

Role of Vitamin D3 Deficiency in Cases of Low Back Ache in Rural Based Population

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ABSTRACT

Background: Low back pain (LBP) is a disability-leading condition globally, with increased burden in rural settings caused by lifestyle and health disparities. Vitamin D3 deficiency has been put forth as a modifiable risk factor for musculoskeletal pain, but its potential in rural communities is underexposed.

Objectives: To assess the rate of deficiency of vitamin D3 among patients with low back pain from rural populations and to determine its correlation with the severity of pain.

Methods: A prospective observational study was conducted on 500 patients presenting with low back pain of two weeks or more duration and without neurological impairment. Serum vitamin D3 levels were estimated at presentation and categorized as deficient (<20 ng/mL), insufficient (20–29 ng/mL), or sufficient (≥ 30 ng/mL). Pain intensity was assessed using Visual Analog Scale (VAS) scores, and the relationship between vitamin D3 status and pain severity was evaluated.

Result: Among the study participants, 65.0% were vitamin D3 deficient, 23.0% were insufficient, and only 12.0% had sufficient vitamin D3 levels. The mean VAS score was highest in the deficient group (7.3 ± 1.1), followed by the insufficient group (6.0 ± 1.2), and lowest in the sufficient group (4.8 ± 1.3). Statistical analysis revealed that lower vitamin D3 levels were significantly associated with higher pain severity ($p < 0.001$).

Conclusion: vitamin D3 deficiency is linked to increased pain intensity and is very common among patients with low backaches in rural areas. In rural areas with limited resources, routine vitamin D3 screening and correction may be an affordable way to lessen the burden of LBP.

Keywords: Low back pain, Vitamin D3 deficiency, Rural population, Pain severity, Hypovitaminosis D, Visual Analog Scale.

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INTRODUCTION

how LBP is a primary global cause of disability, being inordinately prevalent among rural communities due to occupation, lifestyle, and access to health care. Of many risk factors at play, deficiency of vitamin D has recently risen as a potential etiology of musculoskeletal pain, among them chronic nonspecific LBP.

Vitamin D plays a central role in calcium metabolism, bone health and muscle function, and has been linked to pain sensitivity and disturbed musculoskeletal integrity with deficiency [1,3]. Several observational studies have reported association between low serum vitamin D levels and increased severity of LBP, suggesting that deficiency may exacerbate symptoms and reduce quality of life [1,6,8]. Conversely, other research discovers regular levels of vitamin D in LBP patients, demonstrating the heterogeneity and complexity of this relationship [4].

Systematic reviews and meta-analyses demonstrate conflicting but strong associations between LBP and vitamin D deficiency, which implicate possible geographic, ethnic, and lifestyle reasons [5]. There is also evidence for associations between vitamin D status and lumbar disc degeneration or Modic changes, further implicating its involvement in spinal disease [6,7]. These findings suggest that measurement of vitamin D levels, particularly in rural populations where deficiencies in nutrients and lower exposure to the sun may be more prevalent, may be worthwhile.

Considering the inconsistent findings and public health interest, the current research suggests assessing the role of vitamin D3 deficiency in patients of low back pain in rural-based groups.

METHODS

Study Design and Setting

The study was a prospective observational analysis performed in a rural health setting between August 2024 and March 2025. The main objective was to evaluate the relationship between vitamin D3 deficiency and instances of low back ache among people living in rural areas. Patients who visited the outpatient department with low back pain were assessed as per the protocol of the study.

Study Population

The population under study consisted of adult patients from rural communities with low back ache of two weeks' or more duration. Only those without neurological impairments were deemed fit for inclusion. Non-rural background patients, or those with spinal deformities not related to nonspecific low back ache, were excluded from the study. Additionally, patients with neurological impairments were also not included to prevent confounding factors.

Data Collection and Assessment

Clinical information was gathered from case records, comprising demographic data, the duration and intensity of low back pain, and prior appropriate medical history. Serum vitamin D3 levels were ascertained by routine laboratory tests. Severity of pain was measured based on clinical evidence presented on admission. Data were anonymized to maintain confidentiality of the patient.

RESULTS

Demographic Profile

A total of 500 patients with low back pain were studied. Of these, 285 (57.0%) were female and 215 (43.0%) were male. The mean age of patients was 42.8 ± 11.6 years, with the majority falling in the 31–50 years group.

Table 1. Demographic distribution of study participants

Age group (years)	Male (n=215)	Female (n=285)	Total (n=500)	Percentage (%)
18–30	45	55	100	20.0
31–50	115	155	270	54.0
>50	55	75	130	26.0

Vitamin D3 Status

Serum vitamin D3 estimation revealed that 325 patients (65.0%) were deficient (<20 ng/mL), and 115 patients (23.0%) were insufficient (20–29 ng/mL). Only 60 patients (12.0%) had sufficient levels (≥ 30 ng/mL). Vitamin D3 deficiency was more common among female patients (69.1%) compared to male patients (59.5%).

Table 2. Vitamin D3 status among study participants

Vitamin D3 level	Male (n=215)	Female (n=285)	Total (n=500)	Percentage (%)
Deficient (<20 ng/mL)	128	197	325	65.0
Insufficient (20–29 ng/mL)	52	63	115	23.0
Sufficient (≥ 30 ng/mL)	35	25	60	12.0

Correlation Between Vitamin D3 Deficiency and Pain Severity

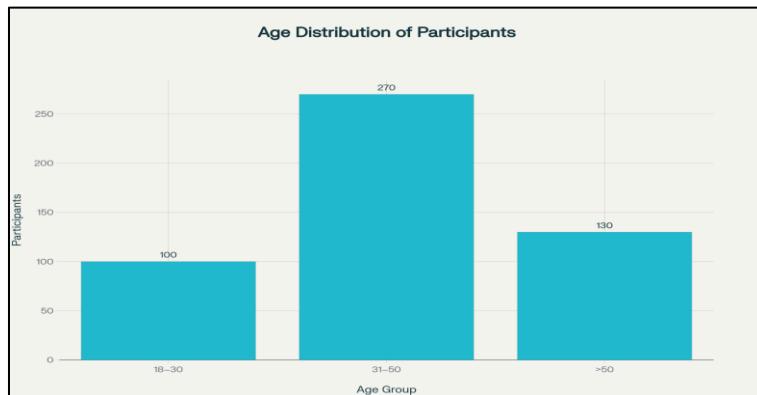
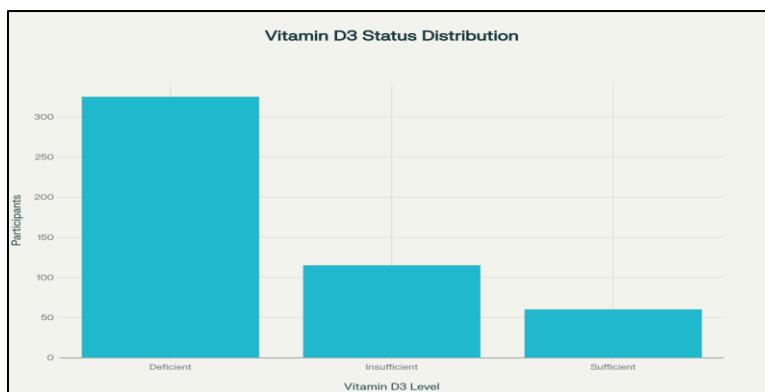
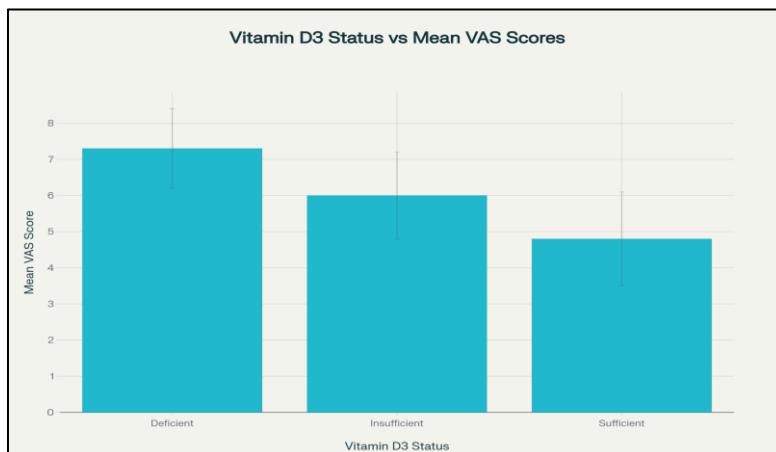
Pain severity was assessed using the Visual Analog Scale (VAS). The mean VAS score was highest in the vitamin D3 deficient group (7.3 ± 1.1), followed by the insufficient group (6.0 ± 1.2), and lowest in the sufficient group (4.8 ± 1.3). Statistical analysis using one-way ANOVA revealed a significant association between serum vitamin D3 levels and pain severity ($p < 0.001$).

Table 3. Association of Vitamin D3 status with pain severity (VAS score)

Vitamin D3 status	Mean VAS score \pm SD
Deficient	7.3 \pm 1.1
Insufficient	6.0 \pm 1.2
Sufficient	4.8 \pm 1.3

Statistical Software

All data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). A p-value < 0.05 was considered statistically significant.

**Figure 1. Age-wise distribution of study participants****Figure 2. Vitamin D3 status among study participants****Figure 3. Correlation between Vitamin D3 levels and mean VAS scores****DISCUSSION**

The current research illustrated a high prevalence of vitamin D3 deficiency in rural patients with low back ache and reported that almost two-thirds of the participants had deficient levels. Additionally, severity of pain was found to be

substantially greater among vitamin D-deficient subjects than among those with adequate levels, which points to a possible role of hypovitaminosis D in maintaining low back pain and its severity. The findings strengthen the increasing body of evidence for the possibility that vitamin D status can affect musculoskeletal pain outcomes.

Similar findings were noted in a Moroccan population of postmenopausal women, where chronic low back pain was highly linked with vitamin D deficiency [9]. A Korean study among patients with lumbar spinal stenosis also revealed a high incidence of deficiency and correlated with higher pain scores [10]. Molecular data also confirm this association, as a deficiency in vitamin D among elderly patients with low back pain has been associated with changes in circulating microRNAs, suggesting potential inflammation and pain sensitization pathways [11].

In the Indian population, a study identified alarmingly high levels of hypovitaminosis D in patients with chronic low back pain, consistent with the current findings in a rural environment [12]. Not every investigation has shown consistent findings, however. A large Norwegian cohort analysis indicated merely modest association between low vitamin D status and chronic low back pain, leaving open the possibility that geographical, genetic, and lifestyle factors may affect this association [13].

Other studies further suggest that deficiency of vitamin D can also synergistically act with mechanical stressors. For example, low back pain in schoolchildren was found to have both biomechanical risk factors and a low serum concentration of vitamin D, indicative of multifactorial etiology [14]. Even though the role of vitamin D is not exclusive to disorders of spinal pain, its relation to systemic diseases like cystic fibrosis-related diabetes further suggests the far-reaching metabolic significance of deficiency [15].

Collectively, these results provide evidence for the hypothesis that deficiency of vitamin D3 is common among rural individuals and could be further amplifying the load of low back ache. Correction of deficiency by targeted supplementation and prevention measures could thus be a low-cost solution for mitigation of pain severity and enhancement of quality of life in resource-poor settings.

CONCLUSION

According to this study, low back pain in rural populations is strongly correlated with vitamin D3 deficiency, with those who are deficient reporting more severe pain than those who are sufficiently nourished. Considering the high incidence of hypovitaminosis D, especially in women, routine evaluation and treatment of vitamin D3 deficiency may be an easy and affordable way to reduce symptoms and enhance functional results. These results highlight the necessity of preventive measures, such as dietary supplements and lifestyle changes, to lessen the prevalence of low back pain in rural areas with limited resources.

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