

Prevalence and Risk Factors of Vitamin D Deficiency among Men

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Background: Vitamin D is vital for human health but its deficiency is worldwide. There is a gap in our knowledge about vitamin D status in Bahrain.

Objective: To identify vitamin D status and associated risk factors among men in Bahrain.

Design: A cross-sectional study.

Setting: Four public and four private maternity hospitals in Bahrain.

Method: The study was carried out in the second and third weeks of April 2012. Three hundred sixty-four men (husbands of mothers who presented in labor) participated in the study. A questionnaire was administered and vitamin D level was measured in the blood. Bivariate and multiple linear regression analysis were used to evaluate differences between variables. P-value <0.05 was considered significant.

Result: The mean age \pm SD was 34.40 ± 7.27 years. Vitamin D mean level \pm SD was 46.14 ± 12.80 nmol/L. Vitamin D level was <50 nmol/L in 233 (64%) men. The following variables showed significant association with vitamin D deficiency: high income (P-value 0.020), smoking (P-value 0.021), lack of sun exposure (P-value 0.001) and high body mass index (P-value 0.022).

Conclusion: Vitamin D deficiency is common among men in Bahrain. High income, lack of sun exposure and high BMI were significant and independent predictors of low vitamin D level. There is a need for population-based study in a randomly selected sample which includes all age groups and both genders.

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The importance of vitamin D stems primarily from its vital role in the musculo-skeletal health¹. Vitamin D deficiency might lead to rickets, osteoporosis and impaired body balance². Furthermore, vitamin D receptors have been identified in most body cells and linked to various cellular functions.

It is well-recognized that vitamin D has roles in inflammatory and immune processes³. Its deficiency is linked with autoimmune disorders, cardiovascular diseases, diabetes mellitus, as well as breast and colon cancers³⁻⁷. Although a causal relationship is controversial, the association of vitamin D deficiency with many disorders has been too strong to be unnoticed.

Despite the recognized importance of vitamin D for human health, its deficiency is a universal problem^{8,9}. Several reports in both Eastern and Western hemispheres have recognized a high prevalence of vitamin D deficiency^{10,11}. However, this nutritional deficiency is more severe in Middle Eastern and Asian populations¹².

Vitamin D research in Bahrain is limited. A recent study on volunteers who attended the blood bank center at Bahrain Defense Force hospital found vitamin D deficiency in 169 (67.6%) of the females and 78 (31.2%) of the males¹³. Another recent multicenter study that included mothers presenting in labor and their newborns, found that vitamin D was deficient in 88.8% of the mothers and 90.3% of their newborns¹⁴.

Vitamin D deficiency is traditionally common among high-risk groups, such as pregnant women, infants and elderly. However, it is increasingly reported among seemingly healthy adults. Our knowledge about vitamin D status among the general population in Bahrain is still limited.

The aim of this study is to identify vitamin D status among men in Bahrain and to identify the associated risk factors.

METHOD

A cross-sectional study was carried out in the second and third weeks of April 2012. The study population was the husbands of women in labor presenting to the eight participating maternity hospitals. It is part of a national multi-center study, which involved mothers in labor and their newborns¹⁴. Three hundred sixty-four out of the 403 men (90.3%) have accepted to be included in this study. The participating (4 public and 4 private) maternity hospitals are the catchment area for 94% of the annual births in the country¹⁵.

Data collection is based on an interview and the administration of questionnaires followed by the collection of 5 ml of blood. Blood was analyzed for 25(OH)D, calcium, phosphorus and alkaline phosphatase. Vitamin D was assayed as 25(OH)D using chemiluminescence method on Architect (Abbott). This method (in our laboratory) has correlation coefficient with high performance liquid chromatography (HPLC) assay of 0.92.

Data management and statistical analysis were done through SPSS version 20. Differences between variables were analyzed using Chi-square or Fisher's exact test as appropriate. Multiple

linear regression analysis was used to evaluate independent predictors of 25(OH)D level. P-value <0.05 was considered significant.

An informed consent was obtained from all participants upon recruitment.

RESULT

The study included 364 men. Their mean age \pm standard deviation (SD) was 34.40 ± 7.27 years, a range of 19-65 years. Three hundred fifty (96.2%) men were below 50 years of age.

Two hundred sixty-five (72.8%) were Bahrainis, 41 (11.3%) were non-Bahraini Arabs, 54 (14.8%) were Asians and 4 (1.1%) were Europeans.

Vitamin D mean level \pm SD was 46.14 ± 12.80 nmol/L with a range of 15.00 - 84.10 nmol/L. Vitamin D level <50 nmol/L was seen in 233 (64%) and <25 nmol/L was seen in 11 (3%) men; compared to their wives, 325 (89.3%) had a vitamin D level <50 nmol/L.

Calcium mean (SD) was $2.21 (.08)$ mmol/L, a range of 1.96 - 2.60 mmol/L. Only 20 (5.5%) patients had calcium level below 2.1 mmol/L. In addition, there was no significant difference in calcium level in men who had low and normal 25(OH)D level (P-value 0.383). Alkaline phosphatase mean (SD) was $99.07 (23.57)$ IU with a range of 56.00 - 186.00.

As shown in table 1, no significant association was found between vitamin D level and the participants' age (P-value 0.720), nationality (P-value 0.718) and exercise (P-value 0.332). However, high income (P-value 0.020), smoking (P-value 0.021), lack of sun exposure (P-value 0.001), and high BMI (P-value of 0.022) showed significant association with vitamin D deficiency. Multiple linear regression analysis showed that lack of direct sun exposure (P-value 0.001), high BMI (P-value 0.001) and high income (P-value 0.028) were associated with vitamin D deficiency.

Twenty-three (6.3%) had hypertension, 16 (4.4%) had diabetes mellitus and 19 (5.2%) had arthritis but none of these comorbidities showed a significant association with vitamin D level.

Table 1: Personal Characteristics and Vitamin D Level

Variables		Number and Percentage	Vitamin D level nmol/L		P-value	LR*
			< 50	≥ 50		
Age in years	19 - 29	96 (26.4)	64 (66.7)	32 (33.3)	0.720	
	30 - 39	188 (51.7)	122 (64.9)	66 (35.1)		
	40 - 49	66 (18.1)	39 (59.1)	27 (40.9)		
	50 - 65	14 (3.9)	8 (57.1)	6 (42.9)		
	Total	364 (100)	233 (64)	131 (36)		
Nationality	Bahraini	265 (72.8)	169 (63.8)	96 (36.2)	0.718	
	Non-Bahraini Arab	41(11.3)	29 (70.7)	12 (29.3)		
	Asian	54 (14.8)	33 (61.1)	21 (38.9)		
	European	4 (1.1)	2 (50)	2 (50)		
	Total	364 (100)	233 (64)	131 (36)		
Income (BD)	None	3 (0.8)	1 (33.3)	2 (66.7)	0.020	0.028
	<300	60 (16.8)	32 (53.3)	28 (46.7)		
	301-500	108 (30.3)	65 (60.2)	43 (39.8)		
	501-1000	146 (40.9)	97 (66.4)	49 (33.6)		
	1001-2000	32 (9)	28 (87.5)	4 (12.5)		
	>2000	8 (2.2)	6 (75.0)	2 (25.0)		
	Total	357**** (100)	229 (64.1)	128 (35.9)		
Smoking	Yes	137 (37.7)	97 (70.8)	40 (29.2)	0.021	.061
	No	226 (62.3)	135 (59.7)	91 (40.3)		
	Total	363**** (100)	232 (63.9)	131 (36.1)		
Exercise	Yes	188 (54.5)	118 (62.8)	70 (37.2)	0.332	
	No	157 (45.5)	103 (65.6)	54 (34.4)		
	Total	345* (100)	221 (64.1)	124 (35.9)		
Sun exposure	Yes	288 (80.2)	175 (60.8)	113 (39.2)	0.001**	0.001
	No	71 (19.8)	57 (80.3)	14 (19.7)		
	Total	359**** (100)	232 (64.6)	127 (35.4)		
BMI (kg/m²)						
18.5 - 24.9	Normal weight	87 (24.2)	48 (55.2)	39 (44.8)	0.022***	0.001
25.0 - 29.9	Overweight	169 (47.0)	106 (62.7)	63 (37.3)		
≥30.0	Obese	104 (28.9)	77 (74.0)	27 (26.0)		
Total		360**** (100)	231 (64.2)	129 (35.8)		

*Liner Regression, **Fisher's Exact, ***Pearson, ****Missing values

DISCUSSION

This study demonstrated that vitamin D deficiency is common among married men in Bahrain. However, it is more common among their pregnant wives (64% in men versus 89.3% in women). This is not surprising; women in most cultures have lower vitamin D level than men^{8,9,12}. This is attributed mainly to less sun exposure and to the high demands on maternal vitamin D stores by the fetus.

In this study, Vitamin D deficiency in men is doubled compared to that reported among male blood donors in BDF hospital (31.2%)¹³. This could be attributed to the healthy pool of blood donors who are mainly from military personnel and their dependents. In addition, this could be attributed to different methods of vitamin D estimation chemiluminescence versus liquid chromatography. However, the correlation coefficient between the two assay methods in the same two laboratories was 0.92.

Furthermore, vitamin D deficiency among men in this study is less than the reported in men from Jeddah (87.8%) and Riyadh (92%) regions^{16,17}. It is largely attributed to their older age, obesity, sedentary lifestyle, poor education and lack exposure to sunlight, smoking and poor dietary vitamin D supplementation.

Many studies indicated that vitamin D deficiency is not limited to the traditional risk groups but it is also documented in men in many Western countries⁸. Based on dietary intake survey data, vitamin D is the only deficient vitamin in Europe¹⁸. In the USA, the overall prevalence rate of vitamin D deficiency was 41.6%, the highest rate was seen in blacks (82.1%), followed by Hispanics (69.2%)¹¹.

In this study, the men's age, nationality, and lack of exercise showed no impact on vitamin D level. However, high income, smoking, lack of sun exposure, and high BMI showed significant association with vitamin D deficiency. These significant associations are compatible with many studies that showed similar links^{8,11,12,16}. The significant association of high income with vitamin D deficiency is unique in this study because traditionally vitamin D deficiency is more common in low-income population. It is most likely to have been caused by the limited sun exposure due to the extreme heat in Bahrain; high income individuals who work, exercise, and socialize mainly indoor get very little sun exposure.

It is not surprising that the lack of sun exposure among the population of this study was significantly associated with vitamin D deficiency. Similar observations were documented in many other studies^{9,11,14}.

In this study, patients with high BMI had vitamin D deficiency (P-value .001). The association between obesity and lower vitamin D is well recognized¹⁹⁻²¹. However, the exact mechanism is not well-established and several hypotheses were suggested²². These included lower dietary intake, reduced cutaneous synthesis, altered metabolism, sequestration of vitamin D in adipose tissues or simply due to dilutional effect caused by the large adipose tissues in obese individuals²³. Furthermore, other studies suggested that high vitamin D could help in reducing body fat mass but so far it has no definite effect on the weight²⁴⁻²⁶.

In this study, tobacco smoking showed a significant association with vitamin D deficiency in bivariate analysis (P-value .021), but in multivariate analysis it became insignificant (P-value .061). Several studies have linked tobacco smoking with increased bone loss, lower bone mass and osteoporotic fractures²⁷⁻²⁹.

Several mechanisms of vitamin D deficiency among smokers have been postulated, such as lower physical activity, poor dietary habits, alcohol consumption and lean body mass. However, the major effects of smoking on vitamin D and calcium homeostasis cannot be explained by these lifestyle variables only. It has been postulated that the low vitamin D-parathyroid system seen among smokers may represent the mechanism for the adverse effects of smoking on the bones and increased risk of osteoporosis³⁰. A recent study showed that the use of cigarette smoke extracts can inhibit the translocation of vitamin D receptors and vitamin D level and function in the body³¹. In smoking women, the lower vitamin D and bone mass has been

attributed to the lowering of estrogen level instigated by increased hepatic turnover³².

Finally, patients with comorbidities such as hypertension, diabetes mellitus and arthritis showed no significant association with vitamin D level. However, this lack of significant association is probably due to the small number of patients with these disorders.

The pervasiveness of vitamin D deficiency revealed in this study is important for the public health decision makers to initiate public education and to consider dairy products and flour fortification with vitamin D.

Although this is a multicenter study and the sample was drawn from a large pool, it cannot be considered to represent the whole population of men in Bahrain. Furthermore, the study did not address the effects of vitamin D deficiency on the study subjects. Therefore, there is a need for a population-based study looking at the prevalence and the health consequences of vitamin D deficiency.

CONCLUSION

Vitamin D deficiency is common among men in Bahrain. High income, lack of sun exposure, and high BMI were significant and independent predictors of low vitamin D level. To accurately estimate vitamin D status at the national level, there is a need for a general population-based study in randomly selected sample including both genders from all age groups.

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