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Knowledge, Attitude and Practice of Vitamin D Deficiency among Adults in Saudi Arabia

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Abstract **Introduction:** Vitamin D is a fat-soluble vitamin with various important functions. It regulates calcium and phosphorus absorption, promoting bone health and growth. It also modulates the immune system, influences cell growth and differentiation and has effects on neuromuscular and cardiovascular function. Vitamin D deficiency can lead to conditions like rickets in children and osteomalacia in adults. Natural sources include fatty fish, cod liver oil, egg yolks and fortified foods. The recommended daily intake ranges from 400 to 800 IU. **Objectives:** This study aimed to assess the knowledge, attitude and practice of vitamin D deficiency among adults in Saudi Arabia. **Methodology:** This is an observational cross-sectional study conducted among adults aged 18 and above at Saudi Arabia by Knowledge, attitude and practice (KAP) regarding vitamin D questionnaire it consistent of 47 questions and divided into 5 sections: demographic information, general knowledge, nutrition knowledge, attitude and practice, it was sharing among the adults aged 18 and above in Saudi Arabia. A total of 377 Saudi adults from different regions participated in this study. Data were tabulated in the Microsoft Excel program (2016) and data analysis was performed using the Statistical Package for the Social Sciences version 20. **Results:** The study assessed the knowledge, attitudes and practices regarding vitamin D deficiency among 383 adults in Saudi Arabia. Findings revealed that while 87.7% recognized the risks of indoor work and 86.9% acknowledged the elderly's vulnerability, only 8.9% demonstrated high nutritional knowledge about vitamin D. A significant 54.8% attributed urbanization to limited sun exposure, with 91.2% acknowledging the challenges faced by indoor workers. Despite high general knowledge levels (63.7%), only 30.5% exhibited strong practices related to vitamin D intake. Notably, educational level significantly influenced both knowledge and attitudes, highlighting the need for targeted public health interventions. **Conclusion:** While the present study highlights a commendable level of general knowledge about vitamin D among adults in Saudi Arabia, it also underscores significant gaps in nutritional awareness and practical application of this knowledge.

Key Words Vitamin D deficiency, Awareness, Knowledge, Saudi Arabia

INTRODUCTION

Insufficiency and shortage of vitamin D are now widespread illnesses [1]. Vitamin D is a family of fat-soluble prohormones that comes in various forms, including D2 (ergocalciferol) and D3 (cholecalciferol) [2]. It is an essential steroid involved in bone metabolism, cell proliferation, differentiation and mineral regulation in the body [3]. The primary function of vitamin D is to enhance calcium absorption from the small intestine [4]. Despite ample sunlight in the region, Saudi Arabia continues to experience a high prevalence of vitamin D deficiency. Approximately 76.1% of the population is affected by this deficiency, with the youngest age group (30-40 years) exhibiting the highest percentage of deficiency [5].

In 2020, research was conducted among the Saudi adult population and the result has shown a lowest

score of 0 and a maximum score of 14; it has been demonstrated that the average score was 9.64±2.5 [6].

Studies have been published on the awareness of vitamin D deficiency in the general population in Jeddah, Saudi Arabia. Reported that the average score for knowledge was 5.9±1.7 (or 39.3%). Benefits knowledge was scored at 3.6±1.2 (60%). For sources, the mean knowledge score was 2.8 1.6 (35%), while for toxicity, it was 0.3±0.1 (30%) [7]. Saudi Arabian cities are characterized by average knowledge and awareness about vitamin D deficiency. In Al-Baha region, 41.7% of participants had a diagnosis of vitamin D deficiency, while 96.8% of participants were aware of vitamin D. When compared to male participants (36.3%), a startlingly high percentage of female participants (49.1%) had a diagnosis of vitamin D deficiency (p-value = 0.009) [8].

This study is essential because it addresses an important gap in the knowledge base of prior research on the subject. Numerous studies have been carried out in various areas, such as the Al-Qassim region in Saudi Arabia in 2018, where there was a significant association between overall awareness of vitamin D and consumption of at least two sources of vitamin D in men (p = 0.001) but not in women (p = 0.920). Despite having higher awareness than men, women had significantly less exposure to the sun. Additionally, Ibrahim *et al.* [1] study found that vitamin D deficiency and insufficiency are extremely common in Saudi Arabia's Central, Western and Eastern regions.

Similar to globally, a 2018 study in Pakistan found that university students had poor knowledge of vitamin D despite being a high-risk population. Interventions are required to raise public awareness of vitamin D's significance to health (Amina).

These studies have shed important light on the significance of adults in Saudi Arabia being aware of vitamin D deficiency, with certain areas demonstrating a severe lack of awareness across all regions. A recent and comprehensive assessment of Saudi Arabia's general population as a whole is, however, lacking. Therefore, our research proposal aims to fill this gap by conducting an updated study on a large sample size that represents all regions of Saudi Arabia. By including participants from various regions, we can ensure that our findings are representative of the entire population and provide a more accurate understanding of the Knowledge and awareness of vitamin D deficiency among adults in Saudi Arabia.

Objectives

The objective of this cross-sectional study is to assess the knowledge, attitude and practice of vitamin D deficiency among adults in Saudi Arabia.

MATERIALS AND METHODS

Study Design

This is a cross-sectional descriptive study on vitamin D deficiency awareness was followed STROBE guidelines, conducted in the Kingdom of Saudi Arabia (KSA), a country in West Asia, from August 2023 to March 2025.

Study Setting

Participants, Recruitment and Sampling Procedure: The study focused on Saudi Arabian adults aged 18 and above as the target population. Participants were recruited in September 2023 from individuals who received the questionnaire.

Sample Size

The study sample was determined by the Raosoft calculator. Keeping a response distribution of 50%, a margin of error of 5% and a confidence level of 95%, the calculated sample size was 377.

Method for Data Collection and Instrument (Data Collection Technique and Tools)

A cross-sectional survey was conducted using the Knowledge, Attitude and Practice (KAP) regarding vitamin D questionnaire. The questionnaire consisted of 47 questions divided into five sections: demographic information, general knowledge, nutrition knowledge, attitude and practice. The demographic information included age, gender, nationality and residential area. D-KAP-38 included 11 general knowledge items, 5 nutrition knowledge items, 12 attitude items and 10 practice items. The possible responses are Yes/No/I don't know options. Some questions are rated on a 5 Likert scale with the possible responses of "strongly disagree to strongly agree," and some questions are rated on a 5 Likert scale with the possible responses of never/rarely/sometimes/often/always.

The validity and reliability of the questionnaire were tested in a pilot study with 30 individuals who were not part of the main sample. The Cronbach's alpha coefficient for the knowledge and awareness sections was 0.82 and 0.79, respectively, indicating good internal consistency.

Scoring System

About 47 questions in our survey include 38 questions about general knowledge, nutrition knowledge, attitude and practice. General knowledge. The possible responses are "Yes/No/I don't know," which should be scored as 2/0/1, respectively. Hence, the total raw scores of "general knowledge" ranged from 0 to 22, which proportionately transformed to 0-100. Nutrition Knowledge The possible responses are "Yes/No/I don't know" and the scores of 0/2/1 are respectively allocated to all of them except for Q21, which should be inversely scored as 2/0/1. Total raw scores of "nutrition knowledge" ranged from 0 to 10, which proportionately transformed to 0-100. Attitude: The related questions are rated on a 5 Likert scale with the possible responses of "strongly disagree to strongly agree" and the allocated scores of 1 to 5, respectively. Total raw scores of attitudes range from 12 to 60 and proportionately transform

to 0-100. Practice: The related questions are rated on a 5 Likert scale with the possible responses of "never/rarely/sometimes/often/always". The scores of 1 to 5 allocated to the responses of questions 38, 39, 40,41, 43 and 45 and other questions should be scored inversely. The raw scores of "practices" ranged from 10 to 50 and were then proportionately transformed to 0-100.

Analysis and Entry Method

- Collected Data was entered on a computer using the Microsoft Excel program (2016)
- For Windows. Data was then transferred to the Statistical Package for Social Science
- Software (SPSS) program, version 20. To be statistically analyzed

RESULTS

Table 1 displays various demographic parameters of the participants with a total number of (383). The respondents' mean age was 30.1 years and the standard deviation was 12.9. The age distribution was very diverse, 21-24 years, with 33.4% of the sample. Overall, 59.3% were females and all were Saudi nationals. Most of the 68.9% were unmarried and highly educated, 79.6% with a bachelor's degree. Makkah was geographically the leading residential region (49.1%) and most participants had a monthly income below 5000 SAR (59.3%). In terms of occupation, 30.8% of students and 24.3% were unemployed. Among participants who examined social interaction, 54.8% regarded the internet as the one most often accessed in pursuing their social impulses.

As shown in Figure 1, in our comprehensive medical research study examining the knowledge, attitude and practice regarding vitamin D deficiency among adults in Saudi Arabia, a total sample of 383 individuals was analyzed to identify key findings. Notably, the data revealed that a significant majority, comprising 336 participants, acknowledged their awareness of potential vitamin D deficiency, underscoring a heightened consciousness of this health issue among the population. Conversely, only 15 respondents reported a lack of awareness, while 32 participants expressed uncertainty about their knowledge on the subject.

Table 2 shows findings from the study of knowledge, attitudes and practice of vitamin D deficiency among adults in Saudi Arabia provides valuable insights into public awareness and misperception of a critical health issue. A large majority of participants (87.7%) were aware that individuals working indoors are at greater risk for vitamin D deficiency and 86.9% were also aware of

Table 1: Sociodemographic characteristics of participants (n = 383)

Parameter		Number	Percentage
Age (Mean:30.1, STD:12.9)	18 to 20	76	19.8
	21 to 24	128	33.4
	25 to 45	95	24.8
	46 or more	84	21.9
Gender	Female	227	59.3
	Male	156	40.7
Nationality	Saudi	383	100.0
	Non-Saudi	0	0
Marital status	Single	264	68.9
	Married	114	29.8
	Widowed	5	1.3
Educational level	Primary	8	2.1
	High school	32	8.4
	Diploma	20	5.2
	Bachelor's degree	305	79.6
	Postgraduate	18	4.7
Residential region	Riyadh	82	21.4
	Eastern region	69	18.0
	Qassim	37	9.7
	Madinah	7	1.8
	Makkah	188	49.1
Monthly income	Less than 5000	227	59.3
	5000 to 10000	63	16.4
	10001 to 15000	34	8.9
	More than 15000	59	15.4
Occupation	Student	118	30.8
	Healthcare sector	36	9.4
	Nonhealthcare sector	48	12.5
	Unemployed	93	24.3
	Others	88	23.0
Sources of socialising	Relatives and friends	145	37.9
	Internet	210	54.8
	Hospitals or clinics	5	1.3
	Others	23	6.0

Table 2: Parameters related to general and nutritional knowledge regarding vitamin D (n = 383)

Parameter		Number	Percentage
People who work indoors are at high risk of vitamin D deficiency	No	15	3.9
	I don't know	32	8.4
	Yes	336	87.7
Vitamin D intake more than the dietary recommendations could be harmful	No	12	3.1
	I don't know	37	9.7
	Yes	334	87.2
Elderly people are at high risk of vitamin D deficiency	No	6	1.6
	I don't know	44	11.5
	Yes	333	86.9
Inappropriate dietary intakes are related to vitamin D deficiency	No	44	11.5
	I don't know	56	14.6
	Yes	283	73.9
Vitamin D supplement intake requirements differ for different age groups	No	22	5.7
	I don't know	20	5.2
	Yes	341	89.0
Pregnant and lactating women are at high risk of vitamin D deficiency	No	25	6.5
	I don't know	97	25.3
	Yes	261	68.1
Most of the vitamin D required is produced when the skin is directly exposed to the sun	No	43	11.2
	I don't know	65	17.0
	Yes	275	71.8
Currently, vitamin D deficiency is one of the most important health issues in our country	No	8	2.1
	I don't know	40	10.4
	Yes	335	87.5
Bone pain and fatigue are among the vitamin D deficiency	No	10	2.6
	I don't know	71	18.5
	Yes	302	78.9
Vitamin D supplement intake requirements differ in various seasons of the year	No	122	31.9
	I don't know	114	29.8
	Yes	147	38.4
Both men and women are at risk of vitamin D deficiency	No	10	2.6
	I don't know	5	1.3
	Yes	368	96.1
Fatty fish are one of the main dietary sources of vitamin D	No	37	9.7
	I don't know	137	35.8
	Yes	209	54.6
Dairy products are one of the main dietary sources of vitamin D	No	78	20.4
	I don't know	129	33.7
	Yes	176	46.0
Eggs are one of the main dietary sources of vitamin D	No	62	16.2
	I don't know	138	36.0
	Yes	183	47.8
Meat and poultry are the main dietary sources of vitamin D	No	92	24.0
	I don't know	143	37.3
	Yes	148	38.6
Fruits are one of the main dietary sources of vitamin D	No	84	21.9
	I don't know	82	21.4
	Yes	217	56.7

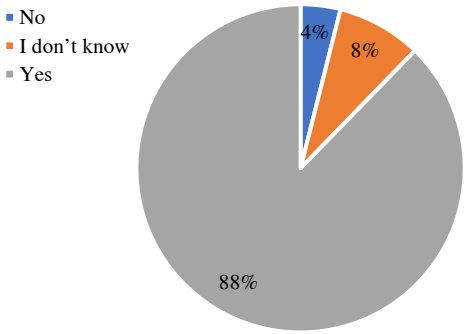

Figure 1: Illustrates whether people who work indoors have a high risk of vitamin D deficiency among participants

the same risk among the elderly. Eighty-seven point two per cent of respondents affirmed they believe vitamin D intake could be harmful if taken in excess. Significantly, 73.9% cited improper dietary intakes as contributing to deficiency and 89.0% concluded that vitamin D supplement requirements are different in each age group. In addition, 68.1% could identify pregnant and lactating women as being at risk and 71.8% understood that a high percentage of vitamin D is produced in the skin by exposure to sunlight.

As shown in Figure 2, A notable aspect of the study pertains to the impact of urbanization on sun exposure and, consequently, vitamin D synthesis. Specifically, 148 respondents agreed that urbanization hinders sun exposure

Table 3: Participants' attitude regarding vitamin D (n = 383)

Parameter		Number	Percentage
Urbanization prevents sun exposure and production of required vitamin D	Agree	148	38.6
	Strongly agree	59	15.4
	Disagree	57	14.9
	Strongly disagree	8	2.1
	No idea	111	29.0
A shortage of public places for outdoor activities prevents the sun exposure required for production of vitamin D	Agree	145	37.9
	Strongly agree	126	32.9
	Disagree	31	8.1
	Strongly disagree	15	3.9
	No idea	66	17.2
Full time indoor occupation prevents the sun exposure required for production of vitamin D	Agree	176	46.0
	Strongly agree	173	45.2
	Disagree	5	1.3
	Strongly disagree	7	1.8
	No idea	22	5.7
Inefficient education regarding benefits of sun exposure prevents production of required vitamin D through sun exposure	Agree	162	42.3
	Strongly agree	107	27.9
	Disagree	30	7.8
	No idea	84	21.9
The undesirable taste of sea foods for Iranians is one of the barriers to their consumption of dietary sources of vitamin D	Agree	53	13.8
	Strongly agree	43	11.2
	Disagree	22	5.7
	Strongly disagree	19	5.0
	No idea	246	64.2
In vitamin D deficiency, supplement intake is more effective compared to dietary intake and sun exposure	Agree	157	41.0
	Strongly agree	109	28.5
	Disagree	63	16.4
	Strongly disagree	19	5.0
	No idea	35	9.1
Taking vitamin D supplement, unless recommended by physicians is wrong	Agree	183	47.8
	Strongly agree	123	32.1
	Disagree	36	9.4
	No idea	41	10.7
Unwillingness of individuals to take vitamin D supplements is one of the barriers of providing this nutrient	Agree	159	41.5
	Strongly agree	97	25.3
	Disagree	32	8.4
	No idea	95	24.8
Taking supplements is necessary for treatment of vitamin D deficiency but not for its prevention	Agree	158	41.3
	Strongly agree	134	35.0
	Disagree	20	5.2
	Strongly disagree	24	6.3
	No idea	47	12.3
Permanent use of sunscreens on face, neck and hands prevents the sun exposure required for production of vitamin D	Agree	35	9.1
	Strongly agree	59	15.4
	Disagree	128	33.4
	Strongly disagree	26	6.8
	No idea	135	35.2
Taking supplement is only necessary in case of lack of exposure to sunlight	Agree	127	33.2
	Strongly agree	91	23.8
	Disagree	90	23.5
	Strongly disagree	18	4.7
	No idea	57	14.9
A high expense of dietary sources of vitamin D is one of the barriers of providing this nutrient	Agree	88	23.0
	Strongly agree	78	20.4
	Disagree	61	15.9
	No idea	156	40.7

necessary for vitamin D production, while an additional 59 strongly agreed with this assertion. In contrast, 57 participants disagreed and 8 strongly disagreed; however, 111 remained uncertain.

Table 3 shows a great part of respondents admitted that urbanization (54%; combined agree/strongly agree) as well as the lack of public outdoor spaces (70.8%; combined agree/strongly agree) made the sun exposure needed to produce vitamin D impossible to obtain. In fact, almost all participants (91.2%) understood that the lack of sun is inherent to full time indoor occupations. Education was a key factor whereby 70.2% of patients agreed that poor awareness of the benefits of sun exposure is part of the causal chain of vitamin D deficiency. Most

Table 4: Practice level regarding vitamin D (n = 383)

Parameters		Number	Percentage
For sufficient exposure to sunlight I regularly engage in outdoor physical activities	Never	58	15.1
	Sometimes	152	39.7
	Always	38	9.9
	Often	48	12.5
	Rarely	87	22.7
To be vitamin D sufficient, I consume fortified milk	Never	43	11.2
	Sometimes	118	30.8
	Always	30	7.8
	Often	65	17.0
	Rarely	127	33.2
In order to be vitamin D sufficient, I consume fish at least twice a week	Never	74	19.3
	Sometimes	85	22.2
	Always	33	8.6
	Often	41	10.7
	Rarely	150	39.2
For sufficient exposure to sunlight I walk outdoors daily	Never	52	13.6
	Sometimes	115	30.0
	Always	60	15.7
	Often	64	16.7
	Rarely	92	24.0
I use caps/hats to avoid severe sun exposure	Never	98	25.6
	Sometimes	63	16.4
	Always	83	21.7
	Often	78	20.4
	Rarely	61	15.9
To be vitamin D sufficient, I take vitamin D supplements	Never	53	13.8
	Sometimes	142	37.1
	Always	79	20.6
	Often	66	17.2
	Rarely	43	11.2
I use sunscreen on my hands	Never	98	25.6
	Sometimes	88	23.0
	Always	88	23.0
	Often	34	8.9
	Rarely	75	19.6
During the day I am directly exposed to sunlight (outdoors)	Never	36	9.4
	Sometimes	130	33.9
	Always	68	17.8
	Often	42	11.0
	Rarely	107	27.9
During the day I am indirectly exposed to sunlight (through glass)	Never	32	8.4
	Sometimes	89	23.2
	Always	90	23.5
	Often	85	22.2
	Rarely	87	22.7
I use sunscreen on my face	Never	76	19.8
	Sometimes	84	21.9
	Always	98	25.6
	Often	111	29.0
	Rarely	14	3.7

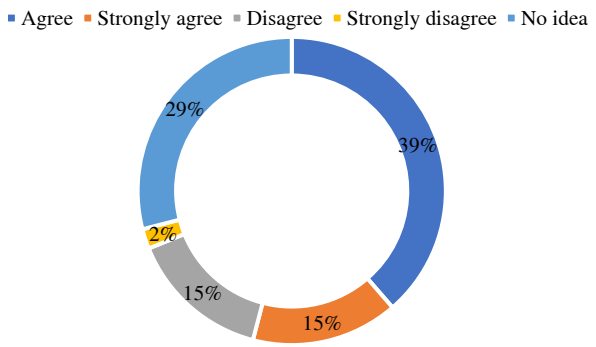

Figure 2: Illustrates whether urbanization prevents sun exposure and production of vitamin D among participants

participants held the belief that supplement intake is better than dietary sources, with 69.5% in agreement that supplement intake is preferable to nutritional status, yet this group included a notable (79.9%) opinion that supplement intake without physician recommendation is inappropriate.

Table 4 shows results of this study on the knowledge and practice and attitude on vitamin D deficiency among adults in Saudi Arabia provided some insights on the practices toward vitamin D sufficiency. Further, a large proportion of participants reported infrequent outdoor physical activity, i.e. having participated in outdoor physical activity at least once a month among 39.7% and never among 15.1%. Additionally, dietary practices

Table 5: Shows general knowledge of vitamin D score results

Knowledge level	Frequency	Percent
High general knowledge level	244	63.7
Moderate general knowledge	127	33.2
Low general knowledge level	12	3.1
Total	383	100.0

Table 6: Shows nutrition knowledge about vitamin D score results

Knowledge level	Frequency	Percent
High nutrition knowledge level	34	8.9
Moderate nutrition knowledge	81	21.1
Low nutrition knowledge	268	70.0
Total	383	100.0

Table 7: Shows attitude of vitamin D score results

Knowledge level	Frequency	Percent
High attitude level	110	28.7
Moderate attitude level	256	66.8
Low attitude level	17	4.4
Total	383	100.0

Table 8: Shows practice of vitamin D score results

Knowledge level	Frequency	Percent
High practice level	117	30.5
Moderate practice level	225	58.7
Low practice level	41	10.7
Total	383	100.0

followed a troubling track, as 33.2% of respondents consumed fortified milk rarely, half of whom (16.3%) claimed not to consume any dairy products, while 39.2% of respondents said they do not eat fish at least twice a week, both of which are important to have enough vitamin D. Vitamin D supplements were used by 37.1% of participants sometimes and 20.6% said they always used them. Furthermore, the data revealed that many people keep their hands and faces out of direct sun, with 25.6% never applying sunscreen to their hands ever and 19.8% never putting sunscreen on their faces.

Table 5 shows the findings of my research on the knowledge, attitude and practice regarding vitamin D deficiency among adults in Saudi Arabia reveal that a significant majority exhibits a high level of general knowledge about vitamin D, with 63.7% of participants scoring highly in this area, encompassing a total of 244 individuals. Meanwhile, 33.2% of the respondents demonstrated a moderate level of knowledge, amounting to 127 individuals, while a small minority, consisting of only 3.1% or 12 participants, displayed a low level of general knowledge.

Table 6 shows findings from my medical research article, which investigates the knowledge, attitude and practices related to vitamin D deficiency among adults in Saudi Arabia, reveal concerning trends in nutritional awareness. As demonstrated in Table 6, the results indicate that only 8.9% of participants exhibited a high level of nutrition knowledge regarding vitamin D, while 21.1% displayed moderate knowledge. Alarmingly, the majority-70.0%-of respondents reported low levels of nutritional knowledge in this area.

Table 7 shows findings from the medical research article examining the knowledge, attitudes and practices regarding vitamin D deficiency among adults in Saudi Arabia illuminate significant trends in public perception. As illustrated in Table 7, the results reveal that a predominant 66.8% of participants exhibited a moderate attitude towards vitamin D, while only 28.7% demonstrated a high level of awareness, suggesting a substantial gap in optimal understanding. Notably, a minimal 4.4% of respondents reflected a low attitude level, indicating that most individuals have at least some recognition of the importance of vitamin D.

Table 8 shows findings of this study, which aimed to assess the knowledge, attitudes and practices concerning vitamin D deficiency among adults in Saudi Arabia, revealing significant insights into the practices related to vitamin D intake. As indicated in Table 8, the categorization of practice levels among the 383 participants illustrates that only 30.5% exhibited a high level of practice regarding vitamin D supplementation and lifestyle choices aligned with sufficient vitamin D levels. In contrast, a substantial majority, 58.7%, demonstrated a moderate practice level, suggesting that while some awareness and actions are present, they may not be sufficient to prevent deficiency. Alarmingly, 10.7% of respondents reported low practice levels.

Table 9 shows that general knowledge about vitamin D has statistically significant relation to age (p-value = 0.038), marital status (p-value = 0.0001), educational level (p-value = 0.0001), residential region (p-value = 0.0001), monthly income (p-value = 0.004), occupation (p-value = 0.0001) and sources of socialising (p-value = 0.0001). It also shows a statistically insignificant relation to gender.

Table 10 shows attitude level regarding vitamin D has statistically significant relation to educational level (p-value = 0.0001), residential region (p-value = 0.001),

Table 9: Relation between general knowledge about vitamin D and sociodemographic characteristics

Parameters		General knowledge level		Total (N = 383)	p-value*
		High general knowledge level	Moderate or low general knowledge		
Gender	Female	150	77	227	0.244
		61.5%	55.4%	59.3%	
	Male	94	62	156	
		38.5%	44.6%	40.7%	
Age	18 to 20	49	27	76	0.038
		20.1%	19.4%	19.8%	
	21 to 24	71	57	128	
		29.1%	41.0%	33.4%	
	25 to 45	61	34	95	
		25.0%	24.5%	24.8%	
	46 or more	63	21	84	
		25.8%	15.1%	21.9%	
Marital status	Single	156	108	264	0.0001
		63.9%	77.7%	68.9%	
	Married	88	26	114	
		36.1%	18.7%	29.8%	
	Widowed	0	5	5	
		0.0%	3.6%	1.3%	
Educational level	Primary	8	0	8	0.0001
		3.3%	0.0%	2.1%	
	High school	27	5	32	
		11.1%	3.6%	8.4%	
	Diploma	5	15	20	
		2.0%	10.8%	5.2%	
	Bachelor's degree	186	119	305	
		76.2%	85.6%	79.6%	
	Postgraduate	18	0	18	
		7.4%	0.0%	4.7%	
Residential region	Riyadh	54	28	82	0.0001
		22.1%	20.1%	21.4%	
	Eastern region	43	26	69	
		17.6%	18.7%	18.0%	
	Qassim	12	25	37	
		4.9%	18.0%	9.7%	
	Madinah	7	0	7	
		2.9%	0.0%	1.8%	
	Makkah	128	60	188	
		52.5%	43.2%	49.1%	
Monthly income	Less than 5000	143	84	227	0.004
		58.6%	60.4%	59.3%	
	5000 to 10000	31	32	63	
		12.7%	23.0%	16.4%	
	10001 to 15000	29	5	34	
		11.9%	3.6%	8.9%	
	More than 15000	41	18	59	
		16.8%	12.9%	15.4%	
Occupation	Student	51	67	118	0.0001
		20.9%	48.2%	30.8%	
	Healthcare sector	36	0	36	
		14.8%	0.0%	9.4%	
	Nonhealthcare sector	11	37	48	
		4.5%	26.6%	12.5%	
	Unemployed	78	15	93	
		32.0%	10.8%	24.3%	
	Others	68	20	88	
		27.9%	14.4%	23.0%	
Sources of socialising	Relatives and friends	106	39	145	0.0001
		43.4%	28.1%	37.9%	
	Internet	115	95	210	
		47.1%	68.3%	54.8%	
	Hospitals or clinics	5	0	5	
		2.0%	0.0%	1.3%	
	Others	18	5	23	
		7.4%	3.6%	6.0%	

*p-value was considered significant if ≤0.05

Table 10: Attitude level regarding vitamin D in association with sociodemographic characteristics

Parameters		Attitude level		Total (N = 383)	p-value*
		High attitude level	Moderate or low attitude level		
Gender	Female	67	160	227	0.678
		60.9%	58.6%	59.3%	
	Male	43	113	156	
		39.1%	41.4%	40.7%	
Age	18 to 20	15	61	76	0.193
		13.6%	22.3%	19.8%	
	21 to 24	37	91	128	
		33.6%	33.3%	33.4%	
	25 to 45	33	62	95	
		30.0%	22.7%	24.8%	
	46 or more	25	59	84	
		22.7%	21.6%	21.9%	
Marital status	Single	83	181	264	0.112
		75.5%	66.3%	68.9%	
	Married	27	87	114	
		24.5%	31.9%	29.8%	
	Widowed	0	5	5	
		0.0%	1.8%	1.3%	
Educational level	Primary	0	8	8	0.0001
		0.0%	2.9%	2.1%	
	High school	0	32	32	
		0.0%	11.7%	8.4%	
	Diploma	2	18	20	
		1.8%	6.6%	5.2%	
	Bachelor's degree	104	201	305	
		94.5%	73.6%	79.6%	
	Postgraduate	4	14	18	
		3.6%	5.1%	4.7%	
Residential region	Riyadh	23	59	82	0.001
		20.9%	21.6%	21.4%	
	Eastern region	18	51	69	
		16.4%	18.7%	18.0%	
	Qassim	11	26	37	
		10.0%	9.5%	9.7%	
	Madinah	7	0	7	
		6.4%	0.0%	1.8%	
	Makkah	51	137	188	
		46.4%	50.2%	49.1%	
Monthly income	Less than 5000	55	172	227	0.054
		50.0%	63.0%	59.3%	
	5000 to 10000	22	41	63	
		20.0%	15.0%	16.4%	
	10001 to 15000	9	25	34	
		8.2%	9.2%	8.9%	
	More than 15000	24	35	59	
		21.8%	12.8%	15.4%	
Occupation	Student	17	101	118	0.0001
		15.5%	37.0%	30.8%	
	Healthcare sector	14	22	36	
		12.7%	8.1%	9.4%	
	Nonhealthcare sector	11	37	48	
		10.0%	13.6%	12.5%	
	Unemployed	41	52	93	
		37.3%	19.0%	24.3%	
	Others	27	61	88	
		24.5%	22.3%	23.0%	
Sources of socialising	Relatives and friends	32	113	145	0.043
		29.1%	41.4%	37.9%	
	Internet	66	144	210	
		60.0%	52.7%	54.8%	
	Hospitals or clinics	1	4	5	
		0.9%	1.5%	1.3%	
	Others	11	12	23	
		10.0%	4.4%	6.0%	

*p-value was considered significant if ≤0.05

occupation (p-value = 0.0001) and sources of socialising (p-value = 0.043). It also shows statistically insignificant relation to gender, age, marital status and monthly income.

DISCUSSION

The purpose of the present study was to assess adults' knowledge, attitudes and practices regarding vitamin D deficiency in Saudi Arabia. Since the vast majority of the population reportedly suffers from vitamin D deficiency in this region, this investigation is particularly important. The results of this study show a great deal of general knowledge about vitamin D, as evidenced by participant responses but as well a disconcertingly low nutritional awareness regarding the dietary sources of vitamin D. In this discussion we shall compare these findings to the results of previous studies and discuss their similarities and discrepancies, as well as the limitations of this study.

Our observation of a very high level of general knowledge of vitamin D, as well as the knowledge mentioned in this study among the populations is above 63.7% that indicates high level of awareness similar with findings by Aljefree *et al.* [9], who reported widely different knowledge on vitamin D between populations in Saudi Arabia, some of which know relatively well. Nevertheless, poor levels of nutritional knowledge were found about vitamin D; only 8.9% of participants had a high level of knowledge of nutrition. Findings from Al-Faris *et al.* [10], that traditional foods of Saudi Arabia are poor sources of vitamin D, as also noted here, support this. A big problem with this lack of awareness about dietary sources of vitamin D is that even if they know how vital vitamin D is, it means that they don't know how to make dietary decisions that could help prevent a deficiency.

In addition, the study found that although the majority of the participants have understood the risks of vitamin D deficiency, such as the vulnerability of the indoor working population and the elderly, there is no correlation between knowledge and practice. For example, only 39.7% of participants said they engaged in outdoor physical activity at least once a month, key to vitamin D synthesis through sunlight exposure. As in the work of Al-Othman *et al.* [11], this finding is echoed in work showing that physical activity and sun exposure significantly contribute to levels of vitamin D status in children and adolescents in Saudi Arabia. Our finding of the low levels of outdoor activity among adults may reflect findings that broader societal trends, such as urbanization and lifestyle changes that prioritize indoor activities, may be barriers to the levels of sun exposure necessary for optimum vitamin D synthesis.

Furthermore, attitudes toward vitamin D supplementation were divided: A large number of participants felt that supplements are better than dietary sources. This view is in accordance with Hariri [12] who reported how the Saudi population relies on supplements for vitamin D, despite dietary sources that may supply sufficient vitamin D. It's a positive aspect of the overall attitude toward supplementation that 79.9% of participants were concerned that supplementation should be along recommended by a physician, indicating a recognition of the need of professional guidance in managing vitamin D intake.

Demographically we found that there was a strong relation of education with the awareness and attitude towards vitamin D deficiency. The vast majority was highly educated-79.6% had a bachelor's degree. Consistent with Alfaris *et al.* [13] observations, it is found that education increases awareness about vitamin D deficiency and its diseases. However, despite high educational levels, the many gaps in nutritional knowledge suggest that educational interventions need to be tailored for specific knowledge deficits about dietary sources and the significance of sun exposure.

However, limitations of the present study are its cross-sectional design, which prohibits the making of any inference of causality between knowledge, attitudes and practices around vitamin D deficiency. Furthermore, applying it is reliant on self-reported data that may involve bias as such as participants reporting more information than they truly possess on vitamin D. Additionally, the sample used for the study was mostly young and educated and may not fully reflect the broader Saudi public. Future studies should aim to include a more diverse demographic to better understand vitamin D awareness across different age groups, educational backgrounds and socioeconomic statuses.

CONCLUSIONS

While the study of the present study indicates a good level of general knowledge about vitamin D among Saudi adults, it also points out a significant lack of nutritional awareness and actual use of such knowledge. Our findings underscore the urgent need for targeted educational interventions aimed not only at raising awareness of vitamin D but also atfacilitating easy measures to boost dietary intake and sun exposure. Ultimately, closing these gaps is necessary to reduce the prevalence of vitamin D deficiency, which is extremely high in Saudi Arabia and improve public health.

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Conflicts of Interest

The authors declare no conflict of interest.

Ethical Approval

After fully explaining the study and emphasizing that participation is optional, each participant gave their informed consent. The information gathered was safely stored and utilized exclusively for study.

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