International Journal of Orthopaedics Research
www.orthopaedicsjournal.in
E-ISSN: 2663-0923, P-ISSN: 2663-0915
Received: 11-01-2021; Accepted: 28-01-2021; Published: 10-03-2021
Volume 3; Issue 1; 2021; Page No. 35-38

# Evaluation of the prevalence of vitamin D deficiency in orthopaedic patients

**Kiran Reddy Ch SRK[1], Anil Kumar Chitumalla[2*]**

[1] Assistant Professor, Department of Orthopedics, Kamineni Institute of Medical Sciences, Narketpally, Telangana, India

[2] Associate Professor, Department of Orthopaedics, Kamineni Institute of Medical Sciences, Narketpally, Telangana, India

[*]Corresponding Author: Anil Kumar Chitumalla

**Abstract**

**Background:** The lack of mobility, motility and sunlight exposure put the orthopaedic patients at higher risk. Among the entire population of patients, adolescent and young adult members of our Indian society are considered as high-risk groups due to vitamin D inadequacy. As per the literature, the high prevalence of vitamin D inadequacy among the world's different countries prompted us to carry out this study. Our study aims to provide a report on vitamin D and related factors among orthopaedic patients in this part of our country.

**Materials and Methods:** In our study, the normal individuals accompanying orthopaedic patients were formally enrolled for this study. Subjects were recruited based on simple variables such as age, gender, weight, height, history of taking nutritional supplements and concurrent diseases. Biochemical estimation of Vitamin D levels in 100 orthopaedic patient group, as well as the same number of control subject group. Serum PTH, calcium, alkaline phosphatase, phosphorus and routine blood investigations were done. Body height and height was used to calculate the BMI, and daily sun exposure was measured. All this consolidated data were analysed using SPSS software.

**Results:** In this study a high prevalence of vitamin D deficiency was observed more in elderly individuals (46-50 years) than in younger patients. Vitamin D sufficiency in elderly individuals (46-50 years) was significantly less than the younger subjects. This difference in vitamin D sufficiency was statistically significant between the 35-40 and 45-50 years age group. Serum PTH among the patient group was significantly higher than of the control group. There was a negative correlation observed between Serum vitamin D levels and serum PTH levels.

**Conclusion:** Our study helps build a consensus that vitamin D deficiency is a significant issue among orthopaedic patients. Specifically, mid-age or old patients are at a higher risk of vitamin deficiency in orthopaedic patients.

**Keywords:** vitamin D; calcium; phosphorus; osteoporosis, vitamin D deficiency

## Introduction

Vitamin D is a prohormone in the body that significantly plays a major role in the human body's various metabolic pathway. Vitamin D is also popularly known as the sunshine vitamin, which is responsible for increasing the intestinal absorption of various micronutrients, mainly calcium, phosphate and magnesium [1]. The human body synthesises vitamin D in response to sunshine exposure. A healthy individual can also increase their vitamin D consumption through certain foods and nutritional supplements, some foods known to cater to vitamin D, including dairy products, eggs, and fish [2].

Vitamin D is scientifically known as a prohormone rather than a vitamin. This is essential to increase the intestinal absorption of calcium into the main blood circulation. Vitamin D is mostly synthesised in the skin in response to solar UVB ray exposure [3, 4]. As it has been reported in many scientific studies that the human liver, kidney play a significant role in transforming the vitamin D into the active hormone called calcitriol [5]. The active vitamin D not only increase the intestinal reabsorption of calcium into blood circulation but also decreases the excretion of calcium by the kidneys. Vitamin D exerts its action by modifying the metabolism of bone cells and is vital in the formation of new bone in growing children and also strengthening the existing one [6].

The significant decrease in serum calcium levels is associated with the action of parathyroid hormone. Parathyroid hormone is responsible for the catalytic activity, which in turn synthesises vitamin D. The synthesis of vitamin D is also related to serum PTH, calcium, phosphate and calcitriol levels [7, 9]. The critical point to be noted that the higher prevalence of vitamin D deficiency among orthopaedic patients put them in grave danger of complications [10]. It is well documented that vitamin D deficiency increases the risk of secondary hyperparathyroidism and osteomalacia [11]. The higher prevalence of vitamin D deficiency in orthopaedic patients reported in recent studies, this should serve as a wake-up signal for orthopaedic surgeons that vitamin D deficiency is extensive – not necessarily depend upon gender, age and socio-economic background. Our present study advocated the desperate need to thoroughly investigate vitamin D and related group of factors among orthopaedic patients. In this present study, we decided to focus mainly on orthopaedic patients visiting/admitted in the OPD and Emergency departments.

## Material and Methods

In our study, the normal individuals accompanying orthopaedic

patients who were visiting/admitted in the OPD and Emergency departments were formally enrolled for this study. A total number of 100 patients and 100 healthy individuals considered as control subjects, from both ender between the age of 35 and 50 years, were included in this study. All participants were briefed adequately in the local language, and their written informed, voluntary consent was obtained. All the enrolled subjects were subjected to a careful history, general and systemic physical examination. The questionnaire recorded information on gender, age, height, weight and comorbidity status (such as hypertension, diabetes mellitus and any other metabolic disorder) and medication use, including oral vitamin D supplementation. The height and weight of the individuals were used to calculate the body mass index (BMI).

Biochemical profile: Each subject was informed about blood analysis, and a 10 ml blood sample was withdrawn after an overnight fast without any complications. The samples were placed in cold boxes. In the biochemistry laboratory, serum was separated after centrifugation at 3000 rpm for 15 min. Serum 25(OH) D concentrations were estimated by using a radioimmunoassay. Serum marker measured included intact parathyroid hormone (PTH-i), alkaline phosphates, inorganic phosphate, 1, 25(OH) 2D and total calcium (Ca). The intact parathyroid hormone was determined by a two-site binding immunoradiometric assay. Direct sunlight exposure was assessed by documenting the average duration of exposure and the percentage of the surface area of the body exposed daily. The subjects were classified as vitamin D normal (sufficient), insufficient, and deficient based on 25(OH) D concentrations of 30-100ng/ml, 21-29ng/ml and <20 ng/ml, respectively [12].

Statistical Analysis: All this consolidated data were analysed using SPSS software. The chi-square test was used to compare the differences. The p-value of <0.05 was taken to be statistically significant.

## Results

A total number of 100 orthopaedic patients (study group) with similar number of normal healthy individuals (control group) were enrolled into this study. Among these patients 100 patients 55% were male and 45% were female.

**Table 1:** Physiological and biochemical profile of control and study group

| Parameters | Control Group (n=100) | Study Group (n=100) | p-Value |
|---|---|---|---|
| Age (years) | 41.56±8.21 | 38.79±6.83 | <0.0001 |
| Gender | | | |
| Male | 62 | 55 | |
| Female | 38 | 45 | |
| Body Mass Index (kg/m$^2$) | 23.86±4.29 | 25.91±3.78 | 0.0572 |
| 25 OH Vit. D (ng/ml) | 39.41±11.57 | 27.84±12.73 | 0.0442 |
| PTH (pg/ml) | 35.49±9.43 | 39.86±10.72 | 0.0071 |
| Calcium (mg/dl) | 9. 92±0.84 | 9.14 ±0.76 | 0.0729 |
| Phosphorous (mg/dl) | 3.94±0.74 | 3.51±0.24 | 0.0568 |
| Alkaline phosphate (U/L) | 93.74±9.27 | 98.29±10.26 | 0.0772 |

The data is presented of Mean ± SD

As results depicted in Table 2, we stratified the data on vitamin D according to defined by Paul Lips [13]. The percentage of patients and control subjects with hypovitaminosis D according to different cut points. The subjects were classified as vitamin D deficient, insufficient and normal (sufficient) on the basis of 25(OH) D concentrations of <20 ng/ml, 21-29ng/ml and 30-100ng/ml respectively.

**Table 2:** Vitamin D status in control and study group

| Parameters | Male | | Female | |
|---|---|---|---|---|
| | Control Group | Study Group | Control Group | Study Group |
| Normal | 48 | 10 | 27 | 9 |
| Insufficient | 11 | 26 | 7 | 24 |
| Deficient | 3 | 19 | 4 | 12 |
| Total | 62 | 55 | 38 | 45 |

Observation Table 3 depicts the altogether (both groups, n=200) Vitamin D deficiency (< 20 ng/ml) was observed in 38 individuals (19%), Vitamin D insufficiency (21-29 ng/ml) was noted 68 individuals (34%) and Vitamin D normal (sufficiency) was seen in 94 individuals (47%).

**Table 3:** Vitamin D status in control and study group

| Parameters | Control Group | Study Group |
|---|---|---|
| < 20 ng/ml | 7 | 31 |
| 21-29 ng/ml | 18 | 50 |
| 30-100 ng/ml | 75 | 19 |
| Total | 100 | 100 |

According to age groups table 4 shows, vitamin D deficiency was more in elderly individuals (46-50 years) than in younger patients. Vitamin D sufficiency in elderly individuals (46-50 years) was significantly less than the younger subjects. This difference in vitamin D sufficiency was statistically significant between 35-40 years and 45-50 years age group.

**Table 4:** Age-wise distribution of vitamin D deficiency in control and study group.

| Age Group | Normal | Insufficient | Deficient |
|---|---|---|---|
| 35-40 years | 39 | 14 | 10 |
| 41-45 years | 24 | 22 | 16 |
| 46-50 years | 19 | 35 | 21 |
| Total | 82 | 71 | 47 |

## Discussion

Vitamin D deficiency in India seems to be a more compelling and curious case. Healthy individuals from any other tropical countries such as Australia, New Zealand and Latin America have enough amounts of vitamin D. Interesting fact to be noted that despite receiving ample sunshine, the individuals from West Asia and Africa show a high prevalence of vitamin D deficiency. Many of the scientists and experts short-listed the reason for vitamin D deficiency in the Indian population are factors that include changing lifestyle, dietary habits, and rising pollution levels [14, 16]. As far as the Indian scenario, there are many prospective studies on vitamin D deficiency, but all these studies specifically focused on healthy individuals. Very few cross-sectional or prospective studies have been reported, which explicitly analyzed vitamin D status in orthopaedic patients [17]. Our study is the first such type of attempt to evaluate the possible

prevalence of vitamin D deficiency in Orthopaedic patients. We have analyzed the significant level of prevalence of vitamin D deficiency in this cohort study. A high prevalence of vitamin D deficiency was observed more in elderly individuals (46-50 years) than in younger patients. Vitamin D sufficiency in elderly individuals (46-50 years) was significantly less than the younger subjects. These observations were corroborated with the results of a similar type of study in orthopaedic surgery patients with a very high prevalence (96.7%) of vitamin D deficiency [18].

The excess secretion of parathyroid hormone (PTH) is known as hyperparathyroidism, but if this excess secretion of PTH related secondary to a chronic stimulus is secondary hyperparathyroidism. The most prominent cause of secondary hyperparathyroidism is vitamin D deficiency [13]. The significant fall in calcium level (hypocalcaemia) and phosphate level (hypophosphatemia) acts as powerful stimuli for the excess secretion of PTH. Vitamin D deficiency or insufficiency has been the principal cause for the excess stimulation of parathyroid glands, resulting in a series of metabolic reactions such as bone turnover, bone loss, fragility, and prone to fractures. Earlier research studies have observed higher PTH concentrations in elderly individuals with or without orthopaedic problem were associated with vitamin D deficiency [19, 21]. Our study shows that the mean PTH was 35.49±9.43 pg/ml among the control group, which was significantly lower than the patient group, which was 39.86±10.72 pg/ml. This difference was also observed to be statistically significant, which further corroborated the role of secondary hyperparathyroidism in the aetiology of osteomalacia and orthopaedic problem.

Vitamin D deficiency and its abnormal metabolic complications significantly contribute to the pathogenesis of secondary hyperparathyroidism in chronic kidney disease (CKD) among elderly individuals. In CKD progression, a slow decline in the levels of calcitriol can be observed, which is a marker of many renal function Impairment [22]. Earlier studies have highlighted that decline in the glomerular filtration rate (GFR) with progressive CKD and age factor were mostly associated with an increase in serum PTH levels [23]. Our study failed to establish a statistical correlation between patient age and serum PTH levels among both the control group and patient groups.

Individuals with vitamin D deficiency exhibit brittle bones, skeletal deformities, and frequent fractures, resulting in osteoporosis in the later stage of life. However, emerging evidence points out that vitamin D deficiency and the decline in phosphorous, magnesium, calcium, and other related factors are involved in far more than bone health. Our present study also observed a decline in the levels of these factors in the patient group.

In general, obesity is associated with different metabolic syndrome. It is also observed that vitamin D deficiency is also responsible for the secular trends in the onset, severity and prevalence of obesity. Our study also highlights the inverse correlation between BMI levels and vitamin D levels. Several factors may affect the vitamin D status, and an increase in BMI may be one of them. In overweight and obese individuals, body fact might act as a reservoir for storage of the fat-soluble vitamin D, in turn decreasing its bioavailability for various metabolic activities [11]. In a few of the research studies, scientists have quantified the risk associated with vitamin D deficiency significantly higher among orthopaedic patients compared with patients with normal BMI, overweight and obese individuals [11, 25].

Because of all of these considerations, our study results highlight the fact that the most appropriate 25-hydroxyvitamin D levels for the Indian population should be higher than 30ng/ml. This study warrants that every individual must undergo mandatory vitamin D profiling before any orthopaedic surgery. Our current study also paves the way for further research with large scale population-based studies is required to determine the exact correlation between vitamin D, serum PTH, bone health, orthopaedic complications.

## Conclusion

Our study indicates a high prevalence of vitamin D deficiency among elderly subjects, either that suffered from orthopaedic problems or healthy. There must be a mandatory preoperative workup for all orthopaedic patients to be screened for serum calcium and vitamin D levels. During this study, it was also observed that individuals had shown a high level of inadequate knowledge about vitamin D deficiency and its consequences. Nevertheless, social workers and non-government organizations may work together with health-care workers and government organizations to efficiently raise public awareness of the benefits of vitamin D and complications associated with vitamin D deficiency.

## References


1. Nair R, Maseeh A. Vitamin D: The "sunshine" vitamin. J Pharmacol Pharmacother. 2012; 3(2):118-26.
2. In: Ross AC, Taylor CL, Yaktine AL, Del Valle HB, editors. Dietary reference intakes for calcium and vitamin D. Washington (DC), 2011.
3. Holick MF, Binkley NC, Bischoff-Ferrari HA, Gordon CM, Hanley DA, Heaney RP. *et al*. Evaluation, treatment and prevention of vitamin D deficiency: An Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. 2011; 96(7):1911-30.
4. Godar DE, Pope SJ, Grant WB, Holick MF. Solar UV doses of young Americans and vitamin D3 production. Environ Health Perspect. 2012; 120(1):139-43.
5. Brandi ML. Indications on the use of vitamin D and vitamin D metabolites inBone Metab. 2010; 7(3):243-50.
6. Sabry M, Halder SK, Allah AS, Roshdy E, Rajaratnam V, Al-Hendy A. *et al*. Serum vitamin D3 level inversely correlates with uterine fibroid volume in different ethnic groups: a cross-sectional observational study. Int J Womens Health. 2013; 5:93-100.
7. Schwalfenberg GK, Genuis SJ. Vitamin D, essential minerals and toxic elements: Exploring interactions between nutrients and toxicants in Clinical Medicine. Scientific World Journal. 2015; 2015:318-595.
8. Shaheen S, Noor SS, Barakzai Q. Serum alkaline phosphatase screening for vitamin D deficiency states. J Coll Physicians Surg Pak. 2012; 22(7):424-7.
9. Kennel KA, Drake MT, Hurley DL. Vitamin D deficiency in adults: When to test and how to treat. Mayo Clin Proc. Quiz 7-8. 2010; 85(8):752-7.
10. Patience S. Vitamin D deficiency in at-risk groups.

Community Pract. 2013; 86(3):38- 40.
11. Bogunovic L, Kim AD, Beamer BS, Nguyen J, Lane JM. Hypovitaminosis D in patients scheduled to undergo orthopaedic surgery: A single-center analysis. J Bone Joint Surg Am. 2010; 92(13):2300-4.
12. Dawson-Hughes B, Heaney RP, Holick MF. *et al*. Estimates of optimal vitamin D status. Osteoporos Int. 2005; 16:713-716.
13. Paul Lips. Vitamin D Deficiency and Secondary Hyperparathyroidism in the Elderly: Consequences for Bone Loss and Fractures and Therapeutic Implications, Endocrine Reviews. 2001; 22 (4):477-501.
14. Burne HJ, McGrath JJ, Eyles DW, Mackay-Sim A. Behavioural characterization of vitamin D receptor knockout mice. Behav Brain Res. 2005; 157(2):299-308.
15. Beloyartseva M, Mithal A, Kaur P. *et al*. Widespread vitamin D deficiency among Indian health care professionals. Arch Osteoporos. 2012; 7(1–2):187-192.
16. Multani SK, Sarathi V, Shivane V. Study of bone mineral density in resident doctors working at a teaching hospital. J Postgrad Med. 2010; 56:65-70.
17. Khadgawat R, Brar KS, Gahlo MET. High prevalence of vitamin D deficiency in Asian-Indian patients with fragility hip fracture: a pilot study. JAPI. 2010; 58:539-542.
18. Kalra S, Kalra B, Khandelwal SK. *et al*. Vitamin D status in patients with musculoskeletal symptoms in Haryana, India. J Med Nutr Nutraceut. 2012; 1(1)):50-53.
19. Lips P, van Ginkel FC, Jongen MJM, Rubertus F, van der Vijgh WJF, Netelenbos JC. *Et al*. Determinants of vitamin D status in patients with hip fracture and in elderly control subjects. Am J Clin Nutr. 1987; 46:1005-1010.
20. Bakhtiyarova S, Lesnyak O, Kyznesova N, Blankenstein MA, Lips P. Vitamin D status among patients with hip fracture and elderly control subjects in Yekaterinburg, Russia Osteoporos Int. 2006; 17:441-446.
21. Bruce DG, St. John A, Nicklason F, Goldswain RT. Secondary hyperparathyroidism in patients from Western Australia with hip fracture: relationship to type of hip fracture, renal function, and vitamin D deficiency. J Am Geriatr Soc. 1999; 47:354-359.
22. Marcus R, Madvig P, Young G. Age-related changes in parathyroid hormone and parathyroid hormone action in normal humans. J Clin Endocrinol Metab. 1984; 58:223-230.
23. Freaney R, McBrinn Y, McKenna MJ. Secondary hyperparathyroidism in elderly people: combined effect of renal insufficiency and vitamin D deficiency. Am J Clin Nutr. 1993; 58:187-191.
24. Maier GS, Jakobs P, Roth KE, Kurth AA, Maus U. Is there an epidemic vitamin D deficiency in German orthopaedic patients? Clin Orthop Relat Res. 2013; 471:3029-3035.