Frontiers in Health Informatics ISSN-Online:2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 3
Open Access

"Understanding Vitamin D Awareness and Deficiency in the Youth of South India: A Cross-Sectional Study"

[1] Anin G S Queency Stylin, [2] Dr.B.Shanthi, [3] Dr.Vinod Narayan, [4] Subhashree.M.V , [5] A.Kavitha, [6] Dr Lahal Mohammed Abdulla, [7] Aadhi C Sekhar, [8] Ms.P.Sandhya, [9] Dr.K Sumathi

1) Tutor, Department of Biochemistry, Sree Balaji Medical College and Hospital, BIHER, Chrompet, Chennai, Tamilnadu, India ORCHID ID :0000-0002-1264-2014

2) Professor & HOD, Department of Biochemistry, Sree Balaji Medical Collegeand Hospital, BIHER, Chrompet,Chennai, Tamilnadu,India. ORCHID ID :0000-0002-7435-5985

3) Assistant Professor of Biochemistry, Sri Ramachandra Faculty of Allied Sciences, SRIHER, Porur, Chennai, Tamilnadu, India
ORCHID ID: 0000-0002-5650-0878

4) Tutor, Department of Physiology, Saveetha Medical College and Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai, India.
ORCID: 0009-0008-8458-5531

5) Assistant Professor, Department of Physiology, Karpaga Vinayaga Institute of Medical Sciences (KIMS), Affiliated to the Tamil Nadu Dr.MGR Medical University, Chengalpattu, Tamil Nadu. India
ORCID ID: 0009-0002-6408-5667.

6) ICU Resident, Highland hospital and diagnostic Center, Mangalore, Karnataka, India.

7) Medical student, SRIHER, Chennai, Tamilnadu, India.

8) Tutor, Department of Biochemistry, Sree Balaji Medical college & Hospital, BIHER, Chennai, Tamil Nadu.ORCID ID: 0000-0002-1838-9128.

9) Professor Department of Biochemistry, Sree Balaji Medical Collegeand Hospital, BIHER, Chrompet, Chennai,Tamilnadu,India. ORCHID ID :0000-0002-0076-7776

Corresponding author

Anin G S Queency Stylin, Tutor, Department of Biochemistry, Sree Balaji Medical College and Hospital,

BIHER, Chrompet, Chennai, Tamilnadu, India **E-mail:** stylinvijo@gmail.com

Orchid ID :0000-0002-1264-2014

Cite this paper as: Anin G S Queency Stylin, Dr.B.Shanthi,Vinod Narayan,Subhashree.M.V , A.Kavitha, Lahal Mohammed Abdulla,Aadhi C Sekhar,Ms.P.Sandhya,K Sumathi (2024) "Understanding Vitamin D Awareness and Deficiency in the Youth of South India: A Cross-Sectional Study". *Frontiers in Health Informatics, 13* (3), 8952-8962

Abstract:

Vitamin D deficiency is a widespread global issue, significantly affecting 70%–100% of the Indian population. This study aimed to evaluate Vitamin D awareness and deficiency among South Indian youth through a cross-sectional survey conducted at Dr.MGR Educational and Research Institute. A total of 619 participants, including 208 males and 411 females, were surveyed. Most respondents (95%) were from Tamil Nadu, with others from Andhra Pradesh and nearby regions. Educational levels showed 78.4% had completed schooling, 19.5% were undergraduates, and 1.1% were postgraduates. Students dominated the sample, accounting for 98.2%. The survey revealed varying awareness of Vitamin D benefits, with 26.5% linking it to bone and teeth health, and 33.1% recognizing all its benefits. While most participants identified the sun, a healthy diet, and other sources as key, 41.6% believed diet alone was sufficient to maintain Vitamin D levels. Sun exposure varied, with 35.9% having received a suntan in the past six months, and 28.1% exposed for more than 30 minutes daily. Clothing preferences, such as wearing kurtas (42%), influenced sun exposure. Sunlight was the primary source for 72.9%, but no

significant correlation with vitamin D levels was found (chi-square = 32.92, p = 0.239). However, 81.9% identified sunlight as the "best" source, showing a significant association with higher levels (chi-square = 18.96, p = 0.015). Dietary sufficiency beliefs correlated with lower levels among the uncertain (chi-square = 23.26, p = 0.026). Awareness of health benefits (p = 0.332), recommendations (p = 0.715), and risk factors (p = 0.413) showed no significant relationships.The findings highlight the need for greater awareness and lifestyle adjustments to improve Vitamin D levels.

To conclude, this study highlights that South Indian youth, primarily students, understand the sun as the main source of vitamin D but lack consistent sun protection and awareness of dietary sufficiency. While beliefs about the sun's benefits correlate with vitamin D levels, awareness of risks and benefits does not strongly relate to actual deficiency. These findings suggest a need for targeted, evidence-based education on safe sun exposure and vitamin D-rich diets. Future research should focus on evaluating the impact of education, supplementation, and lifestyle changes on improving vitamin D status.

Introduction

Vitamin D deficiency is a widespread global issue, affecting both men and women at alarmingly high rates, as indicated by previous research. Vitamin D plays a vital role in maintaining overall health, influencing various immunological functions and metabolic processes in the body Studies have shown that adequate levels of vitamin D can reduce the risk of several medical conditions, including depression, type 1 diabetes, metabolic syndrome, and chronic widespread muscle and bone pain. This highlights its critical role in promoting well-being and preventing disease (1,2).

Vitamin D deficiency is highly prevalent across the Indian subcontinent, affecting 70%–100% of the general population, reaching epidemic levels (3). Vitamin D is crucial for maintaining calcium and phosphorus balance and supporting bone metabolism, as widely acknowledged in research. Its receptors are found in various cell types, indicating broader physiological roles. In children, vitamin D deficiency is linked to nutritional rickets, stunted growth, developmental delays, lethargy, and hypocalcemic seizures. A significant lack of knowledge and awareness about vitamin D deficiency and its sources is a notable risk factor, as highlighted in studies from countries like Hong Kong, Saudi Arabia, the USA, and India (4 -7).

Plasma 25-hydroxyvitamin D (25-OH-D) deficiency, defined as levels below 25 nmol/L, is a significant health issue. Vitamin D, crucial for maintaining bone health and overall well-being, is mainly synthesized in the skin through exposure to ultraviolet B (UVB) rays from sunlight (8). However, dietary sources also contribute, although very few foods naturally contain vitamin D. In the UK, the practice of fortifying foods with vitamin D is uncommon.

The UK National Diet and Nutrition Survey (NDNS) conducted between 2008 and 2012 revealed widespread inadequacies in vitamin D intake. This was attributed to both low dietary consumption and insufficient sunlight exposure. In response, the Scientific Advisory Committee on Nutrition (SACN) issued updated guidelines recommending a daily vitamin D supplement of 10 µg (400 International Units, IU) for everyone over the age of five, particularly during the months from October to April when sunlight exposure is minimal (9).

Despite these recommendations, dietary vitamin D intake among UK adults remains low. The average intake for adults aged 19–65 years is 2.8 µg/day (112 IU), while older adults aged over 65 years consume slightly more, at 3.3 µg/day (132 IU). Alarmingly, about 23% of adults and 21% of older adults have 25-OH-D levels below the deficiency threshold.

Supplementation has limited impact on improving overall vitamin D intake. For adults aged 19–64 years, supplement use only raised the mean intake from 2.8 µg/day (112 IU) to 3.6 µg/day (180 IU). In older adults, supplementation increased intake from 3.3 µg/day (132 IU) to 5.3 µg/day (212 IU). These modest increases are attributed to low compliance and the fact that only a minority of individuals consistently take supplements (9-11)

Additionally, there is ongoing debate among experts regarding the definitions of sufficient, insufficient, and deficient vitamin D levels, as well as the appropriate daily intake recommendations. Different health organizations set varying thresholds for optimal vitamin D levels, reflecting discrepancies in research findings and population-specific needs. For instance, SACN sets the deficiency threshold at 25 nmol/L, while other organizations, like the Institute of Medicine, suggest higher levels for sufficiency. These variations complicate efforts to establish universal guidelines and highlight the need for tailored strategies to address vitamin D deficiencies effectively.

This study evaluates the extent of awareness and understanding of vitamin D among participants.

Method

This cross-sectional study was conducted among students, outdoor workers, indoor office workers, and others within the campus of Faculty of Allied Health Sciences, Dr. MGR Education and Research Institute, Poonamallee, Chennai. Informed consent was obtained from all participants.

The questionnaire used in the study comprised three sections:

Participant Information:

This section gathered basic demographic details, including name, age, sex, marital status, lactation status, place of residence, education level, and profession.

Lifestyle and Skin Exposure:

This section included questions about skin type, frequency of sunscreen use, exposure to sunlight, and typical clothing styles.

Vitamin D Awareness and Practices:

This part assessed participants' knowledge and habits related to vitamin D, including sunlight exposure, use of vitamin D supplements, knowledge of the best sources of vitamin D, awareness of dietary sources, benefits of vitamin D, familiarity with vitamin D recommendations, awareness of populations at risk of deficiency, and reasons for not taking vitamin D supplements.

The study collected comprehensive information on these aspects to evaluate awareness and behaviors related to vitamin D among the participants.

Human Ethics:

The study received approval from the Institutional Ethics Committee of Dr. MGR Educational and Research Institute.

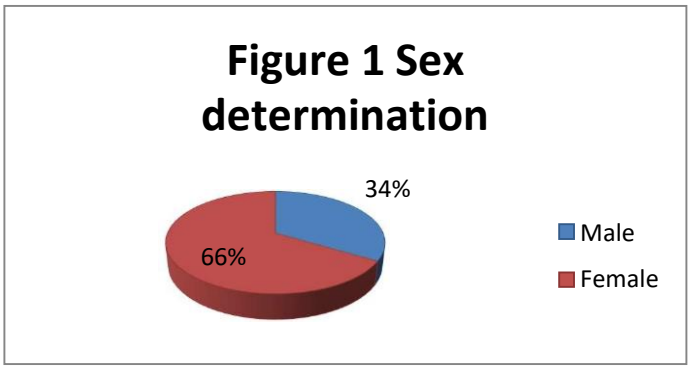
Statistical Analysis:

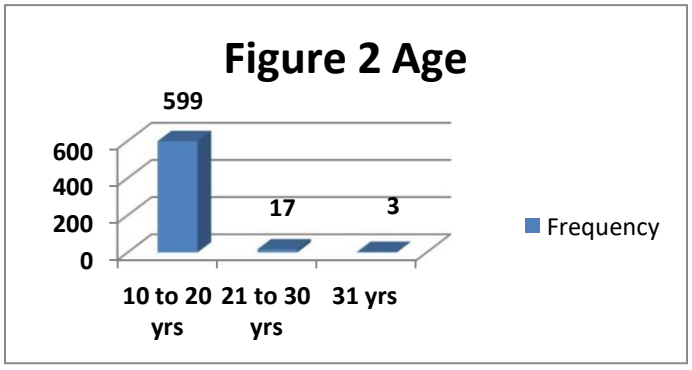
Statistical analyses for the study were conducted using SPSS Statistics version 26 to guarantee accurate data interpretation and dependable results.

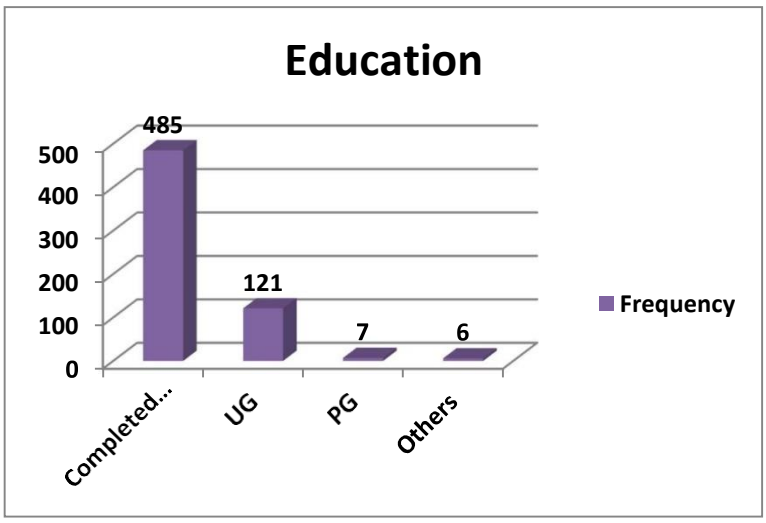
Result:

This cross-sectional study examines Vitamin D awareness and deficiency among South Indian youth, focusing on demographics, education, and lifestyle factors. The table categorizes 619 individuals based on age, gender, state, education, and profession. The majority (96.8%) are aged 10–20 years, with a smaller proportion in older age groups. Females (66.4%) outnumber males (33.6%). Most participants (95%) are from Tamil Nadu, while other states have minimal representation. Regarding education, 78.4% completed schooling, and 19.5% pursued undergraduate studies, with fewer in postgraduate or other categories. Professionally, 98.2% are students, while a minority work outside (0.3%), in office environments (1%), or other fields (0.5%). These statistics highlight a predominantly young, educated, and student-centric demographic from Tamil Nadu. (Table1, Figure1, 2 & 3)

Table 1: Socio-demographic profile of the study subjects		
Variable (Classification of Variable)	**Number (Out of 619)**	**Percentage (%)**
Age		
10 – 20 years	599	96.8
21 – 30 years	17	2.7
31 above	3	0.5
Gender		
Male	208	33.6
Female	411	66.4
State		
Andaman and Nicobar	8	1.3
AP	17	2.7
Kerala	4	0.6
TN	588	95.0
Telungana	2	0.3
Education Status		
Completed Schooling	485	78.4
UG	121	19.5
PG	7	1.1
Others	6	1.0
Profession		
Student	608	98.2
Outside worker	2	0.3
Working inside office Atmosphere	6	1.0
Others	3	0.5







The dataset provides valuable insights into sun exposure and sunscreen usage among 619 individuals, emphasizing variables such as skin type, frequency of sunscreen use, sunscreen application sites, clothing habits, suntan experiences, and sun exposure duration. Skin types are categorized into six groups, with the largest being "white to moderate brown" (35.2%) and "moderate brown" (31.5%), followed by lighter skin types like "light/pale white" (9.7%) and "white/fair" (13.2%). Darker skin types, such as "brown/dark brown" (8.6%) and "very dark brown to black/black" (1.8%), are less represented, indicating a diverse population with varying natural UV protection levels due to differing melanin amounts.

The frequency of sunscreen use raises concerns, as 61.4% of participants reported never using sunscreen, which increases the risk of skin damage and potential skin cancers. Only 11.3% use sunscreen daily, which is ideal for consistent protection, while 22.0% use it rarely, and 5.3% only for planned exposure. These statistics suggest a lack of consistency in sunscreen application, which is vital for long-term skin health. When applying sunscreen, 19.4% of participants apply it to their face, including ears, the most common area for protection. However, only 5.7% apply it to their hands and 0.6% to their legs, while 64.9% do not use sunscreen at all, showing a significant gap in proper sun protection practices.

Regarding clothing, 42% of individuals wear kurthas and 30.2% wear full pants and shirts, providing adequate coverage. However, only 8.1% wear short tops and 6.5% wear short pants, which leave more skin exposed. This reflects cultural preferences and practical considerations in sun protection. Additionally, 35.9% of individuals have received a suntan in the past six months, indicating prolonged sun exposure, while 64.1% have avoided it, possibly due to better sun protection or lower exposure. Sun exposure durations vary, with 37% getting around 10 minutes of daily sun, while 28.1% get more than 30 minutes, heightening the risk of skin damage. The data highlights a

need for increased awareness on sunscreen use and better sun protection education, particularly for individuals with darker skin, who may mistakenly believe they are less susceptible to UV damage (Table 2 & 3)

Table 2: Skintype & Usage of Sunscreen

Variable (Classification of Variable)	Number (Out of 619)	Percentage (%)
SKIN TYPE		
light/pale white	60	9.7
white/fair	82	13.2
white to moderate brown	218	35.2
moderate brown	195	31.5
brown/dark brown	53	8.6
very dark brown to black/black	11	1.8
FREQUENCY OF SUNSCREEN USE		
Daily	70	11.3
Rarely	136	22.0
Only for Planned Exposure	33	5.3
Never	380	61.4
WHERE DO YOU APPLY SUNSCREEN	120	19.4
Face(Including Ears)	7	1.1
Back shoulders	35	5.7
Hands	4	0.6
Legs	51	8.1
All the above	402	64.9
No I don' use sunscreen		
WHAT KIND OF DRESS YOU WEAR		
Saree	4	0.6
Full pant & shirt	187	30.2
Kurthas	260	42.0
Short tops	50	8.1
Shot pants	40	6.5
Other.	78	12.6
HAVE YOU RECEIVED SUNTAN IN THE PAST 6 MONTHS		
Yes	222	35.9
No	397	64.1
APPROXIMATELY HOW MUCH SUN EXPOSURE YOU GET FOR A DAY.	229	37.0
10 Minutes per day	138	22.3
10-20 Minutes per day	78	12.6
20-30 Minutes per day	174	28.1
More than 30 minutes		

Table 3: Frequency of Sunscreen Usage

Skintype * Sunscreen use	Daily	Never	Only for Planned Exposure	Rarely	Total
brown/dark brown	6	32	3	12	53
light/pale white	8	39	0	13	60
light/pale white	17	132	10	36	195
very dark brown to black/black	3	5	0	3	11
white to moderate brown	25	128	17	48	218
white/fair	11	44	3	24	82
Total	**70**	**380**	**33**	**136**	**619**

The dataset explores various factors related to vitamin D sources, awareness, and deficiency risks, along with the relationships between these variables. The primary source of vitamin D, as reported by 72.9% of participants, is the sun, followed by healthy diets (10%). The chi-square value of 32.92 with a p-value of 0.239 suggests that there is no significant correlation between the sources of vitamin D (sun, diet, supplements) and the overall vitamin D levels in the population. When asked about the "best" source of vitamin D, 81.9% identified the sun, and the chi-square result of 18.96 with a p-value of 0.015 indicates a significant association between the belief that the sun is the best source and higher vitamin D levels.

Regarding the sufficiency of dietary sources to maintain adequate vitamin D levels, 29.9% of respondents believed that diet alone suffices, while 47.8% were unsure. The chi-square value of 23.26 with a p-value of 0.026 shows a significant correlation, suggesting that people who are uncertain about dietary sufficiency might have lower vitamin D levels. In terms of vitamin D health benefits, a majority (33.1%) recognized its role in bone and teeth health, with no significant correlation between awareness of benefits and vitamin D levels (p-value of 0.332).

Awareness of updated vitamin D recommendations showed that 74.6% were informed, though no significant relationship was found (p-value 0.715). Finally, regarding individuals at risk for vitamin D deficiency, multiple risk factors were identified, but no statistically significant correlation was found between these factors and vitamin D levels (p-value of 0.413), indicating that the understanding of risk factors does not strongly correlate with actual vitamin D deficiency. Overall, while some correlations are significant, others show no clear relationship between awareness or practices and vitamin D levels (Table 4).

Table 4: Chi-Square and p values shows the awareness of Vitamin D

Variable (Classification of Variable)	Number (Out of 619)	%	State Vs Overall vitamin d		Age Vs Overall vitamin d		Education Vs Overall vitamin d		Dress type Vs Overall vitamin d
			χ^2	p value	χ^2	p value	χ^2	p value	χ^2 p value
OVERALL VITAMIN D SOURCES:			32.92	0.239	5.75	0.97	20.73	0.47	32.64 (0.58)
Sun	451	72.9							
Healthy diet	62	10.0							

Suppliment	6	1.0							
Air	2	0.3							
Water	31	5.0							
Exercise	11	1.8							
Don't know	47	7.6							
Others	9	1.5							
BEST VITAMIN D SOURCE	507	81.9							29.70 **(0.001**)**
Sun	86	13.9	18.96	**0.015****	1.56	0.817	11.72	0.06	
Healthy diet	26	4.2							
Others									
ARE DIETARY SOURCES SUFFICIENT TO MAINTAIN VITAMIN D LEVELS	185	29.9							15.63 (0.407)
	121	19.5							
	296	47.8	23.26	**0.026****	3.02	0.805	8.44	0.49	
Yes	17	2.7							
No									
Not sure									
Others									
VITAMIN D HEALTH BENEFITS									21.35 (0.673)
Bone & teeth health	164	26.5							
Prevention of osteoporosis	34	5.5	22.166	0.332	11.74	0.303	19.54	0.19	
Prevention of rickets	41	6.6							
All the above	205	33.1							
Don't know	141	22.8							
Others.	34	5.5							
AWARE OF UPDATED VITAMIN D RECOMMENDATIONS									6.942 (0.225)
	462	74.6	2.113	0.715	0.255	0.88	2.02	0.56	
Yes	157	25.4							
No									
INDIVIDUALS MOST AT RISK OF VITAMIN D DEFICIENCY.	63	10.2							34.17 (0.274)
Who use sun screen									
Who are staying mostly in a covered atmosphere	111	17.9							
	40	6.5							
Who cover up their skin while going out	63	10.2	24.869	0.413	14.84	0.25	27.54	0.06	
	133	21.5							
Who doesn't take healthy diet	181	29.2							
	28	4.5							
All the above									
Don't know									
Others.									

The study population's awareness of vitamin D was found to be inadequate, highlighting the need for improved education on its importance, sources, and health implications.

Discussion:

In our study, Participants identified vitamin D's health benefits as supporting bone and teeth health (26.5%),

preventing osteoporosis (5.5%) and rickets (6.6%), with 33.1% acknowledging all benefits. However, 22.8% were unaware, and 5.5% cited other benefits.
In the study by Thidar et al., most participants (91.4% and 84.6%) correctly recognized that vitamin D is essential for treating bone diseases and rickets, as well as for maintaining calcium and phosphate balance (12).
Similarly, A recent study among Syrian adults in Damascus found comparable results, with 75.8% showing good knowledge of vitamin D's benefits, recognizing its importance in calcium-phosphate balance and its role in treating rickets and bone diseases (13).
A study in Saudi Arabia revealed that more than two-thirds of the population had adequate knowledge about the benefits of vitamin D (14).
In contrast, a review in Iraq reported a high prevalence of vitamin D deficiency, likely attributed to limited knowledge and awareness about its sources, benefits, factors influencing its levels, and the health impacts of deficiency (15).
Likewise, a study in India found that over half of antenatal mothers had poor knowledge about vitamin D deficiency (16).
In our study, the best sources of vitamin D were identified as the sun, a healthy diet, and other sources. When asked if dietary sources alone were sufficient to maintain vitamin D levels, 41.6% said yes, 38.2% said no, and 20.2% were unsure.
A study in Jordan found that adults had good knowledge of various vitamin D sources, such as milk, fish, cheese, liver, whole wheat cereals, sunlight, and mushrooms. However, it also highlighted a lack of awareness about the recommended duration of sun exposure for adequate vitamin D levels (17).
In our population, similar to previous studies, there was a lack of sufficient knowledge about dietary sources of vitamin D. Vitamin D deficiency may be underestimated in Asian countries like India, possibly due to the assumption that adequate sunlight year-round prevents it (18-25).
In our study, 35.9% of participants reported receiving a suntan in the past 6 months, while 64.1% did not. When it comes to daily sun exposure, 37.0% of participants reported getting 10 minutes, 22.3% get 10-20 minutes, 12.6% get 20-30 minutes, and 28.1% get more than 30 minutes. Additionally, most participants wore kurthas (42.0%), followed by full pant & shirt (30.2%).
In New Delhi, India, it is recommended that exposing arms and legs to sunlight for 10 minutes to half an hour twice a week, between 10 am and 2 pm, is enough for vitamin D production. However, more than 50% of students in our study believed longer exposure (1-4 hours) was needed. This underscores the need to educate students on the factors influencing vitamin D synthesis, such as time of day, exposure duration, skin type, and clothing (25-30).
Similarly, Al-Agha's study found that while people had a good understanding of sun exposure and dietary sources of vitamin D, much lacked knowledge about safe sun exposure times. Additionally, a significant number of individuals struggled to find time for sun exposure due to their busy work schedules (31).
There is a need for increased education on the dietary sources and proven health benefits of vitamin D for bones, muscles, and the immune system. NGOs and social workers can collaborate with government healthcare organizations to raise awareness among parents and children about its importance.

Limitation of the study:

A limitation of this study is its reliance on self-reported data, which may introduce biases or inaccuracies in participants' responses, particularly regarding sunscreen usage and sun exposure. Additionally, the study's regional focus on Tamil Nadu limits its generalizability to other areas or diverse populations across India.

Conclusion:

This study reveals that while South Indian youth, predominantly students, recognize the sun as the primary vitamin D source, there are gaps in consistent sun protection practices and awareness of dietary sufficiency for vitamin D. Significant correlations between beliefs about the sun's benefits and vitamin D levels highlight the need for targeted education on proper sun exposure and dietary practices. However, awareness of vitamin D risks and benefits does not strongly correlate with actual deficiency, emphasizing the need for practical, evidence-based health interventions.
Future studies should focus on evaluating the impact of targeted education, supplementation, and lifestyle interventions on improving vitamin D status.

Abbreviations:
25- OH-D: 25-hydroxyvitamin D
UVB: Ultraviolet B rays
NDNS: The UK National Diet and Nutrition Survey
SACN: The UK National Diet and Nutrition Survey
United Kingdom: UK

Funding
None.

Conflict of interest disclosure
There is no Conflict of Interest.

Acknowledgements
We sincerely thank all study participants for their valuable contributions and acknowledge the laboratory services at Faculty of Allied Health Sciences, Dr. MGR Education and Research Institute.

References:

1. Medhat Taha Awareness of vitamin D deficiency among the general population in Al Qunfudhah, Saudi Arabia Medical Science pISSN 2321–7359; eISSN 2321–7367
2. Abukhelaif AE, Alzahrani SA, Al-Thobaiti LY, Alharbi AA, Al-Shumrani KM, Alghamdi YS. Assessment level of awareness of Vitamin D deficiency among the public residents of Al-Baha region; Saudi Arabia. Medical Science 2021; 25(116):2728-2736
3. Ritu G Vitamin D Deficiency in India: Prevalence, Causalities and Intervention Nutrients 2014 Feb 21;6(2):729–775. doi: 10.3390/nu6020729
4. Lujain Awareness of Vitamin D Deficiency among the General Population in Jeddah, Saudi Arabia Hindawi Journal of Nutrition and Metabolism Volume 2019, Article ID 4138187, 7 pages https://doi.org/10.1155/2019/4138187
5. E. Alemu and R. Varnam, "Awareness of vitamin D deficiency among at-risk patients," BMC Research Notes, vol. 5, no. 1,2012.
6. J. E. Agens, G. T. F. Galasko, A. V. Purandare, and J. Lin,"Awareness of vitamin D deficiency states and recommendedsupplementation doses: survey of faculty and staff atna medical school," e-SPEN Journal, vol. 7, no. 6, pp. e215–e218, 2012.
7. Y. Lhamo, P. K. Chugh, S. R. Gautam, and C. D. Tripathi,"Epidemic of Vitamin D deficiency and its management:awareness among indian medical undergraduates," Journal ofEnvironmental and Public Health, vol. 2017, Article ID2517207, 7 pages, 2017.
8. The National Diet and Nutrition Survey: Results from Years 1, 2, 3 and 4 (Combined) of the Rolling Programme (2008/2009–2011/2012). Available online: https://www.gov.uk/government/statistics/national-diet-and-nutrition-survey-results-from-years-1-to-4-combined-of-the-rolling-programme-for-2008-and-2009-to-2011-and-2012
9. Vitamin D and Health Report (SACN). Available online: https://www.gov.uk/government/publications/sacn-vitamin-d-and-health-report (accessed on 5 April 2018).
10. Del Valle, H.B.; Yaktine, A.L.; Taylor, C.L.; Ross, A.C. Dietary Reference Intakes for Calcium and Vitamin D;The National Academies Press: Washington, DC, USA, 2011.
11. 6. Holick, M.F.; Binkley, N.C.; Bischoff-Ferrari, H.A.; Gordon, C.M.; Hanley, D.A.; Heaney, R.P.; Murad, M.H.;Weaver, C.M. Evaluation, treatment, and prevention of vitamin D deficiency: An endocrine society clinical practice guideline. J. Clin. Endocrinol. Metab. 2011, 96, 1911–1930.
12. Hidar Assessment the awareness of vitamin D deficiency among the general population in Syria: an online cross-sectional study BMC Public Health volume 24, Article number: 938 (2024)
13. Malek O, Al Hajjeh MY, Safiah MH, Alourfi Z. (2023). Assessing vitamin D knowledge among Syrian adults: a population-based cross-sectional study.

14. Alamoudi LH, Almuteeri RZ, Al-Otaibi ME, Alshaer DA, Fatani SK, Alghamdi MM, et al. Awareness of vitamin D Deficiency among the General Population in Jeddah, Saudi Arabia. J Nutr Metabolism. March 2019;3:2019:1–7.
15. Salim S, Ghassan K, B., Al-Temimi AA. Prevalence of vitamin D Deficiency among Population in Iraq: review article. Int J Med Sci Clin Res Stud. 2023;3(4):731–4. https://doi.org/10.47191/ijmscrs/v3-i4-29].
16. Durairaj K, Knowledge. Attitude and practice regarding vitamin D deficiency among antenatal mothers in tamilnadu. Int J Pharma Biosci. October 2015;5:6:486–97
17. Uzrail A, Abu Assab M, Alkalbani R, Kofahi A, R., Kadhim A. Knowledge, attitude and practice (KAP) towards vitamin D deficiency in the Jordanian adult population: a cross-sectional study. Res J Med Sci. 2021;15:62–71.
18. Boland S., A baseline assessment of university students′ vitamin D knowledge, Electronic Thesis and Dissertation Repository, Paper, 2013, no. 1504.
19. Deschasaux M., Souberbielle J. C., Partula V., Lécuyer L., Gonzalez R., Srour B., Guinot C., Malvy D., Latino-Martel P., Druesne-Pecollo N., Galan P., Hercberg S., Kesse-Guyot E., Fassier P., Ezzedine K., and Touvier M., What do people know and believe about vitamin D?, Nutrients. (2016) 8, no. 11, https://doi.org/10.3390/nu8110718.
20. Kotta S., Gadhvi D., Jakeways N., Saeed M., Sohanpal R., Hull S., Famakin O., Martineau A., and Griffiths C., Test me and treat me—attitudes to vitamin D deficiency and supplementation: a qualitative study, BMJ Open. (2015) 5, no. 7, e007401, https://doi.org/10.1136/bmjopen-2014-007401, 2-s2.0-84937206933.
21. Youl P. H., Janda M., and Kimlin M., Vitamin D and sun protection: the impact of mixed public health messages in Australia, International Journal of Cancer. (2009) 124, no. 8, 1963–1970, https://doi.org/10.1002/ijc.24154, 2-s2.0-62449325217.
22. Uddin R., Huda N. H., Jhanker Y. M., Jesmeen T., Imam M. Z., and Akter S., Awareness regarding the importance of calcium and vitamin D among the undergraduate pharmacy students in Bangladesh, BMC Research Notes. (2013) 6, no. 1, article 134, https://doi.org/10.1186/1756-0500-6-134, 2-s2.0-84875868577.
23. Harinarayan C. V., Holick M. F., Prasad U. V., Vani P. S., and Himabindu G., Vitamin D status and sun exposure in India, Dermato-Endocrinology. (2013) 5, no. 1, 130–141, https://doi.org/10.4161/derm.23873, 2-s2.0-84881141117.
24. Ritu G. and Gupta A., Vitamin D deficiency in India: prevalence, causalities and interventions, Nutrients. (2014) 6, no. 2, 729–775, https://doi.org/10.3390/nu6020729, 2-s2.0-84895078482.
25. Srinivasan P. M. and Harinarayan C. V., Vitamin D deficiency in India: fortify or let the sun shine in? Journal of Clinical and Scientific Research. (2015) 4, no. 3, 220–226, https://doi.org/10.15380/2277-5706.jcsr.15.024.
26. Harinarayan C. V., Holick M. F., Prasad U. V., Vani P. S., and Himabindu G., Vitamin D status and sun exposure in India, Dermato-Endocrinology. (2013) 5, no. 1, 130–141, https://doi.org/10.4161/derm.23873, 2-s2.0-84881141117.
27. Ritu G. and Gupta A., Vitamin D deficiency in India: prevalence, causalities and interventions, Nutrients. (2014) 6, no. 2, 729–775, https://doi.org/10.3390/nu6020729, 2-s2.0-84895078482.
28. Srinivasan P. M. and Harinarayan C. V., Vitamin D deficiency in India: fortify or let the sun shine in?, Journal of Clinical and Scientific Research. (2015) 4, no. 3, 220–226, https://doi.org/10.15380/2277-5706.jcsr.15.024.
29. Arya V., Bhambri R., Godbole M. M., and Mithal A., Vitamin D status and its relationship with bone mineral density in healthy Asian Indians, Osteoporosis International. (2004) 15, no. 1, 56–61, https://doi.org/10.1007/s00198-003-1491-3, 2-s2.0-1342332016.
30. Nimitphong H. and Holick M. F., Vitamin D status and sun exposure in Southeast Asia, Dermato-Endocrinology. (2013) 5, no. 1, 34–37, https://doi.org/10.4161/derm.24054, 2-s2.0-84881183096.
31. Eid Al Agha A. and Alorabi S., Awareness of vitamin D and its deficiency in Jeddah population, Saudi Arabia, Journal of Community & Public Health Nursing. (2016) 2, no. 2, https://doi.org/10.4172/2471-9846.1000120.