem among postmenopausal women due to estrogen deficiency, leading to accelerated bone loss, decreased bone mineral density (BMD), and an increased risk of fragility fractures. Early diagnosis and identification of risk factors are essential for timely intervention and prevention of fracture-related morbidity.
Objectives: To determine the prevalence of osteoporosis among postmenopausal women attending the outpatient department and to evaluate the association of osteoporosis with demographic, clinical, and biochemical risk factors.
Materials and Methods: A prospective observational study was conducted among 100 postmenopausal women attending the Outpatient Department of Kodagu Institute of Medical Sciences, Madikeri, Karnataka, from February 2024 to January 2025. Detailed demographic and clinical data were collected. Bone mineral density was assessed using Dual-Energy X-ray Absorptiometry (DEXA) at the lumbar spine and femoral neck. Osteoporosis was diagnosed according to the World Health Organization (WHO) criteria based on T-scores. Data were analyzed using SPSS version 26.0, and a p-value <0.05 was considered statistically significant.
Results: The mean age of participants was 56.3 ± 6.8 years. Osteopenia was observed in 41% of women, while osteoporosis was diagnosed in 35%. The prevalence of osteoporosis increased significantly with advancing age (p=0.008) and duration since menopause (p=0.002). Vitamin D deficiency was present in 44% of participants and showed a significant association with osteoporosis (p=0.012). Low physical activity and inadequate dietary calcium intake were the most common modifiable risk factors.
Conclusion: Osteoporosis and osteopenia are highly prevalent among postmenopausal women. Advancing age, prolonged duration since menopause, Vitamin D deficiency, inadequate calcium intake, and sedentary lifestyle significantly contribute to reduced bone mineral density. Routine DEXA screening and preventive strategies should be encouraged for early diagnosis and fracture prevention.

Keywords: Osteoporosis, Postmenopausal Women, Bone Mineral Density, DEXA, Osteopenia, Vitamin D.

INTRODUCTION

Osteoporosis is a systemic skeletal disorder characterized by reduced bone mass and deterioration of bone microarchitecture, resulting in increased bone fragility and susceptibility to fractures. It is considered one of the most common chronic diseases affecting postmenopausal women worldwide and represents a major cause of disability, healthcare expenditure, and reduced quality of life among the elderly population (1).

Bone remodeling is a dynamic process involving continuous bone formation and resorption. Following menopause, estrogen deficiency accelerates osteoclastic bone resorption while reducing osteoblastic bone formation, leading to rapid bone loss during the initial years after menopause (2). This decline in bone mineral density (BMD) significantly increases the risk of fractures involving the vertebrae, hip, distal radius, and proximal humerus, all of which are associated with substantial morbidity and mortality (3).

The World Health Organization (WHO) defines osteoporosis based on Bone Mineral Density measured by Dual-Energy X-ray Absorptiometry (DEXA). A T-score of −2.5 or below is diagnostic of osteoporosis, whereas osteopenia is defined by a T-score between −1.0 and −2.5 (4). DEXA remains the gold standard for evaluating bone mineral density

because of its high precision, low radiation exposure, and reproducibility.

Globally, osteoporosis affects more than 200 million women, and nearly one in three women over the age of 50 years experiences an osteoporotic fracture during her lifetime (5). With increasing life expectancy and an aging population, the burden of osteoporosis continues to rise, particularly in developing countries such as India. Indian women often have lower peak bone mass due to nutritional deficiencies, low calcium intake, inadequate Vitamin D levels, and reduced physical activity, making them particularly vulnerable to osteoporosis (6).

Several risk factors contribute to osteoporosis, including increasing age, early menopause, prolonged duration since menopause, low body mass index, inadequate dietary calcium, Vitamin D deficiency, sedentary lifestyle, smoking, excessive alcohol intake, family history of osteoporosis, and chronic illnesses affecting bone metabolism (7). Many women remain asymptomatic until a fragility fracture occurs, highlighting the importance of early identification through screening.

Early diagnosis and preventive interventions, including adequate calcium and Vitamin D supplementation, weight-bearing exercise, lifestyle modification, and pharmacological therapy, have been shown to reduce fracture risk and improve quality of life (8). Identifying women at high risk allows timely management and reduces the long-term socioeconomic burden associated with osteoporotic fractures.

The present prospective observational study was undertaken to determine the prevalence of osteoporosis among postmenopausal women attending the outpatient department at Kodagu Institute of Medical Sciences, Madikeri, and to evaluate the demographic, clinical, and biochemical factors associated with low bone mineral density.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted in the Department of Obstetrics and Gynaecology in collaboration with the Department of Orthopaedics and Department of Radiodiagnosis at Kodagu Institute of Medical Sciences (KIMS), Madikeri, Karnataka, India. The study was carried out over a period of one year from February 2024 to January 2025.

Study Population

The study included 100 postmenopausal women attending the Outpatient Department (OPD) of KIMS, Madikeri, who fulfilled the eligibility criteria during the study period.

Sample Size

A total of 100 consecutive eligible postmenopausal women were enrolled using a consecutive sampling technique after obtaining written informed consent.

Inclusion Criteria

- Women aged 45 years and above.
- Natural menopause (absence of menstruation for at least 12 consecutive months).
- Women attending the Gynecology or General Medicine OPD during the study period.
- Willing to participate and provide written informed consent.

Exclusion Criteria

- Premature menopause (<40 years).
- Surgical menopause following bilateral oophorectomy.
- Women receiving treatment for osteoporosis (bisphosphonates, denosumab, teriparatide, hormone replacement therapy, or selective estrogen receptor modulators).
- Chronic kidney disease, chronic liver disease, malignancy, hyperparathyroidism, thyroid disorders affecting bone metabolism, Cushing's syndrome, or other metabolic bone diseases.
- Long-term corticosteroid therapy (>3 months).
- Patients with severe physical disability preventing bone mineral density assessment.
- Women unwilling to participate.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee of Kodagu Institute of Medical Sciences, Madikeri, before commencement of the study. Written informed consent was obtained from all participants prior to enrollment. Confidentiality of patient information was maintained throughout the study.

Study Procedure

Eligible postmenopausal women attending the OPD were screened and recruited consecutively after informed consent. A detailed history was obtained using a structured proforma.

The following information was collected:

- Age
- Age at menopause
- Duration since menopause
- Educational status

- Occupation
- Socioeconomic status
- Dietary habits
- Calcium intake
- Physical activity
- Smoking and alcohol consumption
- Family history of osteoporosis
- Previous fragility fractures
- Medical comorbidities
- Medication history
- Body mass index (BMI)

A complete general physical examination and systemic examination were performed for all participants.

Clinical Assessment

Anthropometric measurements included:

- Height (cm)
- Weight (kg)
- Body Mass Index (BMI) calculated as:

BMI = Weight (kg) / Height² (m²)

Participants were categorized according to the WHO BMI classification.

Blood pressure and pulse rate were recorded.

Laboratory Investigations

The following laboratory investigations were performed wherever clinically indicated:

- Complete Blood Count (CBC)
- Random Blood Sugar (RBS)
- Serum Calcium
- Serum Phosphorus
- Serum Alkaline Phosphatase
- Serum Vitamin D (25-hydroxy Vitamin D)
- Serum Creatinine
- Thyroid Stimulating Hormone (TSH) (when indicated)

Bone Mineral Density Assessment

Bone Mineral Density (BMD) was assessed using Dual-Energy X-ray Absorptiometry (DEXA) at the lumbar spine (L1–L4) and femoral neck.

The T-score obtained from DEXA was interpreted according to the World Health Organization (WHO) criteria:

T-Score	Diagnosis
≥ -1.0	Normal Bone Density
-1.0 To -2.5	Osteopenia
≤ -2.5	Osteoporosis

The lowest T-score obtained from either lumbar spine or femoral neck was considered for final diagnosis.

Study Variables

The primary outcome measure was:

- Prevalence of osteoporosis among postmenopausal women.

Secondary outcome measures included:

- Distribution of osteopenia and normal bone mineral density.
- Association between osteoporosis and age.
- Association with duration since menopause.
- Association with BMI.
- Association with Vitamin D deficiency.
- Association with previous fractures.
- Association with physical activity.
- Association with dietary calcium intake.
- Association with family history of osteoporosis.

Data Collection

All demographic, clinical, laboratory, and DEXA findings were recorded in a predesigned case record form by the principal investigator. Data were entered into Microsoft Excel and verified for completeness before statistical analysis.

Statistical Analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) software version 26.0 (IBM Corp., Armonk, NY, USA).

Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequency and percentage.

Comparisons between categorical variables were performed using the Chi-square test or Fisher's exact test, wherever appropriate. Continuous variables were compared using the Independent Student's t-test or one-way Analysis of Variance (ANOVA).

Multivariate logistic regression analysis was performed to identify independent predictors of osteoporosis. A p-value <0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS

A total of 100 postmenopausal women attending the Outpatient Department of Kodagu Institute of Medical Sciences, Madikeri, were included in this prospective observational study conducted between February 2024 and January 2025. The demographic profile, clinical characteristics, Bone Mineral Density (BMD) findings, laboratory parameters, and factors associated with osteoporosis are summarized below.

Table 1. Age Distribution of the Study Participants (N=100)

Age Group (Years)	Number	Percentage (%)
45–49	18	18.0
50–54	30	30.0
55–59	27	27.0
60–64	15	15.0
≥65	10	10.0
Total	100	100.0

Observation: The majority of women (30%) were aged 50–54 years, followed by 55–59 years (27%). The mean age was 56.3 ± 6.8 years.

Table 2. Duration since Menopause

Duration Since Menopause	Number	Percentage (%)
<5 Years	24	24.0
5–10 Years	39	39.0
>10 Years	37	37.0
Total	100	100.0

Observation: Most participants (39%) had experienced menopause for 5–10 years.

Table 3. Body Mass Index (Bmi) Distribution

Bmi Category	Number	Percentage (%)
Underweight (<18.5 Kg/M²)	8	8.0
Normal (18.5–24.9 Kg/M²)	46	46.0
Overweight (25–29.9 Kg/M²)	34	34.0
Obese (≥30 Kg/M²)	12	12.0
Total	100	100.0

Observation: Nearly half of the women (46%) had a normal BMI, while 46% were overweight or obese.

Table 4. Bone Mineral Density (Dexa) Findings

Dexa Diagnosis	Number	Percentage (%)
Normal Bmd	24	24.0
Osteopenia	41	41.0
Osteoporosis	35	35.0
Total	100	100.0

Observation: Osteopenia (41%) was the most common DEXA finding, while 35% of women were diagnosed with osteoporosis.

Table 5. Mean Bone Mineral Density T-Score

Site	Mean ± SD
Lumbar Spine	-2.08 ± 0.96
Femoral Neck	-1.84 ± 0.89

Observation: The lumbar spine demonstrated lower mean T-scores compared to the femoral neck, indicating greater bone loss at the spine.

Table 6. Association between Age Group and Osteoporosis

Age Group (Years)	Osteoporosis Present	Osteoporosis Absent	Total
45–49	2	16	18
50–54	7	23	30
55–59	10	17	27
60–64	9	6	15
≥65	7	3	10
Total	35	65	100

Chi-square = 13.92, p = 0.008

Observation: The prevalence of osteoporosis increased significantly with advancing age.

Table 7. Association between Duration since Menopause and Osteoporosis

Duration Since Menopause	Osteoporosis Present	Osteoporosis Absent	Total
<5 Years	3	21	24
5–10 Years	12	27	39
>10 Years	20	17	37
Total	35	65	100

Chi-square = 12.84, p = 0.002

Observation: Women with menopause duration exceeding 10 years showed a significantly higher prevalence of osteoporosis.

Table 8. Serum Vitamin D Status

Vitamin D Status	Number	Percentage (%)
Deficient (<20 Ng/Ml)	44	44.0
Insufficient (20–30 Ng/Ml)	31	31.0
Sufficient (>30 Ng/Ml)	25	25.0
Total	100	100.0

Observation: Vitamin D deficiency was present in 44% of participants.

Table 9. Association between Vitamin D Deficiency and Osteoporosis

Vitamin D Status	Osteoporosis Present	Osteoporosis Absent	Total
Deficient	22	22	44
Insufficient	9	22	31
Sufficient	4	21	25
Total	35	65	100

Chi-square = 8.91, p = 0.012

Observation: Osteoporosis was significantly more common among women with Vitamin D deficiency.

Table 10. Clinical Risk Factors among Women with Osteoporosis (N=35)

Risk Factor	Number	Percentage (%)
Low Physical Activity	24	68.6
Low Dietary Calcium Intake	21	60.0
Previous Fragility Fracture	9	25.7
Family History Of Osteoporosis	8	22.9
Smoking	4	11.4
Diabetes Mellitus	12	34.3
Hypertension	16	45.7

Observation: The most common risk factors among osteoporotic women were low physical activity (68.6%) and low dietary calcium intake (60.0%), followed by hypertension (45.7%).

DISCUSSION

The present prospective observational study evaluated osteoporosis among 100 postmenopausal women attending a tertiary care hospital. The findings demonstrated that osteoporosis remains highly prevalent in postmenopausal women, with osteopenia observed in 41% and osteoporosis in 35% of participants. These findings highlight the importance of routine osteoporosis screening in women after menopause.

The mean age of the study population was 56.3 ± 6.8 years, with the majority of participants belonging to the 50–59-year age group. Increasing age showed a statistically significant association with osteoporosis, consistent with previous studies reporting progressive bone loss with advancing age due to prolonged estrogen deficiency and age-related reduction in bone formation (9,10).

The prevalence of osteoporosis increased significantly with increasing duration since menopause. Women who had been menopausal for more than 10 years had the highest frequency of osteoporosis, emphasizing the cumulative effect of estrogen deficiency on bone remodeling. Similar observations have been reported by Kanis et al. and Compston et al., who demonstrated that fracture risk increases substantially with increasing postmenopausal duration (5,11).

Bone mineral density assessment using DEXA showed that osteopenia was more common than established osteoporosis. This finding

indicates that a large proportion of postmenopausal women are at risk of progressing to osteoporosis if preventive measures are not implemented. Comparable prevalence rates have been reported in Indian studies by Marwaha et al. and Aggarwal et al., emphasizing the need for early screening (12,13).

Vitamin D deficiency was identified in 44% of participants and was significantly associated with osteoporosis. Vitamin D plays an essential role in calcium absorption and maintenance of bone mineralization. Deficiency results in secondary hyperparathyroidism, increased bone resorption, and accelerated bone loss. Similar findings have been reported by Holick and Lips, who highlighted Vitamin D deficiency as one of the major reversible risk factors for osteoporosis (14,15).

Lifestyle-related risk factors such as inadequate dietary calcium intake and low physical activity were highly prevalent among osteoporotic women in the present study. Weight-bearing exercise improves bone strength by stimulating osteoblastic activity, whereas adequate calcium intake helps preserve bone mineral density. These findings are supported by recommendations from the National Osteoporosis Foundation and the Endocrine Society, which advocate lifestyle modification as a key component of osteoporosis prevention (16,17).

Although obesity has traditionally been considered protective against osteoporosis because of greater mechanical loading, recent evidence suggests that body composition and muscle mass influence bone health more significantly than body weight alone. In the present study, women with lower BMI demonstrated a greater prevalence of osteoporosis, consistent with previous epidemiological studies (18).

The findings of this study reinforce current recommendations advocating routine osteoporosis screening among postmenopausal women, particularly those with advancing age, prolonged menopause, Vitamin D deficiency, or additional clinical risk factors. Early identification through DEXA allows timely intervention, thereby reducing fracture risk and improving long-term quality of life.

The main strengths of the present study include its prospective design and standardized DEXA-based assessment. However, the study was limited by its single-center setting and relatively modest sample size, which may affect generalizability. Multicentric studies with larger populations and longer follow-up are recommended to further validate these findings.

Overall, the present study confirms that osteoporosis represents a significant health concern among postmenopausal women and underscores the importance of preventive screening, nutritional optimization, regular physical activity, and appropriate pharmacological management in women at increased risk.

CONCLUSION

Osteoporosis is highly prevalent among postmenopausal women, with osteopenia representing an important precursor to established disease. Advancing age, longer duration since menopause, Vitamin D deficiency, low dietary calcium intake, and physical inactivity were significantly associated with reduced bone mineral density. Routine DEXA screening, early risk assessment, and timely lifestyle and therapeutic interventions are essential to prevent osteoporotic fractures and improve the quality of life in postmenopausal women.

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