ORIGINAL ARTICLE

Vitamin D status among the adults of Guwahati and its associated factors: A cross sectional study

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Abstract

Background: Vitamin D deficiency prevails all over the Indian subcontinent, with a prevalence of 70-100% in the general public and this is likely to contribute to enormous burden on the health care system of India. *Aim and Objectives:* To estimate the prevalence of vitamin D status among the adults of Guwahati and assess the vitamin D status in relation to various factors associated with it. *Material and Methods:* This community based cross sectional study was conducted among adults aged between 18-45 years in the municipal wards of Guwahati city. Using the prevalence of vitamin D deficiency in adults as 93.3% and absolute error as 5%, the sample size was calculated to be 100 which was rounded to be 120. The data collected was entered in Microsoft Office Excel and analyzed using Graph Pad Instat. *Results:* In this study, majority (48.3%) had vitamin D insufficiency (20-30 ng/ml), 36.7% had sufficient vitamin D (30-100 ng/ml) level and 15.0% had vitamin D deficiency (< 20 ng/ml). The vitamin D status in relation to nutritional status, lifestyle and the timing of sun exposure was not found to be statistically significant. Whereas, the vitamin D status in relation to the duration of sun exposure and the use of sunscreen was found to be statistically significant ($p = 0.0063$ and $p = 0.0138$ respectively). *Conclusion:* Since vitamin D levels were found to be lower than normal level, health education as well as easy availability of testing for vitamin D and supplementation of vitamin D at various health care facilities is necessary.

Keywords: Vitamin D Deficiency, Vitamin D Insufficiency, Nutritional Status, Lifestyle, Sun Exposure

Introduction

Vitamin D also known as sunshine vitamin is a fat soluble vitamin and in present times, it has gained much importance due to its effect on bone health and also on the extra-skeletal diseases as observed in various studies done by many researchers world-wide. According to the Center for Disease Control and Prevention, vitamin D deficiency is defined as a condition that causes 'inadequate mineralization or demineralization of the skeleton (CDC 2008)' [1].

In one of the studies it has been mentioned that "in the early morning and late afternoon the zenith angle of the sun is also more oblique similar to winter sunlight and as a result very little if any vitamin D_3 can be produced in the skin before 10 a.m. and after 3 p.m. even in the summer time" [2]. Vitamin D deficiency and insufficiency is a global health issue that afflicts more than one billion children and adults worldwide [3].

India is a vast tropical country extending from 8.4° N latitude to 37.6° N latitude. From the data available in the published literature, vitamin D deficiency is very common in India in all the age groups and both sexes across the country.

Although, there is adequate sunshine in India, high temperatures during the day time and humid climate in many areas are the deterrents to sun exposure [4]. The Vitamin D deficiency prevails all over the Indian subcontinent, with a prevalence of 70-100% in the general public and this is likely to contribute to enormous burden on the health care system of India [5]. Prevalence of vitamin D deficiency and vitamin D insufficiency has also been documented in Assam. A study done by Sarma D and co-workers showed that the prevalence of vitamin D deficiency among school children was 8.4% and insufficiency was 14.2% [6]. Vitamin D deficiency affects the bone health, whereby it may affect the quality of life of a person by hampering his ability to work properly. Therefore, the present study was conducted with the objectives to estimate the prevalence of vitamin D status among the adults of Guwahati and to assess the vitamin D status in relation to various factors associated with it.

Material and Methods

This community based cross sectional study was done among the adult population (aged between 18-45 years) of the municipal wards of Guwahati city (Kamrup Metro district) from August 2018 – July 2019. Adults aged between 18-45 years who were permanent residents or those who had been living there for more than 6 months and who gave consent to participate in the study were included in the study, after obtaining clearance from the Institutional Ethics Committee of Gauhati Medical College and Hospital, Guwahati.

Lactating and pregnant mothers, those with serious or acute medical illness, liver or kidney disease, those who had taken vitamin D or calcium supplementation in previous 6 months and/or on corticosteroid medication were excluded from the study.

Using the prevalence of vitamin D deficiency in adults as 93.3% [7] and absolute error as 5%, the sample size was calculated using the formula $N = 4pq/L^2$, where N = required sample size, p = prevalence, q = 100-p and L = precision, the sample size was calculated to be 100 which was rounded to 120. As per Govt. Notification No. GDD. 125/08/Pt-I/212 dated 15/03/2013 and as per provisions of Guwahati Municipal Corporation Act, 1971 (as amended) and under the provisions of Assam Nagara Act, 2007, there are 31 wards under Guwahati Municipal Corporation. From these 31 wards, 10 wards were selected using random number table. From each selected ward, 12 households were selected at random and from each selected household the adult available during home visit, irrespective of the gender was taken to get a sample size of 120, i.e. $10 \times 12 = 120$. In case no adult was found in a household or did not fulfill the inclusion and exclusion criteria, then the adjacent household was taken. If more than one adult were present in a household at the time of visit, then one adult was selected using lottery method.

Data collection tools: Predesigned and pre-tested interview schedule, weighing machine, stadiometer, stethoscope and sphygmomanometer were used for collecting data by house to house visit. On reaching the house the purpose of the visit was briefed and interview was conducted after obtaining their consent. Throughout the study, the privacy and confidentiality of the respondents had been maintained.

Estimation of serum 25 OH-Vitamin D

Serum 25 OH-Vitamin D was estimated using 25 OH- Vitamin D (ELISA) Kit. The Bio-Detect vitamin D uses micro-plate ELISA methodology. The following ranges were suggested for the classification of 25 OH- Vitamin D status- deficiency - < 20 ng/ml; insufficiency – 20-30 ng/ml; sufficiency – 30-100 ng/ml and intoxication - > 100 ng/ml

Operational definitions: The sun exposure from 10 a.m. – 3 p.m. was considered as an adequate timing for sun exposure for vitamin D production. Whereas sun exposure before 10 a.m. and after 3 p.m. was considered inadequate timing for vitamin D production. Exposure to sun for less than 30 minutes was considered as inadequate sun exposure whereas exposure for more than or equal to 30 minutes was considered adequate sun exposure.

Data analysis: The data collected was entered in Microsoft Office Excel and analysed using Graph Pad Instat.

Results

In the present study, out of the 120 respondents, majority were females and majority belonged to the age group of 25-31 years (Table 1). In this study, majority (48.3%) had vitamin D insufficiency (20-30 ng/ml), 36.7% had sufficient vitamin D (30-100 ng/ml) level and 15.0% had vitamin D deficiency (< 20 ng/ml). The vitamin D status in relation to nutritional status and lifestyle was not found to be statistically significant (Tables 2 and 3 respectively). Moreover, the vitamin D status in relation to the timing of sun exposure was not found to be statistically significant (Table 4). The vitamin D status in relation to the duration of sun exposure was found to be statistically significant (Table 5). In this study, 43 respondents used sunscreen and among them 22 (51.2%) had sufficient vitamin D whereas 21 (48.8%) had vitamin D below normal level. Vitamin D status in relation to the use of sunscreen was found to be statistically significant (p = 0.0138). Eighteen respondents used umbrella while exposed to the sun and 11 respondents regularly wore full sleeves and among them vitamin D sufficiency was 6 (33.3%) and 5 (45.5%) respectively. Whereas, the vitamin D status in relation to the use of umbrella (p = 0.7502) and wearing of full sleeves (p = 0.5257) for sun protection was not found to be statistically significant.

Table 1: Socio-demographic profile of the participants (N = 120)

Socio-demographic characteristics		Number	Percentage (%)
Sex	**Male**	54	45.0
	Female	66	55.0
Age (in years)	**18-24**	23	19.2
	25-31	41	34.2
	32-38	29	24.2
	39-45	27	22.5
Social class (Revised Modified B.G. Prasad classification 2017)	**Upper**	10	8.3
	Upper middle	49	40.8
	Lower middle	35	29.2
	Upper lower	15	12.5
	Lower	11	9.2
Educational status	**Illiterate**	5	4.2
	Primary	24	20.2
	Upper primary	13	10.8
	Secondary	20	16.7
	Senior secondary	14	11.7
	Higher education	44	36.7
Occupation	**Professionals**	25	20.8
	Skilled workers	29	24.2
	Semi-skilled workers	14	11.7
	Unskilled workers	14	11.7
	Unemployed	38	31.7

Table 2: Vitamin D status in relation to the nutritional status of the participants

BMI (WHO)	Vitamin D insufficient (%)	Vitamin D sufficient (%)	Total (%)	Chi-square, *p*
Underweight	10 (58.8)	7 (41.2)	17(14.2)	0.1748, 0.9163
Normal	39 (63.9)	22 (36.1)	61 (50.8)	
Overweight	27 (64.3)	15 (35.7)	42 (35.0)	
Total	76 (63.3)	44 (36.7)	120 (100.0)	

Vitamin D insufficiency: < 30 ng/ml, Vitamin D sufficiency: ⩾ 30 ng/ml

Table 3: Vitamin D status in relation to the lifestyle of the participants

Lifestyle characteristics		Vitamin D insufficient (%)	Vitamin D sufficient (%)	Total (%)	Chi-square, *p*
Physical activity	**High**	6 (75.0)	2 (25.0)	8 (6.7)	2.877, 0.0899
	Moderate	25 (52.1)	23 (47.9)	48 (40.0)	
	Low	45 (70.3)	19 (29.7)	64 (53.3)	
	Total	76 (63.3)	44 (36.7)	120 (100.0)	
Alcohol consumption	**Never user**	52 (69.3)	23 (30.7)	75 (62.5)	3.100, 0.0783
	Ever user	24 (53.3)	21 (46.7)	45 (37.5)	
	Total	76 (63.3)	44 (36.7)	120 (100.0)	
Smoking status	**Never/former user**	54 (60.0)	36 (40.0)	90 (75.0)	1.722, 0.1894
	Current user	22 (73.3)	8 (26.7)	30 (25.0)	
	Total	76 (63.3)	44 (36.7)	120 (100.0)	
Blood pressure	**Hypertension present**	14 (60.7)	9 (39.1)	23 (19.2)	0.0744, 0.7851
	Hypertension absent	62 (63.9)	35 (36.1)	97 (80.8)	
	Total	76 (63.3)	44 (36.7)	120 (100.0)	

Vitamin D insufficiency: < 30 ng/ml, Vitamin D sufficiency: ⩾ 30 ng/ml

Table 4: Vitamin D status of the participants in relation to time of sun exposure

Time of the day	Vitamin D insufficient (%)	Vitamin D sufficient (%)	Total (%)	Chi square, *p*
10 am- 3 pm	38 (61.3)	24 (38.7)	62 (51.3)	1.048, 0.5922
Before 10 am	29 (69.0)	13 (31.0)	42 (35.0)	
After 3pm	9 (56.3)	7 (43.7)	16 (13.3)	
Total	76 (63.3)	44 (36.7)	120 (100.0)	

Vitamin D insufficiency: < 30 ng/ml, Vitamin D sufficiency: ⩾ 30 ng/ml

Table 5: Vitamin D status in relation to the duration of sun exposure [n = 62]

Duration	Vitamin D insufficient (%)	Vitamin D sufficient (%)	Total (%)	Chi-square, *p*
⩽ 30 mins	23 (79.3)	6 (20.7)	29 (46.7)	7.457, 0.0063*
> 30 mins	15 (45.5)	18 (54.5)	33 (53.2)	
Total	38 (61.3)	24 (38.7)	62 (100.0)	

*Vitamin D insufficiency: < 30 ng/ml, Vitamin D sufficiency: ⩾ 30 ng/ml; *p<0.05 – statistically significant*

Discussion

In table 1, while assessing for the distribution of the respondents based on gender, it was observed that majority of the respondents were females (55.0%). According to a study done in Kamrup district by Choudhury and Ojah, it was found that majority of the participants were females compared with males [8]. While assessing for the distribution of the respondents according to their age, it was observed that majority (34.2%) belonged to the age group of 25-31 years whereas according to the Census 2011 report, urban population belonging to 15-59 years age group constituted 66.6% of the total [9]. Majority (40.8%) of the respondents belonged to upper middle class whereas Mahanta *et al*. in Assam found that majority of the study population belonged to middle (class II and III) socio-economic class [10]. Most (36.7%) of the respondents had higher education level and according to NFHS- 4, in Assam 72% women and 83% men aged 15-49 years were literate [11]. Kalita *et al*. in their study done in North-East India found that majority of the participants had their education below matriculation [12]. It was also seen that majority (31.7%) of the respondents were unemployed similar to study done by Kalita *et al*. who found that majority (57.3%) of their study participants were unemployed [12].

In this study, it was found that majority (48.3%) of the respondents had vitamin D insufficiency, 36.7% had sufficient vitamin D level and 15.0% had vitamin D deficiency. In contrast, a study done in South India by Vatakencherry *et al*. found that vitamin D deficiency was 78.8%, insufficiency was 8.1% and sufficiency was 13.1% among the participants [13]. In a study done among 150 participants, 70 (46.7%) study subjects were deficient, 54 (36%) insufficient and 26 (17.3%) had sufficient vitamin D [14].

Table 2 shows that the vitamin D status in relation to BMI was not found to be statistically significant. According to a study done by Zagar *et al.* in Kashmir valley, it was found that vitamin D in relation to BMI was not statistically significant [15]. Whereas, a study done by Al Zarooni *et al.* found that low vitamin D levels were associated with high body mass index [16].

In table 3, it is seen that the vitamin D status in relation to physical activity, alcohol consumption, smoking and blood pressure level was not found to be statistically significant. Ganmaa *et al*. in their study found that physical activity was not associated with serum 25-hydroxyvitamin D levels [17]. According to a study done by Ke *et al*., it was found that lower 25(OH)D levels were statistically associated with physical activity [18]. According to Madsen *et al*., it was found that serum 25(OH) D concentration was not associated with alcohol consumption which is similar to our study finding [19]. Whereas, a study done by Lamberg-Allardt *et al*. found that alcohol intake was positively associated with the S-25(OH)D concentration [20]. In a study done by Tønnesen *et al*., it was found that there was no association between smoking and vitamin D insufficiency [21], whereas Datta *et al*., found that current smoking was significantly associated with lower 25(OH)D levels [22]. According to a review done by He and Hao, it was found that there was no significant differences between the vitamin D deficiency group and the control group on the level of change of systolic pressure and on the level of diastolic pressure [23]. On the other hand, a study done by Priya *et al*. in a North Indian population found that there was an inverse association between vitamin D levels and systolic blood pressure [24]. According to a study done by Vatakencherry *et al*. in South India, it was found that severe vitamin D deficiency was highly prevalent in people with hypertension than in people without hypertension [13].

In table 4, it was seen that the vitamin D status in relation to time of sun exposure was statistically not significant. According to a study done by Bawaskar *et al.*, it was found that vitamin D levels are statistically significant in relation to sun exposure [25]. A study done by Husain *et al.* found that majority (64%) of the participants had sun exposure before 10 a.m. and found that the time of sun exposure was not significant with vitamin D level [26].

Table 5 shows that the vitamin D status in relation to the duration of sun exposure was found to be statistically significant. According to a study done by Zargar *et al.* in Kashmir valley, it was found that between the subjects with and without vitamin D deficiency, there was significant difference in the mean exposure to sunlight measured in hours per week [15]. In a study done in Tamil Nadu by Mechenro *et al.*, it was found that the duration of daily sun exposure below 30 min and sun exposure 30-60 min were found to be independently associated with vitamin D sufficiency [27]. Whereas a study done by Binkley *et al.* in Hawaii

found that there was no correlation between serum 25(OH)D and total hours of sun exposure per week [28].

In this study it was found that the vitamin D status in relation to the use of sunscreen for sun protection was statistically significant. A study done by Mechenro *et al.* found that the usage of sunscreen was associated with vitamin D status [28]. A study done by Husain *et al.* found that sun protection creams use was not significant with vitamin D level [26]. Whereas, the use of umbrella and wearing of full sleeves for sun protection was not found to be statistically significant. According to a study done by Junaid *et al.*, it was found that the risk of vitamin D deficiency was not independently associated with body exposure [29], whereas Granlund *et al.* found that the vitamin D deficiency in immigrant population was significantly associated with wearing long sleeved clothes in summer [30].

Limitations of the study

There is a chance of recall bias in certain responses and there is no standard definition or cut off available for vitamin D deficiency.

Conclusion

Since vitamin D levels were found to be lower than normal level, health education must be provided regarding the effects of lower levels of vitamin D on health. There is a need of easy availability of testing for vitamin D and supplementation of vitamin D at various health care facilities.

Acknowledgement

A sincere thanks to the Department of Community Medicine and Department of Biochemistry, Gauhati Medical College and Hospital and all the study participants for their co-operation throughout the study without whom the study would not have been possible.

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How to cite this article:

Khagorika S, Krishnatreya M, Thakur BB. Vitamin D status among the adults of Guwahati and its associated factors: A cross sectional study. *J Krishna Inst Med Sci Univ* 2023; 12(4):122-130

Submitted: *06-July-2023* ***Accepted:*** *06-Sep-2023* ***Published:*** *01-Oct-2023*