Prevalence of vitamin D deficiency in Saudi adults

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ABSTRACT

الأهداف: تحديد مدى انتشار نقص فيتامين د لدى البالغين الأصحاء في السعودية.

الطريقة: أجريت دراسة ميدانية كجزء من مشروع الفحص والتقييم المبكر لأمراض الكلى ، وقد تم قياس فيتامين د على المشاركين في موقعين في مدينة الرياض، المملكة العربية السعودية خلال الفترة من مارس 2008م إلى مايو 2008م. وقد دعي الاشخاص الذين كانوا مواطنين سعوديين و أعمارهم 18 سنة أو أكثر إلى المشاركة.

النتائج: شملت عينة الدراسة 488 شخص متوسط أعمارهم 37.43 (11.32) عام، منهم 50.2% (n=245) من الذكور. كان 29% من المشاركين يعانون من نقص فيتامين د، 22.7% من المجموعة يعانون من قصور نسبي و47.5% في المستويات الطبيعية من فيتامين د. لاحظنا أن الجنس الأنثوي كان مؤشراً مستقلاً عن نقص فيتامين د (OR= 2.99; 95% CI 2.069-4.327). وكان فقر الدم أيضاً مؤشراً لنقص فيتامين د(OR: 3.16; 95% CI 2.02-4.92) . وارتبط مستوى فيتامين د إيجابياً مع مستويات أعمارهم (ارتباط بيرسون = 0.183، p<0.000).

خاتمة: أن نقص فيتامين د هو شائع في البالغين الأصحاء في السعودية. وهو أكثر وضوحاً في الإناث وفي الفئات العمرية الأصغر سناً. ارتداء الملابس التقليدية، وتجنب المتعمد للشمس وعدم كفاية المدخول الغذائي من فيتامين د من المحتمل أن تكون الأسباب الرئيسية لانخفاض المستويات.

Objectives: To determine the prevalence of vitamin D deficiency in healthy Saudi adults.

Methods: A cross-sectional study carried out as part of the screening and early evaluation of kidney disease project. Vitamin D was measured in subjects recruited at 2 screening camps in Riyadh, Saudi Arabia, between March to May 2008. Subjects from the 2 large commercial centers in Riyadh aged ≥18 years and Saudi nationals were invited.

Results: The study sample comprised of 488 subjects. The mean age of the subjects was 37.43 (11.32) years, of which 50.2% (n=245) were males. Twenty-nine percent of subjects were in the vitamin D deficiency group, 22.7% were in the relative insufficiency group, and 47.5% had normal levels of 25-hydroxy vitamin D. We observed that female gender was an independent predictor of vitamin D deficiency or insufficiency (odds ratio [OR]: 2.992; 95% confidence intervals [CI] 2.069-4.327). Anemia was also a predictor for vitamin D deficiency or insufficiency (OR: 3.16; 95% CI 2.02-4.92). Age was positively correlated with vitamin D levels (Pearson correlation=0.183, p<0.000).

Conclusion: Vitamin D deficiency is common in healthy Saudi adults. This is more pronounced in females and in the younger age groups. Wearing of traditional clothes, deliberate avoidance of the sun, and inadequate dietary intake are likely to be the principal causes of low vitamin D levels.

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Vitamin D (Vit D) is recognized for its physiological role in regulating calcium homeostasis.[1] Vitamin D receptors are also expressed in multiple tissues within the body that includes vascular smooth muscle, endothelium, and cardiomyocytes.[1] Mounting evidence from cellular, biochemical, animal and epidemiological investigations also points to Vit D as a pleiotropic regulator for several physiological processes,

including cellular differentiation and proliferation, modulation of immune responsiveness, central nervous system function, and cardiovascular health.[2] Vitamin D deficiency is linked to several diseases, including hypertension, cardiovascular disease, impaired immune function, and malignancies.[3-5] Saudi Arabia is sunny most of the year; hence, the level of Vit D is expected to be adequate. There are several studies on Vit D status among Saudis, but these study was in small scope and lack diversity of age and gender and majority was a hospital based sampling. The present study investigated the status of Vit D among a representative population of Saudi adults using data from the Screening and Early Evaluation of Kidney Disease (SEEK) 2008.[6] Similarly, we examined the risk factors associated with Vit D deficiency in this population.[7-12]

Methods. On March to May 2008, a cross sectional study was conducted in 2 large commercial malls in Riyadh, Saudi Arabia. Every Saudi national aged ≥18 was invited to participate. All participants provided informed consent. Screening data were collected on socio-demographic characteristics, medical history, and medications. Anthropometric measures (weight, height, mid-abdominal and hip circumference), resting blood pressure (BP) and heart rate were measured.[13] Participants were instructed to visit the laboratory in the morning fasting for at least 8 hours prior to their blood draw, and their first urine of the day were collected. Four hundred and ninety-four subjects were screened, 6 subjects were excluded. Two subjects were <18 years of age, 3 pregnant females, and the remaining one had a history of kidney transplant. Four hundred and eighty-eight participants were included in the analysis. 25-OH Vit D levels was assayed in serum by electrochemiluminescence immunoassay (ECLIA) by Cobas machine. Although there is no standard definition for the optimum Vit D level, Vit D deficiency is defined by most experts as a 25-hydroxyvitamin D level of <20 ng per milliliter (50 nmol per liter), which we used in our study.[14] Patients were grouped according to their Vit D levels into: deficiency (<50 nmol/L), relative insufficiency (50-72 nmol/L); and normal level (≥72 nmol/L).[13] Levels below detection by radioimmunoassay (<25 nmol/L) were considered equal to 22.5 nmol/L for the purpose of this analysis. Ethical approval was obtained from Ethics Committee of College of Medicine Research Center at King Saud University according to principles of Helsinki Declaration.

The distribution (mean and standard deviation) of serum 25(OH)D and the percentages of patients in the 3 groups (Vit D deficiency, relative insufficiency, and normal levels) were calculated. Descriptive analyses for the continuous and discrete (categorical) variables were executed. Values were expressed as mean ± standard deviation. Odds ratios for Vit D deficiency were calculated for a number of potential risk factors. Simple linear regression analysis was performed for all potential predictor variables individually. Multivariate analysis was performed to identify the best group of independent predictors of Vit D deficiency in our sample. Five models were considered. We used the enter and stepwise regression methods. None of these models was powerful enough to predict Vit D deficiency in our sample. A p value of less than 0.05 was considered statistically significant. Predictive Analytics Software (PASW) Statistics for Windows, Released 18.0.0. (SPSS Chicago, IL, 2009) was used for statistical analysis of this study.

Results. The SEEK-Saudi cohort clinical and laboratory characteristics are summarized in **Table 1.** All subjects were Saudi nationals, 245 participants (50.2%) were males, and 27.3% were 45 years of age or older. Ages ranged from 18-72 years. The mean ± SD serum 25(OH)D was 71.43 (32.88) nmol/L. Twenty-nine percent of subjects were in the Vit D deficiency group, 22.7% were in the relative insufficiency group, and 47.5% had normal levels of 25-hydroxy vitamin D. Prevalence of various Vit D status stratified by gender are shown in **Table 2.** The mean (SD) of Vit D levels in males were 80.05 (31.93) and in females 62.75 (31.57) nmol/L (p<0.0001). The prevalence of Vit D deficiency was significantly greater in the female group with 34.8%, as compared to only 13.4% among males in these groups (p<0.0001). The odds ratio for Vit D deficiency in female compared with male was 2.99 (95% confidence interval (CI), 2.07-4.33; p<0.0001). There were positive correlation between Vit D and hemoglobin level (r=0.28; p<0.0001). Adults with Vit D relative insufficiency or deficiency had a mean (SD) hemoglobin level of 13.4 g/dl (1.71) whereas the mean level for normal adults was 14.4 g/dl (1.57). The odds ratio for Vit D deficiency in anemic adults was 3.16 (95% CI, 2.02-4.92]. Serum Vit D was higher with

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increasing age in all subjects (r=0.18; p<0.001). Among subjects <45 years, the mean serum Vit D level was 68.8 (32.59) nmol/L; and among patients ≥45 years was 78.45 (32.74) nmol/L (p=0.004). There was no relationship between Vit D deficiency, relative Vit D insufficiency, and hypertension (OR, 0.77; 95% CI, 0.52-1.15), diabetes (OR, 0.64; 95% CI, 0.40-1.02), obesity (OR, 0.91; 95% CI, 0.64-1.31), chronic kidney disease (OR, 0.57; 95% CI, 0.26-1.24), history of high cholesterol (OR, 0.84; 95% CI, 0.54-1.29), history of heart attack (OR, 1.85; 95% CI, 0.55-6.21), and history of stroke (OR, 0.45; 95% CI, 0.04-5.00). Vitamin D level is not influenced by lifestyles, dietary habits, education level or household income.

We used multivariate analysis to construct several models and test for potential risk factors of hypovitaminosis D in the study sample. However, none of the predictors was significant enough to predict serum Vit D level in our sample study.

Discussion. The majority of subjects had Vit D deficiency (29.7%) or relative insufficiency (22.7%) in the SEEK-Saudi cohort. Despite living in one of the sunniest parts of the world. Further, we observed that female gender, younger age, and anemia were independent predictors of Vit D deficiency or relative insufficiency. These results suggest that Vit D deficiency is common even in very sunny areas emphasizing the importance of screening for Vit D deficiency in these populations. Our observation that Vit D deficiency is common among the Saudi national population is consistent with prior studies conducted in different areas of the Kingdom of Saudi Arabia. In a recent study by Elsammak et al, serum 25(OH)D was measured in 139 subjects (87 males aged (mean ± SD) 30.0 (8.5) years and 52 females aged 31.0 (7.2 years). Subjects included in this study were otherwise healthy and seen for routine checkup.[15] The mean levels in males and females were 25.4 (11.7) and 24.7 (11) nmol/L with no significant difference. However, females in our study had a significantly lower level of Vit D 62.75 (31.57) nmol/L versus 80.05 (31.93) in males (p<0.0001) yet higher than the data from Elsammak et al. Notably, Sadat-Ali et al also demonstrated 10% prevalence of 25(OH)D levels <50 nmol/L in healthy Saudi men with a mean age of 28.5 (4.5 years).[16] Similar rates of Vit D

Table 2 - Proportions of subjects in different 25-hydroxy vitamin D subgroups stratified by gender.

Vitamin D state	Total n (%)	Male (n=245) % (CI)	Female (n=243) % (CI)	P-value
Deficiency	145 (29.7)	18.4 (±4.9)	41.2 (±6.2)	0.0002
Relative insufficiency	111 (22.7)	20.8 (±5.1)	24.7 (±5.4)	
Normal	232 (47.5)	60.8 (±6.1)	34.1 (±5.9)	

Table 1 - The Screening and Early Evaluation of Kidney Disease-Saudi cohort clinical and laboratory characteristics of vitamin D.

Characteristics	All subjects (n=488)	Normal levels of vitamin D (n=232)	Insufficiency/deficiency of vitamin D (n=256)	*P*-value
Age (years)	37.43 ± 11.32	39.35 ± 11.58	35.69 ± 10.81	<0.0001
Body mass index	29.25 ± 5.72	29.58 ± 5.28	28.94 ± 6.08	0.216
Systolic blood pressure	117.78 ± 16.52	119.98 ± 16.58	115.78 ± 16.25	0.005
Diastolic blood pressure	77.15 ± 11.36	78.35 ± 11.65	76.07 ± 11	0.027
Hemoglobin (g/dL)	13.88 ± 1.72	14.4 ± 1.57	13.41 ± 1.71	<0.0001
Vitamin D (nmol/L)	71.43 ± 32.88	99.02 ± 23.37	46.43 ± 15.8	<0.0001
Fasting blood sugar (mg/dL)	107.59 ± 38.18	111.69 ± 42.3	103.87 ± 33.69	0.024
Serumcreatinine (mg/dL)	0.75 ± 0.18	0.8 ± 0.17	0.7 ± 0.17	<0.0001
eGFR (MDRD) (mL/min per 1.73 m^2)	107.53 ± 23.82	101.88 ± 19.49	112.64 ± 26.17	<0.0001
Ever-married	408 ± 83.6	85.3	82.0	0.32
College education	293 ± 60	24.5	62.9	0.18
Income (>10,000 SR)	222 ± 45.5	40.9	49.6	0.05
Ever smoked	83 ± 17.0	23.7	10.9	<0.0001
Exercise	253 ± 51.8	52.6	51.2	0.75
Non-vegetarian	481 ± 98.6	100	97.3	0.07
Hypertension	136 ± 27.9	30.6	25.4	0.22
Diabetes	90 ± 18.4	22.0	15.2	0.50
Obesity	213 ± 43.6	44.8	42.6	0.65
Chronic kidney disease	28 ± 5.7	7.3	4.3	0.18

eGFR - estimating glomerular filtration rate, MDRD - modification of diet in renal disease

deficiency or relative insufficiency was observed in other parts of the Arab world. In a study from Qatar, the mean overall Vit D level was 29.2 nmol/L among healthcare professionals. It was lower in females (25.7 nmol/L) than in males (34.2 nmol/L). Ninety-seven percent of all participants had a mean level <75 nmol/L. Eighty-seven percent had a mean level of <50 nmol/L.[17] Other countries closer to the north pole, namely, Belgium, demonstrated higher prevalence of Vit D deficiency (77%) among adults living in Brussels.[18] These studies suggest that we cannot rely on the sun exposure alone for a good Vit D status even in sunny countries. A low Vit D status could be a concern not only in female and the elderly in Saudi Arabia, but also in the younger age groups and adult's men. Females had 3-fold higher prevalence of Vit D deficiency or relative insufficiency than males (OR=2.992; 95% CI 2.069-4.327). This was consistent with other studies.[19] However, these findings demonstrate that the degree of severity of Vit D deficiency in our cohort was inversely related to age. Our study raise a critical observation that Vit D deficiency is not a disease of elderly. Anemic subjects had 2 and half fold likelihood of having Vit D deficiency or insufficiency (OR=3.16; 95% CI 2.02-4.92). Our study supports a recent observation that Vit D plays a role in erythropoiesis.[20-21] The high prevalence of Vit D deficiency could have several potential explanations: 1) low intake of Vit D in diet or as supplements, 2) traditional dress-style of both male and female genders in Saudi Arabia which includes covering of the face and hands in women, so that the skin exposed to the sun is minimal, 3) genetic susceptibility, and 4) effects of skin pigmentation on Vit D metabolism. Since the skin pigmentation was not addressed in our study, the effect of Vit D levels were not evaluated. The study highlights the need for greater awareness among researchers, clinicians, and patients of the high prevalence of Vit D insufficiency in Saudi Arabia and more aggressive screening for Vit D inadequacy across all adults age groups and including men. Even in sunny countries such as Saudi Arabia, having a diet higher in calcium and Vit D as well as oral supplementation with Vit D is needed.

Study limitations. These include the observational and cross-sectional design, with single measurement of Vit D levels. Another limitation is that we recruited study participants at commercial malls. This might have resulted in a biased sample and might explain both the relatively young age and the severity of Vit D deficiency. Individuals who frequently visit the malls may also represent a socio-economic group that does not work outdoors. This potential selection bias might underestimate the magnitude of Vit D deficiency in this population. We also did not inquire into each participant's amount of sunlight, use of sunscreen or clothing and Vit D intake. Further, since this analysis was a part of the SEEK study that sought out subjects at risk for kidney disease, this could have biased the results since Vit D deficiency may be more common in subjects with kidney disease.

In conclusion, this study demonstrates that Vit D deficiency is common in Saudi adults especially among females and in the younger age groups. Continued efforts to improve dietary intake of Vit D are needed, coupled with intensive educational and awareness programs to increase the population's knowledge on this widespread epidemic. Furthermore, larger scale studies are needed to assess the contribution of different modifiable and non-modifiable factors (such as genetic and skin pigmentation differences) to the problem.

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