

# Knowledge, Attitude And Practices Regarding Exposure To Sunlight And Its Effect On Vitamin ( D)Among Adult Male Visitors Of Primary Health Care Centers In Taif City , Saudi Arabia

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**Abstract:** Vitamin D deficiency is an important public health problem in Saudi Arabia. Exposure to sunlight has a great importance in this regard; because of its health effects on building of vitamin D and being the main source of vitamin D.

**Objectives:** To explore the knowledge, attitude and practice of sun exposure affecting vitamin D among adult male visitors of Primary Health Care Centers In Taif City.

**Subjects and Methods:** Analytical cross-sectional study was carried out in Taif governorate in the western region of Saudi Arabia including a representative sample of adult male visitors older than 18 years attending primary health care centers (PHCCs) within the city limits of Taif governorate throughout the study period (January-February, 2018). A pre-designed Arabic self-administered questionnaire was used for data collection.

**Results:** The study included 354 males. More than one-third of them either aged between 25 and 39 years (40.3%) or between 40 and 60 years (34.2%). Most of them (76.3%) were Saudis. Majority of the participants (82.5%) have heard about vitamin D. The most frequent reported sources of awareness about vitamin D were friends/relatives (31.2%), physicians (29.5%), internet (27.4%) and TV (21.9%). Overall only 16.7% of the participants expressed sufficient knowledge regarding vitamin D. Majority of the participants (88.7%) agreed that vitamin D is important for their health. Majority of the participants were like to be exposed to sunlight either always (38.4%) or sometimes (41%) whereas only 4.8% avoided exposure to sunlight and 15.8% exposed to sunlight rarely. Regarding nationality, 11.9% of non-Saudi compared to only 2.6% of Saudis avoided exposure to sunlight,  $p=0.001$ . Regarding participants` educational level, 10.7% of illiterates compared to only 0.7% of university/above educated males avoided sunlight exposure,  $p=0.010$ . Overall adequate practice regarding sunlight exposure and vitamin D intake was observed among approximately two-thirds of the participants (66.4%).

**Conclusions:** Overall knowledge regarding vitamin D was insufficient. Attitude and practice of the participants regarding importance of vitamin D to health and sunlight exposure was adequate, particularly among Saudis, living in urban areas and high educated individuals.

**Keywords:** vitamin D, adult male, public health problem.

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## 1. INTRODUCTION

### 1.1 Background:

Vitamin D deficiency is an important public health problem in Saudi Arabia. Low levels of Vitamin D predisposes to increased incidence of coronary heart disease (CHD), as evident in the recent national data <sup>(1)</sup>.

Exposure to sunlight has a great importance in this regard; because of its health effects on building of vitamin D <sup>(2)</sup>. Exposure to sunlight is the main source of vitamin D, and there are also a few dietary sources of vitamin D, including oily fish and egg yolks, as well as vitamin D dietary supplements <sup>(3)</sup>.

In developing countries, the prevalence of Vitamin D deficiency varies widely by and within regions, between 30 % and 90 % according to the cut-off values used even within specific regions. The problem was identified in Saudi Arabia long back itself <sup>(4)</sup>.

As per recommendations, exposure to sunlight on 15% to 20% of the body like face, arms and legs without sunscreen for 10 -15 minutes 3 times per week from 9 am to 3 pm is required to provide healthy amounts of vitamin D to the body without damaging the skin <sup>(5)</sup>.

### 1.2 Literature review

A Saudi study was carried out on 100 patients (vitamin D-deficient children) and 100 healthy children. Participants were interviewed separately on topics including their awareness, knowledge, and attitudes regarding vitamin D using multiple-choice and short-answer questions. This prospective, cross-sectional study performed between January 2011 and December 2011 at the Security Forces Hospital, Riyadh, Saudi Arabia found that only 28% aware of the sources of vitamin D, while among healthy subjects 64% were aware. Similarly, only 50% of patients and their parents knew of the health benefits of vitamin D, while 70% of healthy subjects had knowledge. Hence, their findings suggested low levels of awareness and knowledge regarding vitamin D <sup>(6)</sup>.

A Study of 4,035 students and 2,104 employees was conducted to estimate the Prevalence of vitamin D deficiency and its associated factors in the Central, Western, and Eastern regions of Saudi Arabia between January 2013 and December 2014 <sup>(7)</sup>. The prevalence of vitamin D deficiency was 49.5% in students and 44% in employees. Life style was not adequate to protect against vitamin D deficiency. Unhealthy nutritional habits were widespread, females, 16-19 years of age, low economic class, obese and lack of omega 3 supplements were risk factors in students. Employees living in the Eastern region, females, middle-income class, carbonated soft drink consumers, and lack of multivitamin supplements were at higher risk.

In a recent study in Saudi Arabia, in 2017, <sup>(8)</sup> using a quantitative approach to estimate knowledge, attitudes and behaviors about vitamin D in subjects with and without CHD in Saudi Arabia showed low levels of knowledge about vitamin D and low consumption of vitamin supplements were associated with vitamin D deficiency. This study was designed to better understand the underlying reasons for the differences in knowledge about vitamin D as well as to explore in more depth behaviors related to vitamin D in Saudi Arabia.

A cross sectional retrospective study was carried out in 2016 to estimate the awareness of vitamin D and its deficiency in Jeddah population, Saudi Arabia. Data were obtained from a questioner designed to collect information about vitamin D. The study population was formed of 1752 parents of children aged from 2 to 18, and dividing them to 746 highly educated, 491 low educated. Both of them had the media as their source of information. As a result of this study, 82.9% of them fail to identify the best time for sun exposure and 65.5% recognize inability to go outside due to work or weather issues as common cause of vitamin D deficiency <sup>(9)</sup>.

A study was carried out on a total of 465 young adult Saudi females aged 19 to 40 years old who were selected from primary health care centers of King Abdulaziz medical city, Riyadh, KSA <sup>(10)</sup>. A questionnaire was used to identify socio-demographic characteristics and risk factors such as sunlight exposure and dietary intake. 25-hydroxy vitamin D [25(OH)D], Parathyroid hormone (PTH) and bone biochemical parameter were measured. The cutoff values for Vitamin D were defined as follows: deficient (<25nmol/L), insufficient (25-75 nmol/L) and normal ( $\geq$  75 nmol/L). Overall, Vitamin D deficiency was identified in all participants. Despite the abundant sunlight in Saudi Arabia, the prevalence of Vitamin D deficiency among young healthy Saudi females was 100%. This finding should be considered a public health problem.

### Sunlight and Vitamin D:

In Saudi Arabia a study was carried out to estimate the Optimum Sun Exposure Times for Vitamin D Status Correction in four different cities (North, South, West and East regions) in the Kingdom. Ampoules containing 7-dehydrocholesterol in ethanol were exposed to sunlight every hour starting from sunrise until sunset in June 2013. The optimum sun exposure time for vitamin D<sub>3</sub> production according to this study in the north, south and west regions of Saudi Arabia during summer is from 8:30 AM to 10:30 AM, as well as 2:00 PM to 4:00 PM. Air pollution might be the cause for the decreased conversion of 7-dehydrocholesterol to pre-vitamin D<sub>3</sub> in the east region. Conservatively, the optimum time for sun exposure therefore in Dammam city is from 8:30 AM to 10:00 AM, as well as 1:00 PM to 2:30 PM. This study confirms that the optimum sun exposure during summer can be highly effective in preventing vitamin D deficiency in Saudi Arabia

A study was conducted In 110 elite New Zealand outdoor athletes volunteered to participate in an interview with a trained interviewer. The interviewer asked the athletes questions on their Vitamin D knowledge, attitudes and practices about sun exposure as well as their concerns about skin cancer. The result of this study was that athletes were more concerned about their risk of skin cancer (66%) than their vitamin D status (6%). Although the majority (97%) were aware of Vitamin D and could identify the sun as a source (76%) only 17% could name another source of Vitamin D. Only 10 (9%) reported always applying sunscreen before going out in the sun. No athlete reported reapplying sunscreen every hour and 25 suggesting that they never reapply sunscreen <sup>(12)</sup>.

In Denmark, a cross-sectional study <sup>(13)</sup> was done to reveal that commonly recommended daily intake of vitamin D is not sufficient if sunlight exposure is limited. This study was among Sixty-nine Arab women (60 veiled, nine non-veiled) and 44 age-matched Danish controls were randomly selected amongst patients contacting the primary health care center for reasons other than vitamin D deficiency. There was severe vitamin D deficiency amongst sunlight-deprived individuals living in Denmark. In veiled Arab women, vitamin D deficiency is the result of a combination of limitations in sunlight exposure and a low oral intake of vitamin D.

### 1.3. Study rationale:

- Vitamin D deficiency is a common health problem affecting children, adult and old age, as has been reported by many studies in the past including studies relating sunlight and Vitamin D
- However we found that there are only two studies exploring knowledge attitude and practices regarding sunlight exposure and Vitamin D in Saudi Arabia <sup>(1)</sup>.
- Although, this subject was studied previously in the Kingdom of Saudi Arabia, it has not been studied properly in Taif region. Taif has a different geography and climate conditions.
- Primary health care settings provide services to all people, thus there is a great chance to screen for prevalence of awareness.
- Therefore, this study on knowledge, attitude and practices regarding sun exposure and vitamin D has been undertaken among adult male visitors of primary health care centers in Taif City

### 1.4. Aim of the study

To explore the knowledge, attitude and practice of sun exposure affecting vitamin D among adult male visitors of Primary Health Care Centers In Taif City

### 1.5. Specific objectives

1. To assess the knowledge, attitude and practices regarding sun exposure and vitamin D among adult male visitors of Primary Health Care Centers In Taif City
2. identify the socio-demographic factors that affecting the knowledge, attitude and practices regarding sun exposure and Vitamin D

## 2. METHODOLOGY

### 2.1 Study design:

Analytical cross-sectional study was carried out.

## 2.2 Study area/settings:

The study was conducted in Taif governorate, in the western region of Saudi Arabia. It is located in the Makkah Province at an elevation of 1700-2500 meters above sea level. The estimated population is 1,281,613 according to 2011 census <sup>(14)</sup>. In Taif, there are 136 primary health care centers (23 inside the city and 116 outside it). This study was conducted in the primary health care centers in the city.

## 2.3 Study population:

All adult male visitors older than 18 years attending primary health care centers (PHCCs) within the city limits of Taif governorate throughout the study period (January-February, 2018.)

## 2.4 Inclusion criteria:

Adult males older than 18 years attending Urban PHCCs in Taif governorate were eligible for study inclusion.

## 2.5 Exclusion criteria:

Those who cannot read and comprehend and those who refused to sign the consent.

## 2.6 Sample size:

The number of adult male visitors attending Urban PHCCs in Taif is approximately 200,000 per year. It is assumed that 29% of the patients in our sample know that exposure to sunlight is the main source of vitamin D, as per available literature <sup>(1)</sup>. Keeping 5% as error (power of 80%), assuming a confidence level of 95%, the sample size was calculated using OpenEpi software. The minimum sample size is 316 ,rounded off to 340, accounting for 10% drop out.

## 2.7 Sampling method:

In the first level, out of 23 PHCCs in Taif city, Four PHCCs were randomly selected. The total sample of 340 was equally distributed between these PHCCs. That means that 85 samples per center were included. The data were collected over a two –month period. Expecting that 11 patients could be interviewed per day, the minimum number of days required per PHCC is 11 days. On each OPD day, all those adult male visitors more than 18 years attending the OPD were approached to explain the study. Those who expressed willingness were taken for the study and given the questionnaire.

## 2.8 Data collection method:

Self-administered questionnaire was given to all participants. A pre-designed Arabic self-administered questionnaire was used. It had four sections. The first section is on the socio-demographic data of the visitors (e.g., age, marital status, income, education, job). The second section was to explore their knowledge and awareness regarding vitamin D sun exposure. Third section was on attitude and fourth one, on practices.

To validate the tool, the investigator distributed the questionnaire to two consultants of family medicine, one consultant of community medicine and one dermatologist who are experts and having interest regarding the subject and corrections were done accordingly.

Regarding responses to knowledge questions, a score of 1 was given to correct answers and a score of 0 was given to incorrect, missing or don't know responses. Total score and its percentage was computed for each participant. Those scored below 50% were considered as having "insufficient" knowledge whereas those scored 50% or more were considered as having "sufficient" knowledge.

Regarding responses to practice questions, a higher score was given to practices in favour of more exposure to sunlight and intake of vitamin D and vice versa. Total score was computed and its percentage from the total score was estimated for each participants. Participants scored at or higher than 50% were categorized as having "adequate practice) whereas those scored below 50% were categorized as having "inadequate practice".

Collected data were entered in Microsoft Excel and analyzed using SPSS software version 22.

## 2.9 Pilot study:

A pilot study was done among 20 adult male visitors from the selected primary health care centers. The pilot study helps to:

- Test the understanding of the visitors of the questionnaires and correcting it accordingly.

- Select the relevant variables suitable for the statistical methods to be used.
- Determine the time needed to answer the questionnaire.

### 2.10 Ethical considerations

1. A verbal consent was obtained from each participant prior to study conduction
2. All collected data were kept confidential
3. Approval of Joint Program of Family Medicine- Taif Region was obtained.
4. Approval of the Regional Research and Ethics committee at Taif was obtained.
5. Permission of the director of primary health care centers in Taif was obtained.

### 2.11 Data Analysis

Collected data were coded, verified and analyzed using SPSS program version 22. Data were described by frequency and percentage since all variables were categorized. Chi-square test was applied to test for the association between variables. Fischer Exact test was used in case of small frequencies (one or more of the cells contain a frequency less than 5). P-value <0.05 was applied as a cut-off level of statistical significance.

### 2.12 Budget:

Self-funded.

## 3. RESULTS

### 3.1 Demographic characteristics

The study included 354 males. Table 1 summarized their demographic characteristics. More than one-third of them either age between 25 and 39 years (40.3%) or between 40 and 60 years (34.2%). Most of them (76.3%) were Saudis. About two thirds of the participants (63.6%) were married. Regarding their educational level, 40.4% were university graduated or above whereas only 7.9% were illiterate. Slightly more than one-third of them (34.2%) were governmental employees, 21.5% were students and 20.3% were private sector employees. More than one third of the participants (36.3% reported an income of 5000 SR/month or less while 10.1% reported an income exceeded 15000 SR/month. Majority of them (91.5%) live in urban places.

**Table 1: Demographics of the participants (n=354)**

	Number	%
<b>Age in years</b>		
18-24	71	20.1
25-39	143	40.3
40-60	121	34.2
>60	19	5.4
<b>Nationality</b>		
Saudi	270	76.3
Non-Saudi	84	23.7
<b>Marital status</b>		
Single	103	29.1
Married	225	63.6
Divorced	17	4.8
Widowed	9	2.5
<b>Educational level</b>		
Illiterate	28	7.9
Primary school	38	10.7
Intermediate school	33	9.3
Secondary school	112	31.6
University/+	143	40.4
<b>Occupation</b>		
Students	76	21.5
Governmental employee	121	34.2

Military	22	6.2
Private sector employee	72	20.3
Retired	40	11.3
Not working	23	6.5
<b>Income in SR/month (n=317)</b>		
≤5000	115	36.3
>5000-10000	86	27.1
>10000-15000	84	28.5
>15000	32	10.1
<b>Residence</b>		
Urban	324	91.5
Rural	30	8.5

### 3.2 Vitamin D awareness and knowledge:

Majority of the male participants (82.5%) have heard about vitamin D as illustrated from figure 1. The most frequent reported sources of awareness about vitamin D were friends/relatives (31.2%), physicians (29.5%), internet (27.4%) and TV (21.9%). Figure 2

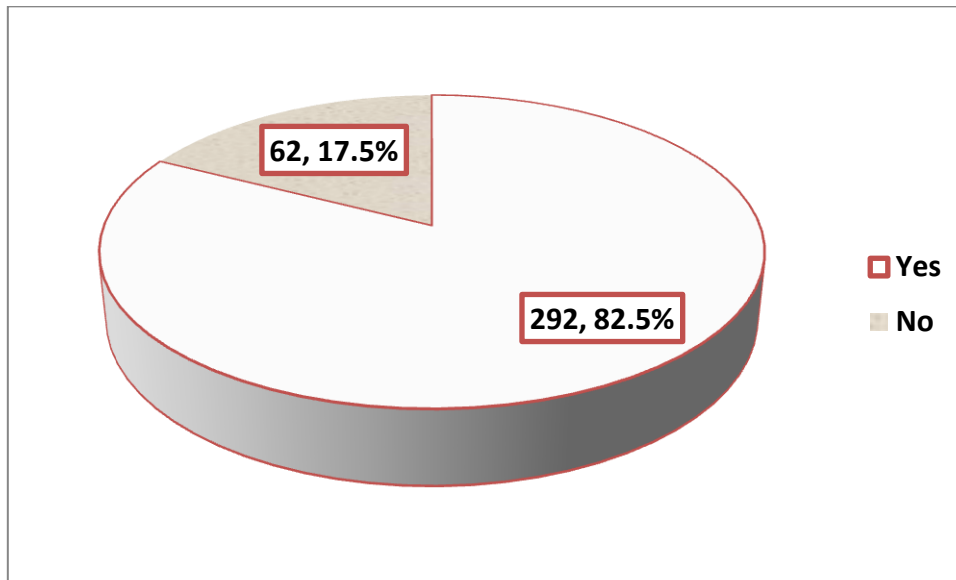


Figure 1: Hearing of the participants about vitamin D

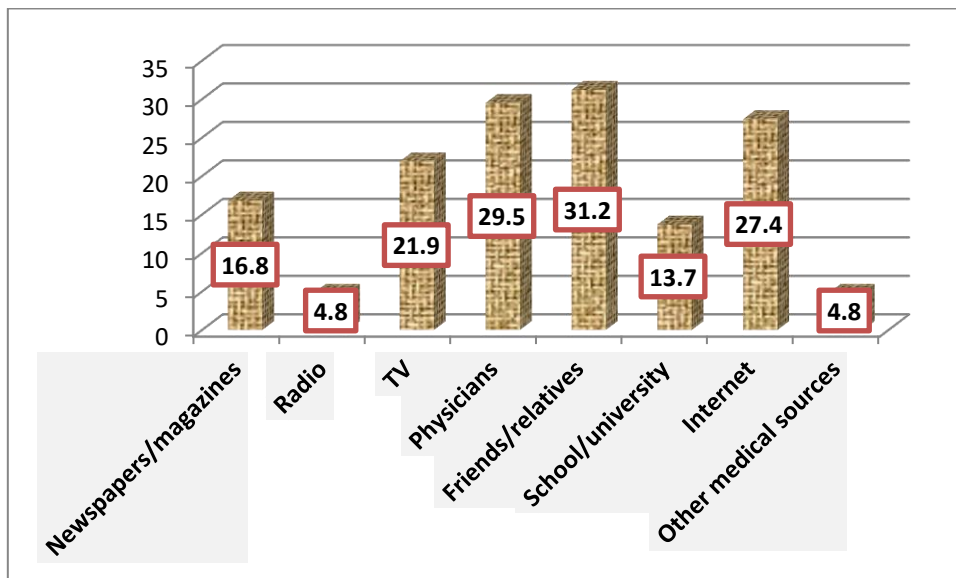


Figure 2: Source of awareness about vitamin D (n=292)

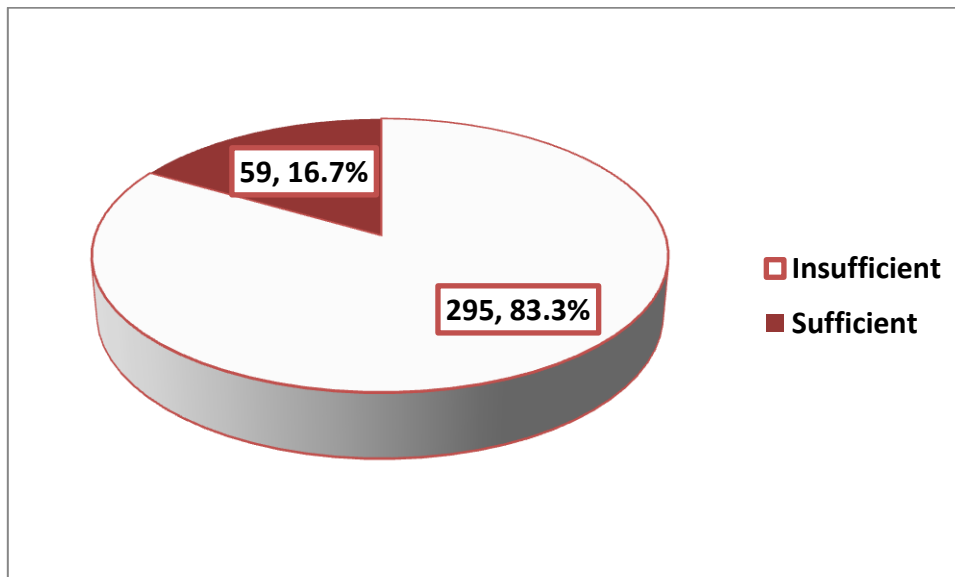
From table 2, it is seen that most of the participants (76.8%) knew correctly that vitamin D is important in keeping healthy bone whereas minorities of them could recognize its importance in prevention of kidney diseases (9%) and cancer (7.6%). Regarding vitamin D source, most of them (75.1%) could recognize sun exposure while diet and supplements were recognized by 29.7% and 15.5% of them, respectively. Concerning the good food sources of vitamin D, the most known one was milk (44.6%), followed by vegetables and fruits (38.4%) and fatty fish “Salmon and sardines” (27.1%).

Overall only 16.7% of the participants expressed sufficient knowledge regarding vitamin D as displayed in figure 3.

**Table 2: Responses of the participants to knowledge regarding vitamin D’s questions.**

	Frequency	Percentage
<b>Importance of vitamin D*</b>		
-Keeping healthy bones	272	76.8
-Prevention of kidney diseases	32	9.0
-Prevention of cancer	27	7.6
-Don` t know	60	16.9
<b>Sources of vitamin D*</b>		
-Diet	105	29.7
-Sun exposure	266	75.1
-Supplements	55	15.5
-Don` t know	44	12.4
<b>Good food sources of vitamin D*</b>		
-Vegetables and fruits	136	38.4
-Milk	158	44.6
-Fatty fish (Salmon and sardines)	96	27.1
-Olive oil	19	5.4
-Eggs	70	19.8
-Don` t know	54	15.3

\*More than one answer was possible



**Figure 3: Level of Knowledge of the participants regarding vitamin D**

Table 3 presents the demographic factors associated with level of vitamin D knowledge among the participants. The highest percentage of sufficient knowledge was observed among males in the age group “25-39 years” (23.1%) whereas the lowest percentage was observed among those in the age group “18-24 years” (8.5%). The difference was statistically significant,  $p=0.040$ . Level of education was high significantly associated with level of vitamin D knowledge as

participants with university graduation and above were more knowledgeable than other categories, particularly illiterate participants as percentage of sufficient knowledge were 26.6% for university graduates versus 3.6% for illiterates,  $p=0.001$ . Regarding participants' job, students expressed the highest percentage of sufficient knowledge (66%) whereas not working participants expressed the lowest percentage of sufficient knowledge (8.7%). The association between participants' job and vitamin D level was statistically significant,  $p=0.039$ . Participants' monthly income was significantly associated with their vitamin D knowledge as those who had an income exceeded 15000 SR/month were more knowledgeable than those who reported an income of 5000 SR/month or less (40.6% versus 14.8%),  $p=0.007$ . Participants' nationality, marital status, and residence were not significantly associated with vitamin D knowledge level.

**Table 3: Demographic factors associated with vitamin D knowledge level among the participants.**

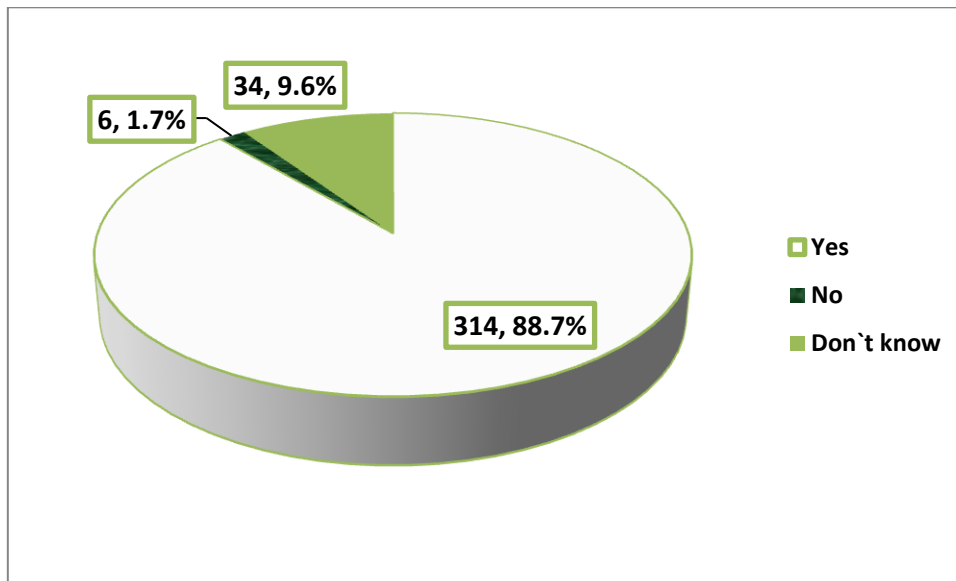
	Vitamin D knowledge		$\chi^2$ (p-value)
	Insufficient N=295 N (%)	Sufficient N=59 N (%)	
<b>Age in years</b>			
18-24 (n=71)	65 (91.5)	6 (8.5)	8.29 (0.040)
25-39 (n=143)	110 (76.9)	33 (23.1)	
40-60 (n=121)	104 (86.0)	17 (14.0)	
>60 (n=19)	16 (84.2)	3 (15.8)	
<b>Nationality</b>			
Saudi (n=270)	223 (82.6)	47 (17.4)	0.45 (0.503)
Non-Saudi (n=84)	72 (85.7)	12 (14.3)	
<b>Marital status</b>			
Single (n=103)	92 (89.3)	11 (10.7)	6.27 (0.099)
Married (n=225)	180 (80.0)	45 (20.0)	
Divorced (n=17)	14 (82.4)	3 (17.6)	
Widowed (n=9)	9 (100)	0 (0.0)	
<b>Educational level</b>			
Illiterate (n=28)	27 (96.4)	1 (3.6)	18.17 (0.001)
Primary school (n=38)	33 (86.8)	5 (13.2)	
Intermediate school (n=33)	29 (87.9)	4 (12.1)	
Secondary school (n=112)	101 (90.2)	11 (9.8)	
University/+ (n=143)	105 (73.4)	38 (26.6)	
<b>Occupation</b>			
Students (n=76)	71 (93.4)	5 (66.0)	11.73 (0.039)
Governmental employee (n=121)	92 (76.0)	29 (24.0)	
Military (n=22)	19 (86.4)	3 (13.6)	
Private sector employee (n=72)	60 (83.3)	12 (16.7)	
Retired (n=40)	32 (80.0)	8 (20.0)	
Not working (n=23)	21 (91.3)	2 (8.7)	
<b>Income in SR/month (n=317)</b>			
≤5000 (n=115)	98 (85.2)	17 (14.8)	12.01 (0.007)
>5000-10000 (n=86)	72 (83.7)	14 (16.3)	
>10000-15000 (n=84)	70 (83.3)	14 (16.7)	
>15000 (n=32)	19 (59.4)	13 (40.6)	
<b>Residence</b>			
Urban (n=324)	269 (83.0)	55 (17.0)	0.417*
Rural (n=30)	26 (86.7)	4 (13.3)	

\* p-value of Fischer exact test



**3.3 Attitude towards importance of vitamin D:**

Majority of the participants (88.7%) agreed that vitamin D is important for their health as shown in figure 4.



**Figure 4: Distribution of the participants according to their thinking of the importance of vitamin D to their health**

**3.4 Attitude towards sunlight exposure:**

Majority of the participants were like to be exposed to sunlight either always (38.4%) or sometimes (41%) whereas only 4.8% avoided exposure to sunlight and 15.8% exposed to sunlight rarely. Table 4

From table 5, it is obvious that 11.9% of non-Saudi compared to only 2.6% of Saudis avoided exposure to sunlight. This difference was statistically significant, p=0.001. Regarding participants` educational level, 10.7% of illiterates compared to only 0.7% of university/above educated males avoided sunlight exposure, p=0.010. Other studied demographic factors (age, marital status, occupation, income and residence) were not significantly associated with attitude towards sunlight exposure.

**Table 4: Attitude of the participants towards sunlight exposure**

Responses	Frequency	Percentage
I like exposure to sunlight always	136	38.4
I like exposure to sunlight sometimes	145	41.0
I exposed to sunlight rarely	56	15.8
I avoid exposure to sunlight	17	4.8

**Table 5: Demographic factors associated with attitude towards sunlight exposure among the participants.**

	Attitude towards sunlight exposure				$\chi^2$ (p-value)
	Always N=136 N (%)	Sometimes N=145 N (%)	Rarely N=56 N (%)	Avoid N=17 N (%)	
<b>Age in years</b>					
18-24 (n=71)	23 (32.4)	27 (38.0)	16 (22.5)	5 (7.0)	6.05 (0.735)
25-39 (n=143)	57 (39.9)	61 (42.7)	18 (12.6)	7 (4.9)	
40-60 (n=121)	49 (40.5)	48 (39.7)	20 (16.5)	4 (3.3)	
>60 (n=19)	7 (36.8)	9 (47.4)	2 (10.5)	1 (5.3)	

<b>Nationality</b>					
Saudi (n=270)	101 (37.4)	113 (41.9)	49 (18.1)	7 (2.6)	15.99
Non-Saudi (n=84)	35 (41.7)	32 (38.1)	7 (8.3)	10 (11.9)	(0.001)
<b>Marital status</b>					
Single (n=103)	38 (36.9)	41 (39.8)	17 (16.5)	7 (6.8)	
Married (n=225)	89 (39.6)	94 (41.8)	34 (15.1)	8 (3.6)	
Divorced (n=17)	5 (29.4)	7 (41.2)	4 (23.5)	1 (5.9)	4.02
Widowed (n=9)	4 (44.5)	3 (33.3)	1 (11.1)	1 (11.1)	(0.910)
<b>Educational level</b>					
Illiterate (n=28)	9 (32.1)	14 (50.0)	2 (7.1)	3 (10.7)	
Primary school (n=38)	20 (52.6)	12 (31.6)	4 (10.5)	2 (5.3)	
Intermediate school (n=33)	16 (48.5)	10 (30.3)	6 (18.2)	1 (3.0)	
Secondary school (n=112)	47 (42.0)	38 (33.9)	17 (15.2)	10 (8.9)	26.23
University/+ (n=143)	44 (30.8)	71 (49.7)	27 (18.9)	1 (0.7)	(0.010)
<b>Occupation</b>					
Students (n=76)	29 (38.2)	27 (35.5)	15 (19.7)	5 (6.6)	
Governmental employee (n=121)	35 (28.9)	62 (51.2)	21 (17.4)	3 (2.5)	
Military (n=22)	)				
Private sector employee (n=72)	10 (45.5)	9 (40.9)	3 (13.6)	0 (0.0)	
Retired (n=40)	33 (45.8)	24 (33.3)	10 (13.9)	5 (6.9)	
Not working (n=23)	21 (52.5)	13 (32.5)	4 (10.0)	2 (5.0)	18.18
	8 (34.8)	10 (43.5)	3 (13.0)	2 (8.7)	(0.253)
<b>Income in SR/month (n=317)</b>					
≤5000 (n=115)					
>5000-10000 (n=86)	38 (33.0)	49 (42.6)	18 (15.7)	10 (8.7)	
>10000-15000 (n=84)	38 (44.2)	38 (44.2)	8 (9.3)	2 (2.3)	
>15000 (n=32)	34 (40.5)	36 (42.9)	13 (15.5)	1 (1.2)	16.04
	8 (25.0)	13 (40.6)	9 (28.1)	2 (6.3)	(0.066)
<b>Residence</b>					
Urban (n=324)	129 (39.8)	129 (39.8)	52 (16.0)	14 (4.3)	5.14
Rural (n=30)	7 (23.3)	16 (53.3)	4 (13.3)	3 (10.0)	(0.162)

\* p- value of Fischer exact test

### 3.5 Practice regarding sunlight exposure and vitamin D intake

More than half of the participants reported that they mainly work in offices and for those not working, mainly stayed indoors. Nearly half of them (48.9%) spent more than 90 minutes outside home at weekend. More than half of them (53.4%) reported face and hands as the most exposed parts of their body to sunlight whereas 14.7% reported covering of all body parts preventing them from sunlight exposure. Most of the participants (76.2%) never used sunscreen preparation when exposed to sunlight while 4% used these preparations frequently (5-6 times/week). Vitamin D and calcium supplements were used by 31.6% and 29.1% of the participants, respectively. Almost two-thirds of the participants (69.2%) reported intake of vitamin supplements. Never drinking milk, eating eggs and fatty fish were reported by 15.3%, 11.9% and 30.8% of the participants, respectively whereas drinking milk, eating eggs and fatty fish frequently (5-6 times/week) were reported by 16.4%, 13.6% and 9% of them, respectively.

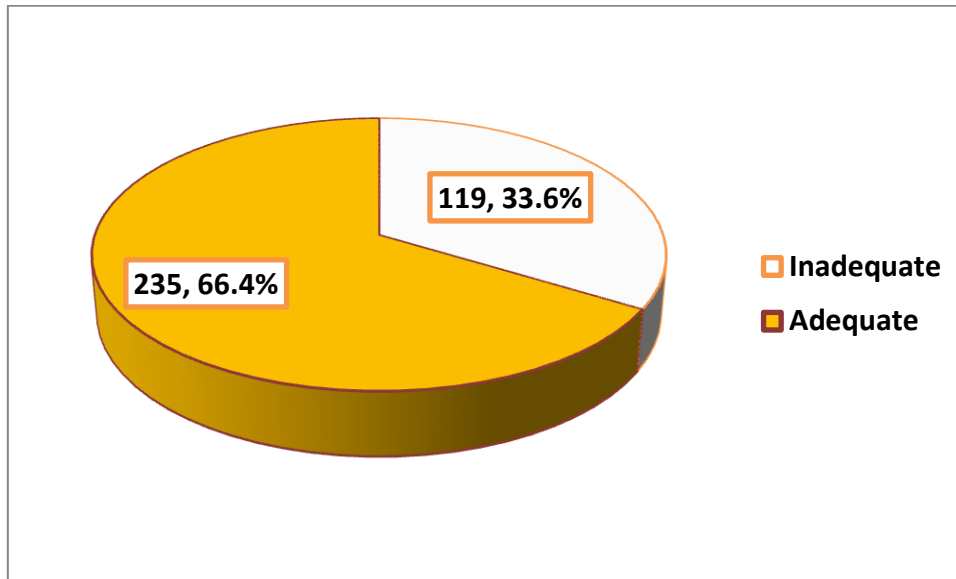
Overall adequate practice regarding sunlight exposure and vitamin D intake was observed among approximately two-thirds of the participants (66.4%) as demonstrated in figure 5.

Table 6: Practice of the participants regarding sunlight exposure and vitamin D intake

	Frequency	Percentage
<b>Your work mainly in</b>		
-Office	195	55.1
-Field	159	44.9
<b>Time spent often outside home at weekend</b>		
-Never	34	9.6
-< 30 minutes	39	11.0
-30-60 minutes	36	10.2
-60-90 minutes	72	20.3
-> 90 minutes	173	48.9
<b>Parts of the body exposed to sunlight*</b>		
-Face	45	12.7
-Hands	39	11.0
-Face/hands	189	53.4
-Arms	38	10.7
-Feet	47	13.3
-Body covered completely	52	14.7
<b>Using sun screen when exposed to sun</b>		
-Never	257	72.6
-Once/week	33	9.3
-Twice/week	24	6.8
-3-4 times/week	26	7.3
-5-6 times/week	14	4.0
<b>Using vitamin D supplements</b>		
-Yes	112	31.6
-No	242	68.4
<b>Using Calcium supplements</b>		
-Yes	103	29.1
-No	251	70.9
<b>Using vitamin supplements</b>		
-Yes	245	69.2
-No	109	30.8
<b>Frequency of drinking milk</b>		
-Never	54	15.3
-Once/week	91	25.7
-Twice/week	77	21.8
-3-4 times/week	74	20.9
-5-6 times/week	58	16.4
<b>Frequency of eating eggs</b>		
-Never	42	11.9
-Once/week	81	22.9
-Twice/week	83	23.4
-3-4 times/week	100	28.2
-5-6 times/week	48	13.6
<b>Frequency of eating fish**</b>		
-Never	109	30.8
-Once/week	114	32.2
-Twice/week	70	19.8
-3-4 times/week	29	8.2
-5-6 times/week	32	9.0

\*More than one answer was possible

\*\*Salmon/Tuna/Sardines



**Figure 5: Level of practice of the participants regarding sunlight exposure and vitamin D intake**

Divorced participants had the lowest percentage of adequate sunlight exposure and vitamin D intake practice (35.3%) whereas married and single participants reported the highest percentage of adequate practice (68.4% and 68%, respectively),  $p=0.039$ . Highest educated males (University and above) reported higher significant percentage of adequate practice compared to illiterates (74.1% versus 46.4%),  $p=0.027$ . Participants living in urban areas had higher adequate practice regarding sunlight exposure and vitamin D intake than those living in rural areas (67.9% versus 50%),  $p=0.047$ . Other studied factors (age, nationality, occupation and income) were not significantly associated with practice of sunlight exposure and vitamin D intake. Table 7

**Table 7: Demographic factors associated with practice of exposure to sunlight and vitamin D intake**

	Sun exposure/vitamin D intake practice		$\chi^2$ (p-value)
	Inadequate N=119 N (%)	Adequate N=235 N (%)	
<b>Age in years</b>			
18-24 (n=71)	25 (35.2)	46 (64.8)	2.56 (0.464)
25-39 (n=143)	43 (30.1)	100 (69.9)	
40-60 (n=121)	42 (34.7)	79 (65.3)	
>60 (n=19)	9 (47.4)	10 (52.6)	
<b>Nationality</b>			
Saudi (n=270)	87 (32.2)	183 (67.8)	0.99 (0.320)
Non-Saudi (n=84)	32 (38.1)	52 (61.9)	
<b>Marital status</b>			
Single (n=103)	33 (32.0)	70 (68.0)	8.38 (0.039)
Married (n=225)	71 (31.6)	154 (68.4)	
Divorced (n=17)	11 (64.7)	6 (35.3)	
Widowed (n=9)	4 (44.4)	5 (55.6)	
<b>Educational level</b>			
Illiterate (n=28)	15 (53.6)	13 (46.4)	10.93 (0.027)
Primary school (n=38)	11 (28.9)	27 (71.1)	
Intermediate school (n=33)	12 (36.4)	21 (63.6)	
Secondary school (n=112)	44 (39.3)	68 (60.7)	
University/+ (n=143)	37 (25.9)	106 (74.1)	

<b>Occupation</b>			
Students (n=76)	30 (39.5)	46 (60.5)	
Governmental employee (n=121)	33 (27.3)	88 (72.7)	
Military (n=22)	8 (36.4)	14 (63.6)	
Private sector employee (n=72)	26 (36.1)	46 (63.9)	
Retired (n=40)	14 (35.0)	26 (65.0)	3.67
Not working (n=23)	8 (24.8)	15 (65.2)	(0.597)
<b>Income in SR/month (n=317)</b>			
≤5000 (n=115)	45 (39.1)	70 (60.9)	
>5000-10000 (n=86)	33 (38.4)	53 (61.6)	
>10000-15000 (n=84)	20 (23.8)	64 (76.2)	6.07
>15000 (n=32)	10 (31.2)	22 (68.8)	(0.108)
<b>Residence</b>			
Urban (n=324)	104 (32.1)	220 (67.9)	3.94
Rural (n=30)	15 (50.0)	15 (50.0)	(0.047)*

### 3.6 Association between knowledge, attitude and practice

As seen in table 8, males who had sufficient knowledge regarding vitamin D were more likely to express adequate practice regarding sunlight exposure and vitamin D intake as compared to those with insufficient knowledge (74.6% versus 64.7%). However, this difference was not statistically significant. Also, participants who like never exposure to sunlight had the lowest percentage of adequate practice, however this was not significant statistically.

None of the participants who had sufficient knowledge about vitamin D expressed an attitude towards never exposure to sunlight compared to 5.8% among those with insufficient knowledge. The difference was statistically significant, p=0.029.

**Table 8: Association between practice of sunlight exposure and vitamin D intake and knowledge of vitamin D and attitude towards sunlight exposure**

	Sun exposure/vitamin D intake practice		$\chi^2$ (p-value)
	Inadequate N=119 N (%)	Adequate N=235 N (%)	
<b>Knowledge of vitamin D</b>			
Insufficient (n=295)	104 (35.3)	191 (64.7)	2.13
Sufficient (n=59)	15 (25.4)	44 (74.6)	(0.145)
<b>Attitude towards sunlight exposure</b>			
Always exposed (n=136)	53 (39.0)	83 (61.0)	
Sometimes exposed (n=145)	40 (27.6)	105 (72.4)	
Rarely exposed (n=56)	18 (32.1)	38 (67.9)	5.54
Never exposed (n=17)	8 (47.1)	9(52.9)	(0.136)

**Table 9: Association between attitude towards sunlight exposure and knowledge about vitamin D among the participants**

	Attitude towards sunlight exposure				$\chi^2$ (p-value)
	Always N=136 N (%)	Sometimes N=145 N (%)	Rarely N=56 N (%)	Avoid N=17 N (%)	
<b>Knowledge of vitamin D</b>					
Insufficient (n=295)	116 (39.3)	114 (38.6)	48 (16.3)	17 (5.8)	8.99
Sufficient (n=59)	20 (33.9)	31 (52.5)	8 (13.6)	0 (0.0)	(0.029)

#### 4. DISCUSSION

Vitamin D deficiency among children and adults is increasing on a global level<sup>(15)</sup>. This is attributed to many factors; mainly insufficient exposure to sunlight radiation<sup>(16)</sup> and inadequate vitamin D intake<sup>(17)</sup>.

In the kingdom of Saudi Arabia (KSA), the high prevalence of vitamin D deficiency in both males and females; children and adults, despite sufficient sunlight throughout the year represents a public health problem<sup>(18-20)</sup>.

Among the important reasons for prevailing of this problem in KSA problem is the lack of public awareness regarding importance and sources of vitamin D as well as the importance of sunlight exposure in this regard. Older Saudi studies carried out among female students<sup>(21, 22)</sup> suggested that limited knowledge about vitamin D could be the underlying reason for vitamin D deficiency among them.

Most of previous studies carried out in Saudi Arabia in this regard focused only on either females or children; therefore this study was conducted to assess the knowledge, attitude and practice of sun exposure affecting vitamin D among adult male visitors of primary health care centers In Taif.

In the present study, most of the respondents have heard about vitamin D (82.5%), which is within the limits reported elsewhere among general population as between 39 and 84% of them has heard of vitamin D<sup>(23-25)</sup>. However, higher percentage was reported among athletes in New Zealand (97%)<sup>(12)</sup>. The differences between athletic group and the general population may be due to the medical support to this group.

Regarding vitamin D knowledge, apart from keeping healthy bones, the knowledge of the importance of vitamin D to human body was very deficient as a minority of the participants could recognize the importance of vitamin D in cancer and renal diseases prevention. Generally, in the present study, sufficient knowledge regarding vitamin D was observed among only 16.7% of the respondents. This observation is in line with those of others. In Australia, limited knowledge about vitamin D among adult population was reported by Janda et al (2010)<sup>(26)</sup>. In another study carried out in Saudi Arabia, low level of vitamin D knowledge, including sources impacts on health was reported<sup>(21)</sup>.

Concerning vitamin D sources, fortunately most of the participants could recognize sunlight exposure. The same has been documented in other studies conducted among general population<sup>(23, 25, 27)</sup>. It has been documented that the lack of sun exposure is among the main reasons for vitamin D deficiency<sup>(28, 29)</sup>. Moreover, Moehrle reported that between 80 and 100% of vitamin D requirement is fulfilled by exposure of the skin to sunlight<sup>(30)</sup>. In Saudi Arabia, an indoor lifestyle has an important role as an obstacle in obtaining the required amount of direct sun light<sup>(31)</sup>.

On the other hand, only around 30% of the respondents in this study could recognize dietary sources of vitamin D, the most known source was milk, followed by vegetables/fruits and fatty fish. Also in other studies conducted among general population, a small proportion could name a correct vitamin D food source<sup>(23, 25, 32)</sup>. Despite the fact that vitamin D intake from food sources alone could not provide sufficient vitamin D, its intake from food could help when sun exposure is limited<sup>(12)</sup>.

It has been observed by Toher et al (2013)<sup>(32)</sup> that people who knew more about the sources of vitamin D tended to consume more vitamin D-containing foods and exposed to safe sunlight. Therefore educating general population about the importance of vitamin D for health may increase concern for their vitamin D status and subsequently, behaviours that improve their vitamin D status, either through food, supplementation, safe sun exposure or a combination of both.

Sufficient knowledge was reported among people of high socio-economic status, manifested by higher educational level and higher monthly income and also more observed among people of middle age (25-39 years) and students. Almost the same has been observed in other studies<sup>(8, 9, 26)</sup>.

Regarding attitude and practice of the participants in this study towards sunlight exposure, majority of them were like to be exposed to sunlight either always or sometimes. Saudis and higher educated persons were more in favour of sunlight exposure. Furthermore, half of them spent more than 90 minutes outside home at week end, exposed their face and hands to sunlight and most of them never used sunscreen preparation when exposed to sunlight. Many factors may influence vitamin D production in the skin such as skin colour, amount of sun exposure, season, time of the day, and latitude<sup>(33)</sup>. In a Saudi study carried out by Alamri et al (2015)<sup>(11)</sup>, the time of the day has been proved to have major influence on cutaneous vitamin D production as the summer conversion of pre-vitamin D3 was found between 9:00 AM- 3:00 PM with peak hours between 10:00 AM and 12:00 noon. In the present study, we did not ask participants about the time of sun exposure during the day. In a study carried out in New Zealand, only 9% of the general population were exposed to

sunlight<sup>(34)</sup>. In Australian study<sup>(25)</sup>, 16% of participants intended to increase their sun exposure and 21% had already changed their behaviour towards sunlight exposure, despite the fear in these two countries from the increased risk of skin cancer as a result of sunlight exposure<sup>(30)</sup>.

#### *Limitations of the study*

This study is strictly confined to adult male in Taif city; result may not apply to other age groups or other areas in kingdom of Saudi Arabia. The study tool as a questionnaire is subject to recall bias. Compliance of visitors to fill out the questionnaire completely was a limitation. However, importance of the study was explained and the clarity of the questionnaire helped to improve their compliance. Also, limitation due to nature of the cross-sectional design has an important concern as it prove only association and not causality.

### 5. CONCLUSION

Awareness of the adult patients attending urban primary health care centers, Ministry of health in Taif city regarding vitamin D was acceptable. However, their knowledge regarding importance to health, apart from keeping healthy bones and sources of vitamin D, apart from sunlight was insufficient. Overall, knowledge level was insufficient. Attitude and practice of the participants regarding importance of vitamin D to health and sunlight exposure was adequate, particularly among Saudis, living in urban areas and high educated individuals.

### 6. RECOMMENDATIONS

1. Education of general population regarding the importance of vitamin D for health and main sources of vitamin D is essential. This could be done through organized sessions at out-patient clinics of hospitals and primary health care centers.
2. Emphasizing the importance of sunlight exposure to adult population is important; particularly duration and timing of exposure.
3. Improving the vitamin D status of the adult population in Taif through increase their concern for their vitamin D level and changing their behaviours that will improve their vitamin D status, either through food, supplementation, and safe sun exposure.
4. Mass media should have an active role in alerting general population regarding the problem of vitamin D deficiency and its close relation to inadequate sunlight exposure.
5. Further study is needed including female adults in addition to males to have a more comprehensive view of the situation in Taif city.

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