

EVALUATION OF KNOWLEDGE, PRACTICES OF VITAMIN D AND ATTITUDE TOWARD SUNLIGHT AMONG INDIAN STUDENTS

HARSH ARORA¹, VIVEK DIXIT², NIDHI SRIVASTAVA^{1*}

¹Center for Medical Biotechnology, Amity Institute of Biotechnology, Amity University, Noida, Uttar Pradesh, India. ²Department of Orthopaedics, All India Institute of Medical Sciences, Delhi, India. Email: nsrivastava@amity.edu

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ABSTRACT

Objective: The current study was carried out to assess the knowledge, practice of Vitamin D and attitudes toward sunlight exposure among Indian students.

Methods: We conducted a cross-sectional study on students, studying in Amity University, Noida, India. A pre-designed and self-administered questionnaire was given to all students to collect the information regarding their knowledge about Vitamin D.

Results: Almost all (99.5%) students had heard of Vitamin D. The majority of students (53.3%) indicated that sunlight as the main source of Vitamin D, however, knowledge in terms of required daily dose and time in the sun were low among students. Despite having awareness regarding the main source of Vitamin D, 64.2% students did not like going in the sun and percentage (%) of female students who disliked being exposed in the sun were significantly higher (71.1% and 51.6%, respectively; $p=0.000$). Moreover, female students were a frequent user of sunscreen, applied sunscreen in both summer and winter seasons (47.2% females vs. 37% males; $p=0.000$). No significant associations were found for the factors, associated with the knowledge of Vitamin D such as the use of sunscreen and hours per day outdoor.

Conclusion: The findings of this survey show a lack of consistency between knowledge and attitude, negative approach toward sunlight exposure may severely affect the Vitamin D status of young students. Implementing awareness campaigns and future health programs such as a workshop or training at the college level may help in building more awareness and knowledge about the Vitamin D importance.

Keywords: Vitamin D, Sun exposure, Knowledge.

INTRODUCTION

Vitamin D, an oldest sunshine hormone is well-recognized for its role in calcium homeostasis and bone health. In addition, the discovery of Vitamin D receptor and extrarenal synthesis of Vitamin D has directed the researchers to explore distinctive and the hidden role of this hormone or vitamin. Evidence of various cross-sectional studies has linked Vitamin D inadequacy to various diseases such as cancers, heart disease, diabetes Type 1 and 2, and many other diseases [1,2]. On one hand, the immune regulatory roles of Vitamin D acquiring an attention these days, on another hand, Vitamin D deficiency gradually reinforcing its roots in the developed as well as in developing countries.

It is estimated that one billion people worldwide have Vitamin D insufficiency or deficiency, and hypovitaminosis D has been reported in both females and males and in all age groups even found in the healthy individuals also [3,4]. Despite being located close to equator, Vitamin D deficiency is very prevalent in India, thereby disproven the belief that Vitamin D deficiency is unlikely common in countries where ample of sunlight is available [5].

Multiple factors, such as season, duration, and timing of sun exposure, latitude, clothing, and skin pigmentation, are the possible contributors of this deficiency [6]. In India due to modernization and sudden rise in temperature, the numbers of hours spent outdoors have been decreased, and sedentary way of working is most appreciated among urban people. Modernization has also brought the changes in the lifestyle and food habits of the young generation which may contribute to low dietary intake of Vitamin D. Moreover, increasing pollution owing to rapid industrialization also prevents ultraviolet-B to reach on earth thus plays a major barrier in the synthesis of optimal Vitamin D in the human skin.

With all above apprehensions, fortification of staple foods with Vitamin D appears to be a good option to reduce this Vitamin deficiency burden in India. However, food fortification is not mandatory and due to the high cost of fortified food supplements; it is not being appreciated in India [7]. Lack of knowledge regarding Vitamin D or non-implementation of the knowledge in daily routine, attitude, and behavior toward the sun may also be the influential causes of this nutritional deficiency.

Among Indian population including young students are at the high risk of Vitamin D deficiency because being a fair skin complexion is believed to be an elite status. Due to this perception, young girls in India tend to avoid the sun or cover their body while going outdoors and use other protective gears such as sunscreen. Furthermore, students, particularly in a sphere of college-going age, have more time and liberty to choose any lifestyle behavior which might be or might not be beneficial in providing long-term health.

Until date, no work has been done so far in India to understand the knowledge of students regarding this nutrient. Therefore, the current study was conducted to assess the knowledge about Vitamin D and the attitudes and behavior toward sunlight exposure among students, studying in India's top leading private university.

METHODS

The cross-sectional study was conducted among male and female students pursuing graduation or post-graduation at the Department of Biotechnology, Amity University, Noida. A self-administered questionnaire was developed to assess the knowledge, attitudes, behavior, and practice on Vitamin D among college students. The study was carried out in the month of August to September 2015 in the Department of Biotechnology and Department of Foods and Technology

of Amity University. The study procedures were conducted following the approval and Guideline of Ethical Committee of Amity University.

Questionnaire

The questionnaire consisted 4 sections, and all sections included 8-10 multiple-choice questions. Section A was about socio-demographic profiles of the participants. Section B was designed to evaluate the knowledge related to Vitamin D, contained 9 questions such as the main source of Vitamin D, factors that affect Vitamin D level, the average time needed to spend in sunlight to have enough Vitamin D, etc. The first question in section B was asked for screening purpose, and only those who had heard of Vitamin D were required to complete the rest of the questionnaire.

Section C and D were about attitude, behavior, and practice toward sun exposure. This section included questions on participants' apprehension such as being tanned in the sun and risk of developing skin cancer, and concern about their Vitamin D status and whether they prefer to take Vitamin D supplements if they found to be Vitamin D deficient. In this section, participants were also asked about the use of sun protection gears such as sunscreen, umbrella, and taking part in any kind of outdoor physical activity.

The questionnaires were administrated in the presence of the researcher so that discussion among students regarding questions and use of any kind of prompts such as the mobile internet can be avoided.

Data analysis

The collected data were entered in Microsoft Excel and checked for any typographical error prior to analysis. Data analysis was conducted using Statistical Package of Social Science Version 20. Descriptive statistics was used to characterize the study population. Frequency tables were constructed and presented as percentages. The Chi-square test was done to compare frequencies between groups.

RESULTS

A total of 599 students between 18 and 25 years of age participated in the survey. Females were more predominant in the study (64.7%). The majority of the students were 18-20 (69.7%) years of age, followed by 20-25 (27%) years. Table 1 shows socio-demographic characteristics of the participants. 84.4% students belonged to the Hindu religion while only 6.3% students were from Muslims families. The average monthly income was more than ₹50,000 (59.2%). The majority of the students (92.3%) were from undergraduate followed by 7.6% of post-graduation. 41% of the students were residing in Delhi NCR (New Okhla Industrial Development Authority), and approximately half (49.9%) of the students opted non-vegetarian food as their most common choice over vegetarian food (36.7%).

Knowledge about Vitamin D

Almost all (99.5%) students reported that they had heard about Vitamin D (Table 2). The main source of information about Vitamin D was schools (45.4%), books (16.6%), family (14.7%), physician/doctor (10%), and others including college, television. Most of the students (53.3%) indicated sunlight as the main source of Vitamin D while 44.9% students thought that the sun and diet both are the main sources of Vitamin D. Only 0.6% students were not aware of the source of Vitamin D. Majority of the students (88.4%) were agreed on that Vitamin D is good for bone health while only 11.5% students reported that Vitamin D is not good for bone health. In terms of Vitamin D synthesis, 48.8% students responded that Vitamin D is synthesis occurring in the body from its precursor while 51.1% students were not agreed with this.

When students were asked about minimum daily intake of Vitamin D dose, only 8% knew the correct answer, while 68.7% did not know the answer. Regarding the time needed to spend outdoors to get enough Vitamin D, 37.5% indicated the correct answer which is 10-20 minutes a day, while 25.5% students did not know the correct answer followed

Table 1: Socio-demographic characteristics of the respondents

Characteristics	Frequency (n)	Percentage
Gender		
Male	211	35.2
Female	388	64.7
Age (years)		
<18	19	3.1
18-20	418	69.7
20-25	162	27.0
Religion		
Hindu	506	84.4
Muslim	38	6.3
Sikh	21	3.5
Christian	9	1.5
Jain	12	2.0
Other	13	2.1
Family Income Rs. per month (pm)		
<20,000	10	1.6
20,000-30,000	57	9.5
30,000-40,000	73	12.1
40,000-50,000	104	17.3
>50,000	355	59.2
Residence		
North Delhi	61	10.1
East Delhi	58	9.6
West Delhi	61	10.1
South Delhi	86	14.3
Noida	245	40.9
Ghaziabad	51	8.5
Other	37	6.1
Educational qualification		
Under-graduate	553	92.3
Post-graduate	46	7.6
Food preference		
Vegetarian	220	36.7
Non-vegetarian	299	49.9
Eggetarian	80	13.3

by 21.3% of students who thought that at least 1 hr per day 1 needs to spend under the sun to get Vitamin D. Students were also asked about the factors that affects Vitamin D status of an individual. 25% (24.8%) students chose skin pigmentation, 27% chose the time of the day, 29.5% chose season and latitude, 20.6% students chose age, 22.8% students chose sunscreen, 13.2% students chose pollution, and 6.8% students opted to smoke as at least one factor that affects Vitamin D status. 35% students could name two or more of these factors, and 25% students did not know about these factors.

ATTITUDES AND BEHAVIOR TOWARD SUN EXPOSURE

Out of 599 students who were surveyed, 64.2% (n=385) responded that they did not like going in the sun (Table 3). When the response was measured between both sexes, it was found that more females compared to males did not like going out in the sun (71.1% and 51.6%, respectively; p=0.000). Almost half (49.7%) of the students thought that sunlight is harmful for the skin and half of the students (50.2%) disagreed with this statement. Approximately 43% students used a parasol to shade from the sun, and this percentage were found to be higher in females as compared to males (53.6% and 23.7%, respectively; p=0.000). Half of the students (51.5%) agreed with the statement that sunscreen is the most effective way of controlling skin tanning. 60% students thought that their Vitamin D is sufficient, however if the medical condition demands, they (89.8%) were more willing to undergo for the Vitamin D test. A higher number of male students believed that they have sufficient Vitamin D status compared to female students (68.2% and 55.4%, respectively; p=0.002). Pills, tablets, or granules were found to be the most preferred way of consuming supplements among 48.5% of the students. Further majority of the students (69.4%) believed that by taking calcium supplements, Vitamin D level can also be maintained in the body.

Table 2: Knowledge of the respondents about Vitamin D

Questions	Male (n=211)	Female (n=388)	Total (n=599)
Heard of Vitamin D			
Yes	209 (99.0)	387 (99.7)	596 (99.5)
No	2 (0.9)	1 (0.2)	3 (0.5)
*Where did you hear about Vitamin D?			
Physician/Nurse/Doctor	18 (8.6)	42 (10.8)	60 (10.0)
Family	30 (14.3)	58 (14.9)	88 (14.7)
Book	38 (18.1)	61 (15.7)	99 (16.6)
School	99 (47.3)	172 (44.4)	271 (45.4)
Other	11 (5.2)	20 (5.1)	31 (4.9)
Multiple responses	13 (6.2)	34 (8.79)	47 (7.8)
*Vitamin D is synthesized in the body from precursor?			
Yes	104 (49.7)	187 (48.3)	291 (48.8)
No	105 (50.2)	200 (51.6)	305 (51.1)
*What are the main sources of Vitamin D?			
Diet	2 (0.9)	1 (0.2)	3 (0.5)
Sunlight	111 (53.1)	207 (53.4)	318 (53.3)
Diet and sun	92 (44.0)	176 (45.4)	268 (44.9)
Others	1 (0.4)	2 (0.5)	3 (0.5)
Don't know	3 (1.4)	1 (0.2)	4 (0.6)
*Vitamin D is good for bone health?			
Yes	186 (89.0)	341 (88.1)	527 (88.0)
No	23 (11.0)	46 (11.8)	69 (11.5)
*Minimum daily intake of Vitamin D?			
200 IU	8 (3.8)	18 (4.6)	26 (4.3)
400 IU	22 (10.5)	29 (7.4)	51 (8.5)
600 IU	20 (9.5)	28 (7.2)	48 (8.0)
800 IU	8 (3.8)	21 (5.4)	29 (4.8)
1000 IU	8 (3.8)	14 (3.6)	22 (3.6)
1400 IU	4 (1.9)	6 (1.5)	10 (1.6)
Don't know	139 (66.5)	271 (70.0)	410 (68.7)
*How much time would the average fair skinned person need to spend outdoor in the summer between 10 AM and 3 PM to get enough Vitamin D?			
10 minutes	26 (12.4)	47 (12.1)	73 (12.2)
10-20 minutes	76 (36.3)	148 (38.2)	224 (37.5)
1 hr	48 (22.9)	79 (20.4)	127 (21.3)
At least 2.5 hrs	7 (3.3)	13 (3.3)	20 (3.3)
Don't know	52 (24.8)	100 (25.8)	152 (25.5)

The results were expressed as frequency and percentage (in brackets), *Data were not reported by 1 female and 2 males, IU: International units

Practice about Vitamin D knowledge and sun exposure in daily routine

Students were also asked about some practice questions which they follow in daily routines, such as a form of protection gears, usage of sunscreen, the time they spend outdoors per day in the sun. Notably, only 16.7% students did not use any forms of safeguards to protect themselves from the sun and 31.4% and 21.4% students used at least three or two forms of the protection gears in daily routine (Table 4). When this response was measured between sexes, a significant difference was observed between male and female students (28.4% vs. 10.3%, respectively; $p=0.000$).

It was observed that the majority of students (67.2%) applied sunscreen in both summer and winter seasons and frequency of the application of sunscreen was once a day (34%) followed by application only while in the sun (7.2%). Again, females were frequent users of sunscreen, applied sunscreen in both summer and winter seasons (47.2% females vs. 37% males; $p=0.000$). Approximately 56.5% of students ensured about the sun protection factor level while purchasing sunscreen products from the market.

Regarding the involvement in any outdoor activities such as morning walk, playing volleyball, or cricket, 63.6% students responded that they do not participate in any of these activities. Percentage of females who were not involved in any outdoor activity were higher as compared to males (74.2% and 44%, respectively; $p=0.000$).

Finally, when the students were asked how many hours per day they spend in the sun, 19.8% of students replied <0.5 hrs, 27.8% replied

between 0.5 and 1 hr, and 46.7% replied between 1 and 2 hrs. Only 4.6% students spent more than 2 hrs per day in the sun. The majority of the students (59.6%) covered themselves in such a way that only face and arms were exposed in the sun while they were outdoors in the sun. Percentage of females were higher who exposed less in the sun as compared to males (50.7% vs. 64.4%; $p=0.002$).

Factors, associated with awareness and knowledge of Vitamin D such as age, use of sunscreen, and hours per day outdoor have also been analyzed. No significant results were found except students who did not like going in the sun used more sunscreen in the sun.

DISCUSSION

We report the first Indian study to date to assess the knowledge, awareness, and attitude toward Vitamin D among college student of a leading private university of north India. Needless to say, Vitamin D is truly a remarkable, as in both forms (nutrient or hormone) it provides a wide variety of health benefits to human. The health benefits of Vitamin D are beyond bone health confirmed from the various studies. Recently, Vitamin D received enormous attention worldwide and referred as the drug of the decade as its deficiency has become pandemic [8].

In our study, almost all (99.5%) students were aware of Vitamin D and the majority (53.3%) of students knew that sunlight is the main source of Vitamin D. However, when students were asked about the synthesis of Vitamin D in the body from precursor, responses were equivalent among the students. Moreover, the majority of students (68.7%) did not know the required minimum daily intake of Vitamin D and time one

Table 3: Attitudes toward sunlight exposure

Questions	Total (n=599)	Male (n=211)	Female (n=388)	p value
Do you like going in the sun?				
Yes	214 (35.7)	102 (48.3)	112 (28.8)	p=0.00
No	385 (64.2)	109 (51.6)	276 (71.1)	
Exposure to sunlight is harmful for the skin				
True	298 (49.7)	101 (47.8)	197 (50.7)	p=0.49
False	301 (50.2)	110 (52.1)	191 (49.2)	
Do you often use a parasol (sunshade or umbrella) to shade from the sun?				
Yes	258 (43.0)	50 (23.7)	208 (53.6)	p=0.00
No	341 (56.9)	161 (76.3)	180 (46.3)	
Sunscreens are the most effective way of controlling skin tanning?				
Yes	309 (51.5)	112 (53.0)	197 (50.7)	p=0.58
No	290 (48.4)	99 (46.9)	191 (49.2)	
Non-vegetarians individuals have better serum vitamin D levels than vegetarians?				
True	265 (44.2)	97 (45.9)	168 (43.3)	p=0.52
False	334 (55.7)	114 (54.0)	220 (56.7)	
Do you think your Vitamin D status is sufficient?				
Yes	359 (59.9)	144 (68.2)	215 (55.4)	p=0.00
No	240 (40.0)	67 (31.7)	173 (44.5)	
If medical condition demands are you willing to undergo test for Vitamin D?				
Yes	538 (89.8)	187 (88.6)	351 (90.4)	p=0.47
No	61 (10.1)	24 (11.3)	37 (9.5)	
*What is your preferred form of consuming a supplement?				
Syrup	154 (25.7)	54 (25.5)	100 (25.7)	p=0.90
Drops	35 (5.8)	11 (5.2)	24 (6.1)	
Pills/tablets/granules	291 (48.5)	101 (47.8)	190 (48.9)	
Injection	26 (4.3)	10 (4.7)	16 (4.1)	
Taking Ca supplements helps in maintaining vitamin D levels in the body				
True	416 (69.4)	138 (65.4)	278 (71.6)	p=0.11
False	183 (30.5)	73 (34.6)	110 (28.3)	

The results were expressed as frequency and percentage (in brackets), *Data were not reported for those who gave multiple responses

needs to spend outdoors to get enough Vitamin D level. We obtained varied responses regarding factors that affect Vitamin D level of an individual. The present findings are consistent with a study conducted on private university students in Malaysia where students had good knowledge about the source of Vitamin D; however, a high proportion of participants had deficit knowledge about time and daily intake of Vitamin D [9]. Results from our study clearly reflect the partial or poor of knowledge about Vitamin D among young college students.

Despite having a considerable awareness regarding the main source of Vitamin D, negative attitudes toward sunlight exposure are observed among students. The majority of the students disliked being outdoors in the sun, and this pessimistic attitude was more common in female students. Therefore, female students were the greatest user of sun protection gears such as umbrella, sunshade, scarf, etc., in our study. Lack of uniformity between attitude for sunlight and knowledge of Vitamin D is further seen by the majority of students who used sunscreen in both summer and winter seasons. Again, female students were higher in the proportion who applied sunscreen at least once a day. We did not explore the reasons for this negative attitude, but we can assume that changes in lifestyle due to modernization and have a great fear of being dark (especially females) in the sun are the possible factors for decreasing sun exposure and considering sunscreen as a most effective way of reducing skin tanning among the female groups.

Our results are consistent with the survey regarding knowledge of Vitamin D and perceptions and attitudes toward sunlight among Chinese middle-aged and elderly women. In their study, 62.3% did not like going in the sun and many took measures to avoid sunlight, particularly among younger (middle-aged) women who had a good awareness of Vitamin D [10]. Similar results have also been reported in an urban population of Vietnam [11].

In the present study, we also observed that negative approach toward sunlight was associated with decreased participation in outdoor activities. Male students were more involved in outdoor activities such as playing volleyball and cricket under the sun. 47% of the surveyed students replied that they spend 1-2 hrs per day from 6.30 a.m. to 7.00 p.m. These hours were mostly utilized while covering a distance from home to college and roaming around in college premises during the study breaks. Furthermore, during these hours majority of students covered their body and exposed only face and arms in the sun. This finding of our study clearly reflects that young male and female students are most unlikely to have enough exposure to sunlight.

Interestingly, 60% of our surveyed students presumed their Vitamin D status sufficient without a getting a laboratory test in the past. However, Vitamin D deficiency has been reported in an even healthy population of Delhi [12]. Similarly, Arya *et al.* in 2004 reported a Vitamin D deficiency in school going children, doctors and paramedical staff, healthy post-menopausal women [13]. Our findings suggest that young students are not aware of their Vitamin D status and hence may be at risk of Vitamin D deficiency due to avoidance or reduced sunlight exposure.

Around 70% of students think taking calcium pills helps in maintaining Vitamin D though around 90% of students are not taking Vitamin D supplements or any multivitamin during this survey. Similar findings reported in a study from a teaching Hospital in Karachi, Pakistan where 98% of the respondents were aware of vitamin supplements, but Vitamin D supplementation has been yet ignored issue [14].

Strengths and limitations of the present study

Our study is the first Indian study investigated knowledge, awareness of Vitamin D, and attitude toward sunlight among young college

Table 4: Practice about Vitamin D knowledge and sun exposure in daily routine

Questions	Total (n=599)	Male (n=211)	Female (n=388)	p value
What do you use most often as protection from sun?				
Scarf/dupatta	40 (6.7)	4 (1.9)	36 (9.2)	p=0.00
Umbrella	19 (3.2)	5 (2.3)	14 (3.6)	
Sunscreens	85 (14.2)	38 (18.0)	47 (12.1)	
Cap/Hat	16 (2.7)	15 (7.1)	1 (0.2)	
Sunglasses	23 (3.8)	16 (7.5)	7 (1.8)	
At least 3 of the above	188 (31.4)	39 (18.4)	149 (38.4)	
Do not use any protection	100 (16.7)	60 (28.4)	40 (10.3)	
Use at least two	128 (21.4)	34 (16.1)	94 (24.2)	
In which season do you use sunscreens?				
Summer	258 (43.1)	78 (37.0)	180 (46.4)	p=0.00
Winter	3 (0.5)	0 (0.0)	3 (0.8)	
Both	141 (23.5)	27 (12.8)	114 (29.4)	
Don't use sunscreen	197 (32.9)	106 (50.2)	91 (23.5)	
How often do you use sunscreens?				
Once a day	204 (34.1)	34 (16.1)	170 (43.8)	p=0.00
Twice a day	39 (6.5)	5 (2.4)	34 (8.8)	
Every time after washing face	12 (2.0)	7 (3.3)	5 (1.3)	
Use only if playing in the sun	43 (7.2)	20 (9.5)	23 (5.9)	
Do not use it regularly	103 (17.2)	39 (18.5)	64 (16.5)	
Never used sunscreens	198 (33.1)	106 (50.2)	92 (23.7)	
Do you check the SPF level when purchasing sunscreens?				
Yes	337 (56.3)	79 (37.4)	258 (66.5)	p=0.00
No	65 (10.9)	26 (12.3)	39 (10.1)	
Do not use sunscreens	197 (32.9)	106 (50.2)	91 (23.5)	
Are you involved in any of the outdoors activity?				
Yes	218 (36.4)	118 (55.9)	100 (25.8)	p=0.00
No	381 (63.6)	93 (44.1)	288 (74.2)	
Which part of your body gets exposed while outdoors activity?				
Only face	18 (3.0)	6 (2.8)	12 (3.1)	p=0.002
only arms	8 (1.3)	1 (0.5)	7 (1.8)	
Both face and arms	357 (59.6)	107 (50.7)	250 (64.4)	
Face, arms, and half legs	216 (36.1)	97 (46.0)	119 (30.7)	
Are you currently taking any multivitamin supplements? If yes specify				
Yes	60 (10.0)	18 (8.5)	42 (10.8)	
No	539 (89.9)	193 (91.4)	346 (89.1)	

The results were expressed as frequency and percentage (in brackets), SPF: Sun protection factor

students. We have surveyed large numbers of students, however, due to ease of accessibility samples were derived from those who were from science discipline only. Therefore, our findings may not be generalized to other students from non-science discipline. Moreover, we got less sample size in the older age group of students, and the percentage of girls was high because of less number of male students present in a science course in the university. Knowledge and awareness play a potential role in reducing the burden of any diseases. Despite these limitations, our data provides a foundation for building strategies for the prevention of Vitamin D deficiency in the young generation.

CONCLUSION

A finding of this survey shows the general trends regarding knowledge of Vitamin D and attitude toward sunlight in young college students. Lack of consistency between knowledge, and attitude and negative approach toward sunlight exposure, especially in girls was observed in this study, which may severely affect the Vitamin D status of young college going students. Implementing awareness campaigns and future health programs like a workshop or training at the college level may help in building more awareness and knowledge about the Vitamin D importance. Potential interventions should be adopted from the government in terms of wide publicity of Vitamin D as a next step to ensure this young segment of the population is acquiring adequate Vitamin D for optimal bone health.

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