Public awareness and attitude of the population of Al-Madinah Al-Munawwarah regarding the effects of sunlight and food on vitamin D homeostasis: A cross-sectional study

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Abstract

Objectives: This is a cross-sectional study aiming at assessing the public awareness regarding the effects of food and sunlight on vitamin D homeostasis in Al-Madinah Al-Munawwarah, Saudi Arabia.

Methods: An electronic validated questionnaire from previously published research was distributed through an online link to the targeted population. The study recruited 790 participants. The questionnaire was directed to Al-Madinah Al-Munawwarah population including all people who are above 15 years of age. We excluded any response from outside Al-Madinah Al-Munawwarah and from children less than 15 years old. All data analyses were carried out using Statistical Packages for Social Sciences (SPSS) version 20.

Results: We found that 91% of the participants (n=719) had sufficient knowledge about vitamin D. The majority of participants (87.5%, n=620) correctly identified 7–9 AM as the best time for sun exposure. Participants working in health fields had more knowledge ($p<0.001$) regarding vitamin D compared to other specialties. High atmospheric temperature causes low participant' exposure to sunlight followed by absence of appropriate places and lack of suitable time. We found that 47.6% (n=367) of participants are taking vitamin D supplements with females as a majority (62.8%) (n=267) vs (29.9%) (n=109) for males. Females' clothes cause less exposure to sunlight 38.4% (n=150). Participants in the healthcare fields (48.9%, n=170) are staying more in the sunlight for 15 minutes duration. ($p=0.016$).

Conclusion: It is recommended to increase the number of outdoor walking sites. Awareness level and health education regarding vitamin D need to be improved in the population of Al-Madinah Al-Munawwarah.

Key words: Awareness, deficiency, dietary supplements, sunlight, vitamin D.

Introduction

Vitamin D is a fat-soluble prohormone produced endogenously in the skin after exposure to sunlight. Following exposure to ultraviolet light, vitamin D precursor (7-dehydrocholesterol) is converted to inactive vitamin D (cholecalciferol) then the active form (Calcitriol) is formed [1]. Exposure to ultraviolet rays of sunlight is the main source of vitamin D. Vitamin D produced in the skin after exposure to sunlight lasts longer in the blood than vitamin D from dietary sources [2]. Vitamin D affects bone homeostasis. That may closely affect orthopedics practice and musculoskeletal surgery outcomes.

The main natural vitamin D source is synthesis by the skin during exposure to sunlight (exposure to ultraviolet B rays) [3]. Exposing face, arms and legs for a period of time can satisfy the body's vitamin D requirement while minimizing sunlight-induced skin damage [4].

The most common exposure time to sunlight in Saudi Arabia was reported to be between 8:00 AM to 4:00 PM and peaked during 10:00 AM to 12:00 PM in both summer and winter. For fear of UV ray exposure-induced risk of cancer during the period between 10 AM to 12 PM, patients should be advised to be exposed to the sun between 8:00 AM to 10:00 AM and 1:00 PM to 3:00 PM [5,6]. Adequate duration to get sufficient amount of vitamin D through skin exposure to sunlight is 10–30 minutes (3 times/week) for a white-skinned population. Dark skinned people need longer duration of sunlight exposure because darker skin has less efficient vitamin D production due to high melanin pigmentation, which acts as a natural sunscreen. This greatly reduces ultraviolet B rays exposure. Vitamin D deficiency is a global public health problem in all age groups that is usually unrecognized by the public. Vitamin D is deficient in several countries and is particularly more deficient in patients in the Middle East [7-8]. A recent meta-analysis study including 20,787 patients reported that the prevalence of vitamin D deficiency among males and females was 63.5% [9]. Moreover, prevalence of vitamin D deficiency was significantly greater in females (34.8%) compared to only 13.4% among the males [10]. Regarding public awareness of vitamin D deficiency in Najran (Saudi Arabia), 11% of the investigated participants had no idea about vitamin D [7]. Regarding awareness of vitamin D deficiency in Jeddah, 1,145 out of 1,752 participants had some idea about foods rich in vitamin D [11]. Regarding the awareness and attitude towards vitamin D deficiency, 28% of participants were aware of vitamin D sources and 50% knew about its benefits. This needs improving people's knowledge and awareness. There is a significant association between the level of vitamin D knowledge and educational level [12].

More health education is needed regarding the dietary sources and established health benefits of vitamin D for muscles, bones, and the immune system. Social workers and non-governmental organizations may work together with governmental healthcare organizations to teach

children and parents about the uses and benefits of vitamin D [13]. Similarly, many people in Al-Madinah Al-Munawwarah have a knowledge gap regarding vitamin D due to many causes e.g. unhealthy lifestyle and lack of knowledge and orientation about vitamin D deficiency and its complications. Unfortunately, there is no current health program able to orient people about vitamin D deficiency and the role of primary health care in raising people's awareness regarding vitamin D deficiency [14]. Furthermore, there is a need to conduct interventions and qualitative studies to assess the level of awareness regarding vitamin D deficiency, to determine the underlying reasons for poor vitamin D level and to fill the knowledge gaps. All of these measures will help to improve vitamin D status and the health problems related to its deficiency or toxicity among Al-Madinah Al-Munawwarah people. Till now, there is no report regarding awareness of the society of Al-Madinah Al-Munawwarah regarding vitamin D deficiency, sources, and complications.

This study aims at measuring the public awareness of vitamin D deficiency in Al-Madinah Al-Munawwarah society and the participants' attitudes towards it. This could be regarded as a cornerstone in the future plans to solve this problem. This cross-sectional study aims at assessing public awareness and attitude regarding the effects of food and sunlight on vitamin D homeostasis in Al-Madinah Al-Munawwarah may closely affect orthopedic practice and musculoskeletal surgery outcomes. This study also consolidates the results regarding public awareness of vitamin D medicine, seals the gap of knowledge seen in Al-Madinah Al-Munawwarah population, and assesses the awareness of the relationship between sun exposure and vitamin D deficiency in Al-Madinah Al-Munawwarah society.

Materials and Methods

• This is a cross-sectional prospective study that was conducted in Al-Madinah Al-Munawwarah, Saudi Arabia from 25th November 2018 to 1st of October 2019. An electronic questionnaire was used to collect data. Validated questionnaires from previously published research were distributed through an online link to the targeted population. Participants' confidentiality was guaranteed. Participation was optional with full participants' right to participate or not. Data was collected randomly using an online questionnaire (Google forms) that was designed to collect the information using self-reported and direct knowledge questions about vitamin D medicine. The questionnaire was uploaded to social media. Target population was the population of Al-Madinah Al-Munawwarah (about 1,152,991) based on the data of the general census of the population and housing (2010) [25]. Sample size was calculated to be 666 with 99% confidence level. We collected 942 responses. The questionnaire was directed to Al-Madinah Al-Munawwarah population including all people who were above 15 years of age. We excluded any response from outside Al-Madinah Al-Munawwarah and from children less than 15 years old. 786 responses were gained. The questions were multiple choice questions. Al-Madinah Al-Munawwarah population were invited to participate in the questionnaire that included socio-demographic characteristics like gender, educational level, house type and monthly income. The questions also asked if people have a history of vitamin D deficiency or had heard about it.

The questionnaire also asked about:
-The benefits of sun exposure, which parts of the body should be exposed, the best time for the exposure, and duration of exposure.
-The amount of daily needs of vitamin D that we get from the sun, the reasons behind lacking sun exposure and which age group have more risk for vitamin D deficiency.
-Vitamin D sources and their background about what foods are rich in vitamin D and what is their importance for their health.
-Role of primary health care regarding awareness of vitamin D deficiency, and what are their sources of information.

Then we applied the mentioned exclusion criteria to the data. Descriptive statistics were presented as numbers and percentages. Statistical analysis was done using chi square test. $p < 0.05$ was considered statistically significant. All data analyses were carried out using Statistical Packages for Social Sciences (SPSS) version 20, (Armonk, NY: IBM Corp). Consent was obtained from all the participants after describing the aim of the study. Privacy and confidentiality were assured.

Results

Female participants had significantly more knowledge about vitamin D. Furthermore, participants working in the health field had more significant knowledge ($p<0.001$) regarding vitamin D compared to those in other occupations. In contrast, house style ($p=0.271$), educational level ($p=0.079$) and monthly income ($p=0.778$) had no significant relationship with the knowledge about vitamin D [Table 1].

Characteristics of the participants regarding exposure to ultraviolet rays of sunlight are described in Table 2. According to our data [Table 2], 58% of the participants (n=458) had exposure to sunlight with males (80%, n=293) having more exposure to sunlight compared to females (38.8%, n=165) ($p<0.001$). The most common duration of sunlight exposure to get vitamin D was 15 minutes (45.8%, n=362) with females having more significant exposure time to sunlight for 15 minutes duration ($p<0.001$). With regard to the best time for sun exposure, a high proportion of participants (78.5%, n=620) correctly identified 7–9 AM ($p=0.548$) while 34.2% (n=270) chose 3–5 PM ($p=0.001$) as the best time for sun exposure. However, 13.4% (n=106) of them incorrectly identified 10 AM-3 PM ($p=0.672$) as the best time for sun exposure. Regarding the body parts that should be exposed to sunlight, 22.5% (n=178) of them correctly identified hands, arms, face and legs ($p<0.001$). The majority of the participants (95.6%, n=755) indicated breastfeeding as the appropriate source of vitamin D ($p=0.526$) with 47.6% (n=367) taking vitamin D as a supplement. The majority of females (62.8%, n=267) had a significant usage of vitamin D supplements ($p<0.001$)

Table 1: Relationship between the knowledge about vitamin D and the socio-demographic characteristics of participants (n=790)

Factor	Knowledge about Vitamin D		p value §
	Yes N (%) (n=719)	No N (%) (n=71)	
Age group in years			
• 15 – 20 years	148 (20.6%)	17 (23.9%)	
• 21 – 25 years	323 (44.9%)	16 (22.5%)	
• 26 – 35 years	179 (24.9%)	26 (36.6%)	0.004 **
• 36 – 45 years	41 (05.7%)	06 (08.5%)	
• >45 years	28 (03.9%)	06 (08.5%)	
Gender			
• Male	314 (43.7%)	51 (71.8%)	
• Female	405 (56.3%)	20 (28.2%)	<0.001 ***
House type			
• Mud house	28 (03.9%)	02 (02.8%)	
• Apartment	436 (60.6%)	50 (70.4%)	0.271
• Villa	255 (35.5%)	19 (26.8%)	
Educational level			
• Secondary or below	166 (23.1%)	23 (32.4%)	
• University or more	553 (76.9%)	48 (67.6%)	0.079
Type of job			
• Work in a health-field	31 (04.3%)	02 (02.8%)	
• Work outside health-field	135 (18.8%)	20 (28.2%)	
• Health-field student	308 (42.8%)	07 (09.9%)	<0.001 ***
• Non-health-field student	96 (13.4%)	14 (19.7%)	
• Not working	149 (20.7%)	28 (39.4%)	
Monthly income level (SAR)			
• <3,000	359 (49.9%)	38 (53.5%)	
• 3,000 – 5,000	77 (10.7%)	08 (11.3%)	0.778
• 5,001 – 10,000	101 (14.0%)	11 (15.5%)	
• >10,000	182 (25.3%)	14 (19.7%)	

§ p value has been calculated using chi square test.
* Significance was set at p<0.05 level.

among whom 68.5% (n=183) were taking vitamin D as prescribed by their physician (p<0.001). The most common reason for receiving vitamin D prescription was body pain (19.5%, n=47) followed by vitamin D deficiency (10.8%, n=26). On the other hand, only 31.1% of the participants (n=246) were given advice by the primary health care physician regarding the importance of vitamin D (p<0.001) with only 10.9% of them (n=86) having attended a health education seminar about symptoms of vitamin D deficiency as organized by a primary health care center (p=0.123) [Table 2].

In Table 3, participants in the healthcare fields (48.9%, n=170) are staying more significantly in the sunlight in a 15 minutes duration to obtain vitamin D (p=0.016). The best time for sun exposure was in the period between 10–3 PM (p=0.030) and 3–5 PM (p=0.002). Both were statistically significant in relation to specialty (p<0.001). Body parts that should be exposed to sunlight were also found to have a significant relationship with specialty. On the other hand, non-healthcare participants (93.1%, n=324) were significantly higher in utilizing breastfeeding practices (p=0.003) while healthcare respondents (51.6%, n=83) significantly needed advice for vitamin D intake (p<0.001). In contrast, exposure to sunlight (p=0.075), taking vitamin D as a supplement (p=0.095), prescribing vitamin D (p=0.067) and attending health education seminar about symptoms of vitamin D deficiency (p=0.113) were all not statistically significant in relation to specialty [Table 3].

Figure 1 explored the reasons for avoiding sunlight exposure. The most commonly known reasons were the high temperature (60.8%) and no place for sunlight exposure (37.7%) while the least of them was sun allergy (6.3%).

In Figure 3, the relationships between gender and the reason to avoid sun exposure were shown. The most common reason to avoid sun exposure among males and females was “high sun temperature” (62.5% vs 60.4%) followed by “having no time” (38.9% vs 36.9%). When comparing the gender in relation to the reason to avoid sun exposure, we found that “no place” (p=0.002) and “disliking sun” (p=0.032) were both not significantly related to gender [Figure 3].

Table 2 Legend (opposite page) >

* Variable with multiple responses.
† Included participants who took vitamin D as supplement
‡ Included participants with prescription from the doctor.
§ p value has been calculated using chi square test.
* Significance was set at p<0.05 level.

Table 2: Characteristics of participants regarding exposure to ultraviolet rays of sunlight according to gender

Characteristics	Overall N (%) (n=790)	Gender		p value [§]
		Male N (%) (n=365)	Female N (%) (n=425)	
Exposure to sunlight				
• Yes	458 (58.0%)	293 (80.3%)	165 (38.8%)	
• No	332 (42.0%)	72 (19.7%)	260 (61.2%)	
Duration of sunlight exposure to obtain vitamin D				
• ≤10 minutes	161 (20.4%)	55 (15.1%)	106 (24.9%)	
• 15 minutes	362 (45.8%)	159 (43.6%)	203 (47.8%)	
• 30 minutes	153 (19.4%)	79 (21.6%)	74 (17.4%)	**<0.001 *****
• >30 minutes	16 (02.0%)	09 (02.5%)	07 (01.6%)	
• I don't know	98 (12.4%)	63 (17.3%)	35 (08.2%)	
The best time for sun exposure *				
• 7–9 am	620 (78.5%)	283 (77.5%)	337 (79.3%)	0.548
• 10 – 3pm	106 (13.4%)	51 (14.0%)	55 (12.9%)	0.672
• 3–5pm	270 (34.2%)	103 (28.2%)	167 (39.3%)	**0.001 *****
• I don't know	32 (04.1%)	17 (04.7%)	15 (03.5%)	0.423
Body that should be exposed to sunlight				
• Hands and face	211 (26.7%)	122 (33.4%)	89 (20.9%)	
• Hands, arms and face	41 (05.2%)	25 (06.8%)	16 (03.8%)	**<0.001 *****
• Hands, arms, face and legs	178 (22.5%)	100 (27.4%)	78 (18.4%)	
• Others	360 (45.6%)	118 (32.3%)	242 (56.9%)	
The method of feeding, which is the most appropriate source of vitamin D				
• Breast feeding	755 (95.6%)	347 (95.1%)	408 (96.0%)	0.526
• Artificial feeding	35 (04.4%)	18 (04.9%)	17 (04.0%)	
Have you ever taken vitamin D as supplement?				
• Yes	376 (47.6%)	109 (29.9%)	267 (62.8%)	**<0.001 *****
• No	414 (52.4%)	256 (70.1%)	158 (37.2%)	
If yes, did you take? *				
• Without prescription	150 (38.4%)	66 (53.2%)	84 (31.5%)	**<0.001 *****
• Prescribed by your doctor	241 (61.6%)	58 (46.8%)	183 (68.5%)	
Prescribed vitamin D, doctor consultation ‡				
• Vitamin D deficiency	26 (10.8%)	06 (10.3%)	20 (10.9%)	
• Body ache	47 (19.5%)	09 (15.5%)	38 (20.8%)	
• Fatigue	09 (03.7%)	0	09 (04.9%)	0.106
• Hair loss	08 (03.3%)	0	08 (04.4%)	
• Others	151 (62.7%)	43 (74.1%)	108 (59.0%)	
Received advice on the importance of vitamin D by the PHC physician				
• Yes	246 (31.1%)	91 (24.9%)	155 (36.5%)	**<0.001 *****
• No	544 (68.9%)	274 (75.1%)	270 (63.5%)	
Attended a health education seminar about symptoms of vitamin D deficiency				
• Yes	86 (10.9%)	33 (09.0%)	53 (12.5%)	0.123
• No	704 (89.1%)	332 (91.0%)	372 (87.5%)	

Table 3: Relationship between specialty among exposure to ultraviolet rays of sunlight and behavior of participants towards vitamin D

Statement	Specialty		p value §
	Healthcare N (%) (n=348)	Non-healthcare N (%) (n=442)	
Exposure to sunlight			
• Yes	214 (61.5%)	244 (55.2%)	0.075
• No	134 (38.5%)	198 (44.8%)	
Duration of sunlight exposure to obtain vitamin D			
• ≤10 minutes	57 (16.4%)	104 (23.5%)	
• 15 minutes	170 (48.9%)	192 (43.4%)	
• 30 minutes	68 (19.5%)	85 (19.2%)	**0.016 ***
• >30 minutes	03 (0.90%)	13 (02.9%)	
• I don't know	50 (14.4%)	48 (10.9%)	
The best time for sun exposure *			
• 7 – 9 am	266 (76.4%)	354 (80.1%)	0.215
• 10 – 3pm	57 (16.4%)	49 (11.1%)	**0.030 ***
• 3 – 5pm	139 (39.9%)	131 (29.6%)	**0.002 ****
• I don't know	11 (03.2%)	21 (04.8%)	0.260
Body that should be exposed to sunlight			
• Hands and face	86 (24.7%)	125 (28.3%)	
• Hands, arms and face	27 (07.8%)	14 (03.2%)	**<0.001 *****
• Hands, arms, face and legs	97 (27.9%)	81 (18.3%)	
• Others	138 (39.7%)	222 (50.2%)	
Most appropriate method of feeding			
• Breast feeding	324 (93.1%)	431 (97.5%)	**0.003 ****
• Artificial feeding	24 (06.9%)	11 (02.5%)	
Have you ever taken vitamin D as supplement?			
• Yes	154 (44.3%)	222 (50.2%)	0.095
• No	194 (55.7%)	220 (49.8%)	
If yes, did you take it? †			
• Without prescription	78 (48.4%)	72 (31.3%)	**0.001 *****
• Prescribed by your doctor	83 (51.6%)	158 (68.7%)	
Prescribed vitamin D and doctor consultation ‡			
• Vitamin D deficiency	07 (08.4%)	19 (12.0%)	
• Body pain	09 (10.8%)	38 (24.1%)	
• Fatigue	03 (03.6%)	06 (03.8%)	0.067
• Hair loss	02 (02.4%)	06 (03.8%)	
• Others	62 (74.7%)	89 (56.3%)	
Received important advice regarding vitamin D			
• Yes	84 (24.1%)	162 (36.7%)	**<0.001 *****
• No	264 (75.9%)	280 (63.3%)	
Attended a health education seminar about symptoms of vitamin D deficiency			
• Yes	31 (08.9%)	55 (12.4%)	0.113
• No	317 (91.1%)	387 (87.6%)	

* Variable with multiple responses. † Included participants who took vitamin D as supplement ‡ Included participants with prescription from the doctor. § p value has been calculated using chi square test.* Significance was set at p<0.05 level.

Figure 1: Reasons for avoiding sunlight exposure (n=332)

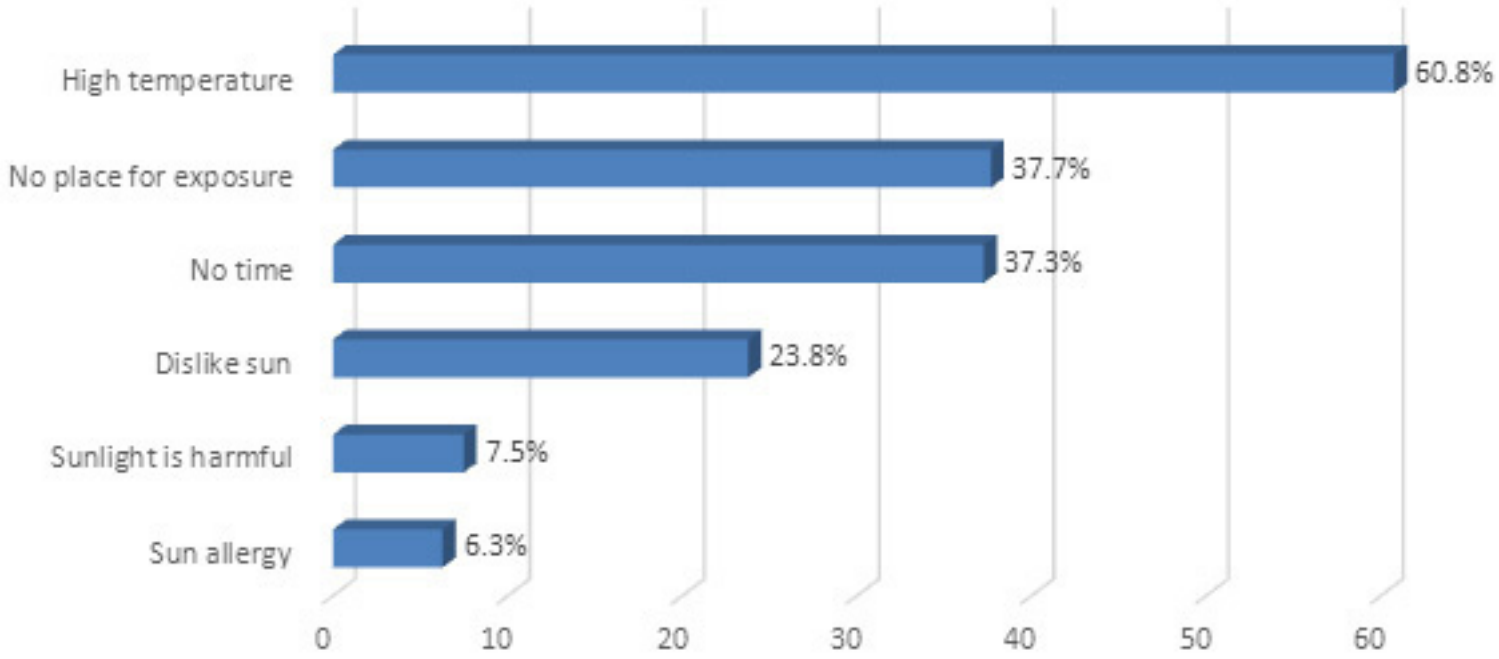


Figure 2: Appropriate sources of vitamin D

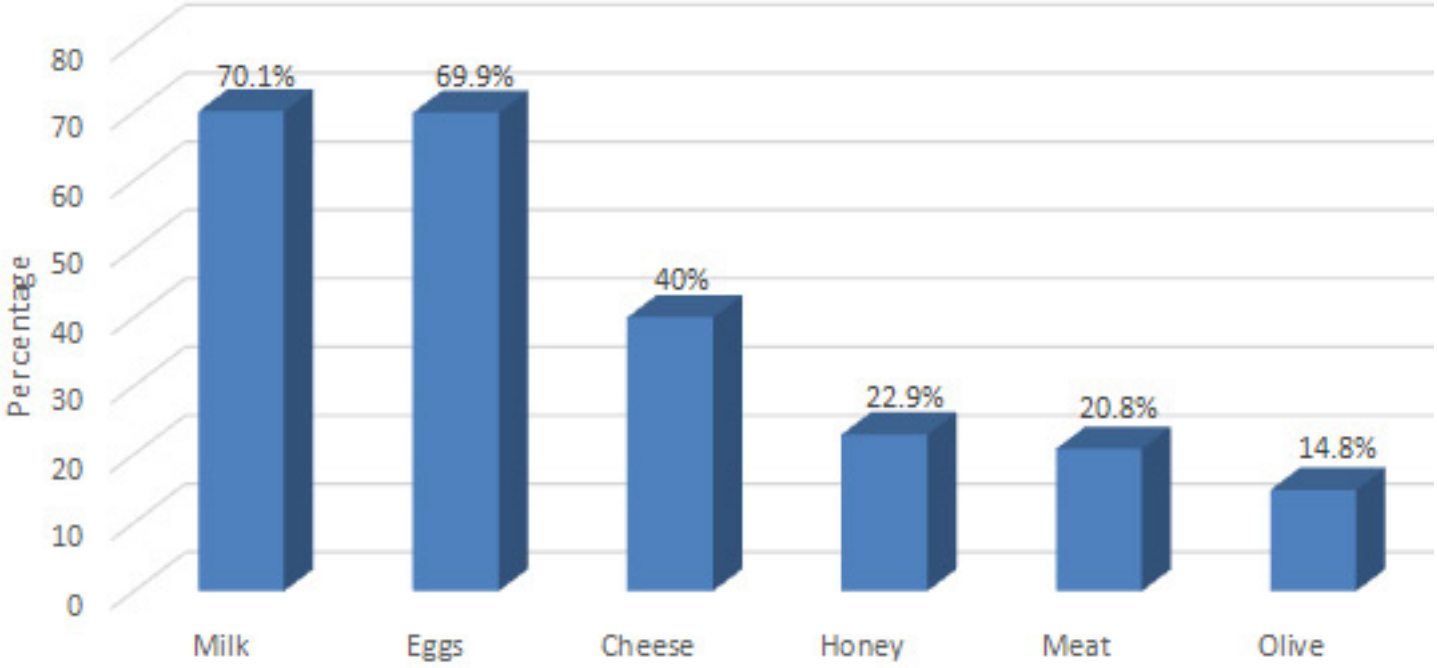
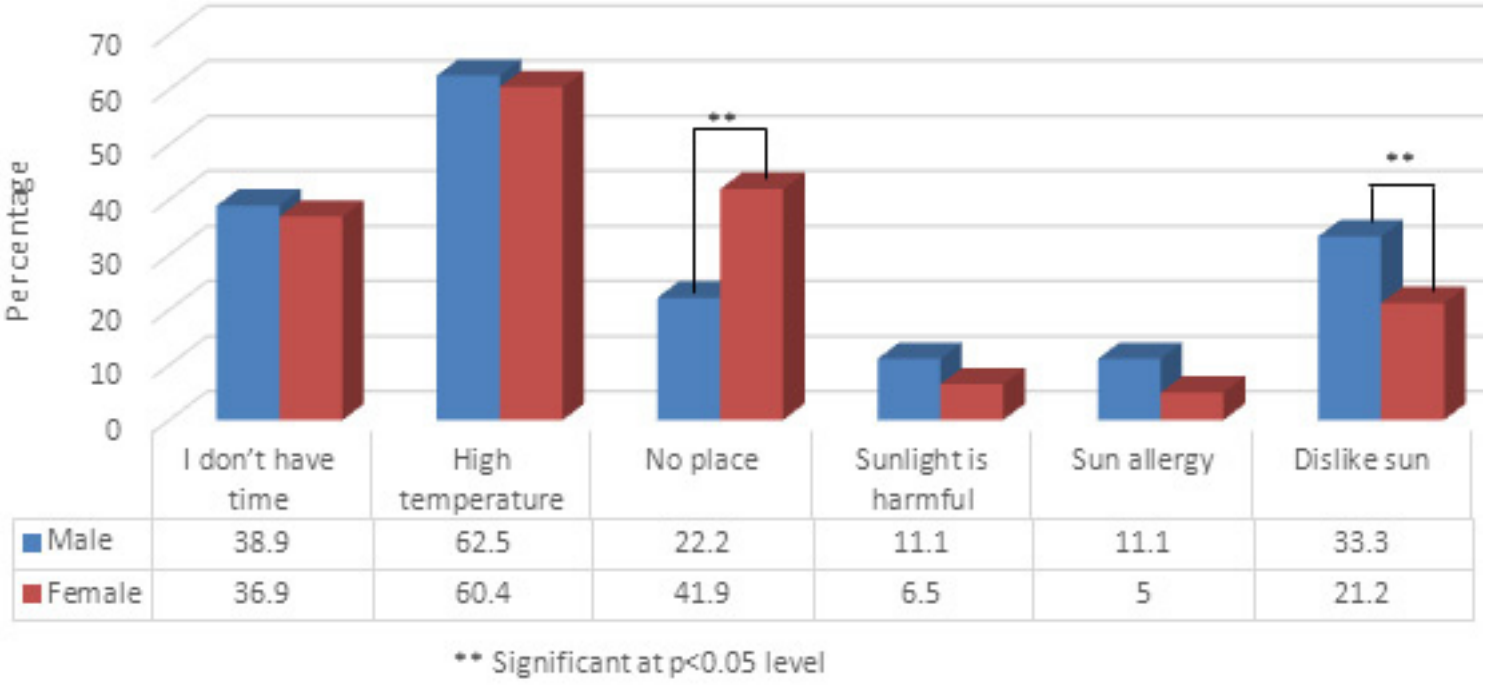


Figure 3: Evaluating the relationship between gender and the reasons to avoid sun exposure



	I don't have time	High temperature	No place	Sunlight is harmful	Sun allergy	Dislike sun
Male	38.9	62.5	22.2	11.1	11.1	33.3
Female	36.9	60.4	41.9	6.5	5	21.2

** Significant at p<0.05 level

Discussion

Socio-demographic features of participants affected their knowledge regarding vitamin D [Table 1]. In our study, female participants (62.8%, n=267) had a more significant knowledge than males (29.9%, n=109) about the importance of vitamin D and were taking it as a supplement (p-<0.001) [Table 2]. Our findings are consistent with a previous study which reported that both older people and men had lower levels of awareness of vitamin D deficiency and its consequences [15]. Gender differences in health-related behaviors have been studied many times and indicated that women are more aware of healthy eating than men [16]. Vitamin D deficiency is one of the major health problems worldwide with highest prevalence in Middle East countries [17-18]. Vitamin D deficiency has a major impact on the human body, and can lead to mild effects like fatigue or serious health effects such as rickets and osteoporotic fractures in the aged people [11] Fortunately, treatment of vitamin D deficiency is applicable and easy.

The current study revealed a number of important findings where the majority of participants had significant knowledge about vitamin D and its main sources particularly sunlight [Table 1-2]. The majority of participants had the knowledge that the sun is the main source of vitamin D [Table 2] and [Figure 1]. More than half of those who did not get exposed to sunlight were avoiding exposure to sun light because of its high temperature [Figure 1]. Students in the health fields had better knowledge regarding vitamin D compared to other occupations (p<0.001) [Figure 1]. A similar report confirmed that students in health fields knew the importance of vitamin D while 93% of them knew about vitamin D deficiency issues [19]. Many studies showed that high educational levels were associated with better knowledge about vitamin D. It was reported that those who had an academic degree had a higher level of knowledge than others. A similar result was found in other countries where the better educated mothers had greater knowledge [20]. In our study, the relation between educational level and knowledge regarding vitamin D wasn't significant (p=0.079) [Table 1].

In our study, 58% (n=458) of the participants had knowledge about the importance of sunlight exposure for vitamin D synthesis [Table 1], which is similar to a finding of other studies that were conducted in Saudi Arabia e.g. a study done in Al-Qassim found that 90% of the participants were aware of vitamin D [21]. Another study done in Jeddah found that 89.6% of the participants had heard about vitamin D,[11] and a study that was conducted in the western Saudi region found that 70% of the participants had knowledge about vitamin D [22].

Vitamin D3 is produced in the skin in response to ultraviolet B radiation from sunlight and can be obtained from diet or dietary supplements. Vitamin D produced in the skin lasts longer in the blood than vitamin D from diet. We investigated if participants in this study have the knowledge that exposure to sunlight is an important source of vitamin D. We found that 58% of participants (n=458) were exposed to sunlight regularly (p=0.004) [Table 2]. In a French study, 72% of participants reported sun exposure as the main source of vitamin D [15]. In the study of Najran (in Saudi Arabia), more than two thirds (69.83%) said that ultraviolet rays of sun is the main source of vitamin D [7].

Then, we investigated participant's knowledge regarding the effects of sun exposure on vitamin D synthesis. Males (80.3%, n= 293) had more exposure to sunlight compared to females (38.8%, n=165) (p<0.001) [Table 2]. This could be attributed to the culture in Saudi Arabia as women spent most of the time indoors taking care of their children while men take the responsibility of working and earning money. Even after the recent increase in the number of women

who are employed, when they get out, they wear "Abaya; a clothing that covers the whole body". Therefore, they do not get enough sunlight exposure. High temperature was the most important cause of low exposure to sunlight followed by absence of appropriate places to get sun exposure and lack of time [Figure 1]. This indicates that the existing facilities are not enough and that we need to increase the number of parks and free walking sites. This finding could guide the authorities to pay more attention to the budgets of such facilities and to give it more focus in future plans. Regarding the needed duration of exposure to sun light, about one out of ten (12.4%, n= 98) did not have an idea at all [Table 2], while a fifth (20.4%, n=161) of the participants thought that 10 minutes is an enough time to meet the body demands, which is wrong [23]. It is recommended to have between 10 to 30 minutes exposure to sunlight [7-8]. More than 30 minutes exposure could increase the risk of skin malignancy especially in such hot weather [6, 23]. A similar result was found in a study that was conducted in Najran (in South Saudi Arabia) [7]. Most of the participants (78.5%, n=620) agreed that the best time for exposure is from 7-9 AM while a fewer number (34.2%, n= 270) believed that sun light exposure at 3-5 PM is also a good time [Table 2]. Only a few people (14.3%, n=178) thought that 10 AM - 3 PM is the right answer. But, the sun is very hot and harmful at this time [6]. Holick's rule dictates that exposing the face, arms and legs is essential to meet the body requirements of vitamin D [24]. Most of the answers were wrong as almost one quarter (22.5%, n=178) of the participants answered this question correctly. In future plans to increase public awareness, this information should be among the top concepts to be corrected. The vast majority of males and females (95.6%, n=755) think that breast feeding is the most important source of vitamin D [Table 2]. However, this is not correct as breast feeding is not enough for infants as a sole source of vitamin D. Formula feeding is better regarding giving enough vitamin D to the baby taking in consideration the level of vitamin D of the mother. An alternative way is to give the mother vitamin D as a supplement to enrich their milk with it [24].

Then, we came across important findings. We found out that the vast majority of participants have chosen milk and eggs as sources of vitamin D, which reflects a good knowledge about foods rich in vitamin D [Figure 2]. Our research found that 22.9% of the participants (n=181) in this study mistakenly chose honey as a rich source of vitamin D [Figure 2]. However, this is not correct as honey only has a small percentage of vitamin D. Olive was the least chosen answer, which reflected a good knowledge about the best source for vitamin D. We found that 47.6% of participants (n=376) are taking vitamin D supplements among whom females are the majority (62.8%, n=267) compared to males (29.9%, n=109) [Figure 2]. This difference may be attributed to the culture as females cover their body with abaya and subsequently there is less exposure to sunlight. Among those, 38.4% (n=150) who took vitamin D were taking it without prescription and more than half of them were males. Our results showed that 61.6% (n=241) had a prescription from a doctor for treating another medical condition. We found that 19.5% of participants (n=47) are taking vitamin D due to body pain while only 10.8% (n=26) had a consultation due to vitamin D deficiency among whom the female ratio was 3 times higher than the males [Table 2].

Limitations and weaknesses

Weakness points in this survey include being electronic and was only distributed through social-media applications. So, people who are not familiar with technology, like the elderly and illiterates, did not participate in this study. Also, many of the referential studies were not conducted in Saudi Arabia as there is lack of local studies.

Conclusion

There is a big need to improve the public knowledge on vitamin D in Al-Madinah Al-Munawwarah, which is consistent with many previous studies that were conducted in different regions of Saudi Arabia. Female participants and those with high levels of education are more aware about vitamin D. Males have more sun exposure than females. There is a knowledge gap regarding the appropriate way to get vitamin D through increasing sunlight exposure, increasing the duration of exposure and selecting the best time of the day and the parts of the body needing to be exposed.

Our recommendations are to improve awareness and health education, to modify the attitude regarding sun exposure and food consumption and to recommend intake of multivitamin tablets that contain 10 micrograms (400 IU) of vitamin D (whenever necessary under medical supervision) that may have an effective role in improving individuals' awareness and preventing vitamin D deficiency.

Moreover, primary health care doctors should encourage and educate the patients and the families about the importance of vitamin D and the consequences of its deficiency. This can be achieved by taking extra clinic time, using social media to share some medical information (the highest as a source of information) and by arranging regular awareness campaigns in the community.

Also, teachers should be educated about Vitamin D and its role. It is good to arrange courses for them to raise their awareness and knowledge regarding Vitamin D. Eventually, they will educate their students.

Social media have an important role in awareness about public health issues, so it will be good for health care workers if they increase the effort and time to participate in programs aiming at health education on media.

We also recommend increasing the number of outdoor areas for women to allow greater sunlight exposure where women can uncover freely. We should increase incidental sun exposure through routine daily outdoor activities that may help increase sunlight exposure for vitamin D activation.

Also, awareness in rural areas should be investigated separately as most of the studies were conducted on major cities where people are more educated.

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References

[1] Albahrani AA, Greaves RF. Fat-soluble vitamins: clinical indications and current challenges for chromatographic measurement. Clin Biochem Rev 2016; 37: 27-47.
[2] Darling AL, Blackbourn DJ, Ahmadi KR, Lanham-New SA. Vitamin D supplement use and associated demographic, dietary and lifestyle factors in 8024 South Asians aged 40–69 years: analysis of the UK Biobank cohort. Public Health Nutr 2018; 21: 2678-88.
[3] Kweder H, Eidi H. Vitamin D deficiency in elderly: Risk factors and drugs impact on vitamin D status. Avicenna J Med 2018; 8: 139-46.
[4] Nimitphong H, Holick MF. Vitamin D status and sun exposure in Southeast Asia. Dermato-endocrinol 2013; 5: 34-7.
[5] Alshahrani FM, Almalki MH, Aljohani N, Alzahrani A, Alsaleh Y, Holick MF. Vitamin D: Light side and best time of sunshine in Riyadh, Saudi Arabia. Dermato-endocrinol 2013; 5: 177-180.
[6] Cicarma E, Porojnicu AC, Lagunova Z, Dahlback A, Juzeniene A, Moan J. Sun and sun beds: inducers of vitamin D and skin cancer. Anticancer Res 2009; 29: 3495-3500.
[7] Alwadei AMA, Hassanein M, Alwadei AMA, Al-Johani NSM and AlZamanan SSM. Public Awareness of Vitamin " D " Deficiency among Children in Najran City and The Role of Primary Health Care Centers in Raising Their Awareness. Egypt J Hospital Med 2018; 70: 2100-2109.
[8] Palacios C, Gonzalez L. Is vitamin D deficiency a major global public health problem? J Steroid Biochem Mol Biol 2014; 144: 138-145.
[9] Al-Alyani H, Al-Turki HA, Al-Essa ON, Alani FM, Sadat-Ali M. Vitamin D deficiency in Saudi Arabians: a reality or simply hype: a meta-analysis (2008–2015). J Family Community Med 2018; 25: 1.
[10] Alsuwadia A, Farag YM, Al Sayyari AA, Mousa DH, Alhejaili FF, Al-Harbi AS, et al. Prevalence of vitamin D deficiency in Saudi adults. Saudi Med J 2013; 34: 814-818.
[11] Al-Agha AE, Alorabi SH, NoorSaeed S, Shalabi NM. Awareness of vitamin D and its deficiency in Jeddah population, Saudi Arabia. J Com Pub Health Nurs 2016; 2:120-8
[12] Alshamsan FM, Bin-Abbas BS. Knowledge, awareness, attitudes and sources of vitamin D deficiency and sufficiency in Saudi children. Saudi Med J 2016; 37: 579-83.
[13] Alamoudi LH, Almuteeri RZ, Al-Otaibi ME, Alshaer DA, Fatani SK, Alghamdi MM, et al. Awareness of vitamin D deficiency among the general population in Jeddah, Saudi Arabia. J Nutr Metab 2019; 2019: 4138187
[14] Kaddam IM, Al-Shaikh AM, Abaalkhail BA, Asseri KS, Al-Saleh YM, Al-Qarni AA, et al. Prevalence of vitamin D deficiency and its associated factors in three regions of Saudi Arabia: A cross-sectional study. Saudi Med J 2017; 38: 381-90.
[15] Alemu E. Varnam R. Awareness of vitamin D deficiency among at-risk patients. BMC Res notes 2012; 5: 17-23.
[16] Wardle J, Haase AM, Steptoe A, Nillapun M, Jonwutiwes K, Bellisie F. Gender differences in food choice: the contribution of health beliefs and dieting. AnnBehav Med 2004; 27: 107-16.
[17] Balasubramanian S. Vitamin D deficiency in breastfed infants & the need for routine vitamin D supplementation. Indian J Med Res 2011; 133: 250-2.
[18] Wagner CL, Taylor SN, Johnson DD, Hollis BW. The role of vitamin D in pregnancy and lactation: emerging concepts. Women's Health 2012; 8: 323-40.
[19] Qureshi AZ, Zia Z, Gitay MN, Khan MU, Khan MS. Attitude of future healthcare provider towards vitamin D significance in relation to sunlight exposure. Saudi Pharm J 2015; 23: 523-7.
[20] Banginwar Y, Dawande A. Assessment of Bacteriological Quality of Drinking Water available in Dental Clinic in Akola City, India Int J Life Sci Special 2014; 182-4.
[21] Alharbi AA, Alharbi MA, Aljafen AS, Aljuhani AM, Almarshad AI, Alomair IA, et al. Gender-specific differences in the awareness and intake of vitamin D among adult population in Qassim region. J Family Community Med 2018; 25: 148-54.
[22] Aljefree NM, Lee P, Ahmed F. Knowledge and attitudes about vitamin D, and behaviors related to vitamin D in adults with and without coronary heart disease in Saudi Arabia. BMC Public Health 2017; 17: 266-272.
[23] Rhodes LE, Webb AR, Fraser HI, Kift R, Durkin MT, Allan D, et al. Recommended summer sunlight exposure levels can produce sufficient (≥ 20 ng ml− 1) but not the proposed optimal (≥ 32 ng ml− 1) 25 (OH) D levels at UK latitudes. J Invest Derm 2010; 130: 1411-8.
[24] Holick MF. Vitamin D deficiency. N Eng J Med 2007; 357: 266-81.
[25] The Sixteen Services Guide 2017, Stats.gov.sa, Available from: https://www.stats.gov.sa/sites/default/files/al-madinah_al-monawarah_region_en.pdf