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Prevalence of serum albumin and Vitamin D level in Idiopathic Low Back Ache patients: A cross-sectional observational study from Orthopaedic OPD patients

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Abstract
Background and Aims: Low back pain (LBP) is one of the most prevalent musculoskeletal disorders, significantly affecting mobility and productivity. Idiopathic LBP poses diagnostic and therapeutic challenges. This study aimed to assess the prevalence of vitamin D and serum albumin levels in idiopathic LBP patients and their potential association with pain severity.
Methods: A cross-sectional observational study was conducted over 24 months in the Orthopaedics Department at Heritage Institute of Medical Sciences, Varanasi, India. Patients aged 18–50 years with idiopathic LBP were included, while those with co-morbidities or factors affecting bone metabolism were excluded. Serum albumin and vitamin D levels were measured, and pain severity was evaluated using the Visual Analog Scale (VAS). Data were analyzed using SPSS and GraphPad Prism, with $p \leq 0.05$ considered significant.
Results: Most participants were aged 31–40 years, and females constituted the majority (52.7%). Vitamin D deficiency was observed in 21.8% of patients, insufficiency in 35.5%, and normal levels in 42.7%. No significant association was found between gender and vitamin D levels ($p = 0.211$). VAS scores and serum albumin levels did not vary significantly among groups, but vitamin D levels showed a statistically significant difference ($p < 0.0001$).
Conclusion: This study identified a high prevalence of vitamin D deficiency in idiopathic LBP patients. However, no significant correlation was found between vitamin D levels, serum albumin, and pain severity. Further research is needed to explore the role of vitamin D supplementation in managing LBP.

Keywords: Low back pain, Vitamin D deficiency, serum albumin, musculoskeletal pain, nutritional assessment

Introduction
Low back pain (LBP) is one of the most prevalent musculoskeletal disorders, significantly impairing mobility, daily activities, and work productivity. It is a leading cause of disability, with idiopathic LBP—pain without an identifiable structural cause—posing a diagnostic and therapeutic challenge [1, 2, 3]. Given its widespread impact, identifying contributing factors beyond mechanical causes is essential for improving patient management [4, 5].
Vitamin D plays a critical role in calcium homeostasis, bone mineralization, muscle function, and nerve signal transmission. Its deficiency is linked to osteoporosis, osteomalacia, muscle weakness, and generalized pain, including nonspecific back pain [6, 7, 8, 9]. Although the body synthesizes vitamin D through sunlight exposure, deficiency remains common across all age groups, particularly among individuals with limited sun exposure, darker skin tones, or inadequate dietary intake [11, 12, 13].
Serum albumin, a key protein synthesized by the liver, serves as an indicator of overall health, nutritional status, and systemic inflammation. Low serum albumin levels are frequently observed in individuals with chronic illnesses, malnutrition, and inflammatory conditions [8, 13]. Since inflammation contributes to musculoskeletal pain, reduced albumin levels may play a role in the pathophysiology of LBP, worsening symptoms and delaying recovery [13, 14].
Despite growing research on the influence of vitamin D and serum albumin on musculoskeletal health, their direct association with idiopathic LBP remains unclear [15, 16]. Some studies suggest that vitamin D supplementation may have a role in pain management, but meta-analyses do not establish a definitive correlation with chronic pain disorders [16, 17, 18]. Similarly, while albumin is recognized as an inflammatory and nutritional marker, its specific impact on LBP requires further investigation [18, 19]. This study assessed serum albumin and vitamin D levels in idiopathic LBP patients, providing insights to improve treatment and patient outcomes.

Material and Methods
This cross-sectional observational study was conducted in the Orthopaedics Department at Heritage Institute of Medical Sciences, Varanasi, Uttar Pradesh, over a period of 24 months to assess the prevalence of serum albumin and vitamin D levels in patients with idiopathic low back pain (LBP). Patients aged 18 to 50 years experiencing LBP and willing to participate were included, while individuals with concomitant medical conditions, pregnant or lactating women, those on medications affecting bone metabolism, individuals with a history of major illnesses, hospitalizations, or surgeries in the past year, and those taking vitamin or mineral supplements were excluded.
The minimum required sample size was calculated as 44 using the formula:

$$N = Z^2PQ / E^2$$

where Z = 1.96, P = 13% (prevalence rate), Q = 87% (100 - P), and E = 10% (margin of error).

Data collection included demographic details such as age, gender, weight, and occupation, along with a comprehensive medical history covering the onset, nature, aggravating and relieving factors, and associated symptoms of LBP. Additional history related to pregnancy, endocrine disorders, trauma, substance use, and congenital abnormalities was also recorded. Biochemical analyses were performed to measure serum albumin and serum 25-hydroxycholecalciferol (vitamin D) levels.

Data was recorded in Microsoft Excel and analyzed using GraphPad Prism (v5) and SPSS (v27.0, SPSS Inc., Chicago, IL, USA). Numerical variables were summarized as mean ± standard deviation (SD), while categorical data were expressed as percentages and counts. Statistical analysis included independent t-tests for comparing means between groups, paired t-tests for within-group comparisons, and the Chi-square (χ^2) or Fisher's exact test for categorical data analysis. A p-value ≤ 0.05 was considered statistically significant, leading to rejection of the null hypothesis in favor of the alternative hypothesis where applicable.

Ethical clearance was obtained from the institutional review board, and informed consent was secured from all participants. So, no ethical concerns were reported, and patient confidentiality was strictly maintained throughout the study.

Results

Distribution of study participants based on age groups, gender, co-morbidities, and vitamin D levels is shown in Table 1. The highest proportion of participants belonged to the 31-40 age group (38.2%), and the majority were female (52.7%). All participants had no co-morbidities. Regarding vitamin D status, 42.7% had normal levels, while 35.5% had insufficiency, and 21.8% had deficiency.

Table 1: Distribution of Age, Gender, Co-Morbidities, and Vitamin D Levels

	Category	Frequency	Percentage (%)
Age Group	≤ 20 Years	5	4.5%
	21 - 30 Years	28	25.5%
	31 - 40 Years	42	38.2%
	41 - 50 Years	35	31.8%
Gender	Female	58	52.7%
	Male	52	47.3%
Co-Morbidities	None	110	100.0%
Vitamin D Group	Deficiency	24	21.8%
	Insufficiency	39	35.5%
	Normal	47	42.7%

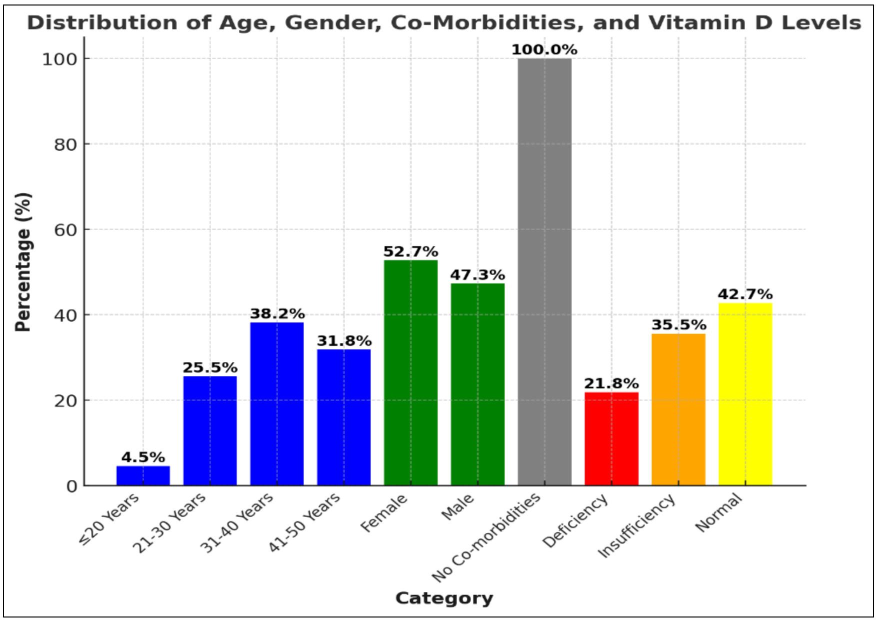

Fig 1: Distribution of Age, Gender, Co-Morbidities, and Vitamin D Levels

Distribution of vitamin D levels by gender and co-morbidities is shown in Table 2. Among females, 16 had vitamin D deficiency, 21 had insufficiency, and 21 had normal levels, while in males, the majority (26) had normal vitamin D levels. The chi-square test ($\chi^2 = 3.1113$, df = 2, p = 0.2110) indicated no significant association between gender and vitamin D status. Additionally, all individuals in the study had no co-morbidities, making direct comparison with other groups impossible.

Table 2: Distribution of vitamin D levels by gender and co-morbidities

Category	Deficiency	Insufficiency	Normal	Total	χ^2, df, p-value
Female	16	21	21	58	3.1113, 2, 0.2110
Male	8	18	26	52	
No Co-morbidities	24	39	47	110	-

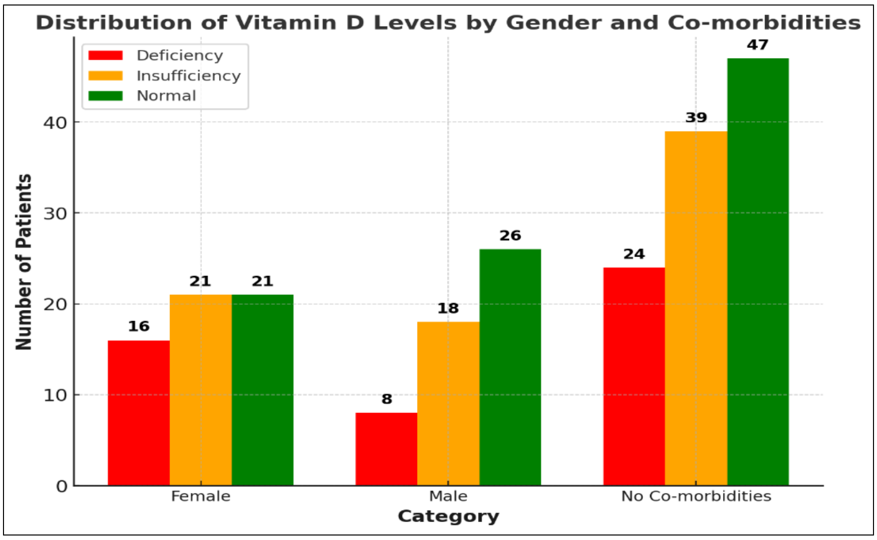

Fig 2: Distribution of vitamin D levels by gender and co-morbidities

Comparison of mean age and VAS scores across different vitamin D groups is shown in Table 3. The mean age was highest in the deficiency group (37.04 years) and lowest in the normal group (34.81 years), with no statistically significant difference (p = 0.5223). Similarly, VAS scores showed no significant variation among the groups (p = 0.6915), indicating no clear association between vitamin D levels and pain severity.

Table 3: Comparison of mean age and VAS scores across different vitamin D groups

	Variables	Deficiency	Insufficiency	Normal	p-value
Age (Years)	Mean±SD	37.04±9.00	36.46±8.03	34.81±9.13	0.5223
	Min Age	24	18	18	
	Max Age	50	50	50	
	Median Age	35.5	38.0	34.0	
VAS Score	Mean±SD	4.96±1.40	4.77±1.44	5.02±1.31	0.6915
	Min VAS	3	3	3	
	Max VAS	7	7	8	
	Median VAS	5	5	5	

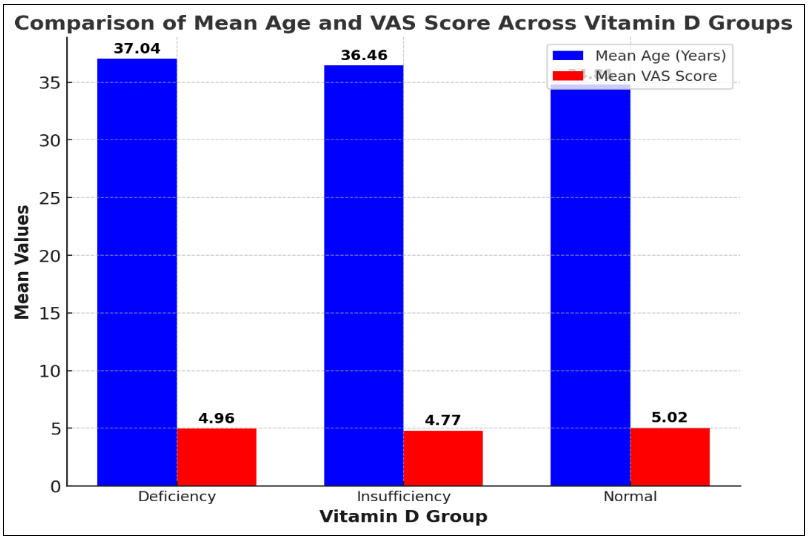

Fig 3: Comparison of mean age and VAS scores across different vitamin D groups

Table 4 shows the distribution of Vitamin D levels across different categories: deficiency, insufficiency, and normal. The mean Vitamin D levels significantly vary across groups, with the highest levels observed in the normal category. The p-value of <0.0001 indicates a statistically significant difference between the groups.

Table 4: Comparison of Vitamin D Levels Among Deficiency, Insufficiency, and Normal Groups

	Variables	Deficiency	Insufficiency	Normal	p-value
Vitamin D (ng/mL)	Mean±SD	7.12±1.43	14.58±3.10	36.87±13.27	**<0.0001**
	Min Vit D	4.49	10.00	20.01	
	Max Vit D	9.73	19.87	66.59	
	Median Vit D	7.10	13.95	33.90	

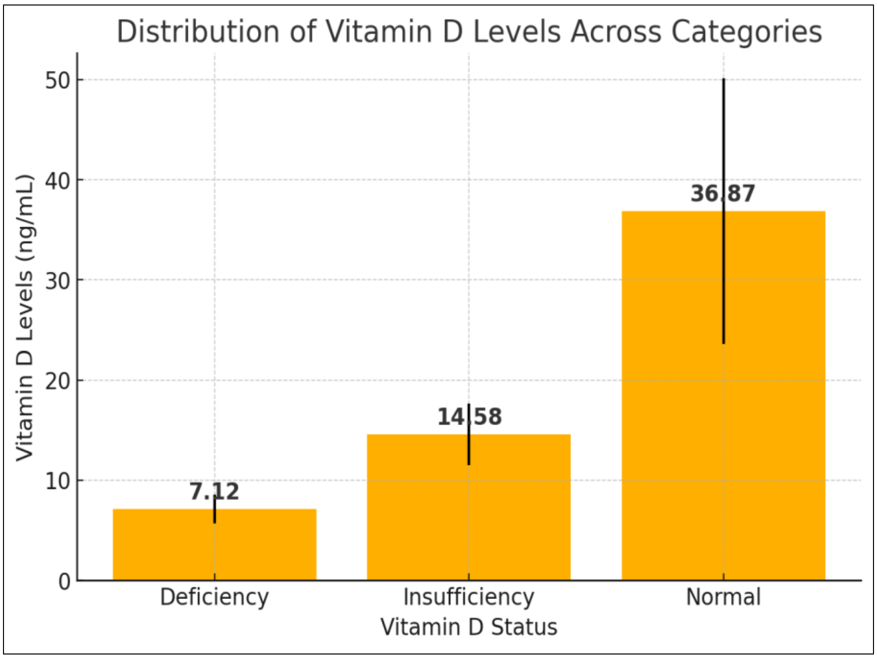

Fig 4: Comparison of Vitamin D Levels Among Deficiency, Insufficiency, and Normal Groups

Table 5 shows the mean, median, and range of serum albumin levels across different groups. The p-value (0.1666) suggests no statistically significant difference in serum albumin levels among the groups. The data indicates relatively stable serum albumin levels across all categories.

Table 5: Comparison of Serum Albumin Levels Among Deficiency, Insufficiency, and Normal Groups

	Variables	Deficiency	Insufficiency	Normal	p-value
S. Albumin (g/dL)	Mean±SD	4.41±0.36	4.55±0.26	4.49±0.29	**0.1666**
	Min S. Albumin	3.85	4.01	3.88	
	Max S. Albumin	4.97	5.08	5.16	
	Median S. Albumin	4.42	4.62	4.48	

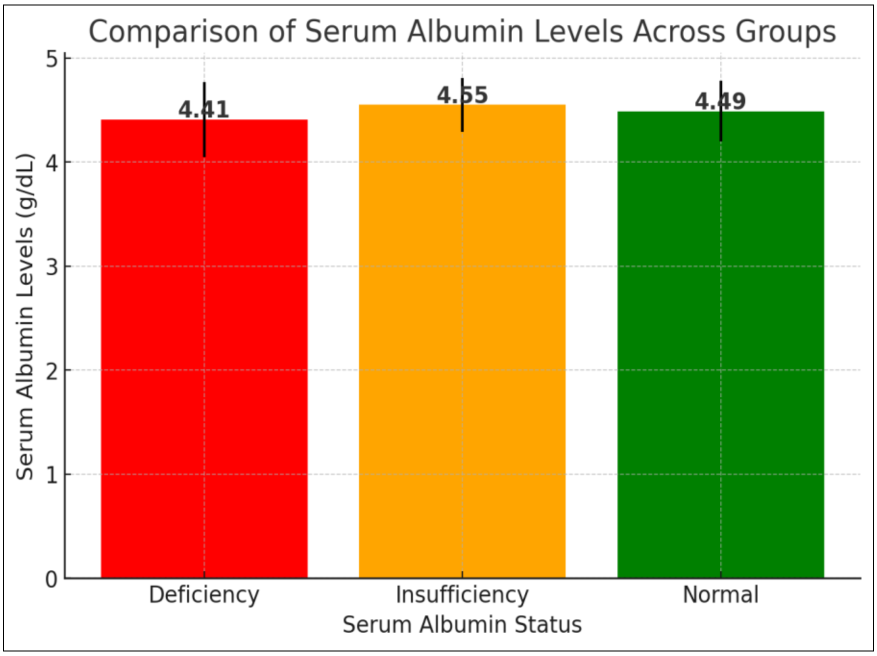

Fig 5: Comparison of Serum Albumin Levels Among Deficiency, Insufficiency, and Normal Groups

Discussion

This study was conducted in the Orthopaedics Department of the Heritage Institute of Medical Sciences, Varanasi, over eighteen months. In this study, most participants were between 31 and 40 years of age, but this finding was not statistically significant (p = 0.2972). Pain levels, as measured by the Visual Analog Scale (VAS), did not show any significant difference among the normal, deficiency, and insufficiency groups (p = 0.6915). However, a statistically significant variation was observed in vitamin D levels among these groups (p < 0.0001). Previous studies have also shown the importance of vitamin D in musculoskeletal health. Hovsepian *et al*. (2011) [20] found significant differences in median 25-OH vitamin D levels between men (21 ng/mL) and women (18 ng/mL, p = 0.05). Sandoughi *et al*. (2015) [21] found no significant differences in age, sex, or weight among groups but demonstrated that vitamin D supplementation significantly increased serum levels from 17.88 ± 9.04 to 27.52 ± 9.04 (p = 0.043). Pal *et al*. (2016) [22] observed that 91.3% of patients had vitamin D deficiency (<30 ng/mL), while 61.2% had severe deficiency (<20 ng/mL), with no significant gender differences (p = 0.75). Kumar Yadav R *et al*. (2021) [23] confirmed that vitamin D deficiency is prevalent in South Asia, particularly among women, and is linked to various chronic conditions.

The mean age of participants in the normal, insufficiency, and deficiency groups was 34.81 ± 9.13, 36.46 ± 8.03, and 37.04 ± 8.99, respectively, with no significant difference (p = 0.5223). VAS scores were also similar, with the normal group (5.0213 ± 1.3103) having slightly higher values than the deficiency (4.9583 ± 1.3981) and insufficiency (4.7692 ± 1.4412) groups (p = 0.6915). However, previous studies by Kumar M *et al*. (2020) [24] and Kumar Yadav R *et al*. (2021) [23] found a significant correlation between vitamin D levels and pain severity in chronic LBP patients.

Vitamin D deficiency is a widespread issue affecting musculoskeletal health. Research by Kumar Yadav R *et al*. (2021) [23] found a significant inverse correlation between vitamin D levels and pain severity (Spearman's rho = -0.554). Similarly, Shilpashree MK *et al*. (2023) [25] recommended vitamin D supplementation for all chronic LBP patients due to the high prevalence of deficiency. Although this study did not find significant differences in blood albumin and calcium levels among the deficient groups, Sarıkahya Durmuş *et al*. (2022) [26] reported changes in albumin levels among vitamin D-deficient individuals. Early screening for vitamin D deficiency is highly recommended for individuals with non-specific body pain, particularly LBP. Lodh M *et al*. (2015) [27] suggested that vitamin D testing should be included in routine diagnostic evaluations alongside other biochemical markers. These findings reinforce the importance of vitamin D in musculoskeletal health and highlight the need for further research on its role in managing LBP.

Conclusion

We concluded the prevalence of vitamin D deficiency among idiopathic low back pain (LBP) patients but found no significant association between vitamin D levels and pain severity. Serum albumin levels also showed no correlation with vitamin D status, suggesting that nutritional markers alone may not determine LBP outcomes. The absence of co-morbidities strengthens the findings, but other factors such as inflammation and lifestyle may influence LBP. Further research with larger cohorts and interventional studies is needed to explore the potential role of vitamin D supplementation in managing LBP effectively.

Strengths

This study minimizes confounding factors by including only idiopathic low back pain patients without co-morbidities. Standardized biochemical assessments and pain evaluation methods enhance reliability. It provides valuable insights into the role of vitamin D and serum albumin in musculoskeletal health. The findings highlight the need for further interventional studies on vitamin D supplementation.

Limitations

A small sample size limits the generalizability of results. The cross-sectional design prevents establishing causality between vitamin D levels and pain severity. Factors like diet, physical activity, and inflammatory markers were not assessed. Future research should include larger, diverse populations and longitudinal studies to explore vitamin D's potential role in low back pain management.

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Consent: Written consent secured.

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