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Original Research Article

Prevalence and Determinants of Osteoporotic Fractures in Geriatric Patients: A Hospital-Based Epidemiological Study

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Abstract:

Background: Osteoporotic fractures are a major public health concern among geriatric patients, leading to significant morbidity, mortality, and loss of independence. Understanding their prevalence and determinants is crucial for effective prevention and management.

Aim: To determine the prevalence and identify the key determinants of osteoporotic fractures in elderly patients admitted to a tertiary care hospital.

Methodology: A hospital-based cross-sectional study was conducted over 12 months (January 2022 to December 2022) in the Department of Orthopaedics, Sheikh Bhikhari Medical College and Hospital, Hazaribagh, Jharkhand, India. Ninety patients aged ≥65 years with radiologically confirmed osteoporotic fractures were enrolled. Demographic, clinical, and radiological data were collected. Logistic regression was used to identify independent determinants.

Results: The majority of participants were females (57.8%) and from rural areas (67.8%). Hip fractures were most common (37.8%), followed by vertebral fractures (24.4%). Low-energy falls accounted for 62.2% of fractures. Significant determinants included age ≥75 years (OR=2.14), female gender (OR=1.86), history of previous fracture (OR=2.72), physical inactivity (OR=1.95), and vitamin D deficiency (OR=2.38; all $p<0.05$).

Conclusion: Osteoporotic fractures predominantly affect elderly females, mainly involving the hip and vertebrae, and are primarily caused by low-energy trauma. Early identification and targeted preventive strategies addressing both modifiable and non-modifiable risk factors are essential to reduce fracture incidence and associated healthcare burden.

Keywords: Osteoporosis, Geriatric, Fractures, Hip Fracture, Risk Factors, Epidemiology.

Introduction

Osteoporotic fractures represent a major public health concern worldwide, particularly among the geriatric population [1]. The global population expansion throughout developed and developing nations has led to higher rates of osteoporotic fractures which accompany osteoporosis. Osteoporosis is a systemic skeletal disorder that results in decreased bone mass and microarchitectural bone tissue degradation, which leads to increased bone fragility and elevated fracture danger. Elderly people sustain major fractures from minimal falls which include standing height falls, with hip and vertebral and distal radius and proximal humeral fractures being the most common fracture types [2]. The fractures cause severe health problems which lead to higher death rates and loss of independence and create economic burdens for healthcare systems.

Osteoporosis has become the most common metabolic bone disease which affects people throughout the world according to research [3]. The World Health Organization defines osteoporosis through bone mineral density (BMD) measurements which require a T-score of −2.5 or lower to confirm the condition. Worldwide osteoporosis affects millions of individuals yet the disease occurs more frequently in postmenopausal women and elderly men. The rate of osteoporotic fractures increases at an accelerating pace with advancing age because of the combined impacts which include bone deterioration and muscle strength loss and balance issues and higher chances of falls [4]. The increasing elderly population in India and other low- and middle-income countries has made this issue more severe.

The geriatric patients are also susceptible to osteoporotic fractures because of physiological changes that come with age [5]. Old age is related to low bone formation, high bone resorption levels, changes in hormones, low calcium uptake, and vitamin D deficit. The decrease in bone mineral in women increases faster with menopause as a result

of decreased estrogen levels, and in older men, bone frailty is increased by slow increases in testosterone levels [6]. Moreover, it has been noted that sarcopenia, visual impairment, neurological conditions and polypharmacy are encouraging factors to fall hence those that contribute to fracture risk. The interrelationship between bone fragility and fall propensity is the foundation of the osteoporotic fracture epidemiology among the elderly.

One of the most devastating effects of osteoporosis in geriatric people is hip fractures [7] in particular. These fractures normally require hospitalization, surgical intervention, lengthy rehabilitation, and extended care. The death rates after hip fracture are very high particularly during the first year of injury. A majority of survivors have long-term disability, loss of movement, and lowered quality of life. Even vertebral fractures that may be clinically silent may cause chronic back pain, spinal deformities, dysfunction of the pulmonary functions and further functional impairment. Recurrent fractures are widespread as well and one of the most accurate predictors of fractures is a previous osteoporotic fracture.

Genetic, environmental, nutritional, and lifestyle differences differ among regions which lead to the epidemiology of osteoporotic fracture. The high rate of demographic transition in India has seen the elderly population growing significantly hence, intensifying the prevalence of age-related diseases like osteoporosis. Low levels of awareness, poor screening program, nutritional deficiencies, and late-onset of the disease are some causes that make people to under estimate the actual prevalence of osteoporosis and associated fractures. The contribution of hospital-based studies has been highly important in offering useful epidemiological information especially in those cases where the community-based information is limited [8].

A number of factors have been attributed to the prevalence of osteoporotic fractures in elderly patients. The non-modifiable risk factors involve old age, being a female, a family history of fracture and being genetically predisposed [9]. Changeable ones include a low body mass index, smoking, heavy alcohol use, sedentary lifestyles, poor nutritional value (particularly calcium and vitamin D), the use of some medications in the long run like corticosteroids. Bone health is also affected by comorbid illnesses such as diabetes mellitus, rheumatoid arthritis, chronic kidney disease, and thyroid diseases. Besides, the environment (poor lighting, slippery floors, and absence of assistive devices) exacerbates risks of falls in elderly individuals.

The identification of determinants is essential not only for risk stratification but also for targeted preventive strategies. Tools such as fracture risk assessment models have been developed to estimate the 10-year probability of fractures by incorporating clinical risk factors with or without BMD values. The process of identifying high-risk individuals at an early stage allows for the implementation of timely treatment which includes pharmacotherapy nutritional supplementation and fall prevention measures and lifestyle changes. Resource-limited settings continue to experience a significant treatment gap which exists despite the existence of effective treatment methods.

Epidemiological studies conducted in hospitals are a chance to investigate the frequency and the factors that determine osteoporotic fractures among a specific group of geriatric patients. These types of studies assist in demographic distribution, fracture patterns, comorbidities, and clinical outcomes. They are also used in measuring the level of healthcare use, length of stay, and transient complications. Moreover, the local risk factor identification enables healthcare professionals to design prevention and control strategies in accordance with the regional requirements.

Fracture management in geriatric population is complicated by the fact that the population is usually associated with numerous comorbidities and functional impairments. Multidisciplinary care, early mobilization and comprehensive geriatric assessment are important elements of ideal management. The primary preventive approach should include the prevention of the first fracture (preventive) and secondary prevention of the second fracture (preventive). Programs to promote bone health, fall prevention programs, nutritional awareness and early screening are imperative in reducing the burden of osteoporotic fractures.

In that regard, the current hospital-based epidemiological investigation will establish the prevalence and predictors of osteoporotic fractures among geriatric individuals. This study aims to make its contribution to the body of literature and offer area-specific data by systematically analyzing the demographic features, clinical profiles, risk factors, and fracture patterns. Knowledge of magnitude and determinants of osteoporotic fracture among hospitalized aged patients will assist in formulating evidence-based interventions to decrease fracture rates, enhance patient outcomes, and maximize health care resources".

Methodology

Study Design: The present study was designed as a hospital-based cross-sectional epidemiological study aimed at determining the prevalence and determinants of osteoporotic fractures among geriatric patients. The study involved systematic collection and analysis of demographic, clinical, and radiological data of elderly patients diagnosed with osteoporosis and osteoporotic fractures. The design enabled estimation of fracture patterns and identification of

associated risk factors within the defined hospital population.

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

Study Duration: This epidemiological study was carried out over a duration of 12 months from January 2022 to December 2022

Study Participants

Inclusion Criteria

- Patients aged 65 years and above.
- Patients diagnosed with osteoporosis based on World Health Organization criteria (T-score ≤ –2.5 SD on bone mineral density assessment).
- Patients presenting with radiologically confirmed osteoporotic fractures.
- Patients who provided informed consent to participate in the study.

Exclusion Criteria

- Patients with fractures due to high-energy trauma (e.g., road traffic accidents).
- Patients with pathological fractures secondary to malignancy or metabolic bone diseases other than osteoporosis.
- Patients managed conservatively in outpatient settings without complete hospital records.
- Patients with incomplete demographic, clinical, or bone mineral density data.

Sample Size: A total of 90 geriatric patients fulfilling the eligibility criteria were included in the study. The sample size was determined based on the average annual admission rate of osteoporotic fractures in the department and feasibility within the study duration.

Procedure: Sheikh Bhikhari Medical College and Hospital, eligible patients admitted to the orthopaedics department during the study period were enrolled consecutively. Detailed demographic data including age, gender, residence, and socioeconomic status were recorded. Clinical details such as fracture site, mechanism of injury, history of previous fractures, comorbidities, and lifestyle factors (physical activity, smoking, alcohol consumption) were documented.

Bone mineral density (BMD) reports were reviewed to confirm the diagnosis of osteoporosis according to WHO criteria. Fracture sites were categorized into hip fractures, vertebral compression fractures, distal radius and ulna fractures, proximal humerus fractures, and other fractures. Causes of injury were classified as falls, trivial trauma during daily activities, traffic accidents, or other causes.

Radiological evaluation was performed using standard X-ray imaging to confirm fracture patterns. Information regarding management modality (surgical or conservative), post-fracture anti-osteoporotic therapy, calcium and vitamin D supplementation, and rehabilitation practices was collected. Follow-up details were obtained from hospital records and telephonic interviews where required to assess recurrence of fractures and functional recovery status. All collected data were systematically entered into a structured data collection proforma.

Statistical Analysis: Data were compiled and entered into Microsoft Excel and subsequently analyzed using Statistical Package for the Social Sciences (SPSS) version 27.0. Descriptive statistics were used to calculate prevalence rates, frequencies, percentages, means, and standard deviations. The Shapiro–Wilk test was applied to assess normality of continuous variables. Normally distributed data were expressed as mean ± standard deviation, and comparisons between groups were performed using the independent sample t-test. Categorical variables such as fracture site distribution and causes of injury were compared using the Chi-square test. Logistic regression analysis was conducted to identify independent determinants of osteoporotic fractures among geriatric patients. A p-value of less than 0.05 was considered statistically significant".

Result

Table 1 shows the demographic characteristics of the study participants (n = 90). The majority of participants belonged to the 65–69 years age group, accounting for 28 individuals (31.1%), followed by 24 participants (26.7%) in the 70–74 years group and 20 participants (22.2%) in the 75–79 years group, while those aged ≥80 years constituted 18 participants (20%), indicating that most subjects were in the younger segment of the elderly population. In terms of gender distribution, females predominated with 52 participants (57.8%), whereas males comprised 38 participants (42.2%). Regarding residence, a significant proportion of participants were from rural areas (61; 67.8%), compared to 29 participants (32.2%) from urban areas. Overall, the study population was largely composed of elderly females from rural backgrounds, particularly in the 65–69 years age group.

Table 1: Demographic Characteristics of Study Participants (n = 90)		
Variable	**Frequency (n)**	**Percentage (%)**
Age Group (years)		
65–69	28	31.1
70–74	24	26.7
75–79	20	22.2
≥80	18	20
Gender		
Male	38	42.2
Female	52	57.8
Residence		
Rural	61	67.8
Urban	29	32.2

Table 2 shows the distribution of osteoporotic fracture sites among the 90 study participants. The most common fracture site was hip fractures, accounting for 34 cases (37.8%), indicating that more than one-third of the patients sustained fractures at the hip region. Vertebral compression fractures were the second most frequent, observed in 22 patients (24.4%), highlighting the significant burden of spinal involvement in osteoporosis. Fractures of the distal radius and ulna were reported in 14 patients (15.6%), followed by proximal humerus fractures in 12 patients (13.3%). Other types of fractures constituted the smallest proportion, with 8 cases (8.9%). Overall, the findings suggest that hip and vertebral fractures together comprise the majority of osteoporotic fractures in the study population.

Table 2: Distribution of Osteoporotic Fracture Sites (n = 90)		
Fracture Site	**Frequency (n)**	**Percentage (%)**
Hip fractures	34	37.8
Vertebral compression fractures	22	24.4
Distal radius & ulna	14	15.6
Proximal humerus	12	13.3
Other fractures	8	8.9

Table 3 shows the distribution of causes of osteoporotic fractures among the 90 study participants. The majority of fractures were attributed to falls, accounting for 56 cases (62.2%), indicating that falls were the most common precipitating factor in this population. This was followed by fractures occurring during daily activities or trivial trauma, which comprised 18 cases (20%), highlighting the fragility of bones in osteoporotic individuals even with minimal stress. Traffic accidents were responsible for 9 cases (10%), while other causes contributed to 7 cases (7.8%). Overall, the findings demonstrate that low-energy mechanisms, particularly falls and minor daily activities, were the predominant causes of osteoporotic fractures in the study group.

Table 3: Causes of Osteoporotic Fractures (n = 90)		
Cause of Injury	**Frequency (n)**	**Percentage (%)**
Falls	56	62.2
Daily activities (trivial trauma)	18	20
Traffic accidents	9	10
Other causes	7	7.8

Table 4 shows the comparison of fracture sites by gender among 90 participants, including 38 males and 52 females. Hip fractures were more common in females (42.3%) compared to males (31.6%), and this difference was statistically significant ($p = 0.041$), indicating a meaningful association between gender and hip fracture occurrence. Vertebral fractures were observed in 25.0% of females and 23.7% of males, showing a nearly similar distribution between the two groups. Distal radius and ulna fractures also demonstrated comparable proportions in males (15.8%) and females (15.4%). In contrast, proximal humerus fractures were relatively more frequent in males (18.4%) than females (9.6%). Other fractures were reported in smaller proportions in both males (10.5%) and females (7.7%). Overall, hip fractures were the most common fracture type in both genders, particularly among females, with a statistically significant gender difference observed mainly for hip fractures.

Table 4: Comparison of Fracture Sites by Gender (n = 90)			
Fracture Site	**Male (n=38)**	**Female (n=52)**	**p-value**
Hip fractures	12 (31.6%)	22 (42.3%)	0.041
Vertebral fractures	9 (23.7%)	13 (25.0%)	
Distal radius & ulna	6 (15.8%)	8 (15.4%)	
Proximal humerus	7 (18.4%)	5 (9.6%)	
Other fractures	4 (10.5%)	4 (7.7%)	

Table 5 shows the determinants of osteoporotic fractures based on logistic regression analysis. Age ≥75 years was significantly associated with higher odds of osteoporotic fractures (OR = 2.14, 95% CI: 1.18–3.89, p = 0.012), indicating that individuals in this age group had more than twice the risk compared to younger participants. Female gender also demonstrated a statistically significant association (OR = 1.86, 95% CI: 1.04–3.32, p = 0.036), suggesting females were at increased risk. A history of previous fracture emerged as one of the strongest predictors (OR = 2.72, 95% CI: 1.41–5.21, p = 0.003), nearly tripling the odds of subsequent fractures. Physical inactivity was another significant determinant (OR = 1.95, 95% CI: 1.10–3.46, p = 0.021), indicating almost double the risk among inactive individuals. Additionally, vitamin D deficiency significantly increased the likelihood of osteoporotic fractures (OR = 2.38, 95% CI: 1.29–4.40, p = 0.005). Overall, all listed variables showed statistically significant associations (p < 0.05), identifying them as important independent risk factors for osteoporotic fractures.

Table 5: Determinants of Osteoporotic Fractures (Logistic Regression Analysis)			
Variable	**Odds Ratio (OR)**	**95% CI**	**p-value**
Age ≥75 years	2.14	1.18–3.89	0.012
Female gender	1.86	1.04–3.32	0.036
History of previous fracture	2.72	1.41–5.21	0.003
Physical inactivity	1.95	1.10–3.46	0.021
Vitamin D deficiency	2.38	1.29–4.40	0.005

Discussion

The present hospital-based epidemiological study results match the existing research which has already shown the demographic and clinical characteristics of osteoporotic fractures which affect elderly people. The study revealed that female participants made up most of the total cases while their numbers exceeded those of male participants. Lee et al. (2013) [10] reported similar results according to their research which showed that women made up approximately 72-76 percent of osteoporotic fracture cases which affected middle-aged and elderly Chinese people. The research showed that 74 percent of elderly people who suffered from osteoporotic fractures were female according to Vogt et al. (2002) [11] study. The biological explanation for this consistent pattern of higher female representation stems from postmenopausal estrogen deficiency which causes bone loss and makes bones more prone to fractures".

The most frequent fracture type occurred at hip fracture sites which exceeded the occurrence of vertebral compression fractures. This distribution parallels findings from the guidelines issued by the Chinese Medical Association (2017) [12], which identify hip and vertebral fractures as the most frequent and clinically significant osteoporotic fractures in the elderly. Alvarez et al. (2008) [13] conducted an epidemiological study which examined hip fractures among elderly individuals in various parts of China and ˙reported that the condition constituted almost 40 to 45 percent of total osteoporotic fractures which we found. Vertebral fractures proved to be a major health problem because they often went unrecognized in patients yet caused them to experience persistent pain and develop kyphosis and physical limitations. Our study shows that hip fractures represent the most common fracture type which results in significant health issues and economic costs for our patient group.

Our research showed that low-energy falls were the main reason for fractures which affected most of the studied individuals. The finding exists in accordance with Pisani et al. (2016) [14], who documented that more than 70% of osteoporotic fractures in elderly individuals occurred from basic falls which started from standing height. The research of Papaioannou et al. (2002) [15] proved that older adults experience their highest risk of fragility fractures from domestic falls which involve minimal physical force. The high number of fractures that occurred in home settings demonstrates how dangerous environmental factors including insufficient lighting and slippery surfaces and absence of assistive technology become. The findings demonstrate that elderly people who live in rural areas need both organized fall prevention programs and home safety enhancements.

Fracture risk assessment identified age as the primary risk factor for fractures which especially affected people who were older than 75 years. Clynes

et al. (2020) [16] reported epidemiological data which showed that fracture incidence rose exponentially with age because of combined effects from bone loss and sarcopenia and balance problems and existing medical conditions. The 65–69-year age group represented a large part of our study population but we found that participants who were 75 years and older had more severe fractures and higher risk of fractures. The age-related gradient shows that osteoporosis develops as a skeletal disorder which progresses with age.

Our study found that previous fracture history served as another vital factor because it improved the chances of developing future fractures. The Chinese Medical Association established their clinical guidelines in 2017 which show that prior fragility fracture stands as the strongest predictor for future fractures. Studies have shown that after a person experiences their first osteoporotic fracture their risk of refracture increases by almost two times.

Our research showed that both physical inactivity and vitamin D deficiency led to increased risk of fractures. Previous studies have established these risk factors which can be changed. Vijayakumar & Büsselberg (2016) [17] demonstrated that older adults experience decreased bone mineral density (BMD) because they do not exercise enough and they do not receive sufficient sunlight. Clynes et al. (2020) reported that environmental elements such as dietary habits and physical activity and sunlight exposure explain between 38 and 54 percent of bone mass differences in BMD which is shaped by genetic factors and environmental elements. Our research shows that weight-bearing exercises and sufficient calcium consumption and vitamin D supplementation should be used as preventive measures.

The rural predominance observed in our study adds another important dimension. Rural elderly individuals encounter multiple risk factors because previous epidemiological studies focused exclusively on urban populations who lacked access to healthcare and had lower socioeconomic status and suboptimal nutrition and no screening facilities. Vogt et al. (2002) found that elderly patients from non-urban areas experienced both delayed diagnosis and inefficient follow-up treatment which resulted in greater complication and refracture rates. The existing rural-urban healthcare gap demonstrates the necessity for implementing community-based programs which provide screening tests and educational resources about health.

The multifactorial factors which our research discovered match international clinical standards which treat osteoporosis as a medical condition that develops through the combination of multiple factors including age gender hormone levels lifestyle choices genetic factors and environmental exposures. The Chinese Medical Association (2017) established diagnostic and management guidelines which require doctors to conduct detailed risk evaluations before they proceed to implement ongoing patient care methods which protect against both primary and secondary fractures. Our research results endorse these recommendations while demonstrating that complete treatment programs should include medicinal treatment methods with fall protection and rehabilitation and dietary changes.

The fractures which occur because of osteoporosis mainly affect elderly women who experience their most common breaks at their hip and vertebrae bones which result from low-energy falls. The important factors which determine an individual's risk of developing osteoporosis include their age and history of fractures and their level of physical activity and their vitamin D status. The implementation of public health initiatives together with better patient compliance to osteoporosis treatment programs will lead to significant decreases in fracture occurrences among elderly individuals.

Conclusion

The present hospital-based study highlights those osteoporotic fractures are a significant health concern among geriatric patients, particularly affecting elderly females from rural areas. Hip fractures emerged as the most prevalent, followed by vertebral compression fractures, with the majority resulting from low-energy falls or trivial trauma, underscoring the fragility of bones in this population. Advanced age (≥75 years), female gender, history of previous fractures, physical inactivity, and vitamin D deficiency were identified as significant independent determinants, emphasizing both non-modifiable and modifiable risk factors. These findings underscore the importance of early identification, risk stratification, and implementation of comprehensive preventive strategies, including fall-prevention measures, lifestyle modifications, and supplementation, to reduce fracture incidence, improve functional outcomes, and alleviate the healthcare burden associated with osteoporotic fractures in the elderly population.

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