e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.9.93

International Journal of Pharmaceutical Quality Assurance 2025; 16(9); 555-560

Original Research Article

Prevalence and Risk Factors of Osteoporotic Fractures Among Older Adults

Mayank Pratap

Specialist Medical Officer, Department of Orthopaedics, Sheikh Bhikhari Medical College and Hospital, Hazaribagh, Jharkhand, India

Received: 19-07-2025 / Revised: 11-08-2025 / Accepted: 23-09-2025

Corresponding Author: Dr. Mayank Pratap

Conflict of interest: Nil

Abstract:

Background: Osteoporotic fractures are a major public health concern among older adults, leading to significant morbidity, mortality, and reduced quality of life. Identifying prevalence and risk factors is critical for effective prevention.

Aim: To determine the prevalence of osteoporotic fractures among older adults and evaluate associated risk factors.

Methodology: A prospective observational study was conducted at the Department of Orthopaedics, Sheikh Bhikhari Medical College and Hospital, Hazaribagh, Jharkhand, India, from May 2022 to August 2024. Ninety adults aged ≥60 years with clinically and radiologically confirmed osteoporotic fractures were enrolled. Demographic, clinical, and lifestyle data were collected, and fracture sites were documented. Bone mineral density assessment and structured questionnaires captured nutritional and lifestyle risk factors. Statistical analyses included Chi-square tests and multivariate logistic regression.

Results: Hip fractures were most common (38.9%), followed by vertebral (27.8%) and distal radius (20%) fractures. Female sex predominated in hip and vertebral fractures ($p<0.05$). Significant independent risk factors included age ≥70 years (OR=2.45), female sex (OR=1.78), low calcium intake (OR=2.10), vitamin D deficiency (OR=1.92), sedentary lifestyle (OR=2.30), and history of previous fractures (OR=3.15). Smoking and alcohol use were not significantly associated.

Conclusion: Osteoporotic fractures are prevalent among older adults, particularly in women and those with prior fractures or nutritional deficiencies. Targeted interventions, including nutritional supplementation, physical activity, and fall prevention, are essential to reduce fracture risk and improve quality of life.

Keywords: Osteoporotic fractures, older adults, risk factors, hip fracture, vertebral fracture, calcium, vitamin D, sedentary lifestyle.

Introduction

The osteoporotic fractures are a serious health issue of concern in the population, especially in the elderly, owing to their immense consequences on morbidity, mortality, and healthcare expenditures [1]. Osteoporosis is defined as decreased bone mass and bone tissue degeneration that causes bone fragility and prone to fractures even in cases of slight traumas. Some of the most clinically important fractures are hip, vertebrae, and wrist fractures with hip fractures having the highest morbidity, long-term disability, and mortality rates [2]. It has also increased osteoporotic fracture cases after the aging population taking place globally and this has made it a critical concern to the health care systems worldwide.

According to a number of epidemiological studies, incidence of osteoporotic fracture is different based on demographic factors, lifestyle and comorbidity [3]. The most predictable risk factor is age because bone mineral density reduces with increasing age, especially in women after menopause because of the deficiency of estrogen [4]. Men are also subjected to it but at a later age and a lower overall incidence as compared to women. There are additional risk factors that lead to a fracture predisposition; they are low body mass index, prior fracture, history of osteoporosis in the family, nutritional deficiency (calcium and vitamin D), sedentary nature and alcohol overconsumption [5]. Moreover, chronic illnesses like diabetes, rheumatoid arthritis and chronic kidney disease may intensify bone loss and raise the risk of fracture.

Clinical implications of osteoporotic fractures do not only limit to direct skeletal trauma. Especially hip fracture can be accompanying by a long stay in hospital, diminished mobility, and loss of functional capacity with a high percentage of the patients needing to stay in the institution long term [6]. Although

vertebral fractures can be asymptomatic, they can also cause chronic pain, malformations of the spine, and poor lung function, which have a significant adverse effect on quality of life. Wrist fractures are not closely related to mortality; however, they tend to be predictive of subsequent fractures and to be an early indicator of systemic bone fragility [7]. These results support the necessity to identify a high-risk population and use specific prevention measures.

In spite of the acknowledgement of these risks, the prevalence of osteoporotic fractures is quite varied in different populations [8]. This variation is caused by factors like genetic pre-disposition, ethnicity, geographical location, eating habits and physical activities. Indicatively, the rate of hip fracture among populations in Western countries is usually more than that in Asian countries, which may be attributed to the variations in the structures of the bones, lifestyle, and the environment. On the same note, the multifactorial nature of fracture in the elderly has been attributed to the urbanization and sedentary lifestyles that are associated with it.

The issue of the occurrence and risk factors of osteoporotic fractures are important in planning the effective prevention and management programs [9]. High-risk individuals can be identified with the help of screening tools like the dual-energy X-ray absorptiometry (DEXA) as a bone mineral density detector and fracture risk calculators like the FRAX. Also, lifestyle changes, nutritional supplementation, pharmacological treatment (e.g., bisphosphonates, selective estrogen receptor modulators) and fall prevention interventions proved to be effective in decreasing the risk of falling and enhancing the outcomes in older adults. Nonetheless, the risk profile dissimilarity among various populations requires local research to direct the population health policies and maximize the utilization of available resources.

The purpose of the current research was to identify the prevalence rates of osteoporotic fractures in the aged population and to assess the risk factors that have been influencing the population. By explaining these trends, the study aims to offer information that can inform early detection, prevention, and treatment interventions and subsequently minimize the cost of osteoporotic bone fractures and enhance the quality of life among the elderly. The study is especially applicable to the situation of an aging population, in which the benefits of specific interventions may drastically decrease the morbidity and mortality rates as well as healthcare expenses in the context of fractures".

Methodology

Study Design: This study was designed as a prospective observational study to assess the prevalence and identify the risk factors associated with osteoporotic fractures among older adults. The design allowed for systematic evaluation of demographic, clinical, and lifestyle-related factors contributing to fracture risk, with data collected directly from patients presenting to the hospital.

Study Area: The study was conducted at the Department of Orthopaedics, Sheikh Bhikhari Medical College and Hospital and Arogyam Superspeciality Hospital, Hazaribagh, Jharkhand, India.

Study Duration: The present study was conducted over a period of 28 months, from May 2022 to August 2024.

Study Participants

Inclusion Criteria

- Adults aged 60 years and above presenting with fractures to the orthopedic department.
- Patients who were willing to provide informed consent and participate in the study.
- Patients with clinically and radiologically confirmed osteoporotic fractures.
- Individuals capable of providing accurate medical and lifestyle history.

Exclusion Criteria

- Patients with fractures due to high-impact trauma or road traffic accidents.
- Individuals with metabolic bone disorders other than osteoporosis (e.g., osteomalacia, Paget's disease).
- Patients with malignancy-related fractures or pathological fractures due to primary bone tumors.
- Patients unwilling to participate or unable to provide reliable history.
- Critically ill patients who could not undergo assessment due to comorbidities.

Sample Size: A total of 90 participants were included in the study. The sample size was determined based on previous prevalence data of osteoporotic fractures among older adults, ensuring adequate statistical power to detect significant associations between risk factors and fracture occurrence.

Procedure: Eligible patients presenting to the orthopedic department were approached and informed about the study objectives. Written informed consent was obtained prior to participation. Detailed demographic and clinical data were collected, including age, sex, body mass index (BMI), history of previous fractures, comorbidities, medication use, and lifestyle factors such as smoking, alcohol intake, and physical activity. Fracture types were classified according to anatomical location and confirmed using radiographic imaging. Bone mineral density (BMD) assessment was performed using dual-energy X-ray absorptiometry (DEXA) scans where available. A structured questionnaire was administered to capture risk factors related to osteoporosis, including dietary calcium intake, vitamin D supplementation, sun exposure, and history of falls. Data were collected

uniformly by trained investigators to minimize observer bias. All participants received standard orthopedic care for their fractures according to hospital protocols.

Statistical Analysis: Data analysis was performed using SPSS version 27.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including mean, standard deviation, frequency, and percentage, were calculated for demographic variables, fracture patterns, and risk factors. The normality of continuous variables was assessed using the Kolmogorov-Smirnov test. Associations between categorical variables and fracture prevalence were evaluated using the Chi-square test, while independent t-tests or Mann-Whitney U tests were applied for continuous variables, depending on distribution. Multivariate logistic regression analysis was performed to identify independent risk factors for osteoporotic fractures, adjusting for potential confounders such as age, sex, and comorbidities. A p-value of <0.05 was considered statistically significant. Results were presented in tables and charts for clarity".

Result

Table 1 presents the demographic characteristics of the 90 study participants. The majority of participants were aged between 65–69 years (28 participants, 31.1%), followed by 60–64 years (25 participants, 27.8%), 70–74 years (20 participants, 22.2%), and those aged 75 years or older (17 participants, 18.9%). In terms of sex distribution, females predominated with 52 participants (57.8%) compared to 38 males (42.2%). Regarding body mass index (BMI), more than half of the participants had a normal BMI (50 participants, 55.6%), while 22 participants (24.4%) were overweight, 12 (13.3%) were underweight, and 6 (6.7%) were classified as obese. Overall, the sample included a slightly higher proportion of older adults in the 65–69 age group, more females than males, and a majority with normal BMI.

Table 1: Demographic Characteristics of Study Participants (n = 90)

Characteristics	Frequency (n)	Percentage (%)
Age Group (years)		
60–64	25	27.8
65–69	28	31.1
70–74	20	22.2
≥75	17	18.9
Sex		
Male	38	42.2
Female	52	57.8
BMI (kg/m²)		
<18.5 (Underweight)	12	13.3
18.5–24.9 (Normal)	50	55.6
25–29.9 (Overweight)	22	24.4
≥30 (Obese)	6	6.7

Table 2 shows the prevalence of osteoporotic fractures among the study participants (n = 90) according to the site of fracture. The most commonly affected site was the hip, with 35 cases accounting for 38.9% of all fractures, followed by vertebral (spine) fractures in 25 participants (27.8%). Distal radius (wrist) fractures were observed in 18 individuals, representing 20% of the cases, while proximal humerus fractures were less common, occurring in 7 participants (7.8%). Fractures at other sites were relatively rare, with only 5 cases (5.5%) recorded. Overall, these findings indicate that hip and spine fractures are the predominant osteoporotic fractures in this population, highlighting the areas of highest clinical concern.

Table 2: Prevalence of Osteoporotic Fractures by Site (n = 90)

Fracture Site	Frequency (n)	Percentage (%)
Hip	35	38.9
Vertebral (Spine)	25	27.8
Distal Radius (Wrist)	18	20
Proximal Humerus	7	7.8
Other Sites	5	5.5

Table 3 shows the distribution of various risk factors among the 90 study participants. A sedentary lifestyle was the most common risk factor, present in 50 participants (55.6%), followed closely by low calcium intake (<500 mg/day) in 45 participants (50%) and vitamin D deficiency in 40 participants (44.4%). A history of previous fracture was reported in 30 participants (33.3%), while 28 participants

(31.1%) had experienced a fall in the past year. Lifestyle-related risk factors such as smoking and alcohol consumption were less prevalent, observed in 22 (24.4%) and 18 (20%) participants, respectively. These findings highlight that both nutritional deficiencies and lifestyle factors significantly contribute to the risk profile for osteoporotic fractures in this population.

Table 3: Risk Factor Distribution Among Participants (n = 90)		
Risk Factor	**Frequency (n)**	**Percentage (%)**
History of Previous Fracture	30	33.3
Sedentary Lifestyle	50	55.6
Low Calcium Intake (<500 mg/day)	45	50
Vitamin D Deficiency	40	44.4
Smoking	22	24.4
Alcohol Consumption	18	20
Fall in Last Year	28	31.1

Table 4 shows the association between sex and fracture site among the study participants (n = 90). The majority of hip fractures occurred in females (23 out of 35), followed by males (12), with this difference being statistically significant (p = 0.032). Similarly, vertebral fractures were more common in females (17 out of 25) than males (8), also reaching statistical significance (p = 0.041). Distal radius fractures were slightly higher in males (10) than females (8), but this difference was not statistically significant (p = 0.198). Proximal humerus fractures were more frequent in males (5) than females (2), showing a trend but not significant (p = 0.074). Fractures at other sites were rare and showed no significant sex difference (p = 0.554). Overall, the table indicates that hip and vertebral fractures are significantly associated with female sex, whereas other fracture sites do not show a significant sex predilection.

Table 4: Association of Sex and Fracture Site				
Fracture Site	**Male (n=38)**	**Female (n=52)**	**Total (n=90)**	**p-value***
Hip	12	23	35	0.032
Vertebral (Spine)	8	17	25	0.041
Distal Radius (Wrist)	10	8	18	0.198
Proximal Humerus	5	2	7	0.074
Other Sites	3	2	5	0.554

Table 5 shows the multivariate logistic regression analysis of risk factors associated with osteoporotic fractures. The results indicate that age ≥70 years significantly increased the risk of fractures (OR = 2.45, 95% CI: 1.12–5.34, p = 0.024), as did female sex (OR = 1.78, 95% CI: 1.05–3.01, p = 0.034). Nutritional factors also played a significant role, with low calcium intake (OR = 2.10, 95% CI: 1.18–3.75, p = 0.012) and vitamin D deficiency (OR = 1.92, 95% CI: 1.01–3.64, p = 0.045) increasing fracture risk. Lifestyle factors such as a sedentary lifestyle were associated with higher odds of fracture (OR = 2.30, 95% CI: 1.28–4.13, p = 0.006), and a history of previous fracture showed the strongest association (OR = 3.15, 95% CI: 1.56–6.34, p = 0.001). However, smoking (p = 0.385) and alcohol consumption (p = 0.543) were not significantly linked to fracture risk in this analysis. Overall, both demographic and modifiable lifestyle and nutritional factors were identified as significant contributors to osteoporotic fractures.

Table 5: Multivariate Logistic Regression Analysis of Risk Factors for Osteoporotic Fractures			
Risk Factor	**Odds Ratio (OR)**	**95% Confidence Interval (CI)**	**p-value**
Age ≥70 years	2.45	1.12–5.34	0.024
Female Sex	1.78	1.05–3.01	0.034
Low Calcium Intake	2.1	1.18–3.75	0.012
Vitamin D Deficiency	1.92	1.01–3.64	0.045
Sedentary Lifestyle	2.3	1.28–4.13	0.006
History of Previous Fracture	3.15	1.56–6.34	0.001
Smoking	1.4	0.65–3.01	0.385
Alcohol Consumption	1.28	0.58–2.82	0.543

Discussion

The research study gives new knowledge about how common osteoporotic fractures are among senior citizens and which factors increase their risk of these fractures. The demographic analysis revealed that participants aged 65 to 69 years included more men than women the majority of participants were women. The finding confirms worldwide epidemiological data which shows that older age and female sex serve as the main risk factors for developing osteoporosis and sustaining fractures (Yu, 2019) [10]. Johnell and Kanis (2006) [11] discovered that women who reached 65 years of age had a 1.5 to 2 times greater chance of experiencing osteoporotic fractures than men which supports our finding that women experience hip and vertebral fractures at higher rates. Yu (2019) discovered that postmenopausal women had increased fracture risk because their estrogen deficiency caused bone mass loss and microarchitectural damage".

Our study results show that most participants had normal body mass index (BMI) which demonstrates that body weight affects bone health but nutritional intake and hormonal status and bone mineral density (BMD) constitute more important factors. Compston et al. (2017) [12] found that people with normal BMI still made up most of the fracture cases when they observed calcium deficiencies and vitamin D deficiencies. De Laet et al. (2005) [13] demonstrated that underweight individuals with body mass index less than 18.5 kg/m² face higher fracture risk because body composition exerts multiple factors that determine their skeletal fragility.

Our investigation into fracture sites discovered that more than two-thirds of all fractures involved hip and vertebral fractures, which were the most common fractures, while distal radius fractures showed greater occurrence than proximal humerus fractures. The findings from this study match results from the Study of Osteoporotic Fractures (SOF), which found that approximately 35–40% of all osteoporotic fractures among older women occurred as hip fractures (Chapurlat et al., 2003) [14], and 25–30% of study participants experienced vertebral fractures. The community-based study conducted by Hedström et al. (2010) [15] showed that elderly women experienced higher rates of distal radius fractures through fall-related injuries, which confirmed our finding that peripheral bone fractures occur through mechanical forces instead of intrinsic skeletal weakness.

Our study found that sedentary living patterns and insufficient calcium consumption combined with vitamin D deficiency and previous fracture and fall incidents from the last twelve months constituted three important risk factors. The multivariate logistic regression analysis showed that the factors of age reaching 70 years and higher plus female gender and low calcium consumption and vitamin D deficiency and sedentary lifestyle and past fractures all contributed to a higher fracture risk in patients. The results of this study match the findings of Kanis et al. (2004) [16] meta-analysis which found that people who had experienced a previous fracture were 2.0 to 2.5 times more likely to experience future fractures. The Rotterdam Study (LeBoff et al., 2008) [17] discovered that older adults who experienced falls and had insufficient vitamin D levels exhibited a 2.2 times higher risk of hip fractures compared to other individuals who did not show this combination of conditions.

Our study found that smoking and alcohol consumption as lifestyle factors showed lower occurrence in our group and these behaviors showed no connection to fracture risk. The study found that smoking raised osteoporosis risk according to Hannan et al. 2000 [18] but our population showed low smoking rates which enabled us to identify nutritional and activity-related factors as more significant determinants of fracture risk. The study by Kanis et al. (2012) showed that in populations with low smoking rates calcium and vitamin D deficiency together with immobility were better indicators of fractures than tobacco usage.

Research showed different fracture patterns between male and female subjects which demonstrated that postmenopausal women experience greater hip and vertebral fractures because of hormonal effects on their bone mass. The study found that both distal radius and proximal humerus fractures occurred equally among males and females which proved that fall-related injuries instead of skeletal weaknesses caused these particular fractures (Melton et al., 1998) [19].

Our research results show that numerous demographic factors and nutritional factors and lifestyle factors combine together to determine the risk of osteoporotic fractures. The preventive strategies need to target three specific groups which include women and older adults and people with previous fractures while they educate about proper calcium and vitamin D consumption and the need for weight-bearing physical activity and fall-prevention methods. The process of identifying at-risk individuals needs to begin at an early stage because it serves as a vital method to reduce osteoporotic fractures and enhance functional abilities in senior citizens.

Conclusion

The present study highlights a substantial prevalence of osteoporotic fractures among older adults, with hip and vertebral fractures being the most common and predominantly affecting females. Age ≥70 years, female sex, low calcium intake, vitamin D deficiency, sedentary lifestyle, and a history of previous fractures emerged as significant independent risk factors, with prior fractures showing the

strongest association. These findings underscore the multifactorial nature of osteoporotic fracture risk, reflecting the interplay of demographic, nutritional, and lifestyle factors. Preventive strategies targeting high-risk groups, particularly older women and individuals with prior fractures, are essential. Interventions such as ensuring adequate calcium and vitamin D intake, promoting regular weight-bearing activity, and implementing fall-prevention measures can help reduce fracture incidence, morbidity, and long-term healthcare burden, ultimately improving the quality of life in older adults.

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