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RESEARCH ARTICLE **OPEN ACCESS**

Knowledge, Awareness and Behaviour Regarding Vitamin D Levels Among Dental Students in South India: A Cross-sectional Survey

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Abstract:

Introduction: Vitamin D plays a crucial role in supporting various physiological activities, thus contributing to overall health and well-being. This study aimed to evaluate the knowledge, awareness, and behaviour regarding vitamin D levels among dental students in South India.

Methods: A multicentric online survey was conducted among dental students from various dental colleges in South India. Prior informed consent was obtained from all the students. A self-administered questionnaire in English was designed to collect information on demographic characteristics, lifestyle characteristics, knowledge, and awareness of vitamin D levels, as well as vitamin D supplement use.

Results: The final sample consisted of 516 dental students, of whom the majority were female [n=384; 74.4%], and the mean age was 22 years [SD: 1.67]. Most dental students were unaware of their current vitamin D levels [92.4%]. Only 39 dental students reported their current vitamin D levels. Only six of the 39 dental students had vitamin D levels above 30ng/ml. There was no significant difference in the knowledge of current vitamin D levels for sex [p=0.129] and academic year of study among dental students [p=0.197]. There was no significant difference in the distribution of vitamin D status among dental students, regardless of variables such as sex [p=0.24], academic year [p=0.76], application of sunscreen [p=0.129], and clothing or use of an umbrella to avoid sun exposure [p>0.99].

Discussion: This study highlighted poor knowledge of vitamin D levels among dental students, irrespective of sex and academic year of study, which may be attributed to a general lack of awareness regarding the role of vitamin D in maintaining physiological functions, as well as insufficient emphasis on periodic vitamin D screening.

Conclusion: This study revealed a lack of awareness of vitamin D status among dental students. Among those who had checked their vitamin D levels, a high prevalence of deficiency was observed.

Keywords: Vitamin D, Prevalence, Deficiency, Dental, Students, Lifestyle, Vitamin D supplements, Physiological functions, Lack of awareness.

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1. INTRODUCTION

Vitamin D plays a crucial role in supporting various physiological activities, thus contributing to overall health and well-being [1]. Optimal vitamin D levels can be maintained through adequate sunlight exposure, a vitamin D-rich diet, or supplementation. Deficiency of vitamin D is linked to osteoporosis, osteomalacia, muscular weakness, metabolic diseases, respiratory disorders, and an increased risk of fractures in adults. It has an important role in the prevention and control of cancer, hypertension, diabetes mellitus, multiple sclerosis, and autoimmune diseases [2, 3].

Few studies on vitamin D deficiency focused on healthcare workers and nurses [4-11] while the literature on dentists or dental students remains limited [12]. Dogruel *et al*. reported that only 4% of dental staff had normal or acceptable vitamin D levels [12]. Similarly, Alavi *et al*. and Rajebi *et al*. reported that only 9.5% and 6.1% of nurses, respectively, had normal levels [6, 11]. More than half of medical residents were vitamin D deficient (<20 ng/ml) [4, 8]. Mahdy *et al*. [10], Varkal *et al*. [5], and Nandyala *et al*. [7] reported prevalence rates of 87%, 88.5%, and 92%, respectively, among healthcare professionals. A recent systematic review identified shift workers, healthcare workers, and indoor workers as high-risk groups for vitamin D deficiency [3]. It was particularly prevalent among bakers and night workers [13], women with indoor occupations [14], and shift and office workers [15]. The research gap identified through the literature search was the lack of prevalence estimates of vitamin D deficiency among dental students.

Given this context, evaluating the vitamin D levels of dental students is crucial to understand the prevalence and predictors of vitamin D deficiency. Hence, this study aimed to assess the knowledge, awareness, and behaviour regarding vitamin D levels among dental students in South India.

2. MATERIALS AND METHODS

A multicentric online cross-sectional survey was conducted among dental students from various dental colleges in South India from March 2024 to January 2025. The protocol was approved by the Institutional Review Committee on ethical issues of Sri Sai College of Dental Surgery, Vikarabad. (Ref no: 01/SSCDS/IRB/2024). Dental students were invited to participate through WhatsApp-based study groups. Prior informed consent was obtained from all the students. No incentives were given for participation.

2.1. Inclusion Criteria

- Dental students who have completed at least 1 year of dental curriculum
- Aged above 18 years
- Willingness to participate

2.2. Exclusion Criteria

- Responses that were 30% incomplete were excluded.

2.3. Sample Size Estimation

A total of 348 dental students were required based on the prevalence of 36% [12] and a precision of 5%. To account for clustering, a design effect of 1.5 was applied, resulting in a final sample size of 522.

2.4. Designing the Questionnaire

A group of dental professionals and general practitioners (n=6) were involved in designing the questionnaire using the Delphi technique. An initial pool of 26 questions was developed and circulated among the Delphi panel with a 2-week time interval to respond as relevant or not relevant for each question. After reviewing the responses, the questions deemed relevant by most panelists were used to create a questionnaire, which was then recirculated among them. The panelists reviewed the questionnaire for clarity and comprehension with minor changes. After achieving a consensus, a structured self-administered questionnaire in the English language was designed to collect information. The questionnaire consisted of three sections: demographic and lifestyle characteristics, knowledge, and awareness of vitamin D levels and supplementation. The questionnaire was pilot tested among five dental students not included in the main study. All the students responded and were able to understand the questionnaire.

Demographic characteristics included age, sex, and current academic year, followed by lifestyle characteristics such as type of diet, duration, and time exposure to direct sunlight on a working day, use of a cloth barrier, or scarf, or umbrella (yes/no), use of sunscreen (yes/no). Also, multiple questions were designed to assess the knowledge of the individual vitamin D levels. They were “Have you ever been asked to check your vitamin D levels?” (yes/no), and “Have you ever checked your vitamin D levels?” (yes/no). “If yes, do you know your current vitamin D levels? (yes/no)”, “When was the last assessment of vitamin D levels?”, “What were

the current vitamin D levels?" and "knowledge of acceptable levels of vitamin D (yes/no)". Additionally, information on the awareness related to vitamin D supplements (yes/no), type of vitamin D supplements (Daily tablets / weekly tablets / Injections/multivitamin supplements / fortified milk/health drinks/ others), and "Have you been prescribed vitamin D supplements based on your levels? (yes/no)" were also assessed (Appendix **1**). The questionnaire was designed using Microsoft Forms and was circulated to dental students from various dental colleges in South India. Students were encouraged to share the questionnaire with their peers.

2.5. Statistical Analysis

Analysis was conducted using SPSS version 25 (SPSS Inc., Ill, USA). A *p*-value of <0.05 was considered statistically significant. Vitamin D levels were categorized as normal (≥ 30ng/ml), vitamin D insufficiency (21-29ng/ml), and vitamin D deficiency (≤20 ng/ml) as per the Endocrine Society Clinical Practice Guidelines [11]. The academic year of study was categorised as preclinical (students learning basic sciences and preclinical dental exercises on dummy models and casts) and clinical (clinical rotations, with basic instructions and hands-on experience on patients). The Chi-Square test was used to establish the relationship between dental students' knowledge of current vitamin D levels and their sex and academic year of study. However, the analysis to establish the relationship between self-reported vitamin D levels and demographic and lifestyle characteristics among dental students did not warrant the use of the Chi-square test as the expected frequency in each cell for the contingency table was less than 5 due to the small sample size. Hence, Fisher's exact test was performed.

3. RESULTS

A total of 528 dental students responded to the questionnaire, of which 12 students declined to participate. The final sample consisted of 516 dental students. The mean age of the students was 22 years (SD: 1.67). A mixed diet was the predominant dietary practice (79.5%). Most dental students reported that morning (26.9%), followed by the afternoon (25.2%), was the time for exposure to direct sunlight. Only 1/4th of the students (25.2%) reported that they covered entirely or used an umbrella when exposed to direct sunlight (Table **1**). Most of the students reported more than 5-30 mins of sun exposure on working days (97.7%).

Less than a quarter of the dental students had previously checked their vitamin D levels (Table **2**). The majority of dental students (92.4%) were unaware of their current vitamin D levels (Fig. **1**). Less than 1/5th (18%) of the dental students reported vitamin D supplementation through some forms (Fig. **2**). A total of 44 dental students responded to the question "When was the last assessment of vitamin D levels?" of which only 39 dental students reported their current vitamin D levels. Among these dental students, the mean self-reported vitamin D levels were 16±10.25 (Range: 4-40). Only six of the 39 dental students had vitamin D levels above 30ng/ml, 28 had vitamin D deficiency (<20 ng/ml), and five students had vitamin D insufficiency (21-29ng/ml).

Table 1. Demographic and lifestyle characteristics of the study participants.

Demographic and Lifestyle Characteristics	Category	N	%
Sex	Male	132	25.6%
	Female	384	74.4%
Current academic year	Preclinical	276	53.5%
	Clinical	240	46.5%
Diet	Lactovegetarian	5	1%
	Mixed diet	410	79.5%
	Others	4	0.8%
	Ovolactovegetarian	6	1.2%
	Vegetarian	91	17.6%
What time of day are you generally exposed to direct sunlight?	Early morning	57	11%
	Early morning and afternoon	8	1.6%
	Early morning and evening	11	2.1%
	Morning	139	26.9%
	Morning and afternoon	35	6.8%
	Morning and evening	33	6.4%
	Afternoon	130	25.2%
	Afternoon and evening	2	0.4%
	Evening	62	12%
	Nil	8	1.6%
	No specific pattern	31	6%
Do you cover yourself entirely or use an umbrella during exposure to direct sunlight?	No	386	74.8%
	Yes	130	25.2%
Do you apply sunscreen?	No	163	31.6%
	Yes	353	68.4%

Table 2. Distribution of knowledge of vitamin D levels among dental students.

Knowledge of Vitamin D Levels among Dental Students	Response	N	%
Have you ever been asked to check your vitamin D levels?	No	384	74.4%
	Yes	132	25.6%
Have you ever checked your vitamin D levels?	No	393	76.2%
	Yes	123	23.8%
Do you know the acceptable levels of vitamin D?	No	287	55.6%
	Yes	229	44.4%
Have you been prescribed vitamin D supplements based on your levels?	No	412	79.8%
	Yes	104	20.2%

The knowledge of current vitamin D levels did not significantly differ by sex (p=0.129) and academic year of study (p=0.197) among dental students (Table **3**). Also, the distribution of vitamin D status among dental students did not significantly differ with sex (p=0.24), academic year (p=0.76), application of sunscreen (p=0.129), and clothing or use of an umbrella to avoid sun exposure (p>0.99) (Table **4**).

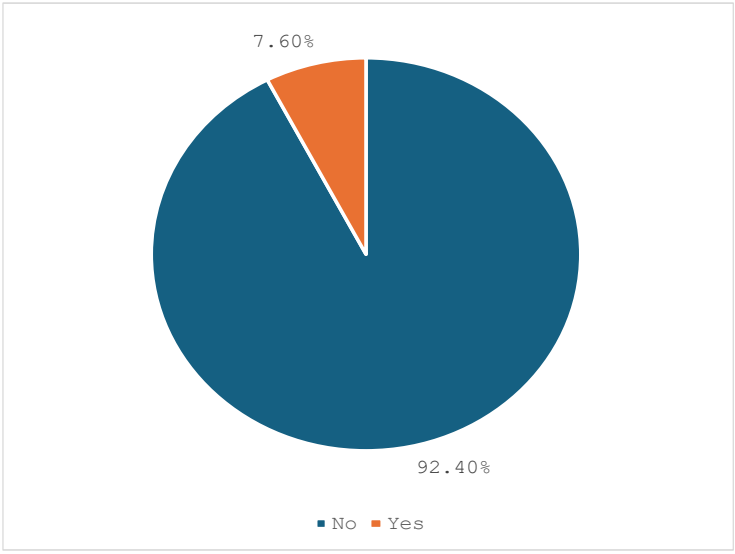

Fig. (1). Knowledge of current vitamin D levels among dental students.

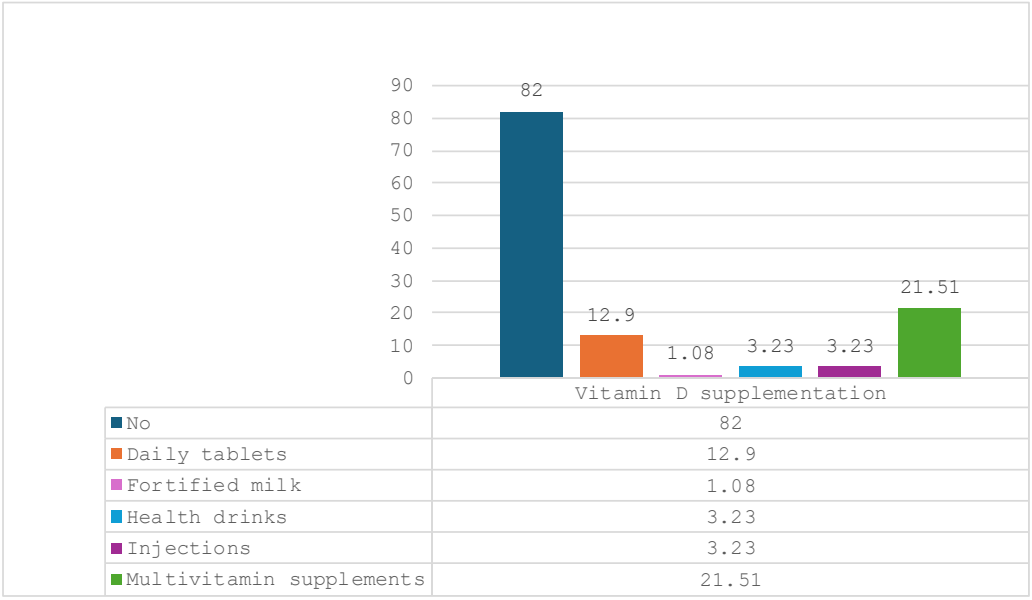

Fig. (2). Distribution of vitamin D supplementation among dental students.

Table 3. Relationship of dental students' knowledge of current vitamin D levels with sex and academic year of study.

Variable	Category	Do you know your Current Vitamin D Levels				*p*-value
		No		Yes		
		N	%	N	%	
Sex	Male	126	26.4%	6	15.4%	0.129
	Female	351	73.6%	33	84.6%	
Academic year	Preclinical	259	54.3%	17	43.6%	0.197
	Clinical	218	45.7%	22	56.4%	

Note: Chi-Square test.

Table 4. Relationship of self-reported vitamin D levels with demographic and lifestyle characteristics among dental students.

Demographic and lifEstyle Characteristics	Category	Self-reported Vitamin D Levels						*p*-value
		Deficient (<20 ng/ml)		Insufficiency (21-29 ng/ml)		Normal (≥30 ng/ml)		
		N	%	N	%	N	%	
Sex	Male	3	10.7%	0	0%	2	33.3%	0.24
	Female	25	89.3%	4	100%	4	66.7%	
Academic year	Preclinical	12	42.9%	1	25%	3	50%	0.76
	Clinical	16	57.1%	3	75%	3	50%	
Use of clothing or an umbrella for sun protection	No	17	60.7%	4	100%	2	33.3%	0.129
	Yes	11	39.3%	0	0%	4	66.7%	
Do you apply sunscreen?	No	4	14.3%	0	0%	0	0%	>0.99
	Yes	24	85.7%	4	100%	6	100%	

Note: Fishers exact test.

4. DISCUSSION

It must be understood that optimum sun exposure without a barrier is a preliminary requisite for optimum vitamin D levels. Optimal vitamin D levels may not be attainable through diet alone without sufficient supplementation. The dentistry curriculum in India is a vigorous program with limited time for leisure and outdoor physical activities. Conditions associated with fewer outdoor activities may impact vitamin D levels [3]. These include modern-day infrastructure like air-conditioned facilities, tinted windows, increased preferences for indoor activities, and lifestyle preferences (clothing, helmet, and sunscreen). Coupled with the above factors and a stringent dental academic curriculum, dental students and professionals are rarely exposed to sunlight, making them prone to vitamin D deficiency. Hence, this study aimed to evaluate the self-reported vitamin D levels, demographics and lifestyle characteristics, knowledge, and awareness about various aspects of vitamin D among dental students of South India.

This study highlighted limited knowledge of vitamin D levels among dental students, irrespective of sex and academic year of study. This may be attributed to a general lack of awareness regarding the role of vitamin D in maintaining physiological functions, as well as insufficient emphasis on periodic vitamin D screening. Most students had never been asked or had never checked their vitamin D levels, and were unaware of their current vitamin D levels. Additionally, among those who were aware of their vitamin D levels, the majority were found to be deficient.

Previous studies have shown a high prevalence of vitamin D deficiency among healthcare workers and nurses [5-10], with only one study reporting findings among dental staff [12]. Hence, a direct comparison of our findings was not feasible, but were consistent with previous studies on healthcare workers and nurses. Based on the findings of the sun exposure, it was seen that most of the students reported more than 5-30 mins of sun exposure on working days. However, factors such as season, time, and length of day, cloud cover, umbrellas, clothing, sunscreen use, pollution, and darker skin tone can affect vitamin D synthesis [16]. As the dentistry curriculum is demanding, with little or no scope for outdoor activities, air-conditioned clinics and classrooms, and tinted windows, it can be concluded that this cohort falls under the high-risk category.

Some limitations include the cross-sectional design of the study, convenience sampling, and the reliance on self-reported vitamin D levels, which may lead to recall bias and social desirability bias, leading to under- or over-estimation of vitamin D deficiency and lifestyle-related variables. Nevertheless, this study was the first to evaluate the vitamin D status among dental students. The strengths of this study include the inclusion of a large sample size, the inclusion of students from various dental colleges, and the use of the Delphi technique to construct the questionnaire. The Endocrine Society Clinical Practice Guidelines recommend screening for vitamin D for high-risk individuals [11]. As dental students predominantly spend time indoors due to the nature of their training, certain recommendations like periodic screening of vitamin D levels and encouraging outdoor activities need to be implemented as primary prevention for vitamin D deficiency among this cohort. Periodic health education and awareness campaigns on the need for vitamin D supplementation and vitamin D-rich diets have to be implemented in all dental colleges. The feasibility of incorporating structured outdoor breaks into the dental curriculum should be explored and implemented, considering the prevailing social, cultural, and religious contexts. Regulatory bodies (Dental Council of India) should mandate periodic evaluations of vitamin D levels for dental students to prevent deficiency and promote their long-term health and well-being and quality education, aligning with the Sustainable Development Goals. Although substantial information exists in the dentistry curriculum regarding the role of vitamin D and its functions, there is scope to integrate education about vitamin D and its importance to dental personnel. Additionally, institutional policies should be developed to promote vitamin D awareness and evaluate the effectiveness of periodic screening, monitoring, and vitamin D supplementation. Future studies should aim to validate this self-reported questionnaire through serum vitamin D assessment.

CONCLUSION

This study highlights the widespread lack of awareness about vitamin D levels among dental students. A high prevalence of self-reported vitamin D deficiency was observed among the students who were aware of their vitamin D

levels. Given the potential risks associated with vitamin D deficiency, dental education programs should incorporate preventive strategies, including regular screening, dietary guidance, and structured outdoor activities.

AUTHORS' CONTRIBUTIONS

The authors confirm their conributions to the paper as follows: A.T., K.P., V.K., N.C., M.P., V.S.: Study concept or design; N.K.: D.V.: Conceptualization. All authors have read and agreed to the published version of the manuscript.

ABBREVIATION

SD = Standard Deviation

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The protocol was approved by the Institutional Review Committee on ethical issues of Sri Sai College of Dental Surgery, Vikarabad, India (Ref no: 01/SSCDS/IRB/2024).

HUMAN AND ANIMAL RIGHTS

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants in this study.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data and supportive information are available within the article.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

Declared none.

Appendix 1: Questionnaire used in the Study

Title: Self-reported Prevalence of Vitamin D Deficiency among Dental Students

Background: Vitamin D deficiency is a silent pandemic due to reasons like insufficient exposure to sunlight. It is common among all population types. The deficiency of Vitamin D can have symptoms like fatigue, lack of sleep, bone pain, depression, hair loss, muscle weakness, loss of appetite, getting sick more easily, pale skin, *etc*. Dental students spend a substantial amount of time indoors during the day due to their academic curriculum. This research aimed to evaluate the prevalence of self-reported vitamin D deficiency among dental students of South India. There are 20 questions. The time required to answer these questions is approximately 5 minutes. Entering a research study is voluntary. You may decline participation without giving any reason. Your participation in this research will not bestow upon you any competitive academic/ occupational/ social/ legal advantage over others who do not volunteer, and we will not impose any academic/ occupational/social/legal penalty on those who do not volunteer. If you have any questions about this form or any study-related issue, you may contact the Principal Investigator.

Consent

I understand that my participation in this questionnaire-based study is voluntary, and I can decline participation without giving any reason. I have been given sufficient time to review the information and have sought the required clarification. I understand that I am allowed to take a screenshot of the form for my reference. By clicking on the "I Agree" button, I consent to be a part of the study.

Demographics and lifestyle characteristics:

1. What is your age?

2. What is your gender? Male/female/ transgender

3. What is your current academic year of study? Preclinical / Clinical

4. What type of diet do you prefer? Vegetarian / Lactovegetarian / Mixed / Ovolactovegetarian/others

5. During working days, how much time in minutes are you exposed to direct sunlight?

6. What time of day are you generally exposed to direct sunlight?

7. Do you cover yourself entirely or use an umbrella during exposure to direct sunlight? Yes / No

8. Do you apply sunscreen? Yes / No

9. What is your height?

10. What is your weight?

Knowledge

1. Have you ever been asked to check your vitamin D levels? Yes / No

2. Have you ever checked your vitamin D levels? Yes / No

3. If yes,

a. Do you know your current vitamin D levels? Yes / No

b. When was the last time it was checked?

c. How much was your current vitamin D level?

4. Do you know acceptable levels of vitamin D? Yes / No

Awareness

1. Did you take any vitamin D supplements or any supplements that may have Vitamin D? Yes / No

2. If yes, what was the type of supplements? Daily tablet / Multivitamin injection / /multivitamin supplements / fortified milk/health drinks/others_____

3. How much was the Vitamin D level before taking supplements?

4. Have you been prescribed vitamin D supplements based on your levels? Yes / No

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