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Original Research Article

Prevalence of vitamin D deficiency among doctors in a tertiary care centre in north India

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ABSTRACT

Background: Vitamin D is unique among vitamins as it can be synthesized from the action of ultra-violet radiation (UVR) upon the skin of human beings. This study was done to investigate the prevalence of vitamin D deficiency among health care professionals.
Methods: This was institution based study conducted over a period of two years at Govt. Medical College Hospital. The study was conducted on 200 healthy doctors working in different departments of Govt. Medical College and Associated Hospitals, Jammu for a period of two years. Data regarding demographic characteristics, lifestyle assessment, exposure to sunshine on workdays and weekends, type of clothing, use of sunscreen, subjective general health, dietary assessment and use of calcium or vitamin D supplements was collected using a structured questionnaire.
Results: Mean value of age of study subjects was 26.18±2.09 years. Results showed that 50% were male and 50% were females. In this study, 65.50% of the study subjects were Hindu and 30% of study subjects were Muslim. Majority of the study subjects had exposure to sunlight for less than 20 minutes and only 10 out of 200 study subjects had exposure to sunlight for more than 30 minutes. In this study, 97% of the study subjects were vitamin D deficient and only 3% were vitamin D sufficient. Among 196 study subjects with vitamin D deficiency, severe deficiency was present in 30.41% (59 out of 194) of study subjects, moderate deficiency was present in 60.82% (118 out of 194) of study subjects and very few study subjects had mild vitamin D deficiency.
Conclusions: Vitamin D deficiency is highly prevalent among healthy medical college students. Lack of awareness regarding importance of vitamin D requirement, inadequate exposure to sunlight, changes in lifestyle and food habits contribute to low vitamin D levels in young population.

Keywords: Doctors, Food habits, Sunlight, Veil, Vitamin D deficiency, Young population

INTRODUCTION

Vitamin D plays a very vital role for the normal homeostasis of calcium and bone growth especially in childhood and adolescent age group. Most of vitamin D in human body is produced via exposure of a precursor 7-dehydrocholesterol (7-DHC) in epidermis to Ultra Violet Radiation which catalyses a reaction producing pre-vitamin D3 which is then further converted to cholecalciferol in the skin and then transported for hydroxylation firstly to 25-hydroxyvitamin D by enzymes in the liver and then to Kidney to produce the active hormonal form 1, 25-Dihydroxyvitamin-D (1, 25(OH)2D).[1] Nutritional rickets now very rare in developed world is still very common in underdeveloped countries is caused by the deficiency of vitamin D in children.[2] Serum 25(OH) D concentrations are generally thought to reflect nutritional status. When adequate

amounts of vitamin D are available, the kidney, the major site of 1, 25(OH)2D production converts some of the 25(OH)D to alternate hydroxylated metabolites, which have low biological activity (e.g., 24,25(OH)2D or 1,24,25(OH)3D).[3]

METHODS

This is a cross sectional prevalence study which was conducted over a period of one year at Govt. Medical College Hospital, Jammu a city located in northern India at latitude and longitude of 32.73º N and 74.87º E and about 327 meters above sea level. The study was conducted on 200 healthy doctors working in different departments of Govt. Medical College and Associated Hospitals, Jammu for a period of two years from January 2017 to February 2019. After taking informed consent from the participants, the data regarding demographic characteristics, phenotypic features, lifestyle assessment, exposure to sunshine on workdays and weekends, type of clothing, use of sunscreen, subjective general health, dietary assessment and use of calcium or vitamin D supplements was collected using a structured questionnaire.

Each subject was interviewed personally by the investigator and their preliminary physical examination was carried out. Data regarding age, body weight, height, and body mass index were recorded from each subject. Serum Vitamin D levels were estimated using chemiluminiscent immunoassay (CLIA) method. Total of 200 healthy subjects participated in this study. Criteria for defining levels of serum vitamin D deficiency was >30ng/mL normal, 20-30ng/mL mild deficiency, 10-20ng/ml moderate deficiency and <10ng/ml severe deficiency.

Inclusion criteria

Healthy doctors working in different departments of Govt. Medical College and Associated Hospitals, Jammu and consenting to participate in the study.

Exclusion criteria

- Who did not give consent.
- Significant renal or hepatic dysfunction defined as serum creatinine of >2.5mg/dl or aspartate aminotransferase (AST) >2.5 times the normal levels.
- Malabsorption including any history of inflammatory bowel disease, small bowel or gastric surgery.
- Diseases associated with altered bone metabolism (Hyperthyroidism, hyperparathyroidism, T1 DM)
- Known metabolic bone diseases.
- Treatment with medications that interfere with Vitamin D metabolism (anti-convulsants, rifampin, glucocorticoids either taking actively or have taken for more than 2 weeks during previous month).

Statistical analysis

The data obtained was analyzed with the help of computer software using Microsoft excel SPSS Version. Continuous variables were expressed as Mean±SD and variables as percentage.

RESULTS

Majority of the study subjects were in the age group 24-26 years and only 19% of study subjects were 27-29 years age group followed by 7.50% of study subjects were more than 29 years old. Mean value of age of study subjects was 26.18±2.09 years. Results showed that 50% were male and 50% were females (Table 1).

Table 1: Demographic characteristics of study subjects.

Demographic characteristics	Frequency	%
Age(in years)		
24-26 years	147	73.50%
27-29 years	38	19.00%
>29 years	15	7.50%
Mean±SD	26.18±2.09	
Median (IQR)	26(25-27)	
Gender		
Female	100	50.00%
Male	100	50.00%
Religion		
Hindu	131	65.50%
Muslim	60	30.00%
Sikh	9	4.50%
BMI		
<25	143	71.50%
>=25	57	28.50%
Department		
ENT	5	2.50%
Microbiology	7	3.50%
Opthamology	6	3.00%
Pathology	6	3.00%
Pharmacology	10	20.00%
Gynecology & obstetrics	15	7.50%
Medicine	76	38.00%
Physiology	6	3.00%
PSM	17	8.50%
Surgery	52	26.00%

In this study, 65.50% of the study subjects were Hindu and 30% of study subjects were Muslim, very few study subjects were Sikh. Majority of the study subjects were of normal weight and only 28.50% of the study subjects were overweight. Most of the study subjects belonged to Medicine and Surgery departments. Only few study subjects were from Gynecology & Obstetrics, Physiology, PSM and other departments. In this study, 78% of study subjects did not use veil, hat or sunscreen.

27 out of 200 study subjects used sunscreen and very few used hat or veil (Table 2).

Table 2: Distribution of use of veil/hat/sun screen of study subjects.

Veil/ Hat/ Sun screen	Frequency	Percentage
No	156	78.00%
Hat	5	2.50%
Sun screen	27	13.50%
Veil	12	6.00%
Total	200	100.00%

Skin color of 69% of study subjects was medium and 26% of study subjects had fair skin color. Only 1 study subject's skin color was brown and skin color of 9 study subjects was olive. Results showed that hair color of 93% of study subjects was black and 37% of study subjects had brown hair. Majority of the study subjects had exposure to sunlight for less than 20 minutes and only 10 out of 200 study subjects had exposure to sunlight for more than 30 minutes. None of the study subjects had taken calcium or vitamin D supplements in previous month. In this study, 97% of the study subjects were vitamin D deficient and only 3% were vitamin D sufficient. Among 196 study subjects with vitamin D deficiency, severe deficiency was present in 30.41% (59 out of 194) of study subjects, moderate deficiency was present in 60.82% (118 out of 194) of study subjects and very few study subjects had mild vitamin D deficiency (Table 3).

Table 3: Distribution of severity of deficiency.

Severity of deficiency	Frequency	Percentage
Mild deficient	17	8.76%
Moderate deficient	118	60.82%
Severe deficient	59	30.41%
Total	194	100.00%

No significant association was seen between age and presence of vitamin D deficiency. All the study subjects of more than 29 years were vitamin D deficient, 97.37% of study subjects in age group 27-29 years and 96.60% of study subjects in age group 24-26 years were vitamin D deficient. In this study, all the females were vitamin D deficient and 94% of males were vitamin D deficient. Significant association exist between gender and vitamin D deficiency ($P<0.05$). No significant association was seen between prevalence of vitamin D There was no significant association seen in vitamin D deficiency and BMI of study subjects. Though higher proportion of overweight subjects had vitamin D deficiency as compared to normal yet distribution of vitamin D deficiency was comparable with no significant difference ($P>0.05$) (Table 4).

Table 4: Association of demographic characteristics and vitamin-D deficiency.

Demographic characteristics	Vitamin-D deficiency		Total	P value
	Not deficient(n=6)	Deficient(n=194)		
Age (in years)				
24-26 years	5 (3.40%)	142 (96.60%)	147 (100.00%)	0.755
27-29 years	1 (2.63%)	37 (97.37%)	38 (100.00%)	
>29 years	0 (0.00%)	15 (100.00%)	15 (100.00%)	
Gender				
Female	0 (0.00%)	100 (100.00%)	100 (100.00%)	0.029
Male	6 (6.00%)	94 (94.00%)	100 (100.00%)	
Religion				
Hindu	2 (1.53%)	129 (98.47%)	131 (100.00%)	0.147
Muslim	3 (5.00%)	57 (95.00%)	60 (100.00%)	
Sikh	1 (11.11%)	8 (88.89%)	9 (100.00%)	
BMI				
<25	6 (4.20%)	137 (95.80%)	143 (100.00%)	0.186
>=25	0 (0.00%)	57 (100.00%)	57 (100.00%)	
Department				
Gynecology & obstetrics	0 (0.00%)	15 (100.00%)	15 (100.00%)	0.677
Medicine	4 (5.26%)	72 (94.74%)	76 (100.00%)	
Physiology	0 (0.00%)	6 (100.00%)	6 (100.00%)	
PSM	0 (0.00%)	17 (100.00%)	17 (100.00%)	
ENT	0 (0.00%)	5 (100.00%)	5 (100.00%)	
Microbiology	1 (14.29%)	6 (85.71%)	7 (100.00%)	
Opthamology	0 (0.00%)	6 (100.00%)	6 (100.00%)	
Pathology	0 (0.00%)	6 (100.00%)	6 (100.00%)	
Pharmacology	0 (0.00%)	10 (100.00%)	10 (100.00%)	
Surgery	1 (1.92%)	51 (98.08%)	52 (100.00%)	

Table 5: Association of demographic characteristics and severity of deficiency.

Demographic characteristics	Severity of deficiency			Total	P value
	Mild deficient (n=17)	Moderate deficient (n=118)	Severe deficient (n=59)		
Age (in years)					
24-26 years	14 (9.86%)	91 (64.08%)	37 (26.06%)	142 (100.00%)	0.08
27-29 years	2 (5.41%)	22 (59.46%)	13 (35.14%)	37 (100.00%)	
>29 years	1 (6.67%)	5 (33.33%)	9 (60.00%)	15 (100.00%)	
Mean±SD	25.65±1.8	26.02±1.8	26.71±2.63	26.18±2.09	0..306
Median (IQR)	25(24-26)	26(25-26)	25(24-28.750)	26(25-27)	
Gender					
Female	0 (0.00%)	62 (62.00%)	38 (38.00%)	100 (100.00%)	<.0001
Male	17 (18.09%)	56 (59.57%)	21 (22.34%)	94 (100.00%)	
Religion					
Hindu	15 (11.63%)	76 (58.91%)	38 (29.46%)	129 (100.00%)	0.257
Muslim	2 (3.51%)	38 (66.67%)	17 (29.82%)	57 (100.00%)	
Sikh	0 (0.00%)	4 (50.00%)	4 (50.00%)	8 (100.00%)	
BMI					
<25	12 (8.76%)	84 (61.31%)	41 (29.93%)	137 (100.00%)	0.973
>=25	5 (8.77%)	34 (59.65%)	18 (31.58%)	57 (100.00%)	
Department					
ENT	1 (20.00%)	2 (40.00%)	2 (40.00%)	5 (100.00%)	0.534
Gyneacology & Obsterics	0 (0.00%)	11 (73.33%)	4 (26.67%)	15 (100.00%)	
Medicine	5 (6.94%)	45 (62.50%)	22 (30.56%)	72 (100.00%)	
Microbiology	1 (16.67%)	4 (66.67%)	1 (16.67%)	6 (100.00%)	
Opthamology	0 (0.00%)	4 (66.67%)	2 (33.33%)	6 (100.00%)	
Pathology	1 (16.67%)	4 (66.67%)	1 (16.67%)	6 (100.00%)	
Pharmacology	0 (0.00%)	8 (80.00%)	2 (20.00%)	10 (100.00%)	
Physiology	0 (0.00%)	5 (83.33%)	1 (16.67%)	6 (100.00%)	
PSM	0 (0.00%)	10 (58.82%)	7 (41.18%)	17 (100.00%)	
Surgery	9 (17.65%)	25 (49.02%)	17 (33.33%)	51 (100.00%)	

There was no significant association seen in vitamin D deficiency and department of study subjects. Distribution of vitamin D deficiency was comparable in all the departments with no significant difference. No significant association was seen between age distribution and severity of Vitamin D deficiency. Majority of study subjects of all the age groups had moderate deficiency except for study subjects with age more than 29 years but the difference was not significant.

Severe Vitamin D deficiency was significantly higher in females as compared to males. None of the female in this study had mild vitamin D deficiency and 18.09% of males were mild vitamin D deficient. Significant association was present between gender and severity of vitamin D deficiency. No significant association was seen between religion and severity of Vitamin D deficiency. Majority of study subjects of any religion had moderate deficiency (P>.05). No significant association was seen between BMI and severity of Vitamin D deficiency. Majority of study subjects of both with BMI<25 and >=25 had moderate deficiency (P>.05) (Table 5).

There was no statistical difference in severity of Vitamin D deficiency between study subjects of various departments. More than 50% of study subjects of all the departments had moderate deficiency and very few study subjects had mild deficiency. Significant association was seen between use of veil/hat/sunscreen and severity of vitamin D deficiency (P<.05).

Study subjects who used sun screen and veil had significantly higher prevalence of severe vitamin D deficiency as compared to study subjects who used hat or nothing. Mild deficiency was seen in 11.33% of study subjects who did not use hat/veil/sun screen whereas none of the study subjects who used veil/hat/sun screen had mild deficiency.

No significant association was seen between skin color and vitamin D deficiency (P>.05). Severity of deficiency was not associated with skin color of study subjects. Moderate deficiency was reported in majority of study subjects irrespective of skin colors with no significant difference (P>.05).

DISCUSSION

Vitamin D has received considerable interest from the medical community and the public at large because of recent evidence for the non-skeletal effects of vitamin D combined with the finding of widespread global deficiency. Vitamin D deficiency is more common than previously thought. It has been estimated that almost 1 billion people in the world suffer from vitamin D deficiency or insufficiency.[4] The study sample in our study consisted of both male (50%) and female (50%) young healthy adults serving as doctors in the age group ranging from 24 to 32 years with a male to female ratio 1:1. Majority of the study subjects were in the age group 24-26 years and only 19% of study subjects were 27-29 years age group followed by 7.50% of study subjects were more than 29 years old. Mean value of age of study subjects was 26.18±2.09 years. Similar study was done by Haney EM et al, on 90 internal medicine residents in the postgraduate department at Oregon Health & Science University in Portland, Oregon (OHSU). In their study, they included 51.4% women and 48.6% men, primarily Caucasian (83%), and evenly distributed among the postgraduate training years (31.4% PGY-1, 31.4% PGY-2, and 37.7% PGY-3). Women with an average age of 30.1 years (range, 26-44 years) and Men with an average age of 30.6 years (range, 26-40 years).[5]

Among 196 study subjects with vitamin D deficiency, severe deficiency was present in 30.41% (59 out of 194) of study subjects, moderate deficiency was present in 60.82% (118 out of 194) of study subjects and very few study subjects had mild vitamin D deficiency. This was found to be in the moderate deficiency range. A huge proportion of the study sample (97%) was found to have inadequate vitamin D levels, which was mostly in the moderate or severe deficiency range. Only 3% of the study sample was seen to have adequate vitamin D levels. Walia HK et al, have also reported similar results in a study on medical students with 95.4% vitamin D deficient subjects.[6] Al-Elq AH, Khushdil A et al, have also reported similar results.[7,8] The present findings are also consistent with the study conducted by Hasanato R et al who observed 87.1% of participants in their study were vitamin D deficient and only 12.9% of the subjects had normal vitamin D levels.[9] In the present study no significant association was seen between age and presence of vitamin D deficiency. All the study subjects of more than 29 years were vitamin D deficient, 97.37% of study subjects in age group 27-29 years and 96.60% of study subjects in age group 24-26 years were vitamin D deficient (P>0.05). The mean serum vitamin D levels in females were found to be lower as compared to males in our study. The difference was found to be statistically significant (p value = 0.016). Our findings were comparable to previous studies which reported the occurrence of vitamin D deficiency more commonly among females as compared to males. El-Menyar A et al, conducted a retrospective, observational study at Hamad General Hospital (HGH), Qatar. The overall mean level of vitamin D among 547 patients was 14.4±11ng/ml. Among the low vitamin D group, 56% were females (mean age 48±12) and 44% males (mean age 49.6±13).[10] A number of factors have been postulated for the relatively lower levels of vitamin D in females including prolonged indoor stay, sunscreen use, lack of adequate sun exposure, pregnancy and lactation (Holick MF, 2007).[11] In the present study, 65% of the study subjects were Hindu and 30% of study subjects were Muslim. Very few study subjects were Sikh among the study population. Among the Hindu study subjects 11.63% shows mild deficiency, 58.91% shows moderate deficiency and 29.46 represents severe deficiency. Among the Muslim study subjects 3.51% shows mild deficiency, 66.67% represents moderate deficiency and 29.82% shows severe deficiency and likewise 0.00% shows mild deficiency, 50% shows moderate deficiency and 50% represents severe deficiency among the Sikh study subjects. In the present study, no significant association was seen between prevalence of vitamin D deficiency and religion.

Also, no significant association was seen between religion and severity of Vitamin D deficiency. Majority of study subjects of any religion had moderate deficiency (P>0.05).[12] In the present study the proportion of study subjects with vitamin D deficiency were comparable between study subjects who used veil/hat/sun screen and who did not use any of these things. Though vitamin D deficiency was seen in all the study subjects who used either hat or veil or sunscreen as compared to 96.15% of study subjects who did not use these things and the difference was not statistically significant (P>0.05). Significant association was seen between use of veil/hat/sunscreen and severity of vitamin D deficiency (P<0.05). Study subjects who used sun screen and veil had significantly higher prevalence of severe vitamin D deficiency as compared to study subjects who used hat or nothing. Mild deficiency was seen in 11.33% of study subjects who did not use hat/veil/sun screen whereas none of the study subjects who used veil/hat/sun screen had mild deficiency. The tradition of veil among Muslim women and its effect on vitamin d levels has been debated a lot. Le Goaziou MF et al, Hatun S et al, Guzel R et al all reported results consistent with our study. It is said that a sunscreen with an SPF of 15 or more blocks more than 99% of incident ultraviolet B radiation and thus reduces vitamin D synthesis in the skin by as much as 99% (Holick MF). Our study also showed that regular use of sunscreens reduces the synthesis of vitamin D in the skin by blocking the ultraviolet B rays.[13-15,11]

In the present study, no significant association was seen between skin color or hair color and vitamin D deficiency (P>0.05). Severity of vitamin D deficiency was also not associated with skin color or hair color of study subjects (P>0.05). Moderate deficiency was reported in majority of study subjects irrespective of skin or hair colors. Majority of study subjects had exposure to sunlight less than 20 minutes. No significant association was seen

between prevalence of vitamin D deficiency and duration of exposure to sunlight (P>0.05). However, severity of vitamin D deficiency was significantly associated with duration of exposure to sunlight (P<0.05). The study group who were exposed to sunlight for 30-40 minutes and 1 hour had mild deficiency in 60% and 50% of study subjects as compared to 6.49% of study group who were exposed to sunlight for less than 20 minutes and the difference was statistically significant. Exposure to sunlight is a major source of vitamin D production. A 30 minute daily exposure of the skin over arms and face, without the use of sunscreens, at noon time is supposed to be adequate to avoid vitamin D deficiency (Londhey V). In our study, the participating doctors didn't even come near to this recommended duration of exposure. Spending 30 minutes in the sunlight at noon time was never possible as this time was mostly pre-occupied with duties. Hectic schedule of duties, prolonged duty hours, use of sunscreens in the study sample all precluded this option of adequate exposure to sunlight.[16] The mean serum vitamin D levels showed a rising trend which was directly proportional to the average time spent outdoors, in the sunlight. The mean serum vitamin D levels were found to be in the adequate range in participants who spent an average of 2 hours or more outdoors. Mean serum vitamin D levels in the severe deficiency range were seen in the group which spent an average of half hour or less in the sun. The role of sunlight, particularly ultraviolet B rays, in the synthesis of vitamin D is well known and has been documented in multiple studies (Webb AR et al).[17] Similar findings were seen in our study and the relation of vitamin D levels with the average time spent outdoors was found to be statistically significant (p-value <0.05).

In the present study, Mean value of height in vitamin D deficient study subjects was 1.65±0.03 meters and in vitamin D sufficient subjects was 1.64±0.01meters. Mean value of height was not significantly different in vitamin D non deficient and vitamin D deficient study subjects (P>0.05). Mean value of weight in vitamin D deficient study subjects was 68.06±5.31kg and in vitamin D sufficient subjects was 65±2.1kg. Mean value of weight was not statistically significant between vitamin D non deficient and vitamin D deficient study subjects (P>0.05). Mean value of weight of study subjects with severe deficiency was 68.24±6.15kg, with moderate deficiency was 68.06±4.92kg and with mild deficiency was 67.41±5.04kg. It is evident that there was no significant difference in weight of the study subjects in terms of severity of vitamin D (P>0.05). Mean value of BMI in vitamin D deficient study subjects was 24.88±1.93kg/m^2 and in vitamin D sufficient subjects were 24.03±0.99kg/m^2. There was no significant difference in mean value of BMI between vitamin D deficient and vitamin D sufficient study subjects (P>0.05). Mean value of BMI of study subjects with severe deficiency was 24.95±2.39kg/m^2, with moderate deficiency was 24.9±1.67kg/m^2 and with mild deficiency were 24.43±1.88kg/m^2. It is evident that study subjects with higher BMI had higher prevalence of severe deficiency as compared to study subjects with lower BMI but the difference was not statistically significant(P>0.05). Obesity is considered as a risk factor for low vitamin D levels. Obese people have suppressing effect of high quantity of subcutaneous fat on circulating vitamin. Aggrawa M et al, Le Goaziou MF et al and Looker AC et al, also demonstrated that overweight or obesity and not participating in outdoor sports were risk factors for hypovitaminosis D.[12,13,18] Primary education targeting younger populations is known to increase the likelihood of positive health behaviour that persists throughout and protects from disease development and progression later in life (Von Ah D et al).[19]

The results of this study demonstrated that even educated medical professionals have low vitamin d levels and are often unaware or unaccepting of the fact that they can be affected by this common epidemic.[19]

Therefore, prevention of vitamin D deficiency by sensible sunlight exposure, food fortification and routine supplementation are the currently recommended options for tackling this nutritional deficiency (Raina K et al).[20]

CONCLUSION

Vitamin D deficiency was observed in 97% of apparently healthy doctors of the Govt. Medical College, Jammu in this study. Lack of awareness regarding importance of vitamin D requirement seems to be the main reason behind this serious health concern. Moreover, inadequate exposure to sunlight, changes in lifestyle and food habits contribute to low vitamin D levels in young population. Doctors are an integral and indispensable part of the healthcare system and often tend to neglect their own health while tending to the sorrows of their patients. The hectic schedule and unrelenting duty hours, sedentary nature of work, minimal exposure to sunlight, with no provision of timely food intake and means of recreation, predisposes doctors to a number of health related issues. This calls for an urgent action to prevent adverse consequences of low vitamin D in young generation of this country.

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