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Awareness and Preventive Practices Regarding Vitamin-D Deficiency in Ha'il Region, Saudi Arabia

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Abstract Vitamin-D deficiency remains a major public health concern in Saudi Arabia despite abundant sunlight, due to inadequate awareness and preventive practices. This study aimed to assess the knowledge, attitude and practice of the Saudi population towards Vitamin-D. A descriptive comparative cross-sectional study was conducted among 306 adults (≥18 years) in the Hail region. Participants completed a web-based survey on Vitamin-D, using a self-administered online questionnaire assessing knowledge, attitudes, practices and self-reported Vitamin-D status. Statistical analysis was conducted using the Statistical Package for the Social Sciences software. Results revealed that the daily recommended dose was not known by just 48%. Half (61.4%) of the respondents believed that a food source is enough to acquire Vitamin-D. A small percentage (36.3%) knew the negative effect of sunblock cream on the absorption of Vitamin-D. The knowledge of respondents regarding drug interactions related to Vitamin-D was limited (30.1%). The protective role of Vitamin-D against weakness and chronic diseases was known by around 50%. Different reasons for Vitamin-D deficiency were known by only around 50%. The ideal time for sunlight exposure was known by 35% of the respondents. Outdoor daytime activities were performed by just 52%. Around half (53.6%) of respondents had blood level assessments for Vitamin-D. Regarding the symptomatology among children, 43.5% and 40.5% of respondents did not know that deformed knee joints and delayed walking could occur. There was no significant association of educational level with Vitamin-D deficiency levels ($p = 0.379$). The majority of respondents did not know the importance of Vitamin-D for health and its daily recommended dose ($p<0.05$). Most of the male respondents were Vitamin-D deficient ($p = 0.002$). In conclusion, this study has provided insights into the population's knowledge, attitudes and practices toward Vitamin-D, which were low. Hence, the study can guide educational initiatives, policy formulation and preventive strategies to improve public health outcomes related to Vitamin-D deficiency in the Hail region.

Key Words Vitamin-D, Deficiency, Knowledge, Attitude, Awareness, Practices, Saudi Arabia, Ha'il Region, Public Health

INTRODUCTION

Vitamin-D deficiency is a major global public health issue. Globally, over 1 billion individuals suffer from Vitamin-D deficiency, defined as serum 25(OH)D levels below 20 ng/mL [1]. Vitamin-D, a member of the steroid hormone group, is a fat-soluble vitamin. It must be dissolved in dietary fat and emulsified by bile salts before absorption [1,2]. It plays an important role in preserving bone health and calcium balance and in the regulation of immune function, inflammation and cellular growth [3].

There two forms of Vitamin-D that later on converted into active form in our body (1.25 dihydroxy Vitamin-D): Ergocalciferol (Vitamin-D2), taken from plants and Cholecalciferol (Vitamin-D3), obtained from animal-supplied meals. However, sun exposure is by far the most essential source of Vitamin-D3, accounting for 90% of the total amount [1,3]. Nowadays, Vitamin-D is one of major interesting topics being discussed in research and clinics, as well as among individuals concerned with their health [3,4].

Maintaining sufficient Vitamin-D levels is an important factor in preventing osteoporosis as well as osteomalacia in adults and rickets in children. Studies are now uncovering its significance in overall health and chronic disease prevention [4]. Although the importance of Vitamin-D has already been

established, Vitamin-D deficiency, defined as a serum 25(OH)D concentration below 20 ng/mL, remains a worldwide health issue [5]. In most European countries, there is a prevalent issue in reaching normal Vitamin-D levels [6]. Except for countries with high fish intake and Vitamin-D supplementation, such as Finland [7,8].

In Saudi Arabia, despite the year-round availability of abundant sunlight, a high prevalence of Vitamin-D deficiency has been documented among people of all ages and genders, with studies estimating the prevalence to be as high as 60%-97% particularly higher levels in females, children and young adults [8]. An analytical cross-sectional study was conducted among the residents of Al-Qunfudhah governorate in Saudi Arabia. A total of 466 individuals participated in this study. Although 91% of them had previously heard of Vitamin-D, only 17.4% could identify sunlight exposure as the primary source of Vitamin-D [9]. Another study employed a self-administered online survey to gather information on the characteristics, knowledge, attitudes and self-reported behaviors of 800 Saudi Arabian mothers regarding Vitamin-D deficiency. The findings revealed that more than half of the mothers had a limited understanding. Less than two-thirds of the participants recognized their inadequate practice of taking Vitamin-D rich foods. Furthermore, two-thirds of the mothers displayed a negative attitude towards Vitamin-D deficiency [10].

A retrospective study was conducted involving patients who visited the outpatient clinics at Alameen General Hospital, Taif (Saudi Arabia) between 2019 and 2021. Demographic, clinical and laboratory data were gathered using a hospital software system. The study encompassed 2153 patients and among them, 900 individuals (41.8%) were found to have Vitamin-D deficiency [11].

A cross-sectional study was conducted in the Qassim Region of Saudi Arabia, utilizing a convenient non-probability sampling method with a sample size of 375 participants [12]. The findings indicate that while most individuals possess some knowledge about Vitamin-D, there are notable deficiencies in awareness of Vitamin-D deficiency among adults in Qassim, Saudi Arabia. Factors such as education, living in urban areas, employment status and income level were significant in determining awareness, highlighting the importance of targeted educational efforts. It is essential to disseminate information about Vitamin-D and its various aspects through different media channels, including television and social media platforms [13].

Deficiency of Vitamin-D can result in multiple other health serious consequences such as depression, fatigue, hyperparathyroidism, obesity, osteomalacia, chronic backache, hypertension, cancer, chronic pain, diabetes, multiple sclerosis and heart disease [14]. Vitamin-D is of great importance for multiple physiological and biological human processes. It is a common misconception that Vitamin-D deficiency mostly affects the elderly or those in medical care. Nonetheless, research indicates that younger adults are more prone to having low level of Vitamin-D. Besides its well-documented role in regulating calcium balance and enhancing bone mineralization, it has been reported that Vitamin-D has an impact on human reproductive system health [15].

Research conducted in Saudi Arabia has shown that almost half of participants generally had a limited understanding of the normal levels of Vitamin-D and 30% of participants don't know the recommended daily intake [10,12,15]. A majority were not aware of its benefits for vision, muscle health, weakness and fatigue [16]. Only 43.1% recognized that a reduced intake of Vitamin-D- rich foods contributes to deficiency. About 33.7% of participants preferred sun exposure to boost their Vitamin-D levels, while 32.4% opted for supplements [17]. However, just 39.2% had ever checked their Vitamin-D status [15-17].

A five-year retrospective study (2017-2021) involving 22.335 individuals from Majmaah found a 67.3% prevalence of Vitamin-D deficiency [18]. A study among elderly patients (above 60 years old) attending primary care centers in Jeddah reported a 60.8% Vitamin-D deficiency with 29.9% insufficiency [19].

Vitamin-D deficiency remains a major public health concern in Saudi Arabia even though Saudi Arabia is an area rich in sunlight. This contributes to increased risk of diseases related to Vitamin-D deficiency. Complications of Vitamin-D deficiency in Saudi Arabia can be minimized by building awareness on various sources of Vitamin-D. Previous studies done in Hail, have reported Vitamin-D deficiency among all age groups [4,11]. The incidence of Vitamin-D is increasing every year [13] hence present study is conducted to assess awareness and preventive practices regarding Vitamin-D deficiency in Ha'il Region, Saudi Arabia.

This study has provided insights into the population's awareness, attitudes and practices toward Vitamin-D, which can guide educational initiatives, policy formulation and preventive strategies to improve public health outcomes in the Hail region.

Objectives:

- Assess knowledge of respondents on the sources of Vitamin-D
- Assess knowledge of respondents on sign and symptoms and of Vitamin-D deficiency
- Assess awareness of respondents on the importance of sunlight
- Assess attitude of respondents towards Vitamin-D rich foods and outdoor practices
- Correlate knowledge of those respondents having low Vitamin-D levels with demographic variables, knowledge, attitude and practices

METHODS

Our study design was a descriptive comparative cross-sectional design was employed to assess knowledge, attitude and practices regarding Vitamin-D deficiency among adults in the Ha'il region. The study was conducted online using a self-administered questionnaire distributed across digital platforms and social media to reach adults residing in the Hail region, Saudi Arabia. The questionnaire was pretested on 10 randomly selected adults in order to maximize reliability and minimize ambiguity in understanding any question.

The estimated sample size for the study came out 306 participants. This number ensured statistical validity and adequate representation of the population in the Hail region, considering expected non-response rates. A questionnaire was written in English and later translated in Arabic by a linguistic expert. The Arabic form was retranslated in English in order to verify its reliability. The Arabic form was fed on Google Form. Pretesting was done on 10 respondents in order to ensure the accuracy and validity of the data by checking for unclear questions and confusing instructions. The link of Google form was sent by WhatsApp and email to all contacts. There was a free choice to ignore the request if they did not consent to participate in the research. The target population includes adults (≥18 years) residing in the Hail region from various educational and occupational backgrounds. The inclusion criteria for our study were to recruit adults aged 18 years and above, residents of the Hail region, individuals able to read and understand Arabic and who voluntarily consent to participate. Exclusion criteria were respondents who submit incomplete questionnaires and those who had medical background as their responses could confound the results due to their prior correct knowledge on the issue.

Statistical Analysis was performed by the IBM SPSS Statistics version 23. After completion of sample size 306, data was transferred from google excel sheet to SPSS version 23 for descriptive and inferential analysis. Descriptive analysis was done in percentages and by graphic presentation. Inferential statistics was done by applying Pearson chi-square test. The respondents' Vitamin-D levels were asked. The most widely accepted threshold for Vitamin-D deficiency is a blood 25-hydroxyVitamin-D (25(OH)D) level below 30 nmol/L.1-3 Relationship of knowledge of those respondents having low Vitamin-D levels with certain variables was done applying Pearson chi-square test, keeping level of significance $p \leq 0.05$ (significance threshold $p \leq 0.05$).

RESULTS

Demographic profile of respondents is shown in Table 1. Fifty one percent (156/306) of the respondents were between 18-28 years of age and 60.5% were males (185/306). University employees and students were 68.3% (209/306).

Table 1: Demographic profile of the respondents (n=306)

Variables		Frequency	Percent
Age (years)	18-16	47	15.4
	18-28	156	51
	28-38	34	11.1
	38-48	29	9.5
	48-58	23	7.5
	>58	17	5.6
Gender	Male	185	60.5
	Female	121	39.5
Educational Level	No formal Education	6	2
	Elementary School	10	3.3
	High School	59	19.3
	Middle School	22	7.2
	University	209	68.3
Area of Residence	Urban	262	85.6
	Rural	44	14.4

The knowledge of the respondents on the nature of Vitamin-D is shown in Table 2. Majority (160/306=52.3%) knew that it is a fat-soluble vitamin, however the daily recommended dose was not known by 48% (147/306). The adequate blood level was known by just 39.2% (120/306).

Table 2: Knowledge on the Nature of Vitamin-D

Variables		Frequency	Percent
Vitamin-D	Co-Factor	31	10.1
	Enzyme	22	7.2
	Fat-Soluble	160	52.3
	Water- Soluble	39	12.7
	Do not know	54	17.6
Adequate Blood Level (ng/mL)	<10	14	4.6
	10-30	50	16.3
	30-50	120	39.2
	>100	22	7.2
	Do not know	100	32.7
Recommended daily dose (IU) of Vitamin-D	200	65	21.2
	600	66	21.6
	800	28	9.2
	Do not know	147	48
Frequency of Vitamin-D level testing (in months) in a Vitamin-D deficient patient	1-3	49	16
	3-6	89	29.1
	6-9	44	14.4
	9-12	16	5.2
	Do not know	108	35.3
Vitamin-D is important for human body	Yes	290	94.8
	No	3	1
	Do not know	13	4.2
Acquiring Vitamin-D from food is not enough	Yes	71	23.2
	It is enough	188	61.4
	Do not know	47	15.3
Sunblock cream decreases the absorption of Vitamin-D	Yes	111	36.3
	No effect	102	33.3
	Do not know	93	30.3
Vitamin-D has drug interaction with certain drugs	Yes	92	30.1
	No drug interaction	72	23.5
	Do not know	142	46.4

Table 3: Knowledge on the importance of Vitamin-D to the Human Body

Variables		Frequency	Percent
Bone Health	Yes	259	84.6
	No	22	7.2
	Do not know	25	8.2
Skin Health	Yes	197	64.4
	No	60	19.6
	Do not know	49	16
Hair Health	Yes	259	84.6
	No	22	7.2
	Do not know	25	8.2
Vision Health	Yes	197	64.4
	No	60	19.6
	Do not know	49	16
Muscle Integrity	Yes	209	68.3
	No	46	15
	Do not know	51	16.7
Body Immunity	Increases	180	58.8
	No effect	45	14.7
	Do not know	81	26.5
Prevent against chronic diseases	Yes	159	52
	No	75	24.5
	Do not know	72	23.5
Protection against weakness	Yes	213	69.6
	No	40	13.1
	Do not know	53	17.3

Table 4: Knowledge on Different Sources of Vitamin-D

Variables		Frequency	Percent
Food Items			
Fatty fish (such as tuna and salmon)	Yes	213	69.6
	No	45	14.7
	Do not know	48	15.7
Egg yolk	Yes	171	55.9
	No	50	16.3
	Do not know	85	27.8
Whole wheat	Yes	90	29.4
	No	106	34.6
	Do not know	110	35.9
Cod Liver Oil	Yes	145	47.4
	No	66	21.6
	Do not know	95	31
Liver	Yes	159	52
	No	64	20.9
	Do not know	83	27.1
Red Meat	Yes	135	44.1
	No	74	24.2
	Do not know	97	31.7
Exposure to Sunlight	Yes	254	83
	No	13	4.2
	Do not know	39	12.7

Table 5: Knowledge on Different Reasons of Vitamin-D deficiency

Variables		Frequency	Percent
Insufficient Sun Exposure	Yes	213	69.6
	No	54	17.6
	Do not know	39	12.7
Malabsorption	Yes	162	52.9
	No	70	22.9
	Do not know	74	24.2
Old Age	Yes	117	38.2
	No	121	39.5
	Do not know	68	22.2
Physical Inactivity	Yes	134	43.8
	No	99	32.4
	Do not know	73	23.9
Diet Poor in Vitamin-D	Yes	206	67.3
	No	45	14.7
	Do not know	55	18
Kidney Diseases	Yes	64	20.9
	No	126	41.2
	Do not know	116	37.9

Table 6: Attitude towards Vitamin-D

Variables		Frequency	Percent
Vitamin-D is vital for overall health	Yes	290	95
	No	16	5
Exposure to Sunlight is necessary for Vitamin-D synthesis in body	Yes	213	69
	No	93	31
Concerned with Vitamin-D blood level	Yes	165	54
	No	141	46
Concerned to know about Vitamin-D deficiency associated symptoms	Yes	164	53
	No	142	47

The "vitamin is important for human body" was acknowledged by 94.8% (290/306). More than half (188/306=61.4%) of the respondents believed that food source is enough to acquire Vitamin-D. A small percentage (111/306=36.3%) knew the negative effect of sunblock cream on the absorption of Vitamin-D. The knowledge of respondents on drug interaction related to Vitamin-D was limited (92/306=30.1%).

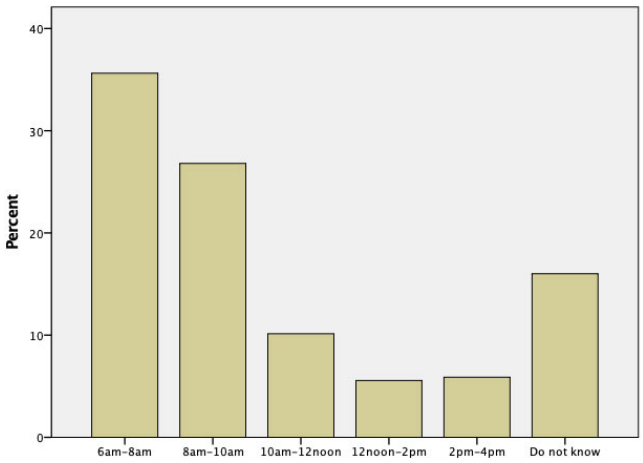

Figure 1: Ideal time for sunlight exposure to get Vitamin-D

In Table 3, the knowledge on different effects of Vitamin-D on human body is shown. Majority (259/306=84.6%) of study respondents knew that Vitamin-D is essential for bone and hair health. However, a significant percentage responded that Vitamin-D has effect on skin, vision and muscle integrity (197/306=64.4%, 197/306=64.4% and 209/306=68.3% respectively). Vitamin-D protects against weakness and chronic diseases were answered by 69.6% (213/306) and 52% (159/306) respectively.

Table 4 shows the knowledge regarding different sources of Vitamin-D. Majority (213/306=69.6%) knew that fatty fish ((such as tuna and salmon) are the major sources of Vitamin-D. More than half of the respondents (171/306=55.9% and 159/306=52%) marked egg yolk and liver as the major sources. Eighty-three percentage of respondents (254/306) had the knowledge that sunlight exposure is necessary to get Vitamin-D.

Table 5 shows knowledge of study participants on different reasons of Vitamin-D deficiency. It was revealed that insufficient sunlight exposure and malabsorption were labelled as the causes by 69.6% (213/306) and 52.9% (162/306) followed by diet poor in Vitamin-D (206/306=67.3%). Renal diseases were not labelled as the cause of Vitamin-D deficiency by 41.2% (126/306) of respondents.

Figure 1 shows different timings (reported by respondents) that are ideal for sunlight exposure in order to have adequate Vitamin-D in body. The time between 6am and 8am is reported by 35.6% (109/306).

As shown in Figure 2, about half of respondents (159/306=52%) got information about Vitamin-D from social media followed by health care practitioners (58/306=19%).

Table 6 reveals different attitude of respondents towards Vitamin-D. Around 50% of the respondents were concerned about their Vitamin-D level and wanted to know the symptomatology of Vitamin-D deficiency (165/306=54% and 164/306=53%).

Table 7 shows different practices of respondents related to Vitamin-D. Around half (164/306=53.6%) of respondents

Table 7: Practices towards Vitamin-D

Variables		Frequency	Percent
Ever had blood level assessment for Vitamin-D	Yes	164	53.6
	No	142	46.4
Outdoor day time activities performed periodically	Yes	159	52
	No	147	48
While going outside during daytime, wear hat, use umbrella and apply strong sunblock cream	Yes	154	50
	No	152	50

Table 8: Different symptoms of Vitamin-D deficiency

Variables		Frequency	Percent
Joints and bone pain	Yes	225	73.5
	No	21	6.9
	Do not know	60	19.6
Muscle pain	Yes	183	59.8
	No	38	12.4
	Do not know	85	27.8
Mood changes	Yes	249	81.4
	No	10	3.3
	Do not know	47	15.4
Deformed knee joints in children	Yes	136	44.4
	No	37	12.1
	Do not know	133	43.5
Delayed walking in children	Yes	153	50
	No	29	9.5
	Do not know	124	40.5
Delayed tooth eruption in children	Yes	165	53.9
	No	31	10.1
	Do not know	110	35.9

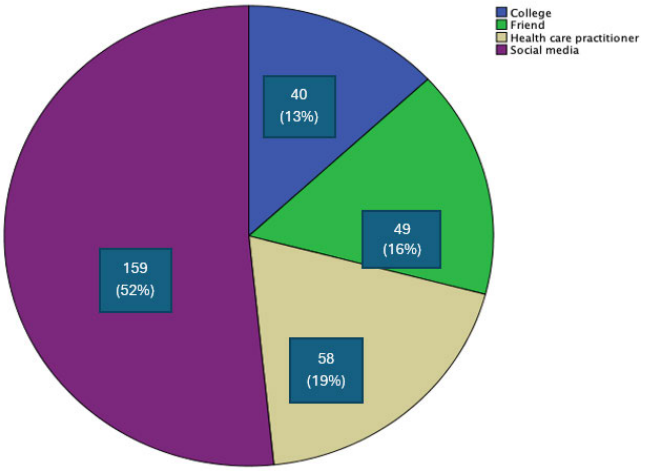

Figure 2: Source of knowledge on Vitamin-D (n=306)

had blood level assessment for Vitamin-D. Outdoor day time activities were performed by 52% (159/306). Fifty percentage (154/306) of respondents covered themselves (use umbrella or hat and apply sun block cream) while going outside during the daytime.

Table 8 shows the knowledge of respondents regarding different symptoms of Vitamin-D deficiency. Majority (225/306=73.5%) knew that there is joints and bone pain. Muscle pain and mood changes also occur in Vitamin-D

Table 9: Relationship of knowledge of those respondents having low Vitamin-D levels with demographic variables, knowledge, attitude and practices. (Application of Chi-Square Test, keeping level of significance p ≤0.05)

Variable	Category	Low Vitamin-D Level: n (%)	χ^2	p-value
Gender	Male	229 (75%)	14.929	0.002
Educational Level	No formal Education	137 (45%)	12.866	0.379
	Elementary School	140 (46%)		
	High School	122 (40%)		
	Middle School	122 (40%)		
	University	113 (37%)		
Nature of Vitamin-D				
Recommended Daily Dose	Do not know	205 (67%)	31.872	0.000
Important for overall health	Do not know	203 (66%)	19.679	0.003
Knowledge regarding food items containing Vitamin-D				
Fatty Fish	Not a source	177 (58%)	12.303	0.056
Egg Yolk	Not a source	211 (69%)	15.651	0.016
Cod Liver Oil	Not a source	189 (62%)	12.693	0.048
Liver	Not a source	203 (66%)	12.777	0.050
Red Meat	It is a source	223 (73%)	8.237	0.021
Knowledge on reasons of Vitamin-D deficiency				
Ideal time for sun exposure	6am-8am	208 (68%)	7.317	0.006
Malabsorption	No related	177 (58%)	9.892	0.097
Old age	Not related	174 (57%)	7.988	0.239
Physical Inactivity	Not related	177 (58%)	5.788	0.049
Diet rich in Vitamin-D	Not necessary	189 (62%)	4.986	0.046
Kidney diseases	Not related	238 (78%)	8.233	0.949
Effect of Sunblock Cream on the absorption of Vitamin-D	Not effect	214 (70%)	13.099	0.055
Attitude towards Vitamin-D deficiency				
Concerned to know Blood Vitamin-D level	Yes	217 (71%)	5.770	0.005
Outdoor day time activities	Not usual	183 (60%)	9.492	0.020
Knowledge on Symptomatology				
Bone and body pain	No effect	214 (70%)	16.067	0.013
Mood changes	No effect	205 (67%)	4.987	0.003
Delayed walking in children	No effect	203 (66%)	6.098	0.000
Deformed knee in children	No effect	189 (62%)	6.143	0.007
Delayed tooth in children	No effect	198 (65%)	18.735	0.005

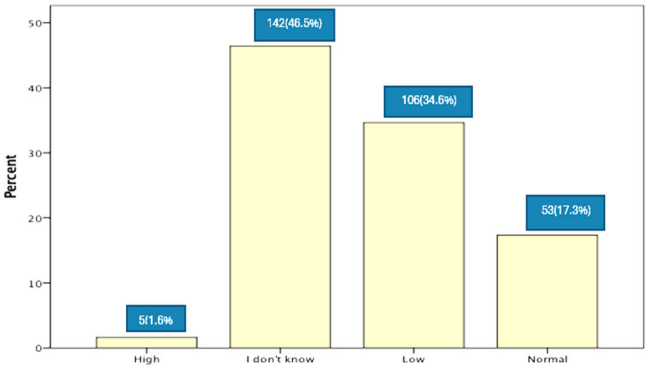

Figure 3: Different levels of Vitamin-D among respondents

deficient patients (answered by 183/306=59.8% and 249/306=81.4% of respondents). Regarding the symptomatology among children, 133/306=43.5% and 124/306=40.5% of respondents did not know that deformed knee joints, delayed walking could occur. Just 165/306=53.9% knew that there is delayed tooth eruption if the child is Vitamin-D deficient.

As shown in Figure 3, just 53/306=17.3% of study participants had normal blood levels of Vitamin-D, majority (142/306=46.5%) did not know as they never had assessment. Among study respondents, the prevalence of Vitamin-D deficiency was 106/306=34.6%.

Results of cross tabulation (between the responses of those having low Vitamin-D levels with certain variables) is shown in Table 9. Regarding the demographic profile, there was no association with any specific age group, deficiency was found in every age group (p=0.179) however most of the male respondents were Vitamin-D deficient (p=0.002). There was no significant association of educational level with Vitamin-D deficiency (p=0.379). Majority of respondents did not know the importance of Vitamin-D for health and its daily recommended dose (p<0.05). Respondents having low levels of Vitamin-D had lack of knowledge on food items containing Vitamin-D (p<0.05) lacking (p<0.05). Those respondents did not perform outdoor day time activities periodically (p<0.05). The knowledge on different symptomatology is also significantly lacking among Vitamin-D deficient respondents (p<0.05).

DISCUSSION

Based on multiple previous well documented studies, Vitamin-D deficiency considered a public health issue in Saudi Arabia. Even though the knowledge, attitudes and practices (KAP) related to Vitamin-D among various Saudi populations, including university students, adults, children and healthcare professionals has been assessed, the general awareness of Vitamin-D importance, sources, recommended intake and optimal sun exposure is often lacking. It is also noticeable that cultural, social and environmental barriers limiting effective practices, has not been well studied in Hail Region. [4,9,12-14].

In our study, more than half of the participants were young adults aged 18-28 years and male. In correlation to previous regional studies, most of them are well-educated and two-thirds holding university degrees [3,15-17]. Regardless their educational level, a noticeable critical gap in Vitamin-D knowledge reported. Although most respondents correctly identified Vitamin-D as a fat-soluble vitamin and agreed on its importance for human health, around half did not know the recommended daily intake and only 39.2% correctly identified the adequate serum Vitamin-D level.

In correlation with previous international, this finding highlights the discrepancy between the general awareness of Vitamin-D role and actionable knowledge such as appropriate dosage, indications for testing and optimal serum levels 5-17). It is also suggested that educational advantages alone do not ensure health awareness in Vitamin-D nutritional domain, reinforcing the need for public health interventions even among the college students and among a young, well- educated population [18].

Understanding the physiological roles of Vitamin-D showed in this study reported mixed results. the awareness of Vitamin-D's role for bone and hair health was higher compared to its role in muscle integrity, immunity and chronic disease prevention. This selective understanding might reflect the long-standing public health campaigns and clinical emphasis on osteoporosis and skeletal disorders, in contrast to limited alertness of Vitamin-D's contribution to muscle function, physiology and its relation to different organs, may lead to reduce motivation for screening and adherence to supplementation, particularly among younger and otherwise healthy individuals. Similar misconceptions have been reported globally, indicating a persistent need for public education on the non-skeletal benefits of Vitamin-D [19].

There was a disparity in knowledge regarding Vitamin-D deficiency manifestations. Vast majority of participants were familiar with musculoskeletal symptoms and mood changes. In contrast, the knowledge of pediatric manifestations such as delayed walking, tooth eruption and knee deformities was limited. This may lead to delay diagnosis and miss early intervention and prevention of Vitamin-D deficiency in children. these findings indicate the need for targeting parents and caregivers through health promotion and emphasizing on the role of Vitamin-D for early childhood growth and development.

When it comes to people's awareness of dietary sources of Vitamin-D, the result is contradictory. while many individuals correctly recognize fatty fish, eggs and liver as sources, a remarkable number of participants are unaware that cod liver oil and red meat also contribute to Vitamin-D intake. Notably, 83% acknowledged sunlight as a major natural source; however, confusion existed regarding the optimal time for sun exposure, with many selecting early morning hours (6-8 AM), which provide limited UVB radiation for Vitamin-D synthesis. In contrast, international evidence suggests that exposing arms and legs (or equivalent skin area) to sunlight for 5-15 minutes at noun, 2-3 times per week, is sufficient for Vitamin-D synthesis in light-skinned individuals [20,21]. The misconception reported in our study believed to contribute to inadequate endogenous Vitamin-D production in Hail

populations due to sun avoidance or incorrect timing than insufficient sunlight exposure like: malabsorption and inadequate diet. Nonetheless, a notable number failed to link kidney disease or aging with this deficiency, highlighting the need for improved public awareness of the physiological and pathological factors that affect Vitamin-D metabolism.

Only half of the respondents reported undergoing Vitamin-D testing or participating in regular outdoor activities indicating that Vitamin-D Practice are not ideal. additional behaviors that may further reduce Vitamin-D synthesis such as using hats and umbrellas were noticed. These findings highlight a behavioral contradiction: while participants recognize the importance of sunlight, protective habits and lifestyle patterns may limit sufficient exposure [20]. In parallel to previously reported high rates in Middle Eastern populations [4,6], Among the participants who knew their Vitamin-D level, 34.6% reported Vitamin-D deficiency. Other 46.4% of participants were unaware of their Vitamin-D status, highlighting the lack of engagement in annual visit and healthcare maintenance visits.

CONCLUSIONS

Overall, the results indicate remarkable gap between general awareness and specific actionable knowledge among residents of the Ha'il region. Despite high level of awareness of Vitamin-D's importance and major sources, the knowledge about dosage, sunlight physiology, food sources and clinical symptoms found to be suboptimal. additionally, the behavior aimed at protecting against Vitamin-D deficiency such as: sun exposure timing and preventive practices was poor and the need for targeted educational interventions.

Limitations

It was a cross-sectional, online survey- based study done in a single region, hence there is an issue with generalizability. There is a chance of potential response bias and self-reported data.

Ethical Statement

Participant did not incur any financial expenses during the research. Ethical approval was obtained from the Ethical Review Board (ERB) of University of Ha'il ((H-2025-931). This study was conducted according to the principles of the Helsinki Declaration (Ethical Principles for Medical Research Involving Human Subjects). The online questionnaire link was shared via social media and institutional platforms. Informed consent was obtained electronically before participants proceed to the questionnaire. Anonymity and confidentiality were maintained. Participants' knowledge, attitude and practices were asked related to Vitamin-D by multiple- choice questions.

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