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Validity of Self-Reported Vitamin D Deficiency among Midlife Arab Women Living in Qatar

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Abstract

Objectives—This study evaluates the level of agreement between self-reported vitamin D deficiency and serum vitamin D measured within the previous calendar year.

Methods—In a study in which serum 25(OH)D levels were retrieved from electronic health records, 523 women were asked whether they considered themselves to have vitamin D deficiency. Serum vitamin D levels were categorized as vitamin D deficiency if serum 25(OH)D was less than 20 ng/ml and as insufficiency if less than 30 ng/ml. The kappa statistic was computed to assess the level of agreement between serum 25(OH)D level and self-report responses.

Results—Agreement between self-reported and measured 25(OH)D levels was poor. The kappa statistic was -0.041 when using a cutpoint of <20 ng/ml and -0.008 using the cutpoint of <30 ng/ml. Among women with levels ≥ 20 ng/ml, 82.4% believed that they were vitamin D deficient, while 13.3% who were below <20 ng/ml did not self-report deficiency. Among women who did not report vitamin D deficiency, 46.3% (37/80) had levels <20 ng/ml while 82.5% (66/80) had levels <30 ng/ml.

Conclusions—These findings suggest that, although the prevalence of $25(\text{OH})\text{D} < 20$ ng/ml and < 30 ng/ml was quite high (53.2% and 84.7%, respectively), there was little agreement between measured levels and self-report of vitamin D deficiency. This may be due to belief in this region that low levels of serum vitamin D is widespread. Better communication is needed between healthcare providers and patients regarding transmission of laboratory results.

Keywords

Vitamin D deficiency; serum 25(OH)D concentration; midlife; menopause; Qatar

Vitamin D is important for skeletal health and may also play a role in many other aspects of human health, including cardiovascular disease, diabetes, neuromuscular disease and cancer (IOM, 2011; LeBlanc et al, 2014; Pittas et al, 2010; Theodoratou et al 2014). Vitamin D

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levels are determined by measuring total serum concentration of 25-hydroxyvitamin D (25(OH)D). Different organizations have suggested various guidelines for defining vitamin D deficiency and insufficiency, with most agreeing that levels lower than 20 ng/ml are associated with bone health (IOM, 2011; LeBlanc, 2014). Guidelines recommended by The Endocrine Society also defined vitamin D levels below 20 ng/ml as deficient but added vitamin D insufficiency as vitamin D of 21–29 ng/ml (Holick et al, 2011).

Low levels of 25(OH)D are common globally and many review articles have documented the variation in suboptimal levels by country and by risk groups (Wahl et al, 2012; Mithal et al, 2009; Palacios and Gonzalez, 2014; Lips, 2010, van Schoor and Lips, 2011, Prentice, 2008, Hagenau et al, 2009, Holick, 2007). Writing on behalf of the International Osteoporosis Foundation, Mithal et al (2009) described 25(OH)D levels in 46 different countries for children and adults, by gender. In countries where data were available, the vast majority of countries had mean or median levels of 25(OH)D less than 30 ng/ml with many having levels less than 20 ng/ml. A systematic review of 103 articles published between 2003 and 2013 concluded that low vitamin D status was a global problem (Palacios and Gonzalez, 2014).

Vitamin D deficiency is especially prevalent in the Middle East and has been associated with cultural and religious factors, female gender, and dietary practices (Lips, 2010; Mithal et al, 2009). Limited sun exposure due to a style of dress that covers most of the body has been noted to relate to high rates of hypovitaminosis D (El-Hajj Fuleihan and Deeb, 1999; El-Sonbaty and Abdul-Ghaffer, 1996; Gannage-Yared et al, 2000, Lips, 2010).

Low levels of 25(OH)D have been reported to be especially low among women in the Middle East (Elshafie et al, 2012; Al-Mohaimeed et al, 2012; Palacios and Gonzalez, 2014). Low consumption of milk (Elshafie et al, 2012) as well as low dietary intake from all food sources have been reported in the Middle East (Bener et al, 2009; Lips 2007). The lack of vitamin D fortified food has also been suggested to contribute to widespread low 25(OH)D levels (Gannage-Yared et al, 2000; Badawi et al, 2012; Musaiger et al, 2011).

Women at midlife are at increased risk for low vitamin D levels (Malabanan and Holick, 2003). In Qatar, as in much of the Middle East, women are at increased risk for vitamin D deficiency due to lifestyle, genetics, obesity, and diet. Among health care professionals in Qatar, although the mean level of 25(OH)D was low in both males and females, females were found to have lower levels (Mahdy et al, 2010). However, another study conducted in Qatar among males and females aged 30 through 60 years found mean 25(OH)D levels to be uniformly low (El-Menyar et al., 2012).

The possible role of alleles associated with vitamin D level in Arabs has also been reported (Elkum et al, 2014). Obesity presents another risk factor since the body fat sequesters vitamin D. Qatar has a very high prevalence of overweight and obesity, estimated to be between two-thirds and three-quarters of all adults (Ng et al, 2010).

As a result of this increased risk and due to media and public health initiatives, many women may believe they are vitamin D deficient. The aim of this study is to evaluate, for a large cross-section of midlife women living in Qatar, the level of agreement between self-reported

vitamin D deficiency and serum vitamin D levels measured within the previous calendar year.

METHODS

Study Population

The Study of Women's Health in Qatar (SWIQ) is a two-phase, mixed methods study conducted in Doha, in the State of Qatar. Data for this study were derived from a cross-sectional study conducted from July 2011 through May 2012. Women were recruited from nine primary health centers. Participants were eligible for inclusion if they were between 40 and 60 years of age, were either of Qatari nationality or other Arab National, and were either Arabic or English speaking. Participants were excluded if they had a history of bilateral oophorectomy. Additional information has been provided in an earlier report (Gerber et al., 2014). The protocol and consent form were approved by the institutional review committees at Weill Cornell Medical College-Qatar and at Hamad Medical Corporation, Qatar.

Survey Instrument

The survey instrument was developed using the Study of Women's Health Across the Nation (SWAN) survey as a foundation, was piloted by a trained moderator and assistant moderator, who were both culturally and linguistically matched to the focus group participants. The survey instrument was first developed in English, translated into Arabic and then back-translated into English to confirm the quality of the translation. Face-to-face interviews were conducted and consisted of demographic, reproductive, and medical history questions.

Measures

Medical History—Participants were asked whether or not they suffer from any of 13 illnesses including vitamin D deficiency. Responses were coded as yes or no.

Serum vitamin D levels—Serum 25(OH)D levels, measured by immunoassay, were retrieved from electronic health records. Documented levels measured within one calendar year of the interview were recorded and the level closest to the interview was used. Vitamin D levels were categorized for the purpose of this report as vitamin D deficiency if serum 25(OH)D was less than 20 ng/ml and as insufficiency if less than 30ng/ml.

Anthropometric measurements—Height and weight were assessed twice by physical examination by a technician. The average of each pair of assessments was used. Body mass index (BMI) was calculated as weight (in kilograms) divided by the square of height (in meters).

Menstrual status—Questions about menopausal status included: asking about the last menstrual cycle, whether menstruation had occurred in the previous 12 months, regularity of menstruation and whether cycles had changed in length. Menopausal status was categorized into premenopausal, perimenopausal, and postmenopausal. Women having a hysterectomy but at least one ovary were categorized separately.

Statistical Analysis

For each participant, accuracy of self-reported vitamin D deficiency was categorized into 4 groups, self-reported vitamin D deficiency “yes” and 25(OH)D < 20ng/ml, self-reported vitamin D deficiency “yes” and 25(OH)D ≥ 20ng/ml, self-reported vitamin D deficiency “no” and 25(OH)D as <20ng/ml, and self-reported vitamin D deficiency “no” and 25(OH)D as ≥ 20ng/ml. Accurate responses included both categories where the self-reported response and the measured 25(OH) agreed. Inaccurate responses included both categories where the self-reported response and the measured 25(OH) levels did not agree.

Characteristics of the study participants were described as standard summary statistics. Student’s t-test was used to assess differences in mean vitamin D level by reported vitamin D deficiency and reported vitamin D supplementation. The unweighted kappa statistic and 95% confidence limits were computed to assess the level of agreement between the dichotomized 25(OH)D levels and self-report values. Multivariable logistic regression analysis was performed to examine factors associated with accuracy of reporting vitamin D deficiency. Age, BMI, education, and menopause status were included in the model. BMI was categorized as <25, 25–<30, 30–<35, and ≥ 35. Given the small number of people with a normal BMI (<25), those that were overweight (25–<30) were used as the referent group. Women who had a hysterectomy were removed from the model due to a small sample size. The odds ratios, 95% confidence intervals, and p values of the covariates were reported. All p-values are two sided and evaluated at the 0.05 alpha level. All analyses were performed using SAS v9.3 (SAS Institute, Cary, NC).

RESULTS

The mean age of the 523 participants was 49.7 ± 5.5 years with approximately half between 40–49 years of age and half between 50–60 years (Table 1). The majority of women were pre- or peri-menopausal (63.9%, 334/523) with a mean BMI of $34.5 \text{ kg/m}^2 (\pm 6.0)$. The mean vitamin D level was $19.8 \text{ ng/ml} (\pm 9.3)$.

Table 2 compares the mean serum 25(OH) D levels by the participants’ self report of vitamin D deficiency and whether or not they reported taking vitamin D supplements. The means are the same for those who reported vitamin D deficiency and for those who did not ($p=0.52$). Similarly, those who reported taking vitamin D supplements had levels not significantly higher from those who did not report taking supplements ($p=0.37$).

The agreement between self-reported vitamin D deficiency and measured serum levels of 25(OH) D is reported in Table 3. The prevalence of 25(OH)D < 20 ng/ml was 53.2% (278/523) while the prevalence of self-reported deficiency was 84.7% (443/523). Agreement between self-reported vitamin D deficiency with measured levels < 20 ng/ml was very poor ($\text{kappa} = -0.041$, 95% CI= -0.100 – 0.019). Agreement was also poor when comparing self-reported vitamin D deficiency using the cutpoint of < 30 ng/ml ($\text{kappa} = -0.008$, 95% CI= -0.040 , 0.023). Agreement between self-reported vitamin D deficiency and measured 25(OH)D levels <20 was also evaluated stratified by categories of age, BMI, education, and menopause status. Agreement within each stratum was close to zero (range of kappa coefficient from -0.07 to 0.06) with no statistically significant differences within strata.

Even among women having levels ≥ 20 ng/ml, 82.4% (202/245) believed they were vitamin D deficient, while 13.3% who were below <20 ng/ml did not report deficiency. Among women who did not report vitamin D deficiency, 46.3% (37/80) had levels <20 ng/ml while 82.5% (66/80) had levels < 30 ng/ml.

Table 4 presents selected characteristics of the study participants, stratified by whether or not their response to self report of vitamin D deficiency was categorized as accurate or inaccurate. Accurate reports did not differ from inaccurate reports by age, BMI, or menopausal status. Among women with more education, inaccurate reports occurred more often than among women with less education (50.6% vs 41.4%, respectively) and mean levels of 25(OH)D were significantly greater for women who gave inaccurate reports when compared to women who gave accurate reports (25.0 ng/ml vs 15.3 ng/ml, respectively).

The distributions of 25(OH)D among women reporting vitamin D deficiency are illustrated by accuracy status in Figure 1. There is a wide range of measured 25(OH)D levels among women reporting vitamin D deficiency. Women who reported they were vitamin D deficient but, in fact, had 25(OH)D levels ≥ 20 ng/ml had a mean 25(OH)D level of 27.6 ng/ml compared to 13.0 ng/ml among women who accurately reported vitamin D deficiency.

Among women who responded inaccurately, the majority (84.5%, 202/239) reported vitamin D deficiency but had measured 25(OH)D levels ≥ 20 ng/ml. Women who did not report vitamin D deficiency but had 25(OH)D levels <20 ng/ml did not differ by age, BMI, education and menopause status from women who reported vitamin D deficiency but had measured 25(OH)D levels ≥ 20 ng/ml (data not shown).

A multivariable logistic regression model predicting inaccuracy of reporting vitamin D deficiency is presented in Table 5. Level of education was a significant predictor of inaccuracy of reporting vitamin D deficiency (adjusted OR = 1.46; 95% CI = 1.02–2.10), after controlling for age, BMI, and menopause status. Menopause status was an additional independent predictor of reporting inaccuracy; perimenopausal women had significantly greater odds of reporting inaccurately than premenopausal women (adjusted OR = 1.65; 95% CI = 1.02–2.64).

DISCUSSION

This study confirms that low levels of serum 25(OH) D are quite prevalent in the Gulf region. This is one of the few reports among women in Qatar and the first to highlight these high prevalence rates in women aged 40–60 years.

Although the prevalence of low levels of 25(OH) D was found to be very high (53% using <20 ng/ml and 80% using <30 ng/ml) and self-report of vitamin D deficiency was also very high (85%), individuals did not accurately report their measured vitamin D status. Mean levels of 25(OH) D were similar among women reporting vitamin D deficiency and those not reporting vitamin D deficiency.

The majority of the women who responded inaccurately, reported having vitamin D deficiency when their measured OH(25)D levels were ≥ 20 ng/ml. These women were more

often university graduates or above when compared with women who responded accurately. Higher education and perimenopausal status were both independent predictors of responding inaccurately, after controlling for age and BMI. Research to date has been limited relating objective to self-reported measures and the current findings support the need for further investigation in this area.

A limitation of this study was that only a single measure of serum 25(OH) D was obtained from the electronic record, although this reflects common clinical practice. These measures were obtained, however, within one year prior to the interviews with the participants, where in all likelihood, recommendations for supplementation were given.

There are many reports in the literature, both scientific and lay press, to heighten awareness to the low levels of vitamin D found in Arab women generally (Ardawi et al, Lips, 2007; Kazmi, gulfnews.com) and in Qatar in particular (Badawi et al, 2012; Alhamad et al, 2014). The results suggest that many women assume their level to be low, either because they do not know their vitamin D had been measured or they were not informed of their results. Better communication is needed between healthcare providers and patients regarding transmission of laboratory results.

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Figure 1.
Distribution of serum 25-hydroxyvitamin D in women reporting vitamin D deficiency (n=443)

Table 1

Selected Characteristics of the Study Participants

Characteristics	N	%
Age group, yrs		
40–49	256	49.0
50–60	267	51.1
Menopause status		
Premenopausal	123	23.5
Perimenopausal	211	40.3
Postmenopausal	175	33.5
Hysterectomy	14	2.7
BMI	34.5	6.0
<25	21	4.0
20–<30	96	18.4
30–<35	178	34.0
35	228	43.6
Education		
Less than university	280	53.5
University graduate & above	243	46.5
	Mean	SD
Serum 25(OH)D, ng/ml	19.8	9.3

Table 2

Mean levels of 25(OH)D by self report of vitamin D deficiency and vitamin D supplementation

Total Sample (n=523)	25(OH) D level (ng/ml) (mean +/- SD)	P-value
Reported vitamin D deficiency		0.516
Yes (N=443)	19.7 +/- 9.1	
No (N=80)	20.4 +/- 10.6	
Reported taking vitamin D supplement		0.367
Yes (N=146)	20.4 +/- 9.1	
No (N=377)	19.6 +/- 9.4	

Self-reported vitamin D deficiency: accuracy in reporting vitamin D deficiency using measured 25(OH)D cutpoints < 20 ng/ml and < 30 ng/ml

Table 3

25(OH)D level	Self-reported Vitamin D Deficiency				
	Yes (N=443)	No (N=80)	P-value	Kappa	95% CI
<20 ng/ml	241 (86.7)	37 (13.3)	0.179	-0.041	(-0.100, 0.019)
20 ng/ml	202 (82.4)	43 (17.6)			
<30 ng/ml	376 (85.1)	66 (14.9)	0.589	-0.008	(-0.040, 0.023)
30 ng/ml	67 (82.7)	14 (17.3)			

Table 4

Selected characteristics of study participants by accuracy of self-reported vitamin D deficiency

	Accurate (N=284)	Inaccurate (N=239)	P-value
Age	49.6 +/- 5.7	49.8 +/- 5.3	0.593
BMI	35.0 +/- 6.5	34.1 +/- 5.6	0.067
25(OH)D (ng/ml)	15.3 +/- 7.4	25.0 +/- 8.7	<.0001
Education			0.035
Less than university	164 (58.6)	116 (41.4)	
University graduate & above	120 (49.4)	123 (50.6)	
Menopause status			0.082
Premenopausal	76 (61.8)	47 (38.2)	
Perimenopausal	104 (49.3)	107 (50.7)	
Postmenopausal	97 (55.4)	78 (44.6)	

Table 5

Multivariable Logistic Regression Analyses Predicting Inaccuracy of Reporting Vitamin D Deficiency

Predictor Variable	Adjusted Odds Ratio (95% CI)	<i>P</i>
Age		
40–49	Reference	
50–60	1.13 (0.74–1.73)	0.573
BMI		
<25	Reference	
25–<30	0.96 (0.37–2.51)	0.934
30–<35	0.97 (0.39–2.42)	0.941
35	0.73 (0.30–1.83)	0.506
Education		
Less than university	Reference	
University graduate & above	1.46 (1.02–2.10)	0.038
Menopause status		
Premenopausal	Reference	
Perimenopausal	1.65 (1.02–2.64)	0.040
Postmenopausal	1.26 (0.72–2.22)	0.423