

# Serum Vitamin D Levels and Bone Health of Patients Suffering from Early Knee Osteoarthritis

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**Abstract:** *Introduction: Vitamin D deficiency is a common cause of impaired bone health. However, it has not been seriously implicated in knee osteoarthritis (OA), the prevalence of which has been observed to rise in India. Hence, present study aimed at assessment of vitamin D status and bone mass density of early knee OA patients. Methods: Fifty patients of early knee OA were selected from K.J. Somaiya Hospital and Research centre using purposive sampling technique and were classified into grades I and II as per the Kellgren-Lawrence classification. They were assessed for bone mineral density (BMD), serum vitamin D levels, calcium, phosphorus and alkaline phosphatase (ALP) status. Data was analysed using SPSS 16.0. Results: 89% of the participants were observed to have low serum vitamin D levels that were positively correlated with BMD, serum calcium, phosphorus and ALP levels. Vitamin D deficiency was more severe among grade II knee OA patients. Conclusions: Deficiency of Vitamin D might contribute to progressive degeneration of cartilage in early knee OA by affecting the BMD. Hence, maintenance of optimum Vitamin D status is crucial in knee osteoarthritis to prevent bone deterioration and slower disease progression.*

**Keywords:** Knee osteoarthritis, serum Vitamin D levels, BMD, bone mass, bone health

## 1. Introduction

Knee osteoarthritis (OA), a degenerative joint disease is the 4<sup>th</sup> leading cause of disability globally [1] and its prevalence is increasing at an alarming rate in India too. Several nutrients influence bone health. Among them, vitamin D is considered crucial for the maintenance of bone mineral density (BMD) and integrity of cartilage. However, role of Vitamin D in knee OA is not explored enough till date, leading to lack of scientific data. Hence, this study aimed at assessment of vitamin D status and bone health of early knee OA patients.

## 2. Literature Reviewed

Knee OA is a whole joint chronic degenerative disease. The cartilage degeneration and inflammation in the joint leads to pain and stiffness affecting the activities of daily living of the individuals. Hence it has a severe impact on the quality of life and productivity. Prevalence of knee OA seems to be increasing in the young adults also, which is a cause of concern. The risk factors for this condition are - obesity, aging, repetitive joint use, stress, smoking, pollution, low bone mass density, and nutritional deficiencies of proteins, vitamins (A, D, E, K) and minerals (calcium, magnesium, zinc, boron and selenium). Among the nutrients, vitamin D, is a well-known bone nutrient which plays a key role in the maintainance of calcium homeostasis in our body and its deficiency will affect intestinal calcium absorption causing hypocalcemia which would trigger skeletal resorption as a defence mechanism, eventually impacting bone health. This would result in osteopenia, osteomalacia and osteoporosis [3, 4]. Studies have reported moderate to severe vitamin D deficiency across India [5]. Hence it is essential to explore

the role of Vitamin D in bone health of people suffering from knee OA.

## 3. Methods

### 3.1 Research Design

Present study is an observational research involving a randomized survey.

### 3.2 Participants

Fifty patients suffering from early knee osteoarthritis were selected using purposive sampling technique from the outpatient department of Orthopaedics and; Department of Diet of K. J. Somaiya Hospital and Research Centre, Mumbai. The following criteria were used to select the patients.

**Inclusion Criteria:** Ambulatory human participants including males and females in the age group of 30-65 yrs, suffering from early knee OA grades 1 and 2 as per Kellgren and Lawrence grading [6].

**Exclusion Criteria:** Human subjects with any history of / diagnosed case of rheumatoid or other forms of arthritis, severe cardiovascular, renal disorders, spondylitis, musculoskeletal disorder, cancer, tuberculosis, parathyroid and thyroid dysfunction, lactation pregnancy or on hyaluronic acids, as well as subjects who are non-ambulatory, subjects who underwent any form of arthroscopy. An informed written consent was obtained from the participants in the comprehensible language and confidentiality of their details was maintained. Ethical

clearance was obtained from Registered Medical Ethics Committee of K.J. Somaiya Medical College, Hospital and Research Centre.

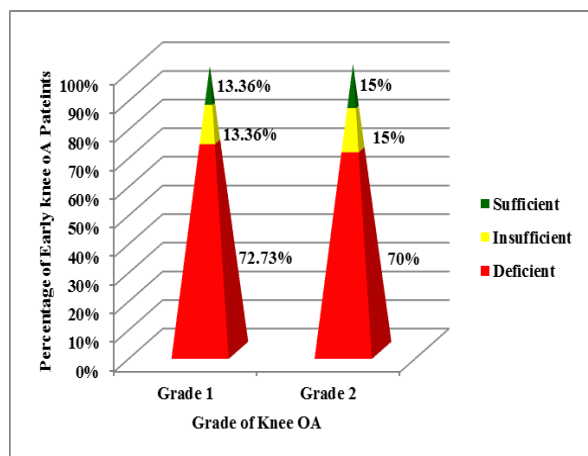
### 3.3 Data Collection

Selected participants were classified for their grade of knee OA as per Kellgren and Lawrence radiographic classification using their radiographic X-ray reports [6]. Further, BMD of the patients was assessed using Achilles Stiffness Index by SONOST 2000 instrument while bone mass was assessed by Tanita Body composition analyzer BC-545. The patients were further assessed for Vitamin D status by serum 25 (OH) D levels (E-CLIA method) [7] and for serum Ca (Arsenzao III) [8], serum P (phosphomolybdate method) [9], serum ALP (P-nitrophenyl phosphate method)[10] levels. According to the guidelines of Institute of Medicine (IOM) for serum 25 (OH) D levels, patients were categorized as those with sufficiency ( $> 30$  ng/ml), insufficiency ( $\leq 30$  ng/ml) as well as deficiency ( $\leq 20$  ng/ml) [11] of vitamin D.

### 3.4 Statistical Analysis

The collected data was entered and managed in a MS-Excel sheet and analysed using SPSS version 16.0. Independent sample 't' test was used to understand the difference between the grades of knee OA with respect to the biomarkers and BMD; and Pearson's correlation coefficient was used to analyse the correlation between serum vitamin D levels, other bone biomarkers and BMD.

## 4. Results



**Figure 1:** Serum Vitamin D levels in early knee OA patients

Overall, low serum Vitamin D levels were observed in 89% of the participants suffering from early knee OA. As seen in figure 1, among the various levels of vitamin D status, deficiency of vitamin D was more prevalent ( $>70\%$ ) in both Grade I and II patients. Overall, the number of patients having sufficient serum vitamin D levels in the body were very few. However, difference in the same was insignificant between the groups. Though serum vitamin D is one of the crucial markers of bone health, assessment of certain other supporting nutrients and biomarkers was felt necessary for further clarity of their role in the bone health status of the participants.

**Table 1:** Differences in the markers of bone health between grade I and grade II knee OA patients

Parameters	Grade I (n = 25) Mean $\pm$ SD	Grade II (n = 25) Mean $\pm$ SD	t value
<b>Anthropometric</b>			
Bone mass (kg)	2.73 $\pm$ 0.41	2.42 $\pm$ 0.51	2.20 *
BMD T score	-1.22 $\pm$ 0.62	-1.66 $\pm$ 0.74	2.04 *
<b>Biomarkers</b>			
Vitamin D (ng/ml)	18.17 $\pm$ 13.05	16.21 $\pm$ 10.81	0.53
Serum Ca (mg/ dl)	8.96 $\pm$ 0.91	9.06 $\pm$ 0.85	-0.35
Serum P (mg/ dl)	3.52 $\pm$ 0.74	3.93 $\pm$ 0.65	-1.92
Serum ALP (IU/L)	160.61 $\pm$ 63.06	152.60 $\pm$ 36.46	0.51

(\*p<.05)

Table -1 highlights the differences in the markers of bone health of the patients with the progression of knee OA. The mean bone mass and BMD T score of grade I knee OA patients was observed to be significantly higher ( $p<.05$ ) than that of grade II patients indicating the progressive degenerative changes in bone structure along with the progression of knee OA.

**Table 2:** Gender differences in BMD T score and bone mass of early Knee OA patients

Parameter	Males (n=25)	Females (n=25)	t value
<b>Anthropometric</b>			
Bone mass (kg)	2.93 $\pm$ .40	2.26 $\pm$ .29	6.24***
BMD T score	-1.21 $\pm$ .74	-1.63 $\pm$ .63	1.96*

(\* p<.05; \*\* p<.001)

Table -2 points out highly significant gender differences in the bone mass of the patients. Males had significantly higher mean bone mass ( $p<.001$ ) and BMD T score ( $p<.05$ ) than females, thus showing a gender specific trend in the predisposition to bone health problems.

**Table 3:** Correlation of serum 25 (OH) D levels with other markers of BMD in early knee OA patients

Parameter	r value
<b>Anthropometric markers</b>	
Bone mass (kg)	0.04
BMD T score	0.05
<b>Biomarkers</b>	
Serum Ca (mg/ dl)	0.11
Serum P (mg/ dl)	0.17
Serum ALP (IU/L)	0.11

As seen in table 3, serum 25 (OH) D levels were positively correlated with bone mass, BMD, serum calcium, phosphorus and ALP levels. However, the association was not significant. This indicates that there may be an increase in bone mass and BMD T score with an increase in serum vitamin D levels.

## 5. Discussion

As per the results of this study, hypovitaminosis of vitamin D was observed in the selected patients of early knee OA. The association between progressive degeneration of cartilage and vitamin D deficiency has been confirmed by the lower mean serum vitamin D levels among grade II knee

OA patients than grade I patients thus implicating deficiency of Vitamin D in the progression of knee OA. The inverse relation between bone remodelling and cartilage degeneration in knee OA has been well recognized [12]. Studies in the past, have also suggested a link between low vitamin D levels and progression of knee OA i.e. an association between low 25-(OH) D levels, BMD and progression of osteoarthritis [13, 14, 15, 16]. However in knee OA, 25-(OH) D levels appear to be related more to the structural changes rather than clinical symptoms.

It is an established fact that Vitamin D influences calcium deposition in the bone and its deficiency decreases BMD. The lower mean bone mass and mean BMD of grade II patients suggested a declining trend in bone health and increased risk of osteoporosis with the progression of knee OA. Low BMD could be a locus in Vitamin D deficiency and knee OA. Interestingly, serum vitamin D levels positively correlated with bone status markers, directing towards Vitamin D as one of the factors of due consideration for improving bone health. Also, a significant association between vitamin D deficiency and presence of knee OA in patients indicates a strong need to assess vitamin D status in any patient with symptoms suggestive of knee OA particularly at the initial stage of disease [17, 18]. Researches have also pointed out an association between knee OA and osteoporosis, in addition to the positive association between longitudinal loss of BMD and the cartilage seen in knee OA. These findings suggest a need to develop suitable strategies to reduce loss of BMD and degeneration of cartilage in Knee OA [19]. There are ongoing clinical trials on the role of Vitamin D in bone health, physical activity and gene expression etc., but not in knee OA [20].

Vitamin D supplementation in elderly adults and women has shown an improvement in BMD [21, 22] and may reduce arthralgias related disabilities [23]. Moreover, the positive association between Vitamin D and BMD in primary knee OA [24] indicates that Vitamin D consumption might improve BMD, reduce cartilage loss and prevents progression of knee OA. However, research is sparse on the effect of nutrient supplementation especially that of vitamin D on the preservation of BMD and prevention of cartilage loss in knee OA, and hence needs to be explored.

## 6. Future Scope of Study

- a) Studies on larger sample size.
- b) Intervention trials on the role of nutrients in the preservation of BMD and bone nutrients levels in knee OA.

## 7. Conclusion

Early knee OA patients with poor vitamin D status are prone to reduction in bone mineral density, bone mass and disease progression. Hence, maintenance of optimum Vitamin D status may be crucial in knee osteoarthritis. There is also a need for well-designed research trials to determine whether vitamin D supplementation can improve BMD, bone mass and attenuate the disease progression in knee OA.

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got around 20 years of academic experience at under graduate and post graduate level. Recognized PhD research guide by the University of Mumbai. Published around 40 research papers in peer reviewed national and international journals. Published 3 reference books. Obtained a Patency No. 225689; on 'Antiestrogenic activity of phytosterols from fenugreekseeds'. Has been Selected as an Ambassador of Goodwill By the Rotary International and sanctioned the Grant for University teachers for an academic assignment at the University of Mauritius for 3 and half months in Mauritius.



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