**ORIGINAL RESEARCH**

# To evaluate the levels of Vitamin D and its association with osteoporosis and the severity of fracture site comminution in patients with osteoporotic hip fractures

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**ABSTRACT**

**Aim:** The objective of this study is to evaluate the levels of Vitamin D and its association with osteoporosis and the severity of fracture site comminution in patients with osteoporotic hip fractures.

**Materials and Methods:** The present study comprised a sample size of 50 individuals. The patient demographics included information on age and gender, the type of fracture, vitamin D levels, Singh's index, and the presence of comminution at the fracture site.

**Results:** Out of the total sample size of 50 individuals, 30 (60%) were female and 20 (40%) were male. The distribution of fractures observed in the study consisted of 54% intertrochanteric fractures and 46% femur neck fractures. The prevalence of Singh index III was observed in 34% of the patients, followed by Singh index IV in 28% of the patients. Singh index I was present in 22% of the patients, while Singh index II was found in 16% of the patients. The average vitamin D levels in the femur neck fracture group were 10.11±1.59, while in the intertrochanteric fracture group, they were 14.06±2.22.

**Conclusions:** The potential benefits of promptly identifying and managing individuals with vitamin D deficiency-induced osteomalacia and implementing anti-osteoporotic treatment plans are expected to improve overall bone, muscle, and overall health outcomes, thereby reducing the incidence of falls and fractures.

**Keywords:** vitamin D, Intertrochanteric fractures, Femur neck fractures



## Introduction

The occurrence of a hip fracture can result in various adverse outcomes, such as disability, diminished quality of life, and premature mortality. Consequently, it is regarded as the most consequential complication associated with osteoporosis. In the year 2000, there was a global incidence of 1.6 million hip fractures, with a subsequent mortality rate of 20-30% among individuals who survived such fractures. The projected increase in elderly populations, particularly in developing countries, is expected to result in a heightened societal and economic burden associated with hip fractures over the next five decades. Vitamin D has emerged as a compelling therapeutic agent for the prevention of hip fractures, which is considered a prominent area of research focus.[1] A matter of global significance pertains to the prevalence of vitamin D deficiency and insufficiency.It is recommended to supplement with vitamin D, either alone or in combination with calcium, for the purpose of preventing fractures. Previous meta-analytical

investigations of randomized controlled trials have yielded findings suggesting that vitamin D does not exhibit any discernible impact on fracture risk. Alternatively, these analyses have indicated that daily intake of 700-800 IU or "received dosages" of 400 IU may be necessary to mitigate the occurrence of fractures. However, it is important to note that the later meta-analyses examined in this study primarily focused on the comparison between placebo and combined vitamin D and calcium supplementation, with a particular emphasis on critically excessive dosage. It is worth mentioning that calcium supplementation has been found to provide independent protection against fractures. This raises skepticism regarding the efficacy of Vitamin D supplementation in the absence of calcium.There exists an elevated susceptibility among pregnant individuals, individuals of diverse racial backgrounds (specifically Blacks, Hispanics, and those with heightened skin melanin pigmentation), individuals who are overweight or obese, and individuals who refrain from direct exposure to sunlight.The laboratory employed an automated analyzer to examine serum levels of 25-hydroxyvitamin D (25-OH vitamin D) through the utilization of the Chemiluminescence Immuno Assay. [5] A serum level of less than 20 ng/ml of Vitamin D was regarded as indicative of deficiency. Vitamin D level was considered to be inadequate between 20 and 29 ng/ml called vitamin D deficiency (hypovitaminosis D) and Vitamin D levels were considered normal between 30 and 100 ng/ml.[6] The implementation of evidence-based screening methods has the potential to enhance the identification of individuals who are most likely to derive benefits from fracture prevention drug treatment. In addition, a comprehensive evaluation of the appropriate timing to initiate pharmacotherapy and the selection of medication and treatment duration can enhance the advantages of fracture prevention while mitigating the potential risks associated with prolonged drug usage.[7] The objective of this study was to investigate the prevalence of vitamin D deficiency among individuals with osteoporotic hip fracture within our rural population, as well as to examine its potential correlation with both osteoporosis and osteoporotic hip fractures in a tertiary care trauma center.

## Materials and Methods

This study was conducted at our tertiary care hospital. The age range of the participants in the study was between 40 and 85 years. The classification system developed by Boyd and Griffin was utilized to grade intertrochanteric fractures, while Garden's staging system was employed to categorize femoral neck fractures. The study encompassed all individuals who experienced fractures following minor incidents, such as slipping and falling while standing or walking. It specifically excluded individuals with a significant trauma history, such as accidents involving motor vehicles or falls from elevated surfaces, as well as those with fractures resulting from underlying pathological conditions. The present study comprised a sample size of 50 individuals. The patient demographics included information on age and gender, the type of fracture, vitamin D levels, Singh's index, and the presence of comminution at the fracture site. The data collected was encoded and inputted into a spreadsheet using Microsoft Excel. The mean and standard deviation were computed. In order to assess the statistical significance, the t-test was employed for continuous variables, while the Chi-square test was utilized for categorical variables. A p-value that is less than 0.05 is generally regarded as being statistically significant.

## Results

The study population consisted of 50 patients. The majority of individuals in question were of the female gender. Out of the total sample size of 50 individuals, 30 (60%) were female and 20 (40%) were male. The majority of patients (50%) fall within the age range of 60-70 years, followed by those aged 50-60 years (24%), individuals above 70 years (14%), and those aged 40-50 years (12%).According to available data, a significant proportion of injuries, specifically 74%, can be attributed to road traffic accidents. The following table (Table 1) presents the relevant data. Table 2 displays the various types of fractures. The distribution of fractures observed in the study consisted of 54% intertrochanteric fractures and 46% femur neck fractures. Table 3 displays the Singh's index. The prevalence of Singh index III was observed in 34% of the patients, followed by Singh index IV in 28% of the patients. Singh index I was present in 22% of the patients, while Singh index II was found in 16% of the patients. The average vitamin D levels in the femur neck fracture group were 10.11±1.59, while in the intertrochanteric fracture group, they were 14.06±2.22, as presented in Table 4. The degree of comminution at the fracture site was observed to be 15 in cases of femur fractures and 8 in cases of intertrochanteric fractures. Table 5

**Table 1 Basic parameter of the patients**

| Gender | Number | Percentage |
|---|---|---|
| Female | 30 | 60 |
| Male | 20 | 40 |
| Age | | |
| 40-50 | 6 | 12 |

| | | |
|---|---|---|
| 50-60 | 12 | 24 |
| 60-70 | 25 | 50 |
| Above 70 | 7 | 14 |
| Road Traffic Accidents | 37 | 74 |
| Fall from the height | 10 | 20 |
| Others | 3 | 6 |
| Co morbidity | | |
| Hypertension | 11 | 22 |
| Diabetic | 6 | 12 |
| Others | 4 | 8 |

**Table 2. Fracture type**

| Fracture type | Number | Percentage |
|---|---|---|
| Femur neck | 23 | 46 |
| Intertrochanteric | 27 | 54 |

**Table 3. Singh index**

| | **Fracture type** | | Total | Percentage | P value |
|---|---|---|---|---|---|
| Singh index | Femur neck | Intertrochanteric | | | |
| I | 5 | 6 | 11 | 22 | |
| II | 5 | 3 | 8 | 16 | 0.17 |
| III | 10 | 7 | 17 | 34 | |
| IV | 3 | 11 | 14 | 28 | |

**Table 4 Vitamin D levels**

| | **Fracture type** | **Mean** | **P-Value** |
|---|---|---|---|
| Vitamin D levels | Femur neck | 10.11±1.59 | 0.03 |
| | IT | 14.06±2.22 | |

**Table 5. Fracture site comminution**

| Fracture site comminution | Fracture type | | Total | p-Value |
|---|---|---|---|---|
| | Femur neck | IT | | |
| No | 8 | 19 | 27 | |
| Yes | 15 | 8 | 23 | 0.03 |
| Total | 23 | 27 | 50 | |

**Discussion**

Fractures of the hip and proximal femur are multifaceted injuries that encompass a multitude of contributing factors. Various factors have the potential to contribute to the occurrence of different types of proximal femur fractures. These factors include age, injury mechanism, local anatomic factors, insulin-like growth factor, and static balance ability. Fractures resulting from osteoporosis manifest in approximately 33% of females and 25% of males aged 50 years and above. On a global scale, it is estimated that approximately nine million individuals experience a fracture annually due to the presence of osteoporosis.[8]. There exists a correlation between reduced serum levels of vitamin D in older adults and various physiological manifestations, including muscle fatigue, generalized body pain, diminished strength and balance, heightened bone turnover, elevated susceptibility to falls, and an increased likelihood of sustaining hip fractures.[9] A notable rise in mortality was observed among patients diagnosed with hip fractures, with men exhibiting higher mortality rates compared to women. There exists a positive correlation between mortality rates and the combination of institutionalization and co-morbidities.[10] Adequate levels of cholecalciferol or ergocalciferol (700-800 IU/day) have been observed to reduce the likelihood of hip and non-vertebral fractures in elderly individuals, whether they are residing in outpatient settings or institutionalized. According to recent research, it is advisable to consider vitamin D supplementation as a means to optimize potential advantages and minimize potential drawbacks. This is particularly relevant when aiming to restore 25-hydroxyvitamin D (25(OH) D) levels within the recommended range of 30-50 ng/ml. It is imperative to consider the patient's individual needs and co-morbidities in this regard. This study aims to investigate the potential correlation between reduced mortality rates and the utilization of prescribed calcium and vitamin D supplementation, along with the concurrent use of anti-osteoporotic medications, in female individuals following a fracture. Additional research is warranted to comprehensively comprehend the underlying factors contributing to

the observed decrease in mortality risk.[13] There is a notable occurrence of hypovitaminosis D among individuals with osteoporotic hip fractures, with secondary hyperparathyroidism being observed in over 50% of these cases. Vitamin D deficiency is notably prevalent among individuals who experience limited exposure to sunlight and possess low nutritional and functional status.According to a study conducted by researchers [14], approximately 75% of individuals diagnosed with hip fractures exhibit a deficiency in vitamin D, while approximately 66% of these patients also present with secondary hyperparathyroidism. Hence, the measurement of 25-OH serum level can serve as a valuable indicator for evaluating the susceptibility to hip fracture in the Indian population.[15] The presence of 25-hydroxyvitamin D (25(OH) D) insufficiency over a period of five years was found to be linked to a higher 10-year risk of hip fractures and major osteoporotic fractures in elderly women.[16]

Collectively, the evidence presented indicates that the development of femoral neck fractures is closely associated with compromised bone mineralization and reduced levels of serum 25-(OH) D. As a result, the act of achieving equilibrium in serum 25-OH D levels and subsequently restoring serum PTH levels to normal can potentially mitigate significant impairments in mineralization and decrease the occurrence of femoral neck fractures.[17] Following the occurrence of a fragility fracture, the medical condition of osteoporosis is identified and managed through the administration of osteoporosis-specific medications in adherence to established guidelines. Ideally, the treatment approach should not hinder the process of fracture healing and significantly reduces the probability of subsequent fractures. Additional research is required to obtain approval for the enhancement of fracture healing.[18] This systematic review and meta-analysis found no evidence of a reduced fracture risk associated with sporadic or regular dosing of standard doses of vitamin D alone. However, a more encouraging strategy was observed in the form of daily supplementation with both vitamin D and calcium.[19]

A significant predictor of mortality risk following a fracture was observed to be the occurrence of accelerated bone loss, which was found to be independent of gender. The association between bone loss and mortality after a fracture was predominantly observed in both women and men who experienced vertebral fractures and non-hip non-vertebral fractures in women. The determination of whether bone loss functions as a marker or exerts a role in fracture-related mortality has yet to be established.[20] There has been a recent association established between non-vertebral fractures and the risk of mortality. In order to enhance comprehension regarding the specific fractures and variables that contribute to the risk of mortality associated with fractures, it is imperative to conduct larger-scale studies. Further research is required to ascertain the impact of bone on post-fracture mortality, particularly in relation to its potential reversibility through the implementation of anti-fracture therapies.[21] The use of both bisphosphonate and non-bisphosphonate osteoporosis medications demonstrated a significant association with decreased mortality due to hip fractures resulting from fragility.[22] Regularly monitoring the annual serum concentrations of 25-hydroxyvitamin D can provide valuable insights into the presence of vitamin D deficiencies. Ensuring sufficient vitamin D levels can be achieved through two primary methods: responsive exposure to sunlight and increased dietary and supplementary intake of vitamin D. Responsive exposure to sunlight typically involves exposing the arms and legs, or alternatively, the hands, arms, and face, to sunlight for a duration of five to ten minutes, at least two or more times per week. Additionally, augmenting one's diet with vitamin D-rich foods and taking vitamin D supplements can also contribute to maintaining adequate vitamin D levels.[23]

## Conclusion

In order to enhance bone health and address osteoporosis, it is advisable for elderly individuals, both women and men, to seek guidance from healthcare professionals regarding their nutritional needs. It is advisable to consume appropriate levels of vitamin D through the intake of both dietary sources and supplements. The potential benefits of promptly identifying and managing individuals with vitamin D deficiency-induced osteomalacia and implementing anti-osteoporotic treatment plans are expected to improve overall bone, muscle, and overall health outcomes, thereby reducing the incidence of falls and fractures.

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