

## SHORT ARTICLE

## Vitamin D Status in Cold Trans-Himalayan Deserts at Altitude of 4000 meter and above in India

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<a href="#">Abstract</a>	<a href="#">Introduction</a>	<a href="#">Methodology</a>	<a href="#">Results</a>	<a href="#">Conclusion</a>	<a href="#">References</a>	<a href="#">Citation</a>	<a href="#">Tables / Figures</a>
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### Abstract

Recent scientific evidence suggests there is high prevalence of Vitamin D deficiency in India. There is paucity of scientific data on Vitamin D status in population residing at high altitude regions in India. Hence, the present study was undertaken to determine Vitamin D status of adult population residing at altitude of 4000 meter and above in Himachal Pradesh, India.

A total of 105 subjects aged 19-56 years were recruited (3 subjects per village) from 35 villages in Lahaul & Spiti district. The data on socio-demographic profile was collected by administering a questionnaire. Venous blood samples were withdrawn. Serum 25-OHD level was measured by using direct competitive chemiluminescence immunoassay. Vitamin D status was categorized as deficient (<20ng/ml), insufficient (21-29ng/ml) and sufficient (≥30ng/ml).

The mean±SD level of 25-OHD was 14.76±7.03 ng/ml. The subjects with vitamin D deficiency, insufficiency and sufficiency were 83.8%, 11.4% and 4.8%, respectively suggestive of significant Vitamin D deficiency in high altitude Lahaul & Spiti district, Himachal Pradesh.

### Keywords

Vitamin D; Adults, High Altitude

### Introduction

Vitamin D deficiency is an important public health problem in India. The prevalence in the plain regions have been reported over 70% in the general population (1,2). There is paucity of scientific data on

Vitamin D status in population residing at high altitude regions in India except one study conducted in Kashmir valley which is situated at an altitude of 480 meter-1654 meter above the sea level (3). We conducted a large study in the year 2015-16 in Lahaul and Spiti district, Himachal Pradesh which has been

published earlier (4,5). The methodology of sample selection, implementation, ethical clearance and other related details have been reported in these publications.

The district lies into the Trans Himalayan zone in the northern and north-eastern part of Himachal Pradesh and makes boundary line between Himachal Pradesh and Jammu & Kashmir and Tibet (China). The region is a mountainous desert, characterized with high mountains, snow covered peaks and deep valleys. The study area Lahaul & Spiti has non-vegetarian population consuming mainly egg, fish, chicken and meat. As Vitamin D mainly comes from non-vegetarian foods and its dermal synthesis is influenced by geographical and climatic conditions. Hence the study was planned in this region.

### Aims & Objectives

To assess Vitamin D status in adults residing in Lahaul & Spiti, Himachal Pradesh, India.

### Material & Methods

This cross-sectional study was conducted in Lahaul & Spiti district (mean altitude > 4000 meter), Himachal Pradesh. The district lies between the North latitude 31°44'57" and 32° 59' 57" and between East longitude 76° 46'29" and 78° 41' 34'.

This is a small part of the main study which was conducted to assess the prevalence of chronic hepatitis B infection and genotyping of hepatitis B virus isolates from Lahaul and Spiti district in Himachal Pradesh, India (4,5). The apparently healthy adults aged 19-56 years were selected with the help of camps organized in 35 villages in the district. Three adult subjects were randomly selected in each village and a total of 105 subjects (36 males, 69 females) were enrolled. The ethical approval for the study was obtained from Indira Gandhi Medical College, Shimla, Himachal Pradesh. An informed written consent was obtained from each subject after explaining the objectives and procedure of blood collection for the study. A questionnaire was administered to obtain data on socio-demographic profile i.e. age, gender, household composition, marital status, caste, religion, educational qualification and present occupation of the subjects. Venous blood sample (5ml) was withdrawn through venipuncture from median cubital vein from each participant. Blood samples were centrifuged and serum thus separated was stored at -20°C until transported (in ice packs) to central laboratory, All India Institute of Medical Sciences, New Delhi, India.

In central laboratory, the serum was stored at -70°C till analysis. The biochemical estimation of serum 25-hydroxyvitamin D (25-OHD) was done by direct competitive chemiluminescence immunoassay on LIAISON (Diasorin) analyzer using kits (DiaSorin Co., Italy). The range of quantitation of the assay was 4.0-150.0 ng/ml. The intrassay and interassay CV was less than 4% and 8%, respectively. The United States Institute of Medicine (IOM) classification was utilized to define Vitamin D status of subjects (6). Statistical analysis was performed on stata 14.0 software. The statistical significance was considered at  $p < 0.05$ .

### Results

A total of 105 adults [36(34.3%) male] aged 19-56 y were included. The majority of subjects belonged age group of 40-49y (37.1%) followed by 19-29y (27.6%), 30-39y (21.9%) and 50-59y (13.3%). All except one subject in our study were Buddhist (104/105). One hundred three out of 105 belonged to scheduled tribe. A total of 27.6% of subjects were educated up to primary level, 26.7% between 6th - 10th level, 21.0% up to senior secondary level and only 6.7% were graduate and above. The proportion of subjects who did not get formal education was 18.1%. It was found that 42.1% participants were domestic workers followed by 23.1% who were engaged in miscellaneous works. The shopkeepers comprised 14.7% and unemployed subjects formed 9.5% of the total population.

The distribution of subjects in two groups of Vitamin D ( $\leq 20$  and  $> 20$  ng/ml) was not significantly different with respect to their age groups (19-29y, 30-39y, 40-49y and 50-59y) ( $p = 0.350$ ). Similarly, their education and occupation were not related to Vitamin D status ( $p = 0.910$  and  $0.190$ , respectively). However, a significant difference was observed in the distribution of subjects according to gender and Vitamin D status ( $p = 0.004$ ). The mean  $\pm$  SD serum 25-OHD level of study population was  $14.76 \pm 7.03$  ng/ml, which was higher in male ( $17.34 \pm 8.21$  ng/ml) compared to females ( $13.45 \pm 5.96$  ng/ml). The overall prevalence of VDD was 83.8% ([Table 1](#)).

### Discussion

Geographical location affects intensity of solar UV radiation (UVR) and thus influences dermal Vitamin D synthesis. Vitamin D status of an individual is determined by the sum of its amount synthesized by the exposure to solar UVR and dietary intake. VDD tend to increase with aging due to lower dermal

Vitamin D production with advancing age, however, we did not find an association between Vitamin D status and age group of study subjects.

In present study, we noted vitamin D deficiency, insufficiency and sufficiency to be 83.8%, 11.4% and 4.8%, respectively. The findings of our study are similar to an earlier study conducted in Kashmir valley which reported VDD in 83% of apparently healthy adults aged 18-40 years (3). Compared to ours, the studies conducted in other parts of India have reported lower (7) as well higher (8) prevalence of VDD in adult population. We, further found that females had higher VDD (91.3%) compared to males (69.4%). It was possibly due to lower outdoor activities and more skin coverage in females. Earlier studies from hilly (3) and plain areas of the country (9) have reported similar trend.

The possible reason for high VDD in Lahaul and Spiti was the climatic conditions (low temperature, average around 15 °C) which led to more clothing and low skin exposure to sunshine. Further, the low UV index (below 4) of the region due to cold and cloudy atmosphere might have resulted in the inefficient dermal Vitamin D production in residents. Similar, to plain areas of the country, our study revealed a high prevalence of VDD in adults residing at high altitude of 4000 meter and above.

The Implementation of population based educational and interventional strategies should be initiated to combat VDD in this population.

**Limitation of the study**

We acknowledge a few limitations as the study lacks information on i) skin type ii) sunlight exposure iii) physical activity and iv) dietary intake of Vitamin D containing foods, which are important determinants of vitamin D status.

**Authors Contribution**

All authors have contributed equally in this manuscript.

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**Tables**

**TABLE 1 PREVALENCE OF VITAMIN D DEFICIENCY ACCORDING TO IOM-2010 CLASSIFICATION**

Vitamin D status (ng/ml)	Total(n=105) Number (%)	Male(n=36) Number (%)	Female(n=69) Number (%)	'p' value
Deficient (≤20)	88(83.8)	25(69.4)	63(91.3)	0.015
Insufficient (21-29)	12(11.4)	8(22.2)	4(5.8)	
Sufficient (>30)	5(4.8)	3(8.3)	2(2.9)	

\*Figure in the parentheses represents column wise percentage.