

Knowledge, awareness and practice of vitamin D among population of Qassim Region, Saudi Arabia before and during COVID-19 pandemic

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Abstract

One billion people globally have been affected by vitamin D deficiency and its associated diseases; therefore, the present study was aimed to estimate the knowledge, awareness and practices of vitamin D in the Qassim region of the adult population before and during the COVID-19 pandemic. A cross-sectional survey was conducted among 195 of the general adult population in the Qassim region, Saudi Arabia from 15th September 2020 to 25th October 2020. The results revealed that a high percentage of participants are cognizant of vitamin D (93.8%). Also, it appears that there was no association between knowledge and awareness of vitamin D and age, gender, education or social status. Around 82.6% of the participants know the sources of vitamin D and the majority of participants enjoy sun exposure (79%), where the most time exposed to the sun is early in the morning and after 3 pm, reported to at 43.6% and 52.3%, respectively. In addition, about 35% of participants increased their knowledge of vitamin D after the emergence of COVID-19. A high percentage of participants thought that vitamin D raising the body immunity against viral infection or improve immunity, in general, was at 67.7%, that thought that vitamin D prevents or increase resistance to COVID-19. From the foregoing results, it could be concluded that a high level of knowledge and awareness about vitamin D in adults living in the Qassim region and increased knowledge after the emergence of COVID-19 is the most important result of the current study.

1. Introduction

Vitamin D is considered an immunomodulatory agent and has hormonal action related to the maintenance of mineral and skeletal homeostasis is essential for maintaining a healthy skeleton. The main function of vitamin D is to regulate the metabolism of calcium and phosphate in the body (Holick, 2007; Prietl *et al.*, 2013).

The primary source of vitamin D in the human body is from the exposure of skin to ultraviolet light which represents more than 90% of vitamin D needed for humans. The 7-dehydrocholesterol under the skin is converted to ultraviolet light band B (UVB) to an inactive precursor vitamin D₃ (cholecalciferol). The remaining need for vitamin D (10%) is gained from different food sources rich in vitamin D (Holick, 2004). However, many factors can affect the synthesis of vitamin D for UVB under the skin such as latitude, pollution, solar zenith angles, ozone layer and pigmentation (Holick, 2007).

Vitamin D deficiency is a global public health

problem. Around 1 billion people worldwide suffer from vitamin D deficiency (Bjorklund, 2016). In this regard, Vitamin D deficiency is common in the Saudi Arabia population (Kelishadi, 2014; Green *et al.*, 2015). The experts work in Prince Mutaib Chair for Biomarkers of Osteoporosis task force in Saudi Arabia have been defined the sufficient level of vitamin D as circulating serum 25(OH) D (≥ 50 nmol or ≥ 20 ng/mL) for the general population (Al-Daghri, 2018), similarly to the IOM, USA that the recommended cut-off of vitamin D status 25(OH) D is (20 ng/mL or 50 nmol/L) for normal healthy people as the main basis of bone health.

In recent years many studies have reported that vitamin D deficiency has been found to be significantly associated with common chronic diseases such as cardiovascular diseases, cancer, diabetes and immune system diseases (Wang, 2017). In addition, it has been reported that vitamin D is involved in regulating immune function, inhibiting inflammatory reactions, autoimmune diseases as well as immune cell biology system (Moreira and Hamadeh, 2010; Jeffery *et al.*, 2015).

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The lack of knowledge and practice of vitamins in addition to the wrong lifestyle, indoor activity, extensive cloths cover as well as lack of regular exposure to sunlight can be considered the major cause of Vitamin D deficiency among the Saudi population. Thus, the increase in knowledge, awareness and importance of effective practices about vitamin D is important for the general population to know. Its benefit on health especially on the prevention of diseases related to deficiency and insufficiency. Therefore, the primary goal of this study was to investigate the amount of knowledge, awareness and practices about vitamin D of adults living in the Qassim region before and during the emergence of the COVID-19 pandemic.

2. Methodology

2.1 Questionnaire

For data collection, a cross-sectional survey was conducted among the general adult population in the Qassim region, Saudi Arabia from 15th September 2020 to 25th October 2020. An electronic self-administered questionnaire (Google form) consisting of five parts was used to collect data (socio-demographic characters, health and anthropometric data, knowledge and awareness of vitamin D, attitude and practices of an individual about vitamin D and sun exposure and awareness associated after COVID-19 pandemic). The questionnaire was designed by the author and validated by three arbitrators in the study area. The questionnaire was previously tested for reliability and accuracy among twenty participants.

2.2 Statistical analysis

Data were statistically analysed using descriptive statistics using IBM SPSS statistics for mac version 25.0 (SPSS Inc., Chicago, IL). Descriptive statistics were used to characterize the participants of the study population. Data were presented as a percentage in frequency tables for each part of the questionnaire to identify the participant's Socio-demographic characters information, knowledge and awareness of vitamin D, sun exposure and practices about vitamin D and after the emergence of COVID-19. A Chi-square test was conducted to identify the association between knowledge and awareness of vitamin D and each of age, gender, education and social status, at the significance level of $p \leq 0.05$.

2.3 Ethics statement

The questionnaire and data collection, a cross-sectional survey was approved by the Ethics Committee of Health Research Ethics, Deanship of Scientific Research, Qassim University, 20-06-13.

3. Results

3.1 Socio-demographic characters information

One hundred and ninety-five participants have completed the survey. Table 1 shows the Socio-demographic characteristics, the ages of participants where 59% were between 18-35 years, 33.8% between 36-50 years and 7.2% over 50 years. Most of the participants were male (61.5%), different education levels were found in this survey where most of them held a bachelor's degree (72.8%). In this survey, almost half of the participants were students (55.5%) and 63.1% of participants were unmarried. Regarding health, most of the participants were not diagnosed with any chronic disease (83.6%).

Table 1. Socio-demographic characters information

Question	Mean	SD
Weight (Kg)	69.9	23.4
Hight (cm)	162.3	15.9
	N	%
Age (year)		
18-35	115	59
36-50	66	33.8
>50	14	7.2
Gender		
Male	120	61.5
Female	75	38.5
Education		
High school	24	12.3
Diploma	18	9.2
Bachelor degree	142	72.8
Higher degree	11	5.6
Job		
Unemployed	37	19
Free business	6	3.1
Housewife	1	0.5
Student	108	55.4
Retired	8	4.1
Teacher	2	1
Government employee	23	11.8
Private employee	10	5.1
Social status		
Wido/widower	1	0.5
Unmarried	123	63.1
Married	67	34.4
Separated	4	2.1
Have you been diagnosed with a chronic disease?		
Yes	32	16.4
No	163	83.6

3.2 Knowledge and awareness of vitamin D

Data presented in Table 2 depicts the knowledge and awareness of vitamin D. Most of the participants (93.8%) were aware that vitamin D is essential for health. There was no significant association between knowledge and awareness of vitamin D in age, gender, education and social status. About 82.6% of the participants understood

Table 2. Knowledge and awareness of vitamin D

Question	N	%
Do you know about vitamin D?		
Yes	183	93.8
No	12	6.2
Is the vitamin D in the body?		
Yes	159	81.5
No	36	18.5
Sources of vitamin D:		
Sun light	28	14.4
vitamins Supplement	3	1.5
Some foods	1	0.5
All the above	161	82.6
I do not know	2	1
Dose vitamin D effect on health:		
Good	148	75.9
Bad	32	16.4
I do not know	15	7.7
Do you know is vitamin D good for bone health?		
Yes	176	90.3
No	3	1.5
I do not know	16	8.2
Is vitamin D deficiency related to muscle pain?		
Yes	133	68.2
No	12	6.2
I do not know	50	25.6
Do you think that vitamin D deficiency has related to other health conditions in the body such as heart disease/diabetes/		
Yes	99	50.8
No	24	12.3
I do not know	72	36.9
Sources of knowledge about vitamin D?		
Newspapers and magazines	3	1.5
TV and radio	16	8.2
Friends and relatives	97	49.7
Social Media	104	53.3
Doctors in net and social sites	92	47.2
Doctors in clinics and hospitals	66	33.8
Health Publications, Brochures	46	23.6
Scientific books in schools and universities	55	28.2
Are you ready to check the level of vitamin D in the body?		
Yes	181	92.8
No	14	7.2
If you are diagnosed with a deficiency in the level of vitamin D, will you take vitamin D as a dietary supplement (tablets/		
Yes	181	92.8
No	14	7.2

the sources of vitamin D, on the contrary, about 14% of participants thought that the only source of vitamin D is sunlight. In this survey, 75.9% and 90.3% of the participants have known that vitamin D has a good effect on overall and bone health, respectively. In addition, vitamin D deficiency has been known to be related to muscle pain and other health issues (68.2% and 50.8%, respectively). The main source of vitamin D knowledge was from social media, friends, doctors on the internet and social sites (53.3%, 49.7% and 47.2% respectively). The majority of the participants were ready to analyse the concentration of vitamin D in the body and will take

vitamin D as a dietary supplement (tablets/injection) if they were diagnosed with a deficiency. There was no significant association that has been found between the knowledge of vitamin D and age, gender, education and social status.

3.3 Sun exposure and practices about vitamin D

The majority of participants (79%) experienced sun exposure. About half of the participants (52%) had sun exposure after 3 pm. However, 43.6% of the volunteers were only exposed early in the morning. Data in Table 3 indicates that 68.2% of the sample population thought

Table 3. Sun exposure and practices about vitamin D

Question	N	%
Would you like to be exposed to the sun?		
Yes	154	79
No	41	21
Do you usually protect yourself from the sun?		
Yes	40	20.5
No	32	16.4
Some time	123	63.1
Do you use sunscreen?		
Yes	45	23.1
No	102	52.3
Some time	48	24.6
If you a person who exposed to the sun, what is your usual time?		
6-8 am	85	43.6
8-10 am	50	25.6
10 am-12 pm	39	20
after 3 pm	102	52.3
What parts of your body are exposed to sunlight?		
Face	141	72.3
Hands	148	75.9
Feets	90	46.2
Hands to elbows	104	53.3
Legs	43	22.1
Face and neck	104	53.3
Other parts of the body	15	7.7
Do you think your time in the sun is enough for you to get vitamin D?		
Yes	31	15.9
No	133	68.2
I do not know	31	15.9
Have you ever done a test on the level of vitamin D in the body?		
Yes	106	54.4
No	89	45.6
What are the reasons for the analysis of vitamin D?		
Doctor prescription	-	31
Personal decision	-	56
Other reason	-	13
What was the result of the analysis?		
Deficiency	76	63.9
Insufficiency	14	11.8
Sufficiency	9	7.6
I do not know	20	16.8
Did you take a vitamin D supplement after the analysis?		
Yes	89	73
No	33	27
Have you ever taken a vitamin D supplement or a group of nutritional supplements that contain vitamin D without having analysis?		
Yes	82	42.1
No	113	57.9
What are the reasons for taking these nutritional supplements that contain vitamin D?		
An increase in health	42	39.6
To raise immunity and prevent diseases	47	44.3
Experiment	8	7.5
To treat the pain you suffer from	41	38.7
Other	9	8.5
Have you taken vitamin D supplements with advice from ...		
A doctor	88	65.7
pharmacist	15	11.2
Friend or relative	27	20.1
The impact of social media	9	6.7
After reading the health and medical awareness publications	23	17.2
Other	14	10.4

Table 3 (Cont.). Sun exposure and practices about vitamin D

Question	N	%
Do you know how much vitamin D is needed from nutritional supplements?		
Yes	69	35.4
No	126	64.6
What is the source or reference for you to know the necessary amount of vitamin D for the body?		
Doctor or pharmacist	66	67.3
Friends or relatives	6	6.1
Publications Health and Medical Awareness	18	18.4
Other	22	22.4
Do you know what is the adequate level of vitamin D in the body?		
Yes	76	39
No	119	61
What is the adequate level of Vitamin D in the body?		
< 10 ng/mL	2	2.2
10-30 ng/mL	11	12.1
30-100 ng/mL	29	31.9
> 100 ng/mL	49	53.8
Do you know what foods are rich in vitamin D?		
Milk, dairy products	120	61.5
Red meat	28	14.4
Chicken	9	4.6
Fatty fish	120	61.5
Fruit	60	30.8
Vegetables	67	34.4
eggs	78	40
Baked goods	4	2.1
Legumes	30	15.4
Butter	23	11.8
Mushroom	33	16.9

that most parts of the body exposed to the sunlight is enough for them to cover their needs. Almost half of the participants have undergone a test of vitamin D level and about 64% of the participants suffered from vitamin D deficiency or insufficiency and 89% have been taking supplements after their test. On the other hand, 42.1% have taken supplements without doing the vitamin D test, which was the main reason to raise immunity and prevent diseases, an increase in health and to treat the pain 44.3%, 39.6% and 38.7%, respectively. In this survey, doctors were the most influenced of the participants who have taken the advice of vitamin D supplementation at 65.7%, then friends and relatives at 20.1%. 61% of participants did not know the adequate level of vitamin D in the body. Milk, dairy products, and fatty fish were reported to be rich in vitamin D.

3.4 Awareness of vitamin D after COVID-19 pandemic

About 35% of participants improved their knowledge and attitude about vitamin D after the COVID-19 pandemic. A high percentage of participants thought that vitamin D raises the body immunity against viral infection or improve immunity in general. Around 67.7% thought that vitamin D prevents or may aid in the resistance of respiratory infections such as COVID-19. The COVID-19 pandemic has affected 23.6% of

participants in their choice of food rich in vitamin D. Only 11.3% of participants have been diagnosed with COVID-19, 38% and 41.2% of them have been informed by doctors to take dietary supplements of vitamin D and increase their exposure to sunlight, respectively (Table 4).

4. Discussion

Vitamin D deficiency is a public health issue around the world (Wahl *et al.*, 2012) even in a country with sunshine most of the year (Green *et al.*, 2015; Santos *et al.*, 2019). Knowledge, awareness and practices about vitamin D may differ between communities and populations. The present study is one of the first studies to examine these factors before and after the emergence of COVID-19 among adults living in the Qassim region.

The finding of this study showed that most of the participants were well-versed about vitamin D. While majority knew the right sources of vitamin D and its benefits for their general health and bones. About half of the participants in this study thought that vitamin D deficiency was related to health conditions such as heart diseases, diabetes, depression, high blood cholesterol, cancer, multiple sclerosis and asthma. Previously, published studies related to vitamin D deficiency and

Table 4. Awareness of vitamin D after the emergence of COVID-19

Question	N	%
Before the emergence of COVID-19	183	93.8
After the emergence of COVID-19	6	3.1
Do not have knowledge	6	3.1
Is the emergence of COVID-19 affected you by increasing your knowledge?		
Yes	69	35.4
No	126	64.6
Do you think there is a relationship between vitamin D and raising the body immunity against viral infection or for improving immunity in general?		
Yes	167	85.6
No	28	14.4
Do you think there is a relationship between vitamin D and the prevention or resistance of COVID-19?		
Yes	132	67.7
No	63	32.3
Did you ensure to take an adequate level of vitamin D throughout the emergence of COVID-19?		
Yes	71	39.4
No	109	60.6
Has the COVID-19 pandemic affected your choices of food rich in vitamin D?		
Yes	46	23.6
No	149	76.4
Have you ever been diagnosed with COVID-19?		
Yes	22	11.3
No	173	88.7
After being infected with COVID-19, have you been informed by doctors to take dietary supplements of vitamin D to raise		
Yes	8	38
No	13	62
After being infected with COVID-19, have you been informed by doctors to expose to sunlight to raise immunity?		
Yes	7	41.2
No	10	58.8

some of those health conditions were reviewed by Wang *et al.* (2017). The high knowledge of participants about vitamin D and their awareness of different sources was the highest from social media, friends, relatives, doctors on the internet and social site, which shows the large influence of social media within a population (Van de Belt *et al.*, 2013).

Reflecting on the results, high knowledge and awareness about vitamin D, affected their readiness to analyse the vitamin D concentrations and treat vitamin D deficiency if they were diagnosed. Thus, this attitude can help the community to increase their health status and prevent any related health issues in the future. As the main source of vitamin D is sunlight (Holick, 2016), 80% of participants liked being exposed to the sun, few have reported to usually protect themselves from the sun, while others were exposed without sunscreen. The usual amount of time participants were exposed to sunlight was in the early morning from 6 to 8 am and after 3 pm, which is an efficient time to receive vitamin D from sunlight as it has been reported the perfect time to get vitamin D from sunlight in the summer and winter was after 9:00 am to 10:30 am, 2:00 pm to 3:00 pm and 10:00 am to 2:00 pm, respectively (Al-Daghri *et al.*, 2017).

The face, neck and hands were the body parts most exposed to sunlight in this survey which reflects the

traditional clothes of this population in Qassim city. However, most participants thought the time exposure about 3 to 4 times a week was not enough to receive vitamin D and tended to expose 20% of their body (Al-Daghri *et al.*, 2017).

About half of the participants have undergone a test to check the vitamin D level in their bodies, which was a personal decision that reflects how educated the participants in this survey were about the importance of vitamin D. Their results of vitamin D level were classified as a deficiency (~64%), insufficiency (~12%), sufficiency (~7%) and unavailable results (~17%). The majority have taken vitamin D supplements after the analysis to increase its potency in the body (Institute of Medicine, 2011). However, around 42% of the participants taking the vitamin D supplement or group of nutritional supplements that contain vitamin D without having analyzed vitamin D were mostly interested in raising their immunity and prevent diseases and treating any ailments they suffer from. Most took the advice of doctors (~65%), friends and relatives (~20%) and after reading health and medical awareness (~17%). Whereas, the impact of social media was the lowest (~6%).

In this study, most of the participants do not know the adequate level of vitamin D in the body and around half of the participants selected (> 100 ng/mL or 250

nmol/L) as the adequate level of vitamin D. The recommended cut-off level of vitamin D by IOM, USA is (20 ng/mL or 50 nmol/L) for normal healthy people as the main basis of bone health whereas the range below (30 ng/mL or 75nmol/L) of 25(OH) D concentration is considered vitamin D deficiency by Holick *et al.* (2011).

At the end of the year 2019, with the prominence of COVID-19 around the world, people are more worried about protecting themselves from the disease. As the awareness of vitamin D after the emergence of COVID-19 was examined in this study, the results showed in the second part of this survey the majority of participants have been reading up about vitamin D (93.8%) and a small percentage (~3%) of the participants were not as knowledgeable about vitamin D after the emergence of COVID-19. However, (~35%) of participants reported that the emergence of COVID-19 affected their needing to boost their immune systems.

The association between vitamin D and body immunity have been reported previously (Charoenngam and Holick, 2020) and in this study, the majority of participants (85.6%) thought there is a relationship between vitamin D and rising the body immunity against viral infection or for improving immunity in general. This is due to reports published in this relation (Zemb, 2020). In this study, some participants around 39 and 23% ensured their intake of an adequate level of vitamin D throughout the emergence of COVID-19 and affected their choices of food rich in vitamin D, which is a good practice among themselves

A few participants in this study have been diagnosed with COVID-19. It was interesting to note that some of the participants, after being infected with COVID-19 have been informed by doctors to take dietary supplements of vitamin D and to increase their exposure to sunlight to raise their immunity. This supports the importance of an adequate level of vitamin D (Charoenngam and Holick, 2020; Zemb, 2020).

5. Conclusion

A high level of knowledge and awareness about vitamin D in general adults living in the Qassim region were reported. There was no association between knowledge and awareness of vitamin D in age, gender, education or social status. The majority of participants under the current study were knowledgeable of the sources of vitamin D and were akin to the exposure of sunlight. The most effective time of exposure was found to be in the early morning and after 3 pm. The increasing awareness about vitamin D and its importance was collected from different sources where social media ranked the highest, before friends and relatives, and

doctors on the internet and social sites. Participants increased their knowledge of vitamin D after the emergence of COVID-19, majority of participants thought that vitamin D raises the body immunity against viral infection and increases their resistance to COVID-19.

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