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Prevalence and Risk Factors of Vitamin D Deficiency among a Sample of Kuwaiti Population: A Sociocultural Study

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A B S T R A C T

Despite the high amount of sunshine that Kuwaitis can receive from sunlight most of the year, there is a high prevalence of vitamin D deficiency among Kuwaiti individuals .This descriptive study aimed to determine the prevalence of vitamin D deficiency and related sociocultural and daily life behavior risk factors among 276 Kuwaiti adults based on their blood serum 25-hydroxyvitamin D 25(OH)D levels. Subjects were selected by using a convenient non-random opportunistic sample. A cross-sectional survey was conducted using a closed-ended questionnaire. The mean vitamin D 25(OH)D level of the participants was 23.44 nmol/L (SD=10.89). The social demographic factors that were significantly associated with vitamin D deficiency were {sex (P<0.05), age, monthly income, marital status, and occupational status (P<0.01) }. Participants' daily lifestyle behaviors risk factors that were significantly associated with vitamin D deficiency were{working environment, smoking habit, fast-food consumption, taking supplements (P<0.05), and clothing style (P<0.001) }.The present study demonstrates that vitamin D deficiency is common among Kuwaiti adults identifies many sociocultural risk factors. Continued effort to increase knowledge and awareness of vitamin D deficiency risk factors and health outcomes is needed through intensive educational programs.

Key words: *Vitamin D deficiency prevalence, Sociocultural factors and health, Kuwait.*

Introduction

Despite the ideal geographical region of Kuwait, located between the latitudes of 28.45 and 30.05 degrees north of the Equator and its sunny dry weather most of the year, there is a high prevalence of vitamin D deficiency among Kuwaiti individuals[1,2]. Kuwaitis can obtain a sufficient amount of ultraviolet rays in the summer where the highest recorded temperature under shadow can sometimes reach 50 °C (122 °F), which is an optimal source of vitamin D one can absorb through the skin[3]. Even with the high amount of sunshine that Kuwaitis can receive from sunlight in the summer months, many risk factors play a significant role in vitamin D synthesis, which contributes to vitamin D deficiency among Kuwaitis. These factors include insufficient exposure to sunlight, genetic background and ethnicity, sedentary lifestyle, socio-demographic characteristics, anthropometric ratios, quality of food consumed, clothing style and smoking habits[4–11]. Vitamin D deficiency outcomes have been investigated by several researchers. The findings reveal that vitamin D deficiency has many health comorbidity and side effects[12–15] .

Several clinical and public health studies have been performed in the Kuwaiti population to determine the prevalence of vitamin D inadequacy, risk factors, and health comorbidity[2,16]. These studies include 17 El-Sonbaty (1996), 18 Molla et al. (2005), 1 Al-Yahya et al. (2014), and 19 Zhang et al. (2016) report a high prevalence of vitamin D deficiency among Kuwaiti individuals[1,17–19]. A study examined the association between clothing style and vitamin D deficiency among veiled Kuwaiti women between 14 and 45 years old[17]. The finding reveals that serum 25-hydroxy vitamin D 25(OH)D level was significantly lower among veiled Kuwaiti women compared to non-veiled women. Another study about the relationship between lifestyle behavior and vitamin D deficiency among Kuwaiti[1] shows that the objective of the study was to consider the risk factors (anthropometric and bone measurements, exposure to sunshine, food intake, physical activity, and skin color) compared to serum 25(OH)D levels < 25 nmol/L among adolescent Kuwaiti females to determine the impact on the women's bone mass. The study

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shows that most (98.7 %) of the Kuwaiti female adolescents had < 50 nmol/L of 25(OH)D serum levels. The following risk factors for their inadequate levels of vitamin D were veiling, not having a private room, and waist-to-hip ratio. The study states that the independent predictors of bone mineral content among adolescent Kuwaiti females were age at puberty, animal protein intake, physical activity, and anthropometric measurements.

Furthermore, a study among Kuwaiti athletes aimed to assess the relationship between vitamin D deficiency and its risk factors such as body composition, lifestyle behavior, and fasting during the month of Ramadan from sunrise to sunset[16]. The study finding reveals that 83% of Kuwaiti athletes had inadequate levels (< 75 nmol/L) of vitamin D; 23% of them were deficient (< 25 nmol/L) in vitamin D. The data also show an inverse relationship between fasting and an athlete's body fat and vitamin D inadequacy. The median serum of 25(OH)D was higher before Ramadan than after. The study also detected a positive significant association between serum 25(OH)D concentrations and both dietary habits and a high dose of vitamin D supplement.

The following research explores the prevalence of vitamin D deficiency among newborn infants and children in Kuwait. The study goal was to detect a correlation between the serum 25(OH)D concentration of the mothers in Kuwait and their newborn infants and the prevalence of rickets among these mothers and infants[18] . Their finding reveals that on the day of delivery, the incidence of vitamin D deficiency among the Kuwaiti mothers was 40% and among their infants it was 60%. The study also demonstrates a significant correlation between the mothers and their newborn infants' serum 25(OH)D levels. The values for the mean level of the mothers' serum 25(OH)D was 13.3 (6.5) ng/mL and the corresponding values for their babies was 8.2 (6.5) ng/mL.

Another study was conducted to examine the association between vitamin D and weight status among Kuwaiti children aged 5 to 19 years old[2]. The data present that 45.2% of the children have vitamin D insufficiency (25(OH)D = 30–49.9 nmol/L) and 42.1% have vitamin D deficiency [25(OH)D < 30 nmol/L]. The study also detects the serum 25(OH)D concentrateion was significantly lower among girls than boys (30.9 vs. 36.0 nmol/L, $p < 0.01$). The children's family income and physical activity were positively associated with the serum 25(OH)D concentration, and negatively associated with the children's age.

In addition, there was a study that showed the association between serum levels of 25(OH)D and the prevalence of diabetes and pre-diabetes among 960 Kuwaiti adults[19] . The study finding illustrates that more than half (56%) of the Kuwaiti adults were diagnosed with vitamin D inadequacy [25(OH)D=12–19.9 ng/mL], and 27% of them were diagnosed with vitamin D deficiency [25(OH) D<12 ng/mL]. And there was a significant association between vitamin D inadequacy and pre-diabetes and diabetes health status of Kuwaiti adults.

Anthropological research on the relationship between sociocultural factors and daily life behavior risk factors of vitamin D deficiency is rare in Kuwait. To the best of the author's knowledge, no clinical research has been conducted in Kuwait to examine sociocultural factors associated with vitamin D deficiency based on participants' blood serum 25-hydroxyvitamin D 25(OH)D levels from an anthropological perspective.

Objective of the Study and Research Questions

The objective of this medical anthropological study is (1) to determine the prevalence of vitamin D deficiency among a sample of Kuwaiti adults, and (2) to detect sociocultural and daily life behavior risk factors of vitamin D deficiency such as clothing style (whether women cover their faces and bodies), amount of exposure to sun, smoking, consumption of fast foods, and physical activity among a sample of Kuwaiti adults based on their blood serum 25-hydroxyvitamin D 25(OH)D levels. The study was designed to answer the following research questions: 1) what is the prevalence of vitamin D deficiency among a sample of Kuwaiti adults? 2) Are there significant differences among the sociocultural characteristics of Kuwaiti adults and how they affect vitamin D serum 25-hydroxy vitamin D 25(OH)D levels? 3) Are there significant differences among Kuwaiti adults' cultural traditions and daily life behaviors (consumption of fast food, working environment, clothing style, exposure to sun, smoking habits, and physical activity) and their vitamin D serum 25-hydroxy vitamin D 25(OH)D levels?

Methodology

Study Design and Population

This is a cross-sectional descriptive study that was conducted among 276 Kuwaiti adults from March 2017 to January 2018. Participants were recruited using a convenient non-random opportunistic sample from the populations living in six Kuwaiti governorates. All of the participants had attended a medical laboratory to have blood drawn for health assessment and they all had 25-hydroxy vitamin D 25(OH)D blood test levels.

Participation in the study was voluntary. The participants were asked to assess their eligibility and willingness to participate in the study. A written informed consent was handed to all study participants after they were completely informed of the study objectives and procedures and of their right to withdraw from the study at any time. The data collection procedures follow the Kuwait University research method rules and regulations. All participants who had had a surgical intervention in the previous year were excluded. Representative subjects included both non-veiled and veiled women, and men who wore the traditional Kuwaiti long garment and Western clothes.

The questionnaire was translated into Arabic and went through a process of forward and backward translation by four faculty experts at Kuwait University in the fields of social science and anthropology to ensure its content validity. Prior to data collection, the translated questionnaire was checked to insure the accuracy and meaning of the questions. The questionnaire was pretested for content, design, clarity, and recognition in 25 subjects. The reliability of the study instrument showed high internal consistency (Cronbach's alpha was 0.83).

Study sample

As shown in Table 1, one hundred and sixteen (42.0%) of the participants' age was between 23 and 39 years, more than half (n = 146; 52.9%) of them were female, half of the participants' marital status was single (n = 138; 50.0%), and more than half (n = 156; 56.5%) of the participants was overweight. The majority (n = 126; 45.7%) of the participants' occupational status was students, and more than half (n = 176; 63.8%) of the participants' educational level was a university degree and above, and half of the participants reported a monthly income between 801-1110 KD (n = 50; 18.1%). About one-fourth of the participants lived in the Al-Jahra district (n = 62; 22.5%), the majority (n = 245; 88.8%) of the participants' religious affiliation was Sunni, and more than half (n = 162; 58.7%) of the participants' ethnic background was Bedouin (tribal).

Study Instruments and Data Collection

The daily behaviors assessment sections of the questionnaire for this study, such as consumption of fast food, intake of vitamin D supplements, smoking habits, and engaging in regular physical activity, were modified from a previously used questionnaire[8] . The extent of exposure to the sun, clothing style, and working environment sections of the questionnaire for this study were modified from a previously used questionnaire[3]. The self-administrative questionnaire composed of closed-ended questions to measure the identified study variables included the following five sections:

(1) *Socio-demographic characteristics*: These characteristics included age, sex, body mass index (BMI), marital status, educational level, working patterns, ethnic background, religious affiliation, monthly income, and governorate district.

(2) *Clothing style (conservative/modern)*: Conservative style of clothing for women refers to the traditional long and black dress that covers the body from the shoulders down to the feet, with a headscarf that covers the hair. The modern style of clothing for women refers to European-style clothing that does not completely cover the arms, legs or hair. Similarly for men, the conservative style of clothing refers to the traditional long and white garment that covers the body from the shoulders down to the feet, with a separate head-cover. The modern style of clothing for men includes pants, shorts, and a shirt which do not completely cover the arms, legs, or head. The questions asked, Do you wear the hijab (headscarf) (Yes = 1, No = 0); Do you wear traditional clothes (Yes = 1, No = 0).

(3) *Daily life behaviors assessment*: These characteristics included consumption of fast food, intake of vitamin D supplements (Yes = 1, No = 0); smoking habits (non-smoker = 0, previously a smoker = 1, smoking = 2), engaging in regular physical activity (Do you walk consistently? Yes = 1, No = 0), exercising indoors or outdoors, duration of exercising indoors and outdoors (How many hours did you exercise outdoors in the last seven days?)

(4) *Frequency of exposure to the sun seasonally*: We asked, Do you get exposure to the sun (for 3–4 days) during the summer months between 9:00 and 10:30 a.m. and between 2:00 and 3:00 p.m.? (Yes = 1, No = 0), Do you get exposure to the sun (for 3–4 days) during the winter months between 10:00 a.m. and 2:00 p.m? (Yes = 1, No = 0).

(5) *Health profile*: We asked, Do you or a member of your family have vitamin D deficiency? (Yes = 1, No = 0), and Were you diagnosed with a chronic disease? (Yes = 1, No = 0), or, What is your serum 25(OH)D score?.

The value of BMI was computed as the weight in kg divided by height in meters squared (kg/m^2). Based on the World Health Organization's measurement of obesity, the participants were classified as underweight (BMI < 18.5 kg/m^2), normal (BMI 18.5 –24.9 kg/m^2), overweight (BMI 25–29.9 kg/m^2), and obese (BMI ≥ 29.9 kg/m^2).

Statistical Analysis

The data was entered and analyzed by using SPSS 25 (SPSS, Inc., USA). Categorical variables were expressed as frequencies and percentages, and continuous variables were presented as means ± standard deviation (M±SD). For all statistical analyses, a p-value of <0.05 was considered as statistically significant. Chi-square was used to compare between participants with optimal vitamin D levels, insufficient levels, and deficiency of vitamin D (measuring total 25(OH)D concentrations) and the independent variables of socio-demographic characteristics, clothing style, daily life behaviors assessment, frequency of exposure to the sun seasonally, and health profile. The results of 25(OH) D were analyzed as a continuous variable and were also stratified with respect to the Institute of Medicine categories definition of vitamin D status that diagnosed vitamin D as sufficient for serum 25(OH)D levels <50 nmol/L, insufficient for 50–75 nmol/L and sufficient for 75–250 nmol/L[20,21]. Vitamin D deficiency in the current study was defined as serum 25(OH)D <50 nmol/L.

Results

Sociocultural Characteristic and Vitamin D serum 25(OH)D Levels

The mean age of the participants was 31.55 years (SD = 13.52); three-fourths (n = 209; 75.7%) of the participants reported deficiency in total serum 25(OH)D < 50 nmol/L, and mean vitamin D 25(OH)D level was 23.44 nmol/L (SD = 10.89). Table 1 reveals that a majority of the female participants said that they regularly wore a headscarf (*Hijab*) (n = 125; 81.16%), more than half of the partici-

TABLE 1.
DISTRIBUTION OF PARTICIPANTS' SOCIODEMOGRAPHIC VARIABLES (N = 276).

Characteristics	N (%)	Characteristics	N (%)
Age category, years		**Walking outdoor**	
< 22	94 (34.1)	Yes	72 (26.1)
23–39	116 (42.0)	No	204 (73.9)
>40	63 (22.8)		
		Season of walking	
Sex	130 (47.1)	summer	59 (21.4)
Male	146 (52.9)	winter	164 (59.4)
Female			
	114 (41.3)	**Hours of exercising outdoor**	
BMI, kg/m²	156 (56.5)	< than half an hour	144 (52.2)
Normal		0.5 to 2	37 (13.4)
Overweight	126 (45.7)	2–4	31 (11.2)
	32 (11.6)	> 4	15 (5.4)
Occupational status	74 (26.8)		
Student	24 (8.7)	**Smoking habits**	
Student & employed	7 (2.5)	Non smoker	184 (66.7)
Employed	12 (4.3)	Previous smoker	23 (8.3)
Retired		Smoker	56 (20.3)
Private business	245 (88.8)		
Housewife	28 (10.1)	**Frequency of eating fast food weakly**	
		Non	58 (21.0)
Religious affiliation		Once	76 (27.5)
Sunni		2–6 times	120 (43.5)
Shiite		Everyday	18 (6.5)
Marital status		**Exposing to sun (3–4 days) in summer**	
Not married	138 (50.0)	**from 9–10:30 and from 2–3 p.m**	
Married	129 (46.7)	Yes	77 (27.9)
		No	196 (71.0)
Roots			
Urban	101 (36.6)	**Exposing to sun (3–4 days) in winter**	
Bedouin	162 (58.7)	**from 10–2**	
		Yes	97 (35.1)
Kuwait governorates		No	176 (63.8)
AlAsimah	44 (15.9)		
Hawalli	37 (13.4)	**My dress cover my whole body**	
Mubarak Al-kabeer	38 (13.8)	Yes	186 (67.4)
ALFarwayniyah	56 (20.3)	No	87 (31.5)
ALJahra	62 (22.5)		
ALAhmadi	35 (12.7)	**Diagnosed with chronic disease**	
		Yes	35 (12.7)
Educational level		No	239 (86.6)
< High school	20 (7.2)		
High school & Diploma	78 (28.3)	**Taking vitamin D supplement**	
>University	176 (63.8)	Yes	90 (32.6)
		No	182 (65.9)
Do you wear a scarf (hijab)			
Yes	125 (81.16)	**25 OHD category**	
No	29 (18.83)	Deficient (<50 nmol/L)	209 (75.7)
		Insufficient (50–75 nmol/L)	37 (13.4)
Working indoor		Sufficient (>75–125/L)	26 (9.4)
Yes	208 (75.4)		
No	44 (15. 9)	**Income K.D**	
		< 500	27 (9.8)
Do you your family have Vit D		501–800	19 (6.9)
deficiency ?	251 (90.9)	801–1110	50 (18.1)
Yes	20 (7.2)	1101–1400	46 (16.7)
No		1401–1700	27(9.8)
		1701–2000	21 (7.6)
Do you regularly go for walking		2001–2300	23 (8.3)
Yes	88 (31.9)	2301–2600	8 (2.9)
No	183 (66.3)	2601–2900	5 (1.8)
		>2901	26 (9.4)

TABLE 2.
PARTICIPANTS' SOCIODEMOGRAPHIC PROFILE, AND 25(OH)D LEVELS

	25 OHD level				X^2	Sig
	Deficient (<50 nmol/L) N (%)	Insufficient (50–75 nmol/L) N (%)	Sufficient (>75–125/L) N (%)	Total N (%)		
Age (years)						
< 22	81 (39.3)	2 (5.4)	9 (34.6)	92 (34.2)	25.892	0.000
23–39	89 (43.2)	20 (54.1)	6 (23.1)	115 (42.8)		
> 40	36 (17.5)	15 (40.5)	11 (42.3)	62 (23.0)		
Sex						
Male	106 (50.7)	15 (40.5)	7 (26.9)	128 (47.1)	5.985	0.050
Female	103 (49.3)	22 (59.5)	19 (73.1)	144 (52.9)		
Monthly income						
< 500	23 (12.0)	1 (3.0)	3 (12.0)	27 (10.8)	33.625	0.014
501–800	14 (7.3)	3 (9.1)	2 (8.0)	19 (7.6)		
801–1110	42 (22.0)	7 (21.2)	1 (4.0)	50 (20.1)		
1101–1400	35 (18.3)	4 (12.1)	6 (24.0)	45 (18.1)		
1401–1700	21 (11.0)	1 (3.0)	3 (12.0)	25 (10.0)		
1701–2000	11 (5.8)	8 (24.2)	2 (8.0)	21 (8.4)		
2001–2300	18 (9.4)	4 (12.1)	1 (4.0)	23 (9.2)		
2301–2600	4 (2.1)	1 (3.0)	3 (12.0)	8 (3.2)		
2601–2900	3 (1.6)	0 (0.0)	2 (8.0)	5 (2.0)		
>2901	20 (10.5)	4 (12.1)	2 (8.0)	26 (10.4)		
Marital status						
Unmarried	113 (55.9)	13 (37.1)	8 (30.8)	134 (51.0)	8.920	0.012
Married	89 (44.1)	22 (62.9)	18 (69.2)	129 (49.0)		
Occupational status						
Students	105 (50.5)	7 (18.9)	12 (46.2)	124 (45.8)	24.348	0.007
Students & employee	24 (11.5)	7 (18.9)	1 (3.8)	32 (11.8)		
Employee	56 (26.9)	11 (29.7)	7 (26.9)	74 (27.3)		
Retired	11 (5.3)	8 (21.6)	4 (15.4)	23 (8.5)		
Private business	5 (2.4)	1 (2.7)	0 (0.0)	6 (2.2)		
Housewives	7 (3.4)	3 (8.1)	2 (7.7)	12 (4.4)		

pants reported wearing long clothes that cover their whole body (n = 186; 67.4%), about three-fourths of the participants said their working environment is indoors (n = 198; 71.7%), and more than one-third of the participants reported that they eat fast food weekly from two to six times (n = 120; 43.5%). In addition, daily physical activity behavior data presents that three-fourths of the participants said they don't walk outdoors in fresh air (n = 204; 73.9%). Out of 223 participants who said that they do walk, more than half (n = 164; 59.4%) of the participants said that they walk in the winter season, and half (n = 144; 52.2%) of the participants reported that they usually exercise outdoors for less than half an hour.

The data in Table 1 shows hours of exposure to the sun and time of exposure to the sun according to season. The data illustrates that in answer to the question about their exposure to the sun in the summer season between 9:00 and 9:30 a.m. and between 2:00 and 3:00 p.m. on average three to four days a week, only one-fourth (n = 77; 27.9%) of the participants said yes they do get exposure to the sun during these hours, compared to only one-third (n = 97; 35.1%) of the participants who said that they have exposure to the sun during the winter season from 10:00 a.m. to 2:00 p.m. on average three to four days a week. Furthermore, Table 1 shows that only one-third (n = 90; 32.6%) of the participants reported that they are taking a vitamin D supplement, the majority (n = 239; 86.6%) of the participants stated that they were not diagnosed with any chronic diseases, and the majority (n = 251; 90.9%) of the participants reported that a member of their family was diagnosed with vitamin D deficiency.

Table 2 displays the social demographic factors that were significantly associated with vitamin D deficiency after applying chi square analysis of the predicted associated factors. These include age ($P < 0.001$), sex ($P < 0.05$), monthly income ($P < 0.01$), marital status ($P < 0.01$), and occupational status ($P < 0.01$).The remainder of the associated factors listed under methods were not significantly associated with vitamin D deficiency. A statistical significance was found between participants' age and

serum levels of total 25(OH) (X^2 = 25.892, p = 0.000), 43.2% of participants whose ages are between 23 and 39 years old reported significantly lower total 25(OH)D than 39.3% of participants whose ages are 22 years old and younger and 17.5% of participants whose ages are 40 years old and older. Also a statistical significance was found between participants' sex and serum levels of total 25(OH) (X^2 = 5.985, p = 0.050), (50.7%) of Kuwaiti males reported significantly lower total 25(OH)D than Kuwaiti females. Moreover, the findings reveal that there were significant differences between participants' monthly income and serum levels of total 25(OH) (X^2 = 33.625, p = 0.014); 22.0% of the participants whose monthly income are between 801–1110 KD reported significantly lower serum levels of total 25(OH) compared to the other participants' monthly income.

The findings also revealed an statistically significant association (X^2 = 19.231, p = 0.012) between the participants' marital status and serum levels of total 25(OH); 55.9% of unmarried participants reported significantly lower serum levels of total 25(OH) than did married participants (44.1%). Table 2 also shows that participants' occupational status is significantly associated (X^2 = 24.348, p = 0.007) with serum levels of total 25(OH) D, half (50.5%) of the participants who are students reported significantly lower serum levels of total 25(OH) compared to 26.9% of employee participants, and 11.5% of students who are employee participants.

Vitamin D deficiency risk factors and serum 25(OH)D levels

Table 3 presents the vitamin D deficiency risk factors of participants' daily lifestyle behaviors {working environment (P<0.05), smoking habit (P<0.05), clothing style (P <0.001), fast-food consumption (P<0.05), and taking supplements (P<0.05)} that were significantly associated with vitamin D deficiency after applying chi square analysis of the predicted associated factors. The remainder of the associated factors listed under Methods was not significantly associated with vitamin D deficiency. A statistical significance was found between participants' smoking habits and total 25(OH) serum levels (X^2 = 10.296, p = 0.036); more than half (65.3%) of the nonsmoking participants reported significantly lower total 25(OH)D levels than did the smoking participants (25.3%). And 48.1% of the participants who reported high prevalence (between 2 to 6 times per week) of fast-food consumption reported significantly lower total 25(OH)D levels compared to 25.7% of participants who reported they consumed fast food once a week (X^2 = 12.682, p = 0.048).

Clothing style also revealed a significant association with vitamin D deficiency: more than half (65.7%) of the participants who said they wear clothing that covers their whole body reported significantly lower total 25(OH)D levels compared to 34.3% of participants who answered they do not wear clothing that covers their whole body (X^2 = 5.538, p = 0.05). Similar to the previous finding, more than three-fourths (75.5%) of female participants who wearing a headscarf reported significantly lower total 25(OH)D levels compared to 24.5% of female participants who do not wear a headscarf (X^2 = 8.215, p = 0.016).

In addition, Table 3 demonstrates that participants' vitamin D supplement intake was significantly associated with their total serum levels of 25(OH) (X^2 = 7.642, p = 0.22). Around three-fourths (71.5%) of participants who reported not taking vitamin D supplements reported significantly lower total 25(OH)D levels compared to 28.5% of participants who reported that they take vitamin D supplements. Furthermore, participants' working environment had a significant association with their total 25(OH) D levels. The majority (80.6%) of participants whose work environment is indoors reported significantly lower total 25(OH)D levels compared to 19.4% of participants whose work environment is outdoors (X^2 = 6.238, p = 0.44).

Discussion

The present study detected high prevalence of vitamin D deficiency among Kuwaiti adults, which confirms the findings of studies conducted in Arabian Gulf countries, including the United Arab Emirates, Oman, Saudi Arabia, Qatar, and in Kuwait[22–26]. The comparable high incidence of vitamin D deficiency in the Gulf region populations may be due to weather conditions. These countries share a similar geographical setting and extreme hot and humid weather most of the year, which prohibits people's outdoor activities and daily lifestyle practices, which encourages them to spend their leisure time doing indoor activities more at indoor shopping malls, cafés, indoor gyms, or house-to-house visiting. Given the extremely hot temperature, people living in the Gulf region tend to restrict their outdoor activities to evenings after sunset which contributes to fewer hours of direct exposure to optimal sunshine necessary for endogenous synthesis of D3 (cholecalciferol) production and results in vitamin D deficiency[27,28] .

Furthermore, the current study reveals that the prevalence of vitamin D deficiency was higher among Kuwaitis (both men and women) who wear conservative clothing and among women who cover their hair, which confirms the findings[29–31] who conducted their research among Arabian Gulf women. The association between vitamin D deficiency and clothing style can be attributed to the fact that Gulf region populations share similar religious and cultural practices and conservative clothing styles. As part of their traditional and religious customs, most women begin to wear traditional conservative clothing at a young age that covers their whole body and hair, and most of the men wear long garments at a young age, covering their whole body and a headscarf to cover their head. The traditional clothing obscures direct sunlight from reaching individuals' skin, which affects the synthesis of vitamin D in the body.

The findings of the current study confirm findings, all of which show a significant association between individuals' socioeconomic status, excessive calorie intake, and

TABLE 3.
PARTICIPANTS' VITAMIN D RISK FACTORS AND 25(OH)D LEVELS

	25 OHD level				X^2	Sig
.	Deficient (<50 nmol/L) N (%)	Insufficient (50–75 nmol/L) N (%)	Sufficient (>75–125/L) N (%)	Total N (%)		
Smoking habits						
Non smoker	130 (65.3)	27 (77.1)	23 (92.0)	180 (69.5)	10.296	0.036
Previous smoker	18 (9.0)	4 (11.4)	1 (4.0)	23 (8.9)		
Smoking	51 (25.6)	4 (11.4)	1 (4.0)	56 (21.6)		
Prevalence of eating fast food						
Non	37 (18.0)	11 (30.6)	8 (30.8)	56 (20.9)	12.682	0.048
Once a week	53 (25.7)	14 (38.9)	9 (34.6)	76 (28.4)		
2–6 times weakly	99 (48.1)	10 (27.8)	9 (34.6)	118 (44.0)		
Everyday	17 (8.3)	1 (2.8)	0 (0.0)	18 (6.7)		
Do your clothes covers your whole body?						
Yes	136 (65.7)	24 (66.7)	23 (88.5)	183 (68.0)	5.538	0.053
No	71 (34.3)	12 (33.3)	3 (11.5)	86 (32.0)		
Do you wear a head scarf (female)						
Yes	83 (75.5)	21 (91.3)	19 (100.4)	123 (80.9)	8.215	0.016
No	27 (24.5)	2 (8.7)	0 (0.0))	29 (19.1)		
Taking vitamin D supplement						
Yes	59 (28.5)	18 (50.0)	11 (42.3)	88 (32.7)	7.642	0.022
No	148 (71.5)	18 (50.0)	15 (57.7)	181 (67.3)		
Is your working environment outdoor?						
Yes	36 (19.4)	11 (31.4)	1 (4.5)	48 (19.8)	6.238	0.044
No	150 (80.6)	24 (68.6)	21 (95.5)	195 (80.2)		

high incidence of vitamin D deficiency[32–34]. These findings can be due to the wide distribution of fast food restaurants in Kuwait with affordable prices and easy access, along with adoption of sedentary lifestyle practices among most Kuwaitis and lack of governmental food fortification policies for dairy products with vitamin D. This study also found that only one-third of the participants with lower serum 25(OH)D concentrations reported taking vitamin D supplements, confirming findings among Kuwaiti adults[19]. This finding necessitates more nutritional programs that teach the public about the food sources of vitamin D, and alternatively, about vitamin D supplements.

Unlike to the following research[2,35–36] who reported high incidence of vitamin D deficiency among women, the current study found a high prevalence of vitamin D deficiency among Kuwaiti men, with significantly lower total 25(OH)D levels than Kuwaiti women. Our findings confirm findings among Luxembourg participants[37]. This might be attributed to the differences in lifestyle behaviors between men and women such as smoking habit as a vitamin D risk factor that is culturally prohibited to Kuwaiti women and only permitted for men, as well as differences in physical activity, working environments, dietary habits, and exposure to the sun among men and

women. Contrary to our expectation, the current study did not detect a significant association between exposure to the sun and lower 25(OH)D levels which confirms the study findings[16]. This may be due to the fact that most of the activities that the participants are engaged in are indoors, along with their working environments that are also indoors, which minimizes the duration of exposure to sunshine during optimal times of receiving sun rays for vitamin D synthesis.

Conclusion

In conclusion, vitamin D deficiency is a major public health issue that affects individuals across all life stages, and from different nationalities. The present study demonstrates that vitamin D deficiency is common among Kuwaiti adults identifies many sociocultural risk factors. Continued effort to increase knowledge and awareness of vitamin D deficiency risk factors and health outcomes is needed through intensive educational programs. Campaigns about the main sources of vitamin D should be held by professional experts in medical and nutritional fields for the community. It is necessary to increase the population's knowledge on consuming fortified products and supplements and encourage them to pursue outdoor activities during their leisure time.

Limitations and Strengths

The present study is the first in Kuwait that highlights an association between vitamin D status and risk factors of vitamin D deficiency from the medical anthropological perspective. It provides reliable information on serum 25(OH)D concentrations, duration and times of exposure to the sun, working environments, and clothing styles. However, since we have used a cross-sectional study design, our method did not allow for the long-term impact of other factors that could be potential confounders to vitamin D concentrations such as skin color, genetic factors, and dietary intake containing vitamin D-fortified foods. Therefore, longitudinal medical anthropological studies are needed to assess other risk factors that affect the synthesis of 25(OH)D concentrations, such as exposure to the sun, duration of exposure, time of day when an individual had exposure to the sun, amount of unprotected skin exposed to the sun, dietary habits, and barriers of outdoor activities. The following recommendations could be helpful to lessen the incidence of vitamin D deficiency among Kuwaitis population such as: (1) The Ministry of Health is recommended to link the immunization schedule of the children with the assessment of vitamin D 25(OH)D blood test levels and link the health screening for job recruitment among the elderly with the assessment of vitamin D 25(OH)D blood test levels, (2) Substitution of the fast food restaurants by healthy restaurants who provide organic food that includes in their menu a variety of soy products, seafood, protein foods, and seeds, (3) Governmental financial support for the local agricultural markets and encouraged them to produce organic food with vitamin D fortified products, and (4) Ministry of Health should adopted public health campaigns that advertise the importance of consuming fortified food specially dairy products with vitamin D among Kuwait's community.

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PREVALENCIJA I ČIMBENICI RIZIKA NEDOSTATKA VITAMINA D U UZORKU STANOVNIŠTVA IZ KUVAJTA: SOCIOKULTURNA STUDIJA

S A Ž E T A K

Unatoč velikoj količini sunčeve svjetlosti koju stanovnici Kuvajta primaju tijekom cijele godine u toj zemlji je prisutna velika prevalencija nedostatka vitamina D. Ova deskriptivna studija usmjerena je na utvrđivanje prevalencije nedostatka vitamina D i povezanih sociokulturnih svakodnevnih rizika u ponašanju 276 odraslih stanovnika Kuvajta na temelju njihovih razina 25-hidroksivitamina D 25(OH)D u krvnom serumu. Ispitanici su odabrani ne-slučajnim uzorkovanjem. Istraživanje poprečnog je provedeno pomoću strukturiranog upitnika. Prosječna razina vitamina D 25(OH)D u ispitanika bila je 23,44 nmol/L (SD = 10,89). Socijalni demografski čimbenici značajno povezani s nedostatkom vitamina D bili su: spol ($P < 0.05$), dob, mjesečni prihod, bračni status i zanimanje ($P < 0.01$). Čimbenici rizika svakodnevnog životnog stila i ponašanja sudionika koji su bili značajno povezani s nedostatkom vitamina D odnosili su se na radnu okolinu, naviku pušenja, brzu hranu, uzimanje prehrambenih dodataka ($P < 0.05$) i stil odijevanja ($P < 0.001$). Ova studija pokazuje da je nedostatak vitamina D uobičajen među odraslim stanovnicima Kuvajta i povezan s brojnim sociokulturnim rizičnim faktorima. Stoga su potrebni stalni napori za povećanjem znanja i svijesti o faktorima rizika nedostatka vitamina D i njegovim učincima na zdravlje.