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Relation between Vitamin D status and hip fractures in elderly women

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Abstract
Background: A proximal femur fracture is the most serious complication of osteoporosis, due to the high mortality and morbidity associated with it. Its risk in the elderly is a function of multiple factors, including bone mineral density, muscle strength, and balance, all of which have been related to Vitamin D status and function. Vitamin D deficiency is common in older adults in Western countries with seasonal winters, when the amount of sunlight is much reduced. There is a paucity of data on the prevalence of vitamin D deficiency in patients with hip fracture in countries such as India where the climate is predominantly tropical.
Methods: We prospectively studied 30 patients with hip fracture admitted to the Orthopedic department over a 1-year period. Younger patients (patients < 50 years) were excluded. Data on patient demographics, comorbidities, functional status, and serum 25-hydroxyvitamin D levels were collected.
Results: The data of 30 patients (aged between 50 to 73), were analyzed. The prevalence of vitamin D insufficiency (25(OH) D < 30 ng/mL) and deficiency (25(OH) D < 20 ng/mL) was 63.3% and 36.6%, respectively. Age and 25(OH) D levels were found to be correlated, with no correlation between the UV index and the 25(OH) D levels.
Conclusions: Supplementation of vitamin D in elderly people with and without fracture might prevent secondary hyperparathyroidism, osteomalacia and fracture.

Keywords: Elderly people, hip fracture, hypovitaminosis d, osteoporosis, vitamin d deficiency.

Introduction
Hypovitaminosis D is a prevalent condition among the elderly population, leading to osteomalacia [1-4]. In addition, many elderly individuals have inadequate dietary calcium intake. Both hypovitaminosis D and low calcium intake contribute to increased secretion of the parathyroid hormone, resulting in bone loss, which plays a crucial role in the development of osteoporosis [1, 5, 6]. Notably, the heightened bone resorption primarily affects cortical bone, raising the risk of hip fractures. In numerous developed countries, hip fractures among the elderly have emerged as a significant health concern. Several epidemiological studies have indicated that low levels of 25(OH) D are associated with a higher risk of hip fracture. Age-related vitamin D deficiency can be attributed to insufficient exposure to sunlight and a deficient dietary intake. The consequences of hypovitaminosis D may be exacerbated by low calcium intake, as food generally contains limited amounts of vitamin D, except for fatty fish. Consequently, diet alone is insufficient to compensate for reduced sunlight exposure [7]. Since the synthesis of vitamin D in the skin depends on ultraviolet irradiation during the spring and summer seasons, its levels are influenced by factors such as the time of year and latitude [1, 8]. Unfortunately, the use of vitamin D supplements is infrequent. Nevertheless, several studies have demonstrated that preventive vitamin D supplementation significantly increases serum 25(OH)D levels, normalizes elevated levels of parathyroid hormone (PTH) and alkaline phosphatase, and leads to an increase in bone mineral density and a reduction in the incidence of hip fractures and other non-vertebral fractures in the elderly population. These findings suggest that treatment with vitamin D, with or without calcium, to prevent fractures may be a cost-effective approach, particularly considering the relatively low cost of vitamin D supplementation.

The aims of this study were to ascertain the prevalence of hypovitaminosis D and the risk factors associated with vitamin D deficiency among hospitalized elderly patients with hip fractures.

Methods and Materials

This was a prospective study of 30 patients with fragility hip fractures, studied between MAY 2022 to MAY 2023 at the department of Orthopaedics, Saveetha medical college and hospital, Thandalam. Patients aged 60 years or older, with hip fractures. Patients with both femoral neck and trochanteric fractures were included. Femoral neck and trochanteric fractures were diagnosed by reviewing the radiographs. Patients with pathological fractures, bone metastases, atypical femoral fractures, and those receiving vitamin D supplementation were excluded. Elderly patients with hip fractures caused by high-energy injuries were also excluded. A detailed history of all patients was taken and recorded in inpatient files. Data on patient demographics (age, gender, race, and living arrangements), falls history, premorbid mobility, premorbid functional status, inpatient mortality and included data on time spent outdoors (little = 1 frequent = 2) and sunshine exposure (low = 1, high = 2). These were added up to a sunshine scare (low = 2, intermediate 3, high = 4). Dietary history restricted to the intake of calcium and vitamin D was obtained by an experienced dietician. The cross- check method was used, daily intake of various nutrients was recalled and subsequently, total consumption of these nutrients per week was questioned to check reliability. Fatty fish may contain a substantial quantity of vitamin D, depending on the source. All patients were assessed clinically. The preoperative medical evaluation of all patients was done to prevent potential complications that can be life-threatening or limb-threatening. The general condition of the patient was assessed with regard to hypovolemia, associated orthopaedic, or other systemic injuries.

All blood tests for serum 25(OH) D measurement were taken during acute care within 2–6 days after the hip fracture event. Serum for 25(OH) D assessment was stored at −80 °C and all measurements were performed in one batch. 25(OH) D serum levels were measured with a radioimmuno assay (sensitivity 1.5 µg/l; coefficient of variation 8.4%). We defined vitamin D deficiency using Holick classification, where vitamin D deficiency is considered when there is a vitamin D level < 20 ng/mL, vitamin D insufficiency is defined as vitamin D level 21 to 29 ng/mL, and normal vitamin D levels are defined as ≥ 30 ng/mL [Table 1]. Serum PTH was measured by a chemoluminescence assay. Serum concentrations of calcium, phosphate, creatinine, alkaline phosphatase, and albumin were measured according to standard laboratory methods. All measurements were performed by the same technician in one batch at the laboratory of the Saveetha University.

We analyzed the data using Stata version 10.1 statistical software. Differences in sunshine score were evaluated by the Chi square test. The relative importance of various determinants of vitamin D metabolite concentrations was assessed by stepwise multiple regression analysis. The following variables were used in the regression analysis on serum 25(OH) D: Age, residence, sunshine score, dietary calcium and vitamin D intake, and the serum concentrations of calcium and phosphate. A P value below 0.05 was considered statistically significant.

Results

30 female Patients with hip fractures were studied between May 2022 to May 2023. The mean age of the patients were 59.9 years (range, 50-73). The mode of injury in all the patients were found to be due to slip and fall.18 patients had injury to right side and 12 patients had left side of the hip affected.17 patients had an Intertrochanteric fracture and 13 of them had a neck of femur fracture. All the patients were found to be living independently. Only 10% went outside daily and 90% of this group seldom went outdoors. A dietary history could be obtained from all the patients. Only 6 patients were found to have taken diet rich in vitamin D and remaining 24 patients did not consume a diet rich in vitamin D [Table 2]. Data on vitamin D status of the patients showed that 19 patients had vitamin D insufficiency with a mean value of 27.42 ngl/ml (range, 20-29 ng/ml) and 11 patients had vitamin deficiency with a mean value of 16.9 ng/ml (range,14-19 ngl/ml) [Fig 2]. The serum PTH value that was collected from the patient had a mean value of 5.81 pmol/l (Range, 4.8-6.9 pmol/l). All the patients were treated by internal fixation or prosthesis. The mortality was 26% in the first year after the fracture. Almost all patients needed crutches or a walking aid one year after the fracture. Half of the patients needed chronic care.

Discussion

Vitamin D metabolism changes with age and vitamin D deficiency or a decreased formation of active metabolites may contribute to the pathogenesis of osteoporosis [1]. Hypovitaminosis D can be diagnosed by measuring the serum concentration of 25 (OH) D. The serum 25 (OH) D concentration is not subject to homeostatic control, but depends on lifestyle and environmental characteristics. Hypovitaminosis D has adverse effects on bone and may cause muscle weakness. Secondary hyperparathyroidism may develop, increasing bone turnover and decreasing bone mass [1]. Vitamin D deficiency is a risk factor for fractures. The most severe osteoporotic fracture is hip fracture, which typically results from falling from the standing position after minor trauma. It is usually painful and nearly always necessitates hospitalisation. Hip fracture is among the most common causes of acute immobilisation in elderly patients. Elderly patients with hip fracture are at high risk of a hip fracture on the other side [9]. Vitamin D status is poor in patients with hip fracture compared with healthy individuals of similar age. In our study, patients with hip fracture had significantly lower 25(OH). Among patients with hip fracture, the prevalence of hypovitaminosis D was almost 100%, according to reference level. About 85% of the total vitamin D derives from ultraviolet radiation and only 15% from diet [7]. Both low ultraviolet light exposure and low vitamin D intake are important factors in the development of hypovitaminosis D. In comparison, Webb *et al*. [10]. Showed that, in Edmonton, Canada (52° Northern Latitude), the ineffective winter period with regard to vitamin D synthesis extended from October through to March, implicating a low solar intensity. In winter, most UV radiation is absorbed in the atmosphere. But in our country the winter season is of shorter duration. Besides this, the risk of vitamin D deficiency in the elderly is greater in cities than in rural communities. Nutrition is the other important source of vitamin D. Fatty fish, such as herring, mackerel and salmon are a very rich source of vitamin D but are rarely eaten by the elderly in our region.

Many investigators have observed an increased serum PTH concentration in elderly people with or without hip fracture associated with vitamin D deficiency [2, 8, 11]. Serum PTH correlated negatively with serum 25(OH) D in these studies.

The increases of serum PTH associated with vitamin D deficiency are usually within the normal reference range. The seasonal variation of serum PTH does not only occur in the elderly, but also in children and adolescents. In our study, serum PTH was significantly higher in the patients with hip fractures but was within the normal range (1.6 to 6.9 pmol/l) [Fig 1]. In a recent study in Singapore by Hawkins [12], Malays being at greater risk of vitamin D deficiency than the Chinese although this was in a younger population. However, in our study we dealt with Indian population and showed a less significant decrease in vitamin D levels when compared to the results of the other study this could be related to religious cultural practice of dressing style (long sleeves, head dress for Muslim Malay females) and this avoidance of sunlight by the Malays could account for the lower vitamin D levels. Sakuma *et al*. [13] reported that the average serum 25 (OH) D level and the prevalence of vitamin D deficiency was 16.3 ng/mL and 79.0%, respectively, in 225 Japanese patients with hip fractures. The results of that study were similar to our study.

Multiple studies have estimated the prevalence of hypovitaminosis D in selected populations at particular risk for vitamin D deficiency, such as the institutionalised elderly. Immobility may be the strongest risk factor for Vitamin D deficiency. Considering the long immobility of patients in hospital after hip fracture, Vitamin D deficiency may aggravate in these patients and osteomalacia might develop. Vitamin D supplementation may prevent the development of secondary hyperparathyroidism. This indicates that vitamin D treatment should begin in the acute stage in all immobile elderly after hip fracture, aiming to reverse or stop the loss of bone mineral density. A previous study showed that vitamin D supplementation prevented bone loss from the spine during the winter in postmenopausal women. In The Netherlands, vitamin D supplementation in the elderly led to an adequate improvement of vitamin D status, as determined by a significant increase of serum 25(OH) D and 1,25(OH)2 D concentration, decrease of serum PTH concentration [11, 15], but hip fracture incidence did not decrease [16]. The effect of the combination of vitamin D and calcium was studied by Chapuy [14]. They observed a 25% decrease in the incidence of hip fracture and other peripheral fractures in women living in a nursing home. Other studies confirmed that treatment with vitamin D and calcium increases bone mass and reduces the risk for fractures [17-19].

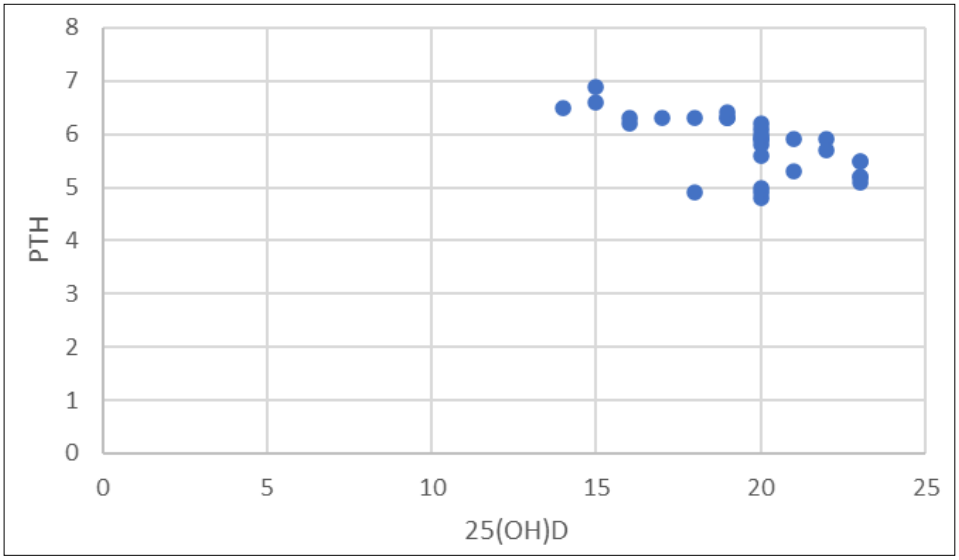

Fig 1: Scattered plot showing correlation between serum 25(OH) D and serum PTH among study population.

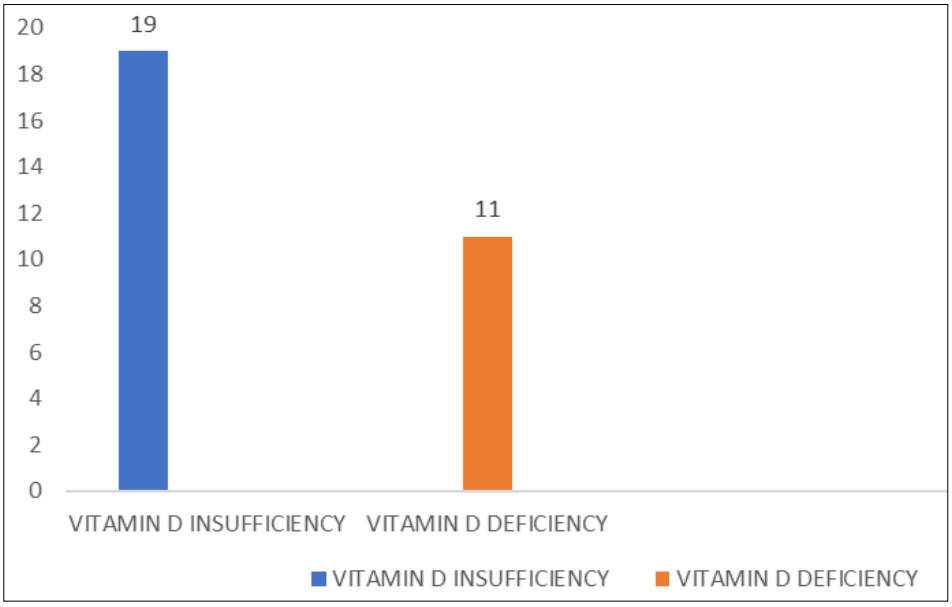

Fig 2: Prevalence of Vitamin D deficiency among the study population

Table 1: Data on serum Vitamin D and serum PTH levels

Vitamin D sufficiency	30 to 100 ng/ml
Vitamin D insufficiency	20 to 29 ng/ml
Vitamin D deficieny	Less than 20 ng/ml
Normal serum PTH range	4.8 to 6.9 pmol/l

Table 2: Patient demographic data

S. No	Age/Sex	Side	Mode of Inury	Type of Hip Fracture	Sunshine Score	Consumption Ofdiet Rich in VIT D and Calcium	Vitamin D Levels Serum 25(OH) D (ng/ml)	PTH Level (Pmol/l)
1.	58/F	RIGHT	Slip and Fall	Inter Trochantric	Low	No	18	4.9
2.	62/F	LEFT	Slip and Fall	Inter Trochantric	Intermediate	No	20	4.8
3.	66/F	LEFT	Slip and Fall	Neck of Femur	Low	No	16	6.2
4.	61/F	RIGHT	Slip and Fall	Inter Trochantric	Intermediate	No	23	5.2
5.	55/F	RIGHT	Slip and Fall	Inter Trochantric	High	Yes	23	5.2
6.	53/F	RIGHT	Slip and Fall	Inter Trochantric	High	No	23	5.1
7.	72/F	LEFT	Slip and Fall	Neck of Femur	Low	No	14	6.5
8.	68/F	LEFT	Slip and Fall	Neck of Femur	Low	No	19	6.3
9.	66/F	RIGHT	Slip and Fall	Neck of Femur	Low	No	20	5.9
10.	67/F	RIGHT	Slip and Fall	Neck of Femur	Intermediate	Yes	22	5.7
11.	51/F	LEFT	Slip and Fall	Inter Trochantric	Intermediate	Yes	23	5.5
12.	59/F	LEFT	Slip and Fall	Inter Trochantric	High	Yes	23	5.5
13.	67/F	RIGHT	Slip and Fall	Neck of femur	Low	No	19	6.3
14.	62/F	RIGHT	Slip and Fall	Inter Trochantric	Low	No	20	5.8
15.	63/F	RIGHT	Slip and Fall	Neck of Femur	Intermediate	No	21	5.9
16.	68/F	RIGHT	Slip and Fall	Neck of Femur	Low	No	16	6.3
17.	61/F	RIGHT	Slip and Fall	Inter Trochantric	Intermediate	No	20	4.9
18.	60/F	LEFT	Slip and Fall	Inter Trochantric	Intermediate	Yes	21	5.3
19.	73/F	LEFT	Slip and Fall	Neck of Femur	Low	No	15	6.6
20.	70/F	RIGHT	Slip and Fall	Neck of Femur	Low	No	15	6.9
21.	64/F	RIGHT	Slip and Fall	Inter Trochantric	Low	No	20	6.2
22.	60/F	RIGHT	Slip and Fall	Inter Trochantric	Low	No	19	6.4
23.	57/F	LEFT	Slip and Fall	Inter Trochantric	Intermediate	No	20	5
24.	50/F	LEFT	Slip and Fall	Inter Trochantric	Intermediate	Yes	22	5.9
25.	55/F	LEFT	Slip and Fall	Inter Trochantric	Intermediate	No	20	6.1
26.	59/F	RIGHT	Slip and Fall	Inter Trochantric	Low	No	18	6.3
27.	62/F	RIGHT	Slip and Fall	Inter Trochantric	Low	No	20	5.9
28.	62/F	RIGHT	Slip and Fall	Inter Trochantric	Intermediate	No	20	6
29.	64/F	RIGHT	Slip and Fall	Inter Trochantric	Low	No	17	6.3
30.	65/F	LEFT	Slip and Fall	Inter Trochantric	Low	No	20	5.6

Conclusion

In conclusion, hypovitaminosis D is a very common problem among elderly patients with and without hip fracture in India. When considering potential adverse effects of vitamin D deficiency on the skeleton and other organs, and the impossibility of widespread screening for vitamin D in Indian circumstances, routine vitamin D supplementation should be considered for elderly persons with or without hip fracture.

Declarations

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Conflict of interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical approval: Not required.

References

1. Lips P. Vitamin D deficiency and secondary hyperparathyroidism in the elderly: Consequences for bone loss and fractures and therapeutic implications. Endocrine Reviews. 2001 Aug 1;22(4):477-501.
2. Thomas MK, Lloyd-Jones DM, Thadhani RI, Snaw AC, Deraska DJ, Kitch BT, Vamvakas EC, Dick IM, Prince RL, Finkelstein JS. Hypovitaminosis D in medical inpatients. N Engl J Med. 1998;338:777-783.
3. McKenna MJ, Freaney R, Meade A, Muldowney FP. Hypovitaminosis D and elevated serum alkaline phosphatase in elderly Irish people. The American Journal of Clinical Nutrition. 1985 Jan 1;41(1):101-9.
4. Parfitt AM. Osteomalacia and related disorders. In: Avioli LV, Krane SM (Ed) Metabolic bone disease, 3rd Ed. Academic Press, San Diego, California; c1998. p. 327-386.
5. Nasonov E. Vitamin D and calcium deficiency: New facts and hypothesis (in Russian). Osteoporosis Osteopat. 1998;3:42-47.
6. Chapuy MC, Chapuy P, Thomas JL, Hazard MC, Meunier PJ. Biochemical effects of calcium and vitamin D supplementation in elderly, institutionalized, vitamin D-deficient patients. Revue du Rhumatisme (English Ed.). 1996 Feb 1;63(2):135-40.
7. Lips PF, Van Ginkel FC, Jongen MJ, Rubertus F, Van Der Vijgh WJ, Netelenbos JC. Determinants of vitamin D status in patients with hip fracture and in elderly control subjects. The American Journal of Clinical Nutrition. 1987 Dec 1;46(6):1005-10.
8. Lips P, Duong TU, Oleksik A, Black D, Cummings S, Cox D, *et al*. Multiple Outcomes of Raloxifene Evaluation Study Group. A global study of vitamin D status and parathyroid function in postmenopausal women with osteoporosis: Baseline data from the multiple outcomes of raloxifene evaluation clinical trial. The Journal of Clinical Endocrinology & Metabolism.

2001 Mar 1;86(3):1212-21.
9. Sato Y, Kaji M, Higuchi F, Yanagida I, Oishi K, Oizumi K. Retracted Article: Changes in Bone and Calcium Metabolism Following Hip Fracture in Elderly Patients. Osteoporosis international. 2001 Jun;12:445-9.
10. Webb AR, Kline L, Holick MF. Influence of season and latitude on the cutaneous synthesis of vitamin D3: Exposure to winter sunlight in Boston and Edmonton will not promote vitamin D3 synthesis in human skin. The Journal of Clinical Endocrinology & Metabolism. 1988 Aug 1;67(2):373-8.
11. Lips P, Wiersinga A, Van Ginkel FC, Jongen MJ, Netelenbos JC, Hackeng WH, Delmas PD, Van der Vijgh WJ. The effect of vitamin D supplementation on vitamin D status and parathyroid function in elderly subjects. The Journal of Clinical Endocrinology & Metabolism. 1988 Oct 1;67(4):644-50.
12. Hawkins RC. 25-OH vitamin D3 concentrations in Chinese, Malays, and Indians. Clinical Chemistry. 2009 Sep 1;55(9):1749-51.
13. Sakuma M, Endo N, Hagino H, Harada A, Matsui Y, Nakano T, Nakamura K. Serum 25-hydroxyvitamin D status in hip and spine-fracture patients in Japan. Journal of Orthopaedic Science. 2011 Jul;16:418-23.
14. Chapuy MC, Arlot ME, Duboeuf F, Brun J, Crouzet B, Arnaud S, Delmas PD, Meunier PJ. Vitamin D3 and calcium to prevent hip fractures in elderly women. New England Journal of Medicine. 1992 Dec 3;327(23):1637-42.
15. Ooms ME, Roos JC, Bezemer PD, Van Der Vijgh WJ, Bouter LM, Lips PA. Prevention of bone loss by vitamin D supplementation in elderly women: A randomized double-blind trial. The Journal of Clinical Endocrinology & Metabolism. 1995 Apr 1;80(4):1052-8.
16. Lips P, Graafmans WC, Ooms ME, Bezemer PD, Bouter LM. Vitamin D supplementation and fracture incidence in elderly persons: A randomized, placebo-controlled clinical trial. Annals of Internal Medicine. 1996 Feb 15;124(4):400-6.
17. Dawson-Hughes B, Harris SS, Krall EA, Dallal GE. Effect of calcium and vitamin D supplementation on bone density in men and women 65 years of age or older. New England Journal of Medicine. 1997 Sep 4;337(10):670-6.
18. Trivedi DP, Doll R, Khaw KT. Effect of four monthly oral vitamin D3 (cholecalciferol) supplementation on fractures and mortality in men and women living in the community: randomised double blind controlled trial. Bmj. 2003 Mar 1;326(7387):469.
19. Larsen ER, Mosekilde L, Foldspang A. Vitamin D and calcium supplementation prevents osteoporotic fractures in elderly community dwelling residents: a pragmatic population-based 3-year intervention study. Journal of Bone and Mineral Research. 2004 Mar;19(3):370-8.

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