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Assessment of knowledge and awareness of vitamin D deficiency among medical students in Saudi Arabia: A cross-sectional study

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ABSTRACT

Background: Vitamin D is a fat-soluble vitamin that has several important roles in our bodies. This study aimed to determine the prevalence of vitamin D deficiency among medical students in Saudi Arabia. *Methods:* A cross-sectional study was conducted among medical college students at Saudi Arabia in the colleges of medicine of Imam Muhammad Bin Saud Islamic University and Alfaisal University. A total of 575 medical students from different academic years participated in this study. *Results:* A total of 475 medical students participated in this survey. Most of them were Saudi citizens. There were no male-to-female differences. The vast majority of the study participants were in the intern year and only 1% were in the clinical year. Results showed that medical students seem to have substantial information regarding the value of vitamin D and vitamin D deficiency-related diseases and bone health. Furthermore, nationality was found to have a strong significant association with all domains of vitamin D benefits. *Conclusion:* A moderate awareness level was detected regarding the deficiency of vitamin D. Age, gender, nationality and academic grades were significant factors affecting the awareness level.

Keywords: Vitamin D deficiency, Saudi Arabia, knowledge, awareness.

1. INTRODUCTION

Vitamin D, also known as calciferol, is a fat-soluble vitamin that aids in calcium, phosphorus and bone health, as well as maintaining neuromuscular function. Although there are two major forms of vitamin D, vitamin D2 received from plants and vitamin D3 obtained from animal-supplied meals,

sun exposure is the most important source of vitamin D3 (90 %) (Sahota, 2014). Vitamin D deficiency is recognized as a pandemic, yet the majority of the population is unaware of the condition. The most prevalent reason for vitamin D deficiency is a lack of understanding that moderate sun exposure is the most important source of vitamin D. Although some foods fortified with vitamin D are available for children and adults, they do not meet the necessary requirements. Vitamin D insufficiency can affect anyone at any age, including infants, children, adults and the elderly and can lead to rickets in children and osteoporosis with fractures in adults. It's also linked to a higher risk of cancer, cardiovascular illness, immunological diseases, hypertension and infectious illnesses. It has been estimated that there is approximately one billion people globally who are vitamin D deficient (Holick & Chen, 2008).

According to a study conducted at Al Kharaj, Saudi Arabia. Approximately 85% of the pupils had a high level of overall knowledge. While the overall attitude was negative in roughly 54% of the participants, there were gender disparities as male participants had more sun exposure time and a higher proportion of females received calcium and vitamin D supplements (Geddawy et al., 2020). A different study also showed that vitamin D insufficiency has reached epidemic proportions, according to 17.8% of participants, whereas 47.2% of students feel it is only prevalent in urban areas and 23.8% believe it is limited to high-risk groups. Infants, pregnant and breastfeeding women were identified as high-risk groups; however, they were unaware that the elderly and diabetics were also at a higher risk of vitamin D insufficiency than the general population (Lmhao et al., 2017). Another study in the United Arab Emirates on vitamin D deficiency among healthy adolescents found that 19.7% of the study participants were vitamin D deficient. Vitamin D deficiency was also found in 45.4% of the subjects in another study (Muhairi et al., 2013). This project was conducted on medical students in Saudi Arabia who were asked about their knowledge and awareness regarding vitamin D deficiency.

2. SUBJECTS AND METHODS

This study is a cross-sectional survey of medical college students at Saudi Al-Imam Muhammad Bin Saud University and Alfaisal University, College of Medicine, Saudi Arabia between February and April 2022. It is made up of students in their first to fifth years of medical college. The study questionnaire was delivered to medical students at the college via an online survey. A total of 475 medical students completed, filled out and participate in this study. The participation was entirely voluntary and complete confidentiality and anonymity were maintained at all times, with no personally identifiable information being recorded in the survey findings. The data were represented as frequencies and percentages. Descriptive statistics were used throughout the analysis. The significance of associations was tested using the Chi-square test. Data were analyzed using the Statistical Package for Social Science (SPSS) version 22. P-value < 0.05 was considered to be significant. This study has been approved by the Institutional Review Board (IRB) at Al-Imam Muhammad Bin Saud University, Riyadh, Kingdom of Saudi Arabia.

3. RESULTS

A total of 475 medical students participated in this study. The majority of them were the Saudi nation (87%) with only about 13% were not belonging to the Saudi ethnicity. There were no male-to-female differences. The vast majority of the study participants (41%) were in the intern year and only 1% was in the clinical year. The rest of the demographic data is in table 1.

Table 1 The socio-demographic status of the participants

Variable	Frequency	Percentage
Age Group		
18-20 years old	119	25%
20-23 years old	130	27%
23-27 years old	226	48%
Gender		
Female	249	52%
Male	226	48%
Nationality		
Non-Saudi	64	13%
Saudi	411	87%
Academic Grade		

Pre-medical year	1	0.2%
First year	43	9%
Second year	44	9%
Third year	57	12%
Fourth year	60	13%
Fifth year	77	16%
Intern year	193	41%

Regarding the awareness of vitamin D, the responses varied accordingly. The results showed that medical students seem to have a substantial level of information regarding the importance of vitamin D in the treatment of bone diseases and rickets, maintenance of calcium and phosphates, as well as bone and teeth (78%, 81% and 79%; respectively). When it comes to the role of vitamin D as a strengthening factor for muscles; only about 48% of the respondents recognize this fact. Another key element for vitamin D is improving immunity; the results revealed that 61% of the participants knew the importance of vitamin D in this domain. Furthermore, only about 28% recognize animal meat as a source of vitamin D with the majority 78% highlighting sun exposure as a primary source of vitamin D. In addition, over half believed that genetics is one of the causes of vitamin D deficiency (55%). Table 2 summarized the awareness level of the medical students regarding Vitamin D.

Table 2 Awareness of the medical students related to Vitamin D

No	Variable		Frequency (Percentage)		
		N	Yes	No	Don't know
1	Vitamin D is used to treat bone disease and rickets	472	368 (78%)	56 (12%)	48 (10%)
2	Vitamin D is important in the maintenance of calcium and phosphates	471	381 (81%)	55 (12%)	35 (7%)
3	vitamin D is important in the maintenance of bone and teeth	471	370 (79%)	65 (14%)	36 (8%)
4	Vitamin D helps to strengthen muscles	471	224 (48%)	110 (23%)	137 (29%)
5	Vitamin D helps to strengthen immunity	474	290 (61%)	78 (16%)	106 (22%)
6	Sun exposure encourages vitamin D production in the skin	470	367 (78%)	58 (12%)	45 (10%)
7	Vitamin D is found in animal meat but not in vegetables and fruits	469	129 (28%)	212 (45%)	128 (27%)
8	People residing in cloudy areas are more prone to vitamin D deficiency	472	309 (65%)	69 (15%)	94 (20%)
9	Use of sunscreen creams may be a cause of vitamin D deficiency	471	155 (33%)	189 (40%)	127 (27%)
10	Dark skin is more prone to vitamin D deficiency than fairer skin	471	167 (35%)	153 (32%)	151 (32%)
11	Vegetarians are more likely to have vitamin D deficiency than non-vegetarians	470	223 (47%)	110 (23%)	137 (29%)
12	Genetic is one of the causes of getting vitamin D deficiency	472	261 (55%)	211 (45%)	0 (0%)

When the students were asked about the proper time to get most of the sun exposure; 37% of the respondents stated that 5 to 8 in the morning (AM) was the most efficient time while 35% suggested that it is 9 to 12 AM. A fatty fish diet was proposed by about 34% as a primary vitamin D-rich diet with only 28% indicating milk-containing products as a plentiful source of vitamin D. On the other hand, vitamin D efficiency was found to be a contributing factor to the development of numerous diseases by medical students; rickets was the most common one 65% Figures 1, 2, 3.

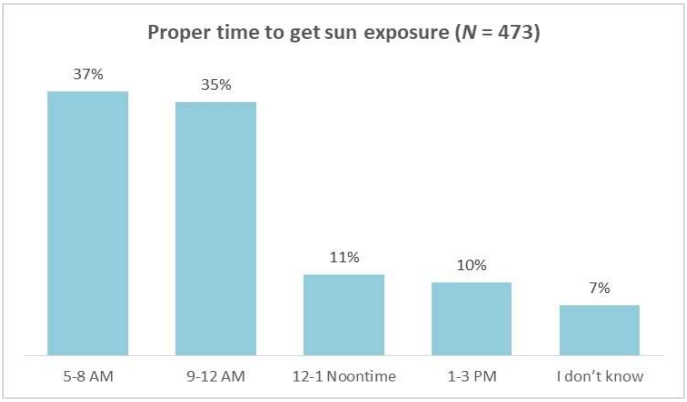

Figure 1 Frequency distribution for proper time of getting sun exposure.

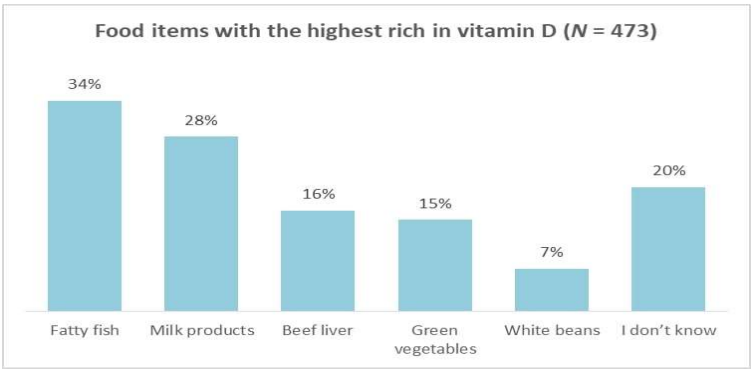

Figure 2 Frequency distribution for food items with the highest rich in vitamin D.

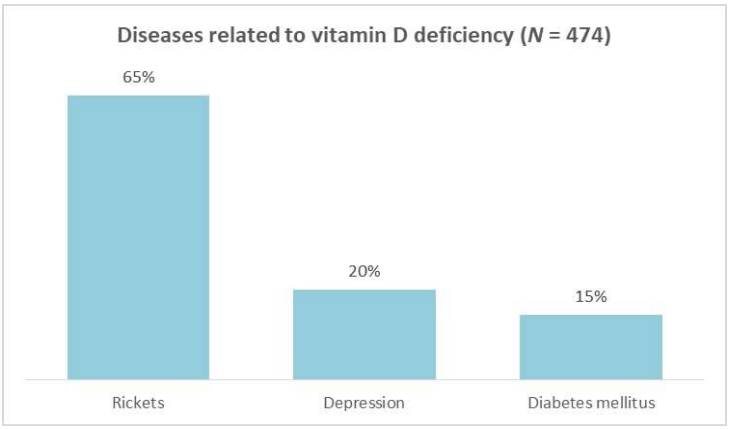

Figure 3 Frequency distribution for most diseases linked to vitamin D deficiency.

In comparing age groups there was a significant difference found among age groups for knowledge of the benefit of using vitamin D at a 5% level since all p-values are less than 0.05. The results indicate that there is a significant relationship between age and awareness of vitamin D in which the older age group tends to agree more with the benefit of vitamin D. In terms of sources of vitamin D deficiency, significant differences among age groups were found only for residing in the cloudy area and people with dark skin, showing that older age groups also more believe that people residing in the cloudy area and with dark skin are more prone to vitamin D deficiency. Table 3 presents the awareness of vitamin D by age group.

Apart from two questions about the use of sunscreen creams and genetic predisposition as a potential cause of vitamin D deficiency ($p < 0.001$ and < 0.025; respectively). The results showed no statistically significant values between most knowledge domains at 5% level (Table 4). Furthermore, males tend to agree more for the vitamin D deficiency etiologies are due to the use of sunscreen creams and genetics-related than females.

Table 3 Awareness of vitamin D by age group

	Column Percentage				Chi-square Test		
	18-20 years	20-23 years	23-27 years		Value	df	p-value
Vitamin D is used to treat bone disease and rickets							
Yes	62%	80%	85%		24.2	4	<0.001*
No	22%	11%	8%				
I don't know	16%	9%	8%				
Vitamin D is important in the maintenance of calcium and phosphates							
Yes	65%	85%	86%		24.8	4	<0.001*
No	23%	8%	8%				
I don't know	12%	6%	6%				
Vitamin D is important in the maintenance of bone and teeth							
Yes	61%	84%	85%		28.3	4	<0.001*
No	25%	11%	10%				
I don't know	14%	5%	6%				
Vitamin D helps to strengthen muscles							
Yes	35%	50%	53%		15.4	4	0.004*
No	36%	21%	19%				
I don't know	30%	29%	29%				
Vitamin D helps to strengthen immunity							
Yes	45%	62%	69%		20.1	4	<0.001*
No	22%	16%	14%				
I don't know	33%	22%	17%				
Sun exposure encourages vitamin D production in the skin							
Yes	66%	78%	84%		22.3	4	<0.001*
No	24%	11%	7%				
I don't know	10%	11%	8%				
Vitamin D is found in animal meat but not in vegetables and fruits							
Yes	28%	30%	26%		3.8	4	0.435
No	48%	38%	48%				
I don't know	24%	32%	27%				
People residing in cloudy areas are more prone to vitamin D deficiency							
Yes	53%	72%	68%		13.1	4	0.011*
No	23%	12%	12%				
I don't know	23%	16%	20%				
Use of sunscreen creams may be a cause of vitamin D deficiency							
Yes	29%	32%	35%		2.8	4	0.587
No	46%	40%	37%				
I don't know	25%	28%	27%				
Dark skin is more prone to vitamin D deficiency than fairer skin							
Yes	31%	32%	40%		10.1	4	0.038*
No	34%	42%	26%				
I don't know	34%	27%	34%				
Vegetarians are more likely to have vitamin D deficiency than non-vegetarians							
Yes	42%	53%	47%		7.9	4	0.097

Table 4 Awareness of vitamin D by gender

	Column Percentage			Chi-square Test		
	Female	Male		Value	Df	p-value
Vitamin D is used to treat bone disease and rickets						
Yes	80%	76%		1.07	2	0.586
No	11%	13%				
I don't know	9%	11%				
Vitamin D is important in the maintenance of calcium and phosphates						
Yes	80%	82%		0.89	2	0.642
No	12%	12%				
I don't know	9%	6%				
Vitamin D is important in the maintenance of bone and teeth						
Yes	80%	77%		1.70	2	0.427
No	14%	13%				
I don't know	6%	9%				
Vitamin D helps to strengthen muscles						
Yes	47%	48%		0.67	2	0.716
No	25%	22%				
I don't know	28%	30%				
Vitamin D helps to strengthen immunity						
Yes	59%	64%		1.22	2	0.543
No	18%	15%				
I don't know	23%	21%				
Sun exposure encourages vitamin D production in the skin						
Yes	80%	76%		1.63	2	0.444
No	12%	13%				
I don't know	8%	11%				
Vitamin D is found in animal meat but not in vegetables and fruits						
Yes	27%	28%		4.72	2	0.094
No	42%	49%				
I don't know	31%	23%				
People residing in cloudy areas are more prone to vitamin D deficiency						
Yes	68%	63%		1.33	2	0.515
No	14%	15%				
I don't know	18%	22%				
Use of sunscreen creams may be a cause of vitamin D deficiency						
Yes	28%	39%		16.14	2	<0.001*
No	49%	31%				
I don't know	24%	31%				
Dark skin is more prone to vitamin D deficiency than fairer skin						
Yes	33%	38%		1.32	2	0.517
No	34%	31%				
I don't know	33%	31%				
Vegetarians are more likely to have vitamin D deficiency than non-vegetarians						
Yes	48%	47%		3.34	2	0.189
No	20%	27%				
I don't know	32%	26%				
Genetic is one of the causes of getting vitamin D deficiency						

Yes	50%	61%		5.44	1	0.020*
No	50%	39%				

Nationality on the other hand demonstrated a strong significant association with all domains of vitamin D benefits. Saudi citizens however were almost twice more likely to agree on the benefit of vitamin D to treat bone disease and rickets and also to strengthen muscles and improve immunity than non-Saudi residents. In terms of sources of vitamin D deficiency, there is a significant difference in whether people residing in cloudy are more prone to vitamin D deficiency between Saudi and non-Saudi residents ($p < 0.001$). Saudi citizens are nearly twice as likely as non-Saudi to think that those residing in cloudy areas are more prone to vitamin D deficiency. Yet, the results showed no significant relationship between nationality and whether sunscreen creams cause vitamin D deficiency and dark skin is more prone to vitamin D deficiency than fairer skin. Table 5 illustrates the awareness of vitamin D by nationality.

Table 5 Awareness of vitamin D by nationality

	Column Percentage			Chi-square Test		
	Saudi	Non-Saudi		Value	Df	p-value
Vitamin D is used to treat bone disease and rickets						
Yes	82%	48%		38.82	2	<0.001*
No	9%	31%				
I don't know	9%	21%				
Vitamin D is important in the maintenance of calcium and phosphates						
Yes	85%	55%		50.76	2	<0.001*
No	8%	39%				
I don't know	8%	6%				
Vitamin D is important in the maintenance of bone and teeth						
Yes	82%	56%		22.84	2	<0.001*
No	12%	29%				
I don't know	6%	16%				
Vitamin D helps to strengthen muscles						
Yes	51%	23%		18.85	2	<0.001*
No	21%	39%				
I don't know	28%	39%				
Vitamin D helps to strengthen immunity						
Yes	64%	41%		13.85	2	0.001*
No	15%	28%				
I don't know	21%	31%				
Sun exposure encourages vitamin D production in the skin						
Yes	82%	54%		23.59	2	<0.001*
No	10%	26%				
I don't know	8%	20%				
Vitamin D is found in animal meat but not in vegetables and fruits						
Yes	26%	35%		4.40	2	0.111
No	45%	48%				
I don't know	29%	17%				
People residing in cloudy areas are more prone to vitamin D deficiency						
Yes	70%	38%		34.56	2	<0.001*
No	11%	38%				
I don't know	19%	25%				
Use of sunscreen creams may be a cause of vitamin D deficiency						
Yes	33%	35%		1.30	2	0.521

No	40%	44%				
I don't know	28%	21%				
Dark skin is more prone to vitamin D deficiency than fairer skin						
Yes	36%	29%		3.00	2	0.223
No	31%	42%				
I don't know	33%	29%				
Vegetarians are more likely to have vitamin D deficiency than non-vegetarians						
Yes	46%	55%		2.88	2	0.237
No	23%	25%				
I don't know	30%	20%				
Genetic is one of the causes of getting vitamin D deficiency						
Yes	54%	65%		2.45	1	0.117
No	46%	35%				

Finally, the association between academic grades and knowledge with regards to vitamin D was also investigated. The results revealed that academic grade was re-categorized so that they represented those who are on internship and those who are not. It shows the association between academic grade and knowledge of vitamin D benefits was statistically significant at 5%. The proportion who agrees with the benefit of vitamin D is significantly higher among interns than non-interns. Non-interns were more likely to believe that genetics is one of the causes of getting vitamin D deficiency than interns and the difference was statistically significant ($p = 0.017$).

4. DISCUSSION

Vitamin D deficiency is widespread in Saudi Arabia; it has been reported in 50% of first-trimester pregnant women in Riyadh (Al-Faris, 2016), 49% of students and 44% of employees in three Saudi Arabian regions (Kaddam et al., 2017) and it was found to be prevalent (96%) among medical students at King Faisal University in 2009 (Al-Elq, 2012). In this study, we sought to see how many medical students knew about vitamin D deficiency; a total of 475 medical students were recruited for the study. Students had a high understanding of the purpose and health benefits of vitamin D; nevertheless, they had a moderate understanding of the source of vitamin D. In addition, the results revealed that medical students had a moderate understanding of vitamin D insufficiency.

A cross-sectional study from Qassim University found that medical students had moderate awareness, with a mean score of 9.53 out of 15 points. In addition, 51.2% had low understanding, whereas 48.8% had strong knowledge (Naeem et al., 2011). This is consistent with our findings, which showed that medical students had a reasonable understanding of vitamin D deficiency and this should urge professors to educate students with more information about the vitamin's lack in order to raise awareness. In India, medical students' awareness about vitamin D insufficiency was likewise low; just 54% of medical students were aware of this devastating issue (Lmhao et al., 2017). Another study involving 113 female medical students in India found that students' knowledge of vitamin D, its advantages, deficiency and management was lacking (Nowreen & Hameed, 2019). Also, the awareness of Vitamin D was reported to be limited among Chinese medical students (Zhou et al., 2016). In Pakistan, just 9% and 33% of university students reported knowing the correct food source of vitamin D and were aware of the vitamin's bone health benefits, respectively (Tariq et al., 2020).

A Sudanese study conducted at Ahfad University for females found that women were more conscious of vitamin D deficiency. The majority of female medical students were aware of the need for vitamin D (Ali et al., 2019). The age of students was a fundamental factor determining the amount of students' awareness in our study, with the awareness level changing dramatically with the student's age. The older age group was more likely to believe in the benefits of vitamin D. Older age groups also believed that living in foggy locations and having dark skin were causes of vitamin D insufficiency. In this study, gender had a lower impact on awareness than age, with no significant differences observed for most knowledge domains, except for the contributing factors of vitamin D deficiency, where males were more likely than females to report that the use of sunscreen and creams, as well as genetics, are the causes of vitamin D deficiency.

In the current study, nationality was a significant factor influencing medical students' degree of knowledge, with Saudi students believing in the benefits of vitamin D more than non-Saudi students. In addition, a higher percentage of Saudi students believed that overcast environments caused vitamin D insufficiency. The academic grade was the last element we discovered to affect

students' level of awareness in our study and there was a significant correlation between academic grades and the level of awareness.

Interns are substantially more likely than non-interns to believe in the benefits of vitamin D. They conducted a study on medical students and found that only age was the significant factor in determining knowledge level, with older students having higher awareness (Alfayyadh et al., 2020). Another study conducted on female medical students in Sudan confirmed age as a significant effective factor in awareness level (Ali et al., 2019). Another Study conducted in Riyadh, Saudi Arabia demonstrated that females were discovered to have limited knowledge regarding vitamin D deficiency (Christie & Mason, 2011).

5. CONCLUSION

A moderate level of awareness among medical students was detected regarding the deficiency of Vitamin D. Age, gender, nationality and academic grades were significant factors affecting the level of awareness of students; however, gender was a less effective factor compared to other factors. Further studies are recommended with a well-established scoring system, defining the gaps of knowledge and investigating the opinion of students about the strategy to increase their awareness.

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Authors Contributions

Prof Khalid A Bin AbdulRahman: Contributed to writing the discussion section.
Khalid Ahmed Aljasser: Contributed to data collection and writing the methodology section.
Aishah Ahmed Al-Kabi: Contributed to data collection and writing the introduction section.
Zainab Tariq Alramadhan: Contributed to writing the abstract and conclusion and research concepts.
Jehad T Alhussaini: Contributed to writing the results section.
Asma M Almutair: Contributed to data collection and writing the methodology
Anmar Yasser Alshibely: Contributed to data analysis and writing the results section
Amal Mohammed Alharthi: Contributed to data collection and writing the introduction
Maryam Fahad Oraif: Contributed to the design of tables and figures and writing the results.
Rakan Mohammad Alotaibi: Contributed to the manuscript revision, data analysis, and writing the discussion.

Ethical Approval

The study was approved by the Medical Ethics Committee of Al-Imam Muhammad Bin Saud University, Riyadh, Kingdom of Saudi Arabia, Ethical approval code: HAPO-01-R-011.

Informed Consent

Written & Oral informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

Limitations

The limitation of this study is that the study did not measure the level of awareness based on a scoring system.

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This study has not received any external funding.

Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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