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Original Research Article

Prevalence of vitamin D deficiency among medical students in central India: a cross-sectional study

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ABSTRACT

Background: Vitamin D deficiency is widely prevalent in India despite adequate sunlight availability. Young adults, particularly medical students with predominantly indoor academic schedules, may be at increased risk of inadequate vitamin D status. However, data regarding vitamin D status among healthy young adults from Central India remain limited.
Methods: A cross-sectional observational study was conducted at Central India Medical College, between May 2024 and June 2025. A total of 152 apparently healthy first-year MBBS students aged 17–23 years were enrolled. Demographic characteristics, dietary habits, educational status of the head of the family, socioeconomic status and monthly family income were recorded. Serum 25-hydroxyvitamin D (25(OH)D) levels were estimated using chemiluminescent immunoassay (CLIA) and classified as deficient (<20 ng/ml), insufficient (20–29.9 ng/ml) or sufficient (≥30 ng/ml). Data were analyzed using SPSS version 26.0, with $p<0.05$ considered statistically significant.
Results: The mean age of participants was 19.69±1.18 years. The mean serum vitamin D level was 13.98±7.51 ng/mL. Vitamin D deficiency was observed in 133 participants (87.5%). No significant association was observed between vitamin D deficiency and gender ($p=0.946$), dietary pattern ($p=0.164$) or socioeconomic status ($p=0.867$).
Conclusions: A high prevalence of vitamin D deficiency was observed among apparently healthy first-year medical students in Central India. The findings highlight the importance of continued attention to vitamin D status among young adults.

Keywords: Central India, Cross-sectional study, Medical students, Prevalence, Vitamin D deficiency, Young adults

INTRODUCTION

Vitamin D is a fat-soluble secosteroid hormone that plays an important role in calcium and phosphorus homeostasis, skeletal health and maintenance of normal neuromuscular function. In addition to its classical effects on bone metabolism, vitamin D has been implicated in several physiological processes including immune regulation, cellular differentiation and muscle function through its interaction with the vitamin D receptor.[1] Vitamin D deficiency has emerged as a global public health concern affecting populations across different age groups and geographical regions. It is estimated that approximately one billion people worldwide have inadequate vitamin D levels.[2] A systematic review and meta-analysis reported a high prevalence of vitamin D deficiency among South Asian adults, highlighting the substantial burden of deficiency in this region.[3] Despite abundant sunlight availability throughout most of the year, vitamin D deficiency remains highly prevalent in India. Multiple factors including limited sunlight exposure, predominantly indoor lifestyle, skin pigmentation, atmospheric pollution, dietary practices and rapid urbanization have been proposed to contribute to inadequate vitamin D status.[4,5] Previous Indian studies

have reported vitamin D deficiency prevalence ranging from 70% to 100% in different population groups, indicating that vitamin D deficiency continues to be a common nutritional concern in the country.[4] Young adults pursuing professional education may represent a population at increased risk of vitamin D deficiency. Medical students often spend prolonged periods indoors attending lectures, practical sessions and academic activities, which may reduce opportunities for adequate sunlight exposure. Since vitamin D deficiency frequently remains asymptomatic in young adults, a substantial proportion of affected individuals may remain unidentified.[5-7] Although several studies have evaluated vitamin D status in different Indian populations, data from Central India remain relatively limited. Furthermore, evidence regarding vitamin D status among apparently healthy young medical students is scarce. Understanding the prevalence of vitamin D deficiency in this population may help generate regional data and provide insight into the magnitude of the problem among young adults.

Therefore, the present study was undertaken to determine the prevalence of vitamin D deficiency among apparently healthy first-year medical students in Central India and to evaluate its association with selected demographic and socioeconomic variables.

Aim of the study

To determine the prevalence of vitamin D deficiency among apparently healthy first-year medical students in Central India.

Primary objective

To estimate the prevalence of vitamin D deficiency among apparently healthy first-year medical students in Central India.

METHODS

A cross-sectional observational study was conducted in the Department of Physiology at a government medical college located in Central India between May 2024 and June 2025. The study included apparently healthy first-year MBBS students aged 17–23 years who were willing to provide written informed consent. Students with diabetes mellitus, hypertension, neurological disorders, peripheral neuropathy, severe systemic illness, unstable psychiatric or mental health conditions and those who were chronic alcoholics or substance abusers were excluded from the study. Students fulfilling the eligibility criteria were informed about the study and invited to participate voluntarily and those providing written informed consent were enrolled consecutively until the required sample size was achieved. The minimum required sample size was calculated using Cochran's formula, $n=Z^2pq/d^2$, where Z=1.96 at a 95% confidence interval, p=estimated prevalence of vitamin D deficiency (75%) based on previous Indian studies, q=1−p and d=allowable error of 7%. The calculated sample size was 147 participants and a total of 152 participants were enrolled in the study.[4] Data regarding age, gender, dietary habits, educational status of the head of the family, socioeconomic status, monthly family income and serum vitamin D levels were recorded. Socioeconomic status was assessed using the Modified Kuppuswamy Socioeconomic Scale.[8] Venous blood samples were collected under aseptic precautions and analyzed at the institutional central laboratory. Serum 25-hydroxyvitamin D (25(OH)D) levels were estimated using a chemiluminescent immunoassay (CLIA)-based method. Vitamin D status was classified according to Indian guideline recommendations 5 as deficient (<20 ng/ml), insufficient (20–29.9 ng/ml) or sufficient (≥30 ng/ml).

Ethical clearance was obtained from the Institutional Ethics Committee of Medical College, prior to commencement of the study and written informed consent was obtained from all participants. Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS), version 26.0. Continuous variables were expressed as mean±standard deviation, while categorical variables were expressed as frequencies and percentages. The Chi-square test was used to assess associations between categorical variables, the independent-samples t-test was used to compare mean vitamin D levels between groups and Pearson's correlation coefficient was used to evaluate the relationship between age and serum vitamin D levels. A p value <0.05 was considered statistically significant.

RESULTS

A total of 152 participants were included in the study. The mean age was 19.69±1.18 years, with males constituting 70.4% of the study population. Most participants were vegetarians (69.1%) and belonged to middle socioeconomic status households. Baseline characteristics of the participants are shown in (Table 1).

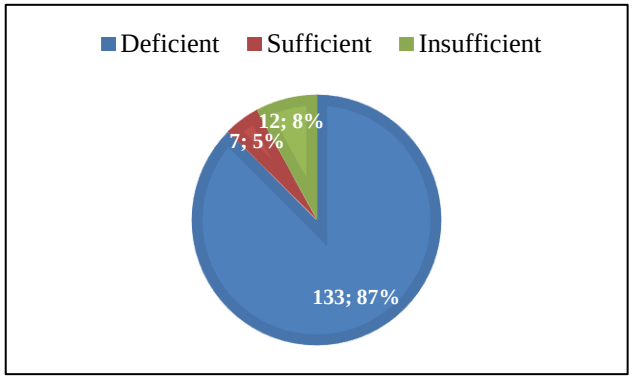

Figure 1: Distribution of vitamin D status among study participants (n=152). Vitamin D deficiency (<20 ng/ml) was observed in 133 (87.5%) participants, while 12 (7.9%) were vitamin D insufficient and 7 (4.6%) had sufficient vitamin D levels.

The mean serum vitamin D level was 13.98±7.51 ng/ml. Vitamin D deficiency (<20 ng/ml) was observed in 133 (87.5%) participants, while 12 (7.9%) were insufficient and 7 (4.6%) had sufficient vitamin D levels (Table 2, Figure 1). No statistically significant association was observed between vitamin D deficiency and gender (p=0.946), dietary pattern (p=0.164) or socioeconomic status (p=0.867) (Table 3). Similarly, mean serum vitamin D levels did not differ significantly according to gender (p=0.926) or dietary pattern (p=0.179) (Table 4). A weak positive correlation was observed between age and serum vitamin D levels; however, the association was not statistically significant (r=0.143, p=0.078).

Table 1: Baseline characteristics of study participants (n=152).

Variable	Category	Frequency (%)/Mean±SD
Age (in years)	Mean±SD	19.69±1.18
	Median	20
	Range	17–23
Gender	Male	107 (70.4)
	Female	45 (29.6)
Dietary pattern	Vegetarian	105 (69.1)
	Non-vegetarian	47 (30.9)
Educational status of head of family	High school	3 (2.0)
	Bachelor's degree	126 (82.9)
	Master's degree	23 (15.1)
Socioeconomic category*	Lower middle	1 (0.7)
	Middle	127 (83.6)
	Upper middle	24 (15.8)
Monthly family income	< ₹50,000	1 (0.7)
	₹50,000–1,00,000	127 (83.6)
	> ₹1,00,000	24 (15.8)

Table 2: Vitamin D profile of study participants.

Parameter	Value
Mean Vitamin D (ng/ml)	13.98±7.51
Median Vitamin D (ng/ml)	12.73
Minimum Value (ng/ml)	4.52
Maximum Value (ng/ml)	44.01
Deficient (<20 ng/ml)	133 (87.5)
Insufficient (20–29.9 ng/ml)	12 (7.9)
Sufficient (≥30 ng/ml)	7 (4.6)

Table 3: Association between participant characteristics and vitamin D deficiency.

Variable	Deficient N (%)	Non-deficient N (%)
Gender		
Male	93 (86.9)	14 (13.1)
Female	40 (88.9)	5 (11.1)
Dietary pattern		
Vegetarian	95 (90.5)	10 (9.5)
Non-vegetarian	38 (80.9)	9 (19.1)

Table 4: Comparison of mean vitamin D levels according to participant characteristics.

Variable	Mean Vitamin D (ng/ml)
Gender	
Male	14.01±7.78
Female	13.90±6.89
Dietary pattern	
Vegetarian	13.32±6.84
Non-vegetarian	15.45±8.72

DISCUSSION

The present study reveals a strikingly high prevalence of vitamin D deficiency (87.5%) among apparently healthy, first-year medical students in Central India. This finding highlights an important public health concern often termed the "Indian subcontinent paradox" the widespread occurrence of hypovitaminosis D in a region that receives abundant, year-round ambient sunlight. The high rate of deficiency observed in this young, health-literate population underscores that vitamin D deficiency is no longer restricted to clinical sub-populations but represents a major, substantial public health burden across modern urban India.

Our results are highly consistent with broader global and regional data outlining the ubiquity of this condition. At a macro level, Dominguez et al and Amrein et al, have emphasized that vitamin D deficiency remains one of the most underdiagnosed and undertreated nutritional conditions globally, cutting across geographic boundaries.[1,2] Within the South Asian context, a recent systematic review and meta-analysis by Siddiqee et al documented a high pooled prevalence of vitamin D deficiency among adults, mirroring the trends identified in our cohort.[3]

Historically, this trend has been well-documented in regional Indian literature. Ritu and Gupta, alongside Aparna et al, have previously shown that despite India's tropical coordinates, hypovitaminosis D affects 50% to 94% of ostensibly healthy individuals across various demographic strata.[4,5] This vulnerability is heavily exacerbated among healthcare workers, residents and medical students who face extensive indoor professional schedules. The findings align closely with global literature demonstrating that indoor workers, medical trainees and shift-working healthcare personnel face severe occupational risks for inadequate ultraviolet light exposure, leading to prolonged subclinical deficiency.[9,10]

While some literature suggests a higher severity of deficiency among females due to cultural clothing choices or a higher prevalence among strict vegetarians, our study demonstrated a uniformly high burden across all sub-groups.[5,6] This lack of demographic variance is likely attributable to two factors, first, the uniform homogeneity of our study population, where over 80% of participants belonged to the middle socioeconomic tier with similar educational backgrounds, second and more crucially, the overriding impact of shared environmental and institutional factors. As first-year medical undergraduates, these students share identical, intensive indoor academic routines, which heavily restrict potential sunlight exposure regardless of their gender or baseline diet.

Furthermore, the lack of dietary association highlights a critical public health reality in India: natural, unfortified dietary sources of vitamin D (such as unfortified milk or eggs) possess an inherently low vitamin D content that is insufficient to correct deep-seated operational deficiencies.[7,11] This points directly toward an urgent need for structural, population-based preventive measures rather than relying solely on individual dietary modifications.

From a community medicine and institutional health perspective, these findings suggest that a transition from passive clinical management toward active, scalable health interventions could be highly beneficial. For instance, academic medical centers might consider adopting institutional lifestyle modifications, such as introducing optional outdoor wellness breaks or subtly integrating designated 'sunlight hours' into the medical curriculum to gently encourage safe, midday sun exposure.

Additionally, given that individual dietary modifications often show limited impact on serum levels, institutional dining halls and student hostels could look into utilizing staple foods, such as milk and vegetable oils, that are systematically fortified with vitamin D in accordance with current Food Safety and Standards Authority of India (FSSAI) guidelines.[11] Finally, since medical students represent future healthcare providers, addressing subclinical deficiencies early on remains quite essential.[12] This could be supported through supportive measures such as introducing affordable, periodic wellness screenings or offering routine, evidence-based supplementation protocols during annual institutional health check-ups, which could collectively help lower the silent burden of hypovitaminosis D in professional educational settings.[9,10]

This study has certain limitations that must be noted. As a descriptive cross-sectional design conducted at a single institution, the findings represent a distinct baseline assessment and cannot be broadly generalized to the entire youth demographic of Central India. Additionally, precise quantitative data regarding seasonal variations in sampling, individual physical activity levels, daily hours of direct sunlight exposure, sunscreen usage patterns and body mass index (BMI) were not recorded.[13]

Future multi-centric, longitudinal studies incorporating these precise lifestyle and environmental determinants are highly recommended to more comprehensively map the multi-factorial dynamics of vitamin D deficiency in young adults.

CONCLUSION

In conclusion, vitamin D deficiency is highly prevalent among first-year medical students in Central India, operating independently of basic socioeconomic and demographic parameters. The predominantly indoor lifestyle associated with medical education may contribute substantially to the observed high prevalence of vitamin D deficiency. These findings support consideration of institutional awareness programmes, safe

sunlight exposure practices, appropriate nutritional strategies including food fortification where feasible and targeted educational initiatives to improve vitamin D status among young adults.

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