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A study on Role of Vitamin D in Patients with Pott's Spine and Its Clinical Management at a Tertiary Care Centre of West Bengal: A Cross-Sectional Study .

Dr. Sumit Shivraj Mathapati[1], Dr. Sheth Hardik Grishkumar[2], Dr. Ravishankar Paswant[3] , Dr. Naresh Kumar Munda[4]

[1]Assistant Professor, Department of Orthopaedic, Faculty of IQ City Medical College Hospital, Durgapur .
[2]Assistant Professor, Department of Orthopaedic, Faculty of IQ City Medical College Hospital, Durgapur
[3]Assistant Professor, Department of General Surgery, Faculty of Kanti Devi Medical College, Hospital & Research Centre, Mathura.
[4]Assistant Professor, Department of Community Medicine, Faculty of Icare Institute of Medical Sciences and Research and Dr. B C Roy Hospital, Haldia, India.

Corresponding Author: Dr. Naresh Kumar Munda

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ABSTRACT

Background: Pott's spine (spinal tuberculosis) is a debilitating extrapulmonary manifestation of tuberculosis, accounting for nearly 50% of osteoarticular TB cases in India. Vitamin D plays a pivotal role in immune modulation, particularly in mycobacterial defence. Despite India receiving abundant sunlight, vitamin D deficiency remains paradoxically prevalent, especially in the eastern states including West Bengal. **Objectives:** To assess serum vitamin D levels in patients diagnosed with Pott's spine and to study the clinical management strategies employed at a tertiary care hospital in West Bengal. **Methods:** A hospital-based cross-sectional study was conducted over 18 months. A total of 64 confirmed cases of Pott's spine were enrolled using purposive sampling. Serum 25-hydroxyvitamin D [25(OH)D] levels were measured. Sociodemographic data, clinical features, radiological findings, and treatment details were recorded and analysed. **Results:** Vitamin D deficiency (<20 ng/mL) was found in 65.6% of patients (n=42), insufficiency (20–29 ng/mL) in 21.9% (n=14), and only 12.5% (n=8) had sufficient levels. The majority of patients (50%) received anti-tubercular therapy (ATT) combined with vitamin D supplementation, while 12.5% required surgical intervention in addition to pharmacological management. **Conclusion:** Vitamin D deficiency is highly prevalent in patients with Pott's spine in West Bengal. Routine screening and supplementation of vitamin D alongside standard ATT may improve treatment outcomes and should be incorporated into clinical protocols.

Keywords: *Pott's spine, Spinal tuberculosis, Vitamin D deficiency, Anti-tubercular therapy, West Bengal, Tertiary care*

1. INTRODUCTION

Tuberculosis (TB) continues to be one of the foremost public health burdens in India, with the country accounting for nearly 26% of the global TB burden according to the World Health Organization (WHO) estimates[1]. Amongst the various extrapulmonary manifestations of TB, spinal tuberculosis — commonly known as Pott's spine — constitutes approximately 50% of all skeletal TB cases. It predominantly affects the thoracic and lumbar vertebrae, leading to vertebral destruction, kyphotic deformity, and in severe cases, neurological compromise[2].

West Bengal, with its dense population, high rates of poverty, malnutrition, and overcrowded living conditions, presents an epidemiological setting particularly vulnerable to TB and its complications. The co-existence of vitamin D deficiency in such patients is a matter of considerable clinical significance[3]. Vitamin D, through its active metabolite 1,25-dihydroxyvitamin D, stimulates the production of antimicrobial peptides such as cathelicidin and beta-defensin-2, which are directly bactericidal against Mycobacterium tuberculosis. Hence, deficiency of vitamin D may impair the host's immunological response and predispose individuals to more severe and prolonged TB infection[4].

Despite India being a tropical country with abundant sunlight, vitamin D deficiency is paradoxically widespread — attributed to factors such as dietary insufficiency, dark skin pigmentation reducing cutaneous synthesis, traditional attire limiting sun exposure, and indoor occupational habits. In the eastern states of India including West Bengal, these factors are compounded further by cultural and socioeconomic constraints[5].

This study was undertaken to evaluate serum vitamin D levels in patients with confirmed Pott's spine attending a tertiary care centre of West Bengal, and to study the clinical management strategies, with a view to improve holistic patient care.

2. OBJECTIVES

Primary Objective:

To assess the serum vitamin D [25(OH)D] levels in patients diagnosed with Pott's spine at a tertiary care centre of West Bengal.

Secondary Objectives:

1. To study the sociodemographic profile of patients with Pott's spine.
2. To determine the prevalence of vitamin D deficiency and insufficiency in the study population.

3. To evaluate the clinical management strategies — conservative, pharmacological, and surgical — adopted in these patients.

4. To correlate vitamin D levels with disease severity and treatment outcomes.

3. METHODOLOGY

3.1 Study Design and Setting

This was a hospital-based, observational cross-sectional study conducted at the Department of Orthopaedics and General Surgery.

3.2 Sample Size Calculation

The sample size was calculated using the standard formula for cross-sectional studies:

$$\mathbf{n = Z^2 \times p \times q / d^2}$$

Where:

Z = 1.96 (Z value at 95% confidence interval)

p = 0.65 (estimated prevalence of vitamin D deficiency in TB patients = 65%, based on similar Indian studies)

q = 1 – p = 0.35

d = 0.12 (allowable error = 12%)

$$n = (1.96)^2 \times 0.65 \times 0.35 / (0.12)^2$$

$$n = 3.8416 \times 0.2275 / 0.0144 \approx 60.65 \approx 61$$

After adding a 5% non-response rate adjustment, the final sample size was rounded to n = 64. This sample size provided adequate statistical power for the study objectives.

3.3 Method of Sampling

Purposive (consecutive) sampling technique was employed. All patients presenting to the orthopaedics and medicine outpatient and inpatient departments with confirmed diagnosis of Pott's spine during the study period and fulfilling the eligibility criteria were enrolled consecutively until the required sample size of 64 was achieved.

3.4 Inclusion and Exclusion Criteria

Inclusion Criteria: Patients aged ≥18 years with confirmed diagnosis of Pott's spine (clinical, radiological, and/or microbiological), willing to give informed consent.

Exclusion Criteria: Known cases of primary hyperparathyroidism, chronic renal/hepatic disease, patients on long-term corticosteroids, pregnant women, and those previously on vitamin D supplementation within the past three months.

3.5 Data Collection and Laboratory Methods

A structured, pre-tested proforma was used to collect sociodemographic data, clinical history, examination findings, radiological details (X-ray spine, MRI spine), and treatment records. Fasting venous blood samples (5 mL) were drawn in the morning to measure serum 25(OH)D levels by Electrochemiluminescence Immunoassay (ECLIA) method. Vitamin D status was classified as: Deficient (<20 ng/mL), Insufficient (20–29 ng/mL), and Sufficient (≥30 ng/mL) as per Indian Council of Medical Research (ICMR) and Endocrine Society guidelines. Statistical analysis was performed using SPSS v.25. Descriptive statistics (frequency, percentage, mean ± SD) were used for data representation.

4. RESULTS

A total of 64 patients with confirmed Pott's spine were enrolled in this study. The following section presents the sociodemographic profile, vitamin D levels, and clinical management details.

4.1 Sociodemographic Profile

Table 1 presents the sociodemographic characteristics of the study population. The majority of patients (40.6%) belonged to the 31–45 year age group, which is a productive working-age population, indicating the significant socioeconomic burden of the disease. Males constituted 59.4% of the study group. A large proportion (65.6%) were from rural areas, and 31.3% were found to be illiterate. Farmers and daily wage labourers constituted the dominant occupational group (43.8%). Notably, 46.9% of patients were underweight (BMI <18.5 kg/m²), reflecting the nutritional vulnerability common in this patient population.

Table 1: Sociodemographic Profile of Study Participants (n = 64)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–30	18	28.1
	31–45	26	40.6
	46–60	14	21.9
	>60	6	9.4
Sex	Male	38	59.4

	Female	26	40.6
Residence	Rural	42	65.6
	Urban	22	34.4
Education	Illiterate	20	31.3
	Primary	18	28.1
	Secondary	16	25.0
	Graduate+	10	15.6
Occupation	Farmer/Labour	28	43.8
	Housewife	18	28.1
	Service/Business	12	18.8
	Student	6	9.4
BMI (kg/m²)	<18.5 (Underweight)	30	46.9
	18.5–24.9 (Normal)	24	37.5
	≥25 (Overweight)	10	15.6

4.2 Vitamin D Status in Study Participants

As depicted in Table 2, vitamin D deficiency was documented in 42 patients (65.6%), while 14 patients (21.9%) had insufficient levels. Only 8 patients (12.5%) had serum 25(OH)D levels in the sufficient range (≥30 ng/mL). The mean serum vitamin D level was 16.4 ± 7.2 ng/mL. These findings reveal that an overwhelming 87.5% of the study population had suboptimal vitamin D levels.

Table 2: Distribution of Serum Vitamin D Levels (n = 64)

Vitamin D Level (ng/mL)	No. of Patients	Percentage (%)
Deficient (<20)	42	65.6
Insufficient (20–29)	14	21.9
Sufficient (≥30)	8	12.5
Total	**64**	**100**

4.3 Clinical Management

Table 3 summarises the clinical management strategies adopted. All 64 patients received standard anti-tubercular therapy (ATT) as per Revised National TB Control Programme (RNTCP) / National TB Elimination Programme (NTEP) guidelines. In 32 patients (50%), vitamin D supplementation (60,000 IU weekly for 8 weeks, followed by monthly maintenance) was added to ATT. Eight patients (12.5%) with neurological deficits or vertebral instability underwent surgical intervention — primarily posterior spinal stabilisation or decompressive laminectomy — along with ATT and vitamin D therapy.

Table 3: Clinical Management Modalities (n = 64)

Treatment Modality	No. of Patients	Percentage (%)
ATT alone (conservative)	24	37.5
ATT + Vitamin D supplementation	32	50.0
ATT + Vitamin D + Surgery	8	12.5
Total	**64**	**100**

Patients who received combined ATT and vitamin D supplementation showed earlier clinical improvement — reduced back pain, improved erythrocyte sedimentation rate (ESR), and enhanced functional mobility — at six-month follow-up compared to those on ATT alone.

5. DISCUSSION

The present study provides important clinical insights into the association between vitamin D deficiency and Pott's spine in the West Bengal population. The high burden of vitamin D deficiency (65.6%) in our study cohort is consistent with existing literature from South Asian countries. Nnoaham and Clarke (2008) and Nathavitharana et al. have previously demonstrated that vitamin D deficiency predisposes to and worsens the clinical course of TB by impairing the innate immune response, particularly through defective macrophage function and reduced production of antimicrobial peptides[6].

The immunological rationale is well established: 1,25-dihydroxyvitamin D [$1,25(OH)_2D$] binds to the vitamin D receptor (VDR) on macrophages and monocytes, upregulating cathelicidin LL-37 — a peptide that disrupts the mycobacterial cell membrane. In deficient states, this pathway is compromised, allowing mycobacterial proliferation and dissemination, potentially facilitating haematogenous seeding of the spine. This biological mechanism supports our clinical observation of near-universal vitamin D deficiency in the Pott's spine patients studied here[7].

The sociodemographic findings are particularly revealing. The predominance of patients from rural areas (65.6%), with low educational attainment and engagement in outdoor physical labour, may appear contradictory — since outdoor work typically implies greater sun exposure. However, dark skin pigmentation, habitual use of full-covering clothing, and dietary patterns deficient in vitamin D-rich foods (fish, eggs, fortified dairy) in this population likely explain the paradox[8]. The high prevalence of undernutrition (BMI <18.5 in 46.9%) further compounds the immunological vulnerability, as malnutrition independently suppresses cellular immunity[9].

The therapeutic approach adopted in this study — combining ATT with vitamin D supplementation in 50% of patients — aligns with emerging evidence advocating adjunctive vitamin D therapy in TB management. Martineau et al. (2011) in a randomised controlled trial demonstrated accelerated sputum culture conversion in patients with the TaqI VDR polymorphism receiving vitamin D supplementation alongside TB treatment[10]. A more recent Cochrane analysis (Vorkas et al., 2021) suggested that while routine vitamin D supplementation in all TB patients may not be universally recommended, it is particularly beneficial in those with documented deficiency[11].

In our cohort, 12.5% of patients required surgical intervention. These cases predominantly involved significant vertebral collapse with kyphotic deformity exceeding 30° and/or neurological deficits (paraparesis)[12]. Surgical stabilisation followed by adequate ATT and vitamin D replacement led to favourable neurological recovery in most cases, in line with published outcomes from similar settings in India.

The limitation of this study is its cross-sectional design, which precludes causal inference. The absence of a matched control group and the single-centre nature restrict generalisability. Long-term randomised trials evaluating vitamin D supplementation as adjunctive therapy in spinal TB with larger sample sizes are warranted.

6. CONCLUSION

This cross-sectional study conclusively demonstrates that vitamin D deficiency is highly prevalent among patients with Pott's spine in West Bengal, with 87.5% of patients having suboptimal 25(OH)D levels. The data strongly suggest that vitamin D deficiency may be a contributing factor to the pathogenesis and severity of spinal tuberculosis in this population. Incorporating routine serum vitamin D assessment in all patients diagnosed with Pott's spine, along with appropriate supplementation as an adjunct to standard ATT, is a simple, affordable, and clinically impactful intervention. This study advocates for the inclusion of vitamin D screening and replacement in the standard management protocol of Pott's spine at tertiary care centres across West Bengal and similar high-burden regions of India.

7.DECLARATION

Conflict of Interest: The authors declare no conflict of interest.

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