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KNOWLEDGE and AWARENESS of VITAMIN D DEFICIENCY AMONG the GENERAL ADULT POPULATION in BAHRAIN: A CROSS-SECTIONAL STUDY

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Abstract:

Background: Vitamin D deficiency is a common health problem in many countries, including Bahrain. However, little data exists about the awareness and the level of knowledge of vitamin D among Arab Gulf populations.

Method: A cross-sectional study design was employed. A self-administered questionnaire was administered to an adult sample of 335 participants seeking information on their knowledge about vitamin D.

Findings: 81.2% of the study participants had unsatisfactory total knowledge score of vitamin D. Level of education and the sources of information about vitamin D were the main significant factors that appear to influence the participants' vitamin D awareness status. Most the participants recognized that exposure to sunlight encourages the production of vitamin D, however, only a small proportion of participants were aware of the sources of vitamin D in daily food intake and health consequences of vitamin D deficiency.

Conclusion: There is inadequate knowledge and awareness regarding vitamin D deficiency among adult Bahrain population. Health campaigns are urgently needed in order to improve the community's knowledge about the benefits and sources of vitamin D.

Keywords: Vitamin D, Deficiency, Knowledge, Awareness, Adult population

INTRODUCTION

Background

Vitamin D, the sunshine vitamin plays a leading physiological role in maintaining extracellular calcium ion levels in the human body. Extracellular calcium is important for the functioning of many metabolic processes and neuromuscular activities **(Ross, Taylor, Yaktine. & Del Valle, 2011).** Vitamin D influences calcium levels primarily by controlling the absorption of calcium from the intestine, through the direct effects on bone and through its effects on parathyroid hormone secretion **(Gallagher et al,1979)**. The status of vitamin D

in the health and biomedical fields has attracted considerable scientific attention during the last decade. Many studies have been conducted to examine the benefits, use, and deficiency of vitamin D **(Kaddam, et al, 2017)**

The health consequences of vitamin D deficiency were identified in several studies. It was found to be associated with non-musculoskeletal chronic diseases, such as cardiovascular diseases and diabetes mellitus **(Ford et al, 2014 ; Mitri, Muraru, & Pittas, 2011)**. Moreover, vitamin D deficiency results in decreased bone mineralization, secondary hyperparathyroidism, and increased cortical bone loss; it has been linked to the pathogenesis of osteoporosis and hip fractures **(Rizzoli, & Bonjour, 2004)**.

Vitamin D deficiency is currently considered as a global health problem that not only affects adults but children as well **(Wahl et al, 2012)**. In addition, the magnitude of vitamin D deficiency is found in all age groups, including pregnant women and their neonates, toddlers, school children, men, women, and elderly. These high prevalence rates were also reported from rural and urban areas as well **(Holick, 2007)**. In addition, it was found that vitamin D deficiency is a potential contributing factor for the death of patients from cardiovascular diseases, and cancers **(Chowdhury et al, 2014)**.

It could be a challenging task to determine vitamin D status of a population **(Jones, Horst, Carter, & Makin, 2007)**. In adult populations, early diagnosis, treatment along with appropriate preventive measures are identified as key tools to promote health and reduce the health burden; especially in elderly **(Bjelakovic et al, 2011)**.

In Saudi Arabia, studies show a very high prevalence rate of vitamin D deficiency with rates of 81% among various age groups **(Al-Daghri,2018)**. In Jeddah, the prevalence reached approximately 80% and was related to obesity, low sun exposure, inadequate vitamin D supplementation, high waist-to-hip ratio, and old age **(Ardawi et al, 2011)**.

Lack of awareness about the importance of vitamin D, its health benefits, and prevention of deficient among populations is believed to be one of the major reasons for the worldwide spread of this nutritional disorder **(Hagenau et al , 2009)**. Literature show a lack of awareness and knowledge of vitamin D role and sources in several countries, including, United Kingdom, Hong Kong, India, and **USA (Alemu & Varnam, 2012; Kung & Lee, 2006; Lhamo, Chugh, Gautam, & Tripathi, 2017; Agens, Galasko, Purandare, & Lin, 2012)**. There are several factors that have contributed to vitamin D deficiency such as decreased sunlight exposure because of the fear of pigmentation, cancer, or weather variation and low dietary intakes of vitamin D **(Balasubramanian, Dhanalakshmi & Amperayani, 2013)**. This significant decrease in vitamin D levels worldwide in different age groups is thought to be a consequence of the lack of awareness regarding vitamin D importance and its resources among public. Therefore, awareness of the importance of vitamin D in the regulation of normal physiology and the effects of its deficiency in the community is needed in order to protect the general population from potential widespread of bone and other vitamin D deficiency disorders **(Khan, Iqbal, Naureen, Dar, & Ahmed, 2012)**. It has been suggested that at the community level targeting general and high-risk populations could help to prevent its long-term health consequences via conducting educational campaigns about vitamin D to improve the community knowledge and awareness **(Tariq, Khan, & Basharat, 2020)**.

Recent studies have reported that almost half of adult Bahraini population are suffering from vitamin D deficiency **(Golbahar et al, 2014)** . Despite this situation, limited research exists about the reasons for such high prevalence rates in Bahrain. The aim of this study was to explore the level of awareness about vitamin D deficiency among the population in Bahrain. Such information is urgently needed in order to guide health policy makers in planning effective future preventive and management initiatives for the prevention of vitamin D deficiency.

MATERIAL AND METHODS

Research design and setting
A descriptive cross-sectional study design was used to conduct this research project at four governorates in Bahrain (Capital, Southern, Northern, and Muharraq).

Participants
A convenience sample of 335 participant was recruited from general adult population who went to four malls (one mall from each governorate) during the study duration. The inclusion criteria were subject being aged 18 or older while those who had language communication problems were excluded from the study. The sample size was calculated based on an estimate of a 95% confidence interval for the mean knowledge score with 5.0 width and 15.0 standard deviation using the single mean equation for sample size **(Hulley et al, 2013)**, and accounting for a non-response rate of about 10%.

Data collection tool
Self-administered questionnaire based on pertinent literature was used to obtain data from participants **(Habib., Al-Motairi, & Al-Mutairi, 2014; O'Connor, Glatt, White & Revuelta, 2018).** It was administered in both Arabic and English languages for Bahrain population in order to assess their knowledge and level of awareness about vitamin D deficiency. It consisted of five sections, the first section sought information on participant's demographic characteristic such as age, gender, nationality, educational level, and residence governorate. The second section included four questions designed to assess the knowledge of vitamin D (Sources of information, benefits, and sources of vitamin D). The third section included three questions exploring the attitude towards sun exposure. The fourth section included four questions to assess the knowledge of dietary intake that contain vitamin D. Four questions exploring vitamin D testing were also included in this final section. For the calculation of the knowledge score, a correct response was scored as "1" and the incorrect answer was given a "zero". For each section and for the total knowledge score, the sum obtained was divided by the number of items, and then converted into a percentage score. Means, standard deviations and medians were calculated for each individual section score and for the total knowledge score. The research tool was rigorously revised by a panel of experts for face and content validity and necessary modifications were made. A pilot study was conducted on 30 persons in order to assess the questionnaire's internal consistency. Accordingly, the tool was then modified based on the pilot results.

Procedure
The researcher met with each eligible participant in the settings and provided them with the instructions concerning their filling-in and any clarifications needed. Approximately 10-15 minutes was given to each participant to complete the questionnaire. The completed forms were collected by the researcher and revised on-site in order to ensure that the subject has answered all the questions in the form.

Statistical analysis

Data analysis was performed using the statistical software SPSS version 23. Frequency distribution tables and percentages were produced to describe the socio-demographic characteristics and the participant's awareness level. A cross-tabulation test (chi-square) was used to determine whether there was a significant relationship between the awareness and socio-demographic data such as age, gender, and education status. A p-value of less than 0.05 was considered statistically significant. Multiple logistic regression model was employed in order to identify the independent socio-demographic characteristics. The odds ratio (OR) was considered significant if the confidence interval (CI) did not include the value of one (1).

ETHICAL CONSIDERATIONS

The researcher obtained an informed verbal consent from each individual participant after explaining to him/her the study goals. They were informed of their right to refuse or withdraw at any time with no questions asked. Total anonymity and confidentiality were guaranteed, and reassurances were given that the collected information would be used only for research purposes.

RESULTS

Table 1 presents the socio-demographic characteristics of the of subjects in the study sample. Most of the participants were under the age of 50 (89.3%), with two-third of the sample being female and 70% Bahraini citizens. The sample population was obtained from all the four governorates of Bahrain in order to allow geographical coverage of all regions. Most of the participant have attained a relatively high level of education (67.2%).

Most of the participants in the study sample had received in the past information about vitamin D (95.2%)-Table 2. The main source of information was the media (62.1%). However, many of the participants have derived their information on vitamin D from more than one source (Mean ±SD 2.6±1.4; median = 2), some of which may not have provided them with accurate information such as family members and friends (Table 2). This would likely lead to miss perceptions about the sources of vitamin D among the study subjects.

As demonstrated in Table 3, knowledge of the benefits of vitamin D seems to be linked in peoples' minds with mainly bone conditions as the majority of the participants (81.8%) have correctly identified keeping health bones as a benefit from the consumption of vitamin D while only 12.5% were aware of the role of vitamin D in the prevention of stroke..

Table 4 shows that most of the participants have correctly recognized exposure to sunlight as a mechanism that promotes production of vitamin D in the body (92.2%). On the contrary, only few subjects were aware of the relation between fortified food items and drinks with vitamin D.

Table 5 demonstrates the percentage of respondents who have successfully identified the correct sources of vitamin D in our daily food intake and which food items are rich with this vitamin. Sea food items were successfully identified by 60.9% of participants, egg yolk 54.9%, with lowest being breakfast cereals (36.1%). Participants were clearly less informed about food items that have poor contents of vitamin D which is probably reflects their source of information.

Based on the responses of participants' awareness of vitamin D benefits, sources, food items, and proper timings for sun exposure, a total satisfactory knowledge score for vitamin D was calculated. There was a disappointedly low percentage of participants who attained a total knowledge satisfactory score (18.8%) - Table 6.

The potential relation between the respondents' knowledge and their demographic characteristics was explored in Table 7. As shown in the table, none of the socio-demographic features of the subjects were related to their knowledge about vitamin D. However, subjects who have received reliable information about vitamin D sources and benefits has significantly higher satisfactory knowledge scores compared to those who did not (p-value 0.049). This further emphasizes the role of public health educational campaigns in the prevention of vitamin D deficiency in the community.

Table 8 shows that the subjects' educational background (P-value 0.04) and having received information about the importance of vitamin D intake (P-value 0.06) play a significant role in the practice of consuming daily vitamin D supplement.

The subjects' perceptions, beliefs, and behaviours towards daily intake of vitamin D is presented in Table 9. In a hot climate country like Bahrain with the sun shining most of the year, it is not unexpected that a majority of respondents have opted for sun light exposure as a free source of vitamin D. However, most of those people were usually in covered up places or in the shade which would give the people in Bahrain a false feeling of getting enough daily vitamin D supplementation. Such poor practices are reinforced in the finding that only 12.2% of subjects have attempted to check the vitamin D content in the food items that they purchase (Table 9).

Of greater concern is that half of the populations had never had a vitamin D testing in the past. Moreover, even those subjects who reported taking vitamin D supplements have done so based on physician instructions (71%) rather than their personal self-awareness about the value to their health of the daily intake of vitamin D. In order to explore which of the subjects' characteristics affects their decision to take vitamin D test, a best fitting multiple logistic regression model was employed. It was found that subjects' level of education was the main significant factor that determines his/her decision to go for a vitamin D test (OR 1.55; 95% CI 1.07- 2.25) – Table 10.

DISCUSSION

It is acknowledged worldwide that there is a low level of vitamin D awareness and correct knowledge among most populations **(Alemu & Varnam, 2012)**, particularly in the Gulf Arab region. However, the findings of the current study that four out of every five adult persons in Bahrain have inadequate level of knowledge about vitamin D benefits and sources in diet are much lower than that reported from similar populations in the area. For example, the overall level of inadequate knowledge about vitamin D among Saudi population in 2019 was 60% **(Alamoudi et al, 2019)**. These findings are in line with those from Kuwait where low level of knowledge among the participant regarding the effect of vitamin D deficiency were reported **(Al Bathi et al, 2012)**.

The present study has also demonstrated that most of the participants in the study sample had received information about vitamin D (95.2%). The main source of knowledge about vitamin D was media 62.1%, followed by Doctors (54.3%). Almost one-third of the participants got their knowledge from family members. Similarly, **(Ibrahim, Al-Tameemi & Dawoud, 2019)**

In United Arab Emirates found that the main sources of knowledge about vitamin D was from doctors (40%), followed by 12.5% from the media and 29.0% from relatives. This may reflect the trend of change in peoples' daily lives over the past ten years with the wide use of web-based internet as the first line source of information.

One of the striking findings in this study is that while three-fourth of subjects have correctly identified keeping healthy bones as a benefit from the daily consumption of vitamin D, most of the participants have failed to recognize the role of vitamin D in the prevention of many chronic illnesses such as cancer, diabetes, stroke, arthritis, and high blood pressure, which is in congruence with the findings of **(Habib, Al-Motairi & Al-Mutairi, 2014)** who found that only 14.2% of the subjects had good knowledge about vitamin D, while (85.8%) of the subjects either had poor or fair knowledge about vitamin D. In the current study most of the participants were aware that exposure to sunlight promotes vitamin D production. However, there is still a gap of knowledge on peoples' mind when it comes to the safe times of exposure to the sun.

Major gaps and contradictory ideas in peoples' knowledge about sources of vitamin D in our daily food items were observed in this study which may reflects their multiple unreliable sources of information about vitamin D. For example, while 60.9% of the subjects have correctly identified sea food items as a rich source of vitamin D, only 22.7% have recognized meat as a poor source. Moreover, most subjects have failed to identify dairy product and breakfast cereals as a rich source for vitamin D. It is interesting that a substantial proportion of participants (83%) have identified green leafy vegetables and fruits as a rich source of vitamin D which raises the possibility of the people confusing information on vitamin D with that for vitamin C as a result of obtaining information from unreliable sources. Not surprisingly then, data from this study show that only a small proportion of subjects have attained a satisfactory total knowledge score (18.8%).

The relationship between subjects' accurate knowledge of Vitamin D and their demographic characteristics in the current study reveal that the educational status a subject has attained was the only statistically significant factor related to knowledge of Vitamin D. As expected, those persons with higher educational levels obtained higher scores compared with those with lower educational levels.

CONCLUSION AND RECOMMENDATIONS

In conclusion, the study showed that inadequate level of knowledge and awareness regarding vitamin D deficiency exist among Bahrain adult population. Such poor knowledge was significantly related to their educational status and the sources of information. Health educational campaigns are urgently needed in order to improve the community's knowledge about the benefits and sources of vitamin D.

DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon request.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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Table 1: Socio-demographic characteristics of subjects in the study sample (n=335)

	Frequency	Percent
Age:		
<30	155	46.3
30-	144	43.0
50+	36	10.7
Range	13-77	
Mean ±SD	32.6±11.5	
Median	30.0	
Gender:		
Male	108	32.2

Female	227	67.8
Nationality:		
Bahraini	234	69.9
Non-Bahraini	101	30.1
Education:		
Illiterate	4	1.2
Primary	16	4.8
Secondary	88	26.3
University	198	59.1
Postgraduate	27	8.1
Intermediate	2	0.6
Governorate:		
Capital	88	26.3
Southern	135	40.3
Northern	45	13.4
Muharaq	67	20.0

Table 2: Sources of information about Vit D among subjects in the study sample (n=335)

	Frequency	Percent
Received information about Vit D:		
No	16	4.8
Yes	319	95.2
Sources of information:		
Family	179	53.4
Friends	159	47.5
Doctors/health care providers	182	54.3
Media	208	62.1
School/university	112	33.4
Other	19	5.7
No. of sources:		
Range	0-6	
Mean ±SD	2.6±1.4	
Median	2.0	

Table 3: Knowledge of the benefits of Vit D among subjects in the study sample (n=335)

	Frequency	Percent
Knowledge of the benefits of Vit D:		
Healthy bones	274	81.8
Prevention of cancer	100	29.9
Prevention of diabetes	54	16.1
Reduces high blood pressure	62	18.5
Healthy pregnancy	142	42.4
Heart health	96	28.7
Healthy immune system	163	48.7
Prevention of stroke	42	12.5
Prevention of arthritis (inflammation of the joint)	194	57.9

Table 4: Knowledge of the sources of Vit D among subjects in the study sample (n=335)

	Frequency	Percent
Knowledge of the sources of Vit D:		
Correct sources:		
Fortified foods	77	23.0
Fortified drinks	59	17.6
Supplements	175	52.2

Sunlight	309	92.2
Incorrect sources:	5	1.5
Water	79	23.6
Natural foods	143	42.7
Natural drinks	94	28.1

Table 5: Knowledge of the food items rich in Vit D among subjects in the study sample (n=335)

	Frequency	Percent
Knowledge of food items rich in Vit D:		
Rich items:		
Sea food (fish, shrimps, tuna, etc.)	204	60.9
Egg yolk	184	54.9
Liver	145	43.3
Dairy products (milk, cheese, yogurt, etc…)	162	48.4
Breakfast cereals	121	36.1
Poor items:		
Meat	76	22.7
Fruit	53	15.8
Green leafy vegetables	57	17.0
Nuts (almonds, pistachio, etc.)	52	15.5
Sweets (chocolate, cookies, etc.)	145	43.3
Legumes (beans, lentils, etc.)	73	21.8

Table 6: Total knowledge of Vit D among subjects in the study sample (n=335)

	Frequency	Percent
Total satisfactory knowledge (60%+) of Vit D.:		
Benefits	80	23.9
Sources	101	30.1
Food items	259	77.3
Proper time for sun exposure	85	25.4
Total knowledge:		
Satisfactory	63	18.8
Unsatisfactory	272	81.2

Table 7: Relations between subjects' knowledge of Vit D and their characteristics

	Knowledge				X^2 test	p-value
	Satisfactory		Unsatisfactory			
	No.	%	No.	%		
Age:						
<30	26	16.8	129	83.2		
30-	31	21.5	113	78.5	1.23	0.54
50+	6	16.7	30	83.3		
Gender:						
Male	20	18.5	88	81.5		
Female	43	18.9	184	81.1	0.01	0.93
Nationality:						
Bahraini	43	18.4	191	81.6		
Non-Bahraini	20	19.8	81	80.2	0.09	0.76
Education:						
Basic/Intermediate	23	20.9	87	79.1		
University	31	15.7	167	84.3	5.34	0.07
Postgraduate	9	33.3	18	66.7		
Governorate:						
Capital	16	18.2	22	81.8		
Southern	21	15.6	114	84.4	2.43	0.49
Northern	10	22.2	35	77.8		
Muharaq	16	23.9	51	76.1		
Received information about Vit D:						
No	0	0.0	16	100.0		

Yes	63	19.7	256	80.3	Fisher	0.049*

(*) Statistically significant at p<0.05

Table 8: Relations between subjects' Vit D supplement intake and their characteristics

	Had Vit D supplement				X^2 test	p-value
	No		Yes			
	No.	%	No.	%		
Age:						
<30	71	45.8	84	54.2		
30-	65	45.1	79	54.9	0.05	0.97
50+	17	47.2	19	52.8		
Gender:						
Male	55	50.9	53	49.1		
Female	98	43.2	129	56.8	1.77	0.18
Nationality:						
Bahraini	101	43.2	133	56.8		
Non-Bahraini	52	51.5	49	48.5	1.97	0.16
Education:						
Basic/Intermediate	58	52.7	52	47.3		
University	88	44.4	110	55.6	6.57	0.04*
Postgraduate	7	25.9	20	74.1		
Governorate:						
Capital	33	37.5	55	62.5		
Southern	69	51.1	66	48.9	4.01	0.26
Northern	20	44.4	25	55.6		
Muharaq	31	46.3	36	53.7		
Received information about Vit D:						
No	11	68.8	5	31.3		
Yes	142	44.5	177	55.5	3.61	0.06

(*) Statistically significant at p<0.05

Table 9: Attitudes and behaviours related to Vit D among subjects in the study sample (n=335)

	Frequency	Percent
Sun exposure habits:		
Usually, direct sun	104	31.0
Usually, shade	170	50.7
Usually cover up	49	14.6
I do not go outside	12	3.6
Sun exposure habits:		
Direct sun	104	31.0
Indirect (shade)	170	50.7
None	61	18.2
Use of sunscreen:		
Never	111	33.1
Rarely	126	37.6
Often	53	15.8
Always	45	13.4
Look for Vit D label on purchased food:		
No	232	69.3
Yes	41	12.2
Yes, but do not understand	62	18.5
Attitude towards food fortified in Vit D:		
No risk	183	54.6
Uncertain	105	31.3
Risky	47	14.0
Willing to purchase and consume Vit D rich food:		
No	37	11.0
Yes	298	89.0
Ever undergone vitamin D testing:		
No	167	49.9
Yes	168	50.1
Frequency (n=168):		
Bi-monthly	8	4.8

Six-monthly	37	22.0
Yearly	18	10.7
As requested	105	62.5
Ever taken vitamin D supplement:		
No	153	45.7
Yes	182	54.3
Prescribed by (n=182):		
Physician	129	70.9
Pharmacist	2	1.1
Lab technician	10	5.5
None	41	22.5

Table 10: Best fitting multiple logistic regression model for having Vit D test

	Wald	Df	P	OR	95.0% CI for OR	
					Upper	Lower
Constant	5.237	1	.02	.19		
Education	5.400	1	.02	1.55	1.07	2.25
Nagelkerke R Square: 0.02						
Hosmer and Lemeshow Test: p=0.33						
Omnibus Tests of Model Coefficients: p<0.001						