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Original Article

The association between Vitamin D Level and Body Mass Index in a Sample of Childbearing Age Women in Erbil

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Abstract

Backgrounds: There is a high prevalence of Vitamin D deficiency worldwide, especially in developing countries, but there is wide variance with regions the prevalence of Vitamin D deficiency ranges between 30% and 90%. **Objectives:** The aim of this study was to explore the prevalence of Vitamin D deficiency and insufficiency and its association with body mass index (BMI) in a female childbearing sample. **Methods:** In this cross-sectional study, a purposive sample of female patients who were in childbearing age was invited from Erbil in Iraqi Kurdistan. The information required for the study was collected through the self-reported technique between January 20, 2019, and October 20, 2019. **Results:** The study showed that 51.0% of the study population was in the 27–37 years of age group. 33% and 16% of the study population were overweight and obese, respectively. Half of them did never physical activity followed by 1–2 and 3–4 times/week, 42%, and 8%, respectively. The study showed that 54.5% and 54% worked indoor and outdoor house for <30 min, 16% for between 30 and 60 min, and 2% for more than 60 min. The population was regularly exposed to the sun (23.5%), the occasionally (34.0%), and scantly (42.5%). The patients had insufficient Vitamin D (44%), followed by deficient 34%, and sufficient (22%). Population with deficient Vitamin D were more likely to be obese (43.8%) compared to overweight (28.8%), normal weight (39%), and underweight (20%), but the overall difference was not significant among BMI groups. **Conclusions:** The present investigation showed a high prevalence of deficient and insufficient Vitamin D in young childbearing females, especially among overweight and obese individuals.

Keywords: Body mass index, childbearing female, Erbil, Vitamin D deficiency

Introduction

There is a high prevalence of Vitamin D deficiency worldwide, especially in developing countries. The prevalence of Vitamin D deficiency is a difference according to geographic areas between 30% and 90%.[1] The prevalence of Vitamin D deficiency and insufficiency in Erbil city is 76.9% and 11%, respectively.[2] Vitamin D is a fat-soluble vitamin that is essential for the maintenance of calcium-phosphate homeostasis and healthy bone growth. It is acquired from sun-light exposure or diet.[3]

Vitamin D is presented as calciferol (Vitamin D1) mainly found in cod-liver, ergocalciferol (Vitamin D2) mainly found in plant and mushroom. The third type is acquired from sunlight exposure owing to dermal biosynthesis. It is found in food such as mushrooms, fish, butter, and milk.[1] Vitamin D deficiency is a critical public health issue.[3,4] It is a major health issue across the world in all age groups. Vitamin D deficiency is found even in geographic areas with low latitude with sufficient ultraviolet radiation and even in the industrialized world.[5]

Vitamin D deficiency may cause the following health issues, such as secondary hyperparathyroidism, rickets, osteomalacia, osteoporosis, and even fragility fractures.[6] Vitamin D deficiency is related to other extraskeletal chronic diseases such as diabetic, hypertension, metabolic syndrome, infectious, and autoimmune diseases these conditions are major public health problem worldwide.[7,8]

Access this article online

Quick Response Code:

Website: www.medjbabylon.org

DOI: 10.4103/MJBL.MJBL_11_20

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Submitted: 17-02-2020 **Accepted:** 19-02-2020 **Published Online:** 17-06-2020

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How to cite this article: Hamza PJ, Hasan MK. The association between Vitamin D level and body mass index in a sample of childbearing age women in Erbil. Med J Babylon 2020;17:165-71.

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Vitamin D receptors are found in various body cells, including the immune system (T and B lymphocytes and natural killer cells).[9] Vitamin D deficiency has been shown to associate with several autoimmune system diseases such as inflammatory bowel syndrome, type 1 diabetes mellitus and multiple-sclerosis, breast and colon cancer.[9] These receptors were reported in pancreatic cells, adipose tissues, gastrointestinal, and hepatic cells.[10]

The prevalence of obesity is increasing dramatically worldwide.[11] Some studies have reported the lower serum Vitamin D concentration in obese persons compared to normal weight persons.[4,12,13]

However, most countries are still having not sufficient lacking data, especially population-representative data. There are very limited data in infants, children, adolescents, pregnant women, and childbearing women. According to the few existing data, Vitamin D deficiency in childbearing age, women are a common public health problem in our society.

The aim of this study was to explore the prevalence of Vitamin D deficiency and insufficiency and its association with body mass index (BMI) in a female childbearing sample in Erbil city and also to identify factors associated with Vitamin D deficiency.

Materials and Methods

Study design

In this cross-sectional study, a purposive sample of 200 childbearing age females who have attended the outpatient clinic of Brayati and Shady Family Health Centers/Erbil/Kurdistan Region/Iraq. The patients were included in the study purposively according to the study objectives. The information required for the study was collected through the self-reported technique between January 20, 2019, and October 20, 2019. The verbal consent was taken from all patients before the interview.

Inclusion and exclusion criteria

Inclusion criteria included the young female patients aged 16 years and older regardless of their sociodemographic aspects were included in the study. Exclusion criteria included the pregnant women, those with chronic diseases such as hypertension, diabetes mellitus, heart disease, and asthma were not included in the study. The chronic diseases were determined by self-reported technique and clinical examinations in medical settings. In addition, the patients who had a history of taking Vitamin D supplementation were excluded as well.

Data collection and measurement

A predesigned structured questionnaire was used to collect the information required for the study. The questionnaire was separated into three following parts.

Part I

The first part covered the following sociodemographic information, including age (categorized as childbearing 16–26, 27–37, and 38–49), education (illiterate, primary, intermediate, and secondary), occupation (homemaker, student, and employee), and marital status (single, married, divorced, and widow).

Other information was physical activity categorized as never, 1–2, and 3–4 times/week physical activity. The physical activity types were walking, running, gym, climbing, and cycling. The smoking was documented as a smoker and nonsmoker. The family income was categorized as not enough (family income <500,000 IQD/month), enough (family income 500,000–1,000,000 IQD/month), and exceeded (>1 million IQD/month). In addition, the parity was categorized as nullipara, primigravida, and multigravida.

Part II

The second part measured the following information for the study. The information was BMI measured in weight (kg) divided by the square root of height (m). The BMI was categorized as underweight (<18.5), normal weight (18.5–24.9), overweight (25–29.9), and obese (30–30.9).

Part III

In this part, the serum Vitamin D was recorded. The serum Vitamin D was measured using 25-hydroxycholecalciferol from the drawn venous blood samples. The drawn blood samples were stored in the appropriate tubes and were sent to the lab of the hospital. The Vitamin D measurements were performed in one medical laboratory by the same technician for all patients using the Cobas machine.

Vitamin D status

This was determined by the concentration of 25-hydroxyvitamin D (25(OH)D) (ng/ml), and was measured in ng/ml by the total Vitamin D II, MODULAR ANALYTICS E170 Cobas (ROCHE) method. Vitamin D status was categorized into the following three categories: deficient (Below 20 ng/ml), insufficient (20–30 ng/ml), and sufficient (>30 ng/ml) for additional analysis (Carl *et al*., 2015).

Statistical analysis

The prevalence of Vitamin D deficiency (sufficient, insufficient, and deficient) was determined in number and percentage. The prevalence of patients with different BMI categories was determined in number and percentage. The association of Vitamin D measurement with sociodemographic and sun exposure characteristics was examined in Pearson Chi-squared and Fisher's exact tests. $P < 0.05$ was considered a statistically significant difference. The statistical calculations were performed by Statistical Package for Social Sciences version 25 (SPSS; IBM Corp, USA).

Ethical consideration

The study protocol was approved by the Ethical Committee at the College of Medicine/Hawler Medical University. The Directorate of Health guaranteed conduction of this study. The confidentiality of the personal information of the patients was protected based on the condition of the Directorate of Health.

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Results

The study showed that 51% of the study population was in the 27–37 years of age group followed by 38–49 years old (27%). The majority of them were from urban areas (86%). They were educated in primary (31.5%), intermediate (22%), and secondary (22.5%). Family income of them was enough (52.5%), not enough (25%), and exceeded (22.5%). More than half of them (53.5%) were homemaker and employees (26%). The study showed that 38.5% of the study population were in normal BMI, 33% were overweight, and 16% were obese. Half of them did never physical activity followed by 1–2 and 3–4 times/week, 42%, and 8%, respectively. The study showed that 18.5% of the population were smokers [Table 1]. Most of the study populations were married (62.5%) followed by single subjects (29.5%) and most of them had multigravida (51.5%), as presented in Table 1.

Table 1: General characteristics of study population

Characteristics (n=200)	Statistics, frequency (%)
Age	
16-26	44 (22.0)
27-37	102 (51.0)
38-49	54 (27.0)
Residence	
Rural	28 (14.0)
Urban	172 (86.0)
Education	
Illiterate	48 (24.0)
Primary	63 (31.5)
Intermediate	44 (22.0)
Secondary and higher	45 (22.5)
Family income	
Not enough	50 (25.0)
Enough	105 (52.5)
Exceeded	45 (22.5)
Occupation	
Homemaker	107 (53.5)
Student	41 (20.5)
Employee	52 (26.0)
BMI	
<18.5	25 (12.5)
18.5-24.9	77 (38.5)
25-29.9	66 (33.0)
30-39.9	32 (16.0)
Physical activity	
Never	100 (50.0)
1-2/week	84 (42.0)
3-4/week	16 (8.0)
Smokers	37 (18.5)
Marital status	
Single	59 (29.5)
Married	125 (62.5)
Divorced	9 (4.5)
Widow	7 (3.5)
Parity	
Nulli para	56 (28.0)
Primigravida	41 (20.5)
Multigravida	103 (51.5)

The study showed more than half of the study population worked indoor house (54.5%), and more than half of them (54%) spent their time outdoor house for <30 min, 16% for between 30 and 60 min, and 2% for more than 60 min. The study population exposure their face and hand to the sun (67.0%) followed by face (21.5%), both arms (8.5%), and both legs (3%). The percentage of the population who were regularly exposed to the sun was 23.5%, the occasional user was 34%, and scant exposure to nonusing the exposure to the sun was 42.5%. The time of Vitamin D examination was winter (26.5%), spring (38.5%), summer (32.5%), and autumn (2.5%). The study showed that 44% of the study population had insufficient Vitamin D, followed by deficient 34%, while only 22% of the study population had sufficient Vitamin D [Table 2].

The study showed the study population with deficient Vitamin D were more likely to be obese (43.8%) compared to overweight (28.8%), normal weight (39%), and underweight (20%), but the level of difference was not significant (P = 0.205). The deficient Vitamin D was more prevalent in summer (46.2%) followed by winter (44.4%) and spring (44.4%), but the overall difference was not significant among BMI groups [Table 3a and Figure 1].

The association of Vitamin D measurement with two categories of sufficient and insufficient/deficient showed that the overweight and obese patients have a high prevalence of insufficient/deficient (81.8% and 84.4%), respectively [Table 3b and Figure 2].

The study showed that deficient Vitamin D was more prevalent in population in 27–37 years of age group (37.3%), live in urban areas (34.3%), with secondary education level (42.2%), have exceeded financial income (42.2%), students (39.0%), did never physical activity (37%), nonsmokers (36.2%), single subjects (39%), and those who had nulliparous (37.5%), but the overall difference was not significant except for physical activity (P = 0.048), as presented in Table 4.

The study showed that deficient Vitamin D was more prevalent in individuals stay at home (37.6%), spent less time outdoor (33.9% and 38.9%), had exposure to the sun by their both legs only (66.7%), as presented in Table 5.

Discussion

The present study showed that a high percentage of the females who were included in this study have insufficient or deficient Vitamin D levels. A retrospective study conducted in Erbil city aimed to determine the levels of 25(OH)D among the patients who referred to two private laboratories. In addition, they examined the relation of Vitamin D deficiency to sunlight exposure, sex, and age.[2] The study was conducted among 10,823 patients. The study showed that 78% of the

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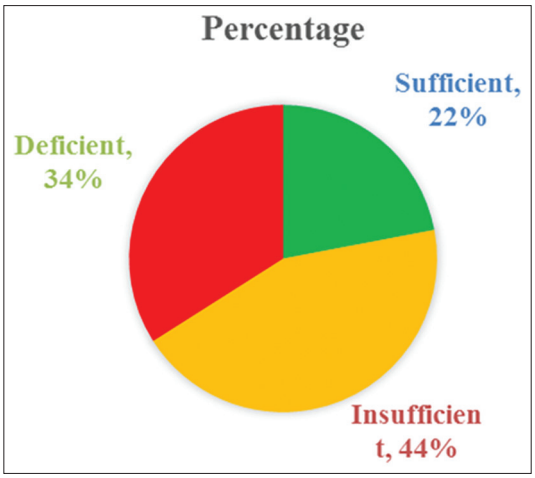


Figure 1: Level of Vitamin D deficiency and insufficiency in female childbearing population in Erbil

Table 2: The prevalence of Vitamin D deficiency level and its related factors

Characteristics (n=200)	Statistics, frequency (%)
Working	
Indoor	109 (54.5)
Outdoor	91 (45.5)
Spent outdoor (min)	
Never-<10	56 (28.0)
10<30	108 (54.0)
30-60	32 (16.0)
>60	4 (2.0)
Sun exposure	
Face	43 (21.5)
Face and hand	134 (67.0)
Both arms	17 (8.5)
Both legs	6 (3.0)
Time examination	
Winter	53 (26.5)
Spring	77 (38.5)
Sumer	65 (32.5)
Autumn	5 (2.5)
Vitamin D measurement	
Sufficient	44 (22.0)
Insufficient	88 (44.0)
Deficient	68 (34.0)

population has Vitamin D deficiency defined as 25(OH) D lower than 20 μ/L. The percentages of Vitamin D were insufficient (52.8%), deficient (24.1%), adequate (11%), optimal (12%), and intoxication (0.2%). Their study showed that there is no significant difference between male and female patients. While the 40–60 and 20–40 years of age groups had the lowest concentrations of Vitamin D.

The present study showed that 66.0% of female patients have insufficient or deficient Vitamin D levels. However, the study did not find a significant difference in the prevalence of Vitamin D deficiency between patients with different age groups.

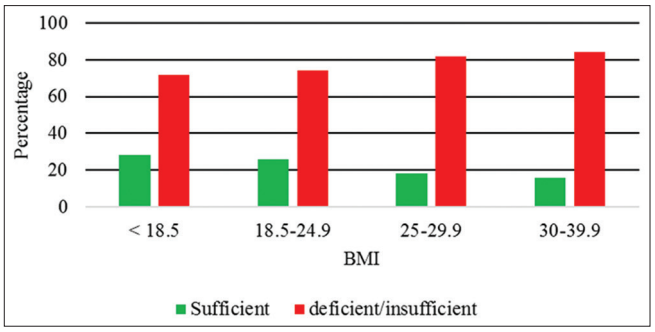


Figure 2: Level of Vitamin D among individuals with different body mass index

Gallagher[14] showed that the aging results in decreasing the calcitriol form of Vitamin D to half owing to decrease in the renal functions and calcium absorption. Heaney[15] reported that there is a decreased hydroxylation of Vitamin D and response toward the intestinal mucosa to circulating Vitamin D.

A study was conducted in 300 apparently healthy women, including 200 pregnant and 100 nonpregnant to determine Vitamin D deficiency in Duhok in 2012 showed that Vitamin D is low in pregnant and nonpregnant women in this region.[16] The concentrations of Vitamin D were 27.0 (standard deviation: 15.6 ng/mL) and 31.7 (13.3 ng/mL) in pregnant and nonpregnant women, respectively. The percentage of the individuals had <10, 10–29.9, and ≥30 ng/mL in pregnant and nonpregnant were 14%, 51%, 35% and 1%, 51%, and 48%, respectively. The screening for serum Vitamin D level in healthy women, especially pregnant women was recommended.[16] Another study was conducted in 1270 newborn and infants, primary school children, adolescents, adults, ad elderly in Duhok city reported Vitamin D deficiency.[17] The study found that overall 57.6% had insufficient Vitamin D (defined as 10–29.9 ng/mL); however, 6.3% had severe Vitamin D deficiency (defined as <10 ng/mL). They found that the elderly have the lowest level of Vitamin D.

The present study did not reveal a significant difference in the prevalence of Vitamin D deficiency among patients with different BMI, but Vitamin D deficiency and insufficiency were more prevalent in overweight (28.8% and 53.0%) and obese (43.8% and 40.6%), respectively. A study conducted among pregnant teachers in Malaysia aimed to measure the serum 25(OH)D level and its relation to adiposity using different adiposity indicators among multi-ethnic adults.[18] The study was conducted in 858 participants in tertiary education. The prevalence of Vitamin D deficiency (<20 ng/ml) was 67.4%. The significant negative association was found between serum 25(OH)D level and BMI ($\beta = -0.23$) and body fat percentage ($\beta = -0.14$). The multivariate linear regression analysis showed that higher BMI and larger waist circumference is associated with lower serum 25(OH)D level. This association was responsible for 32.8% of the variation between participants in the serum 25(OH)D level. Al-Timimi and Salih[17] found the level of Vitamin D is decreased with an increased level of BMI ($r = -0.254$; $P < 0.05$).

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Table 3a: General Association of Vitamin D deficiency with body mass index in different categories

BMI	Vitamin D measurement			*P*
	Sufficient	Insufficient	Deficient	
BMI				
<18.5	7 (28.0)	13 (52.0)	5 (20.0)	0.205*
18.5-24.9	20 (26.0)	27 (35.1)	30 (39.0)	
25-29.9	12 (18.2)	35 (53.0)	19 (28.8)	
30-39.9	5 (15.6)	13 (40.6)	**14 (43.8)**	
Winter				
<18.5	1 (20.0)	2 (40.0)	2 (40.0)	0.956
18.5-24.9	6 (26.1)	8 (34.8)	9 (39.1)	
25-29.9	4 (25.0)	8 (50.0)	4 (25.0)	
30-39.9	2 (22.2)	3 (33.3)	**4 (44.4)**	
Spring				
<18.5	1 (8.3)	9 (75.0)	2 (16.7)	0.132**
18.5-24.9	9 (30.0)	9 (30.0)	12 (40.0)	
25-29.9	3 (11.5)	15 (57.7)	8 (30.8)	
30-39.9	2 (22.2)	3 (33.3)	**4 (44.4)**	
Summer				
<18.5	5 (62.5)	2 (25.0)	1 (12.5)	0.187**
18.5-24.9	4 (18.2)	10 (45.5)	8 (36.4)	
25-29.9	4 (18.2)	12 (54.5)	6 (27.3)	
30-39.9	1 (7.7)	6 (46.2)	**6 (46.2)**	
Autumn				
18.5-24.9	1 (50.0)	0 (0.0)	**1 (50.0)**	1.00**
25-29.9	1 (50.0)	0 (0.0)	**1 (50.0)**	
30-39.9	0 (0.0)	1 (100.0)	0 (0.0)	

*Pearson chi-squared and **Fishers' exact tests were performed for statistical analyses

Table 3b: Prevalence of sufficient compared to insufficient/deficient in patients with different BMI

BMI	Vitamin D measurement		*P*
	Sufficient	Deficient/insufficient	
BMI			
<18.5	7 (28.0)	18 (72.0)	0.466
18.5-24.9	20 (26.0)	57 (74.0)	Pearson Chi-square
25-29.9	12 (18.2)	54 (81.8)	
30-39.9	5 (15.6)	27 (84.4)	

*Pearson Chi-squared and **Fisher's exact tests were performed for statistical analyses. BMI: Body mass index

Table 4: The association of Vitamin D level with study population' characteristics

Characteristics (*n*=200)	Vitamin D measurement			*P*
	Sufficient	Insufficient	Deficient	
Age				
16-26	9 (20.5)	20 (45.5)	15 (34.1)	0.825*
27-37	22 (21.6)	42 (41.2)	**38 (37.3)**	
38-49	13 (24.1)	26 (48.1)	15 (27.8)	
Residence				
Rural	7 (25.0)	12 (42.9)	9 (32.1)	0.916*
Urban	37 (21.5)	76 (44.2)	**59 (34.3)**	
Education				
Illiterate	13 (27.1)	21 (43.8)	14 (29.2)	0.744*
Primary	11 (17.5)	31 (49.2)	21 (33.3)	
Intermediate	11 (25.0)	19 (43.2)	14 (31.8)	
Secondary	9 (20.0)	17 (37.8)	19 (42.2)	
Family income				
Not enough	11 (22.0)	25 (50.0)	14 (28.0)	0.670*
Enough	24 (22.9)	46 (43.8)	35 (33.3)	
Exceeded	9 (20.0)	17 (37.8)	**19 (42.2)**	
Occupation				
Homemaker	25 (23.4)	44 (41.1)	38 (35.5)	0.574*
Student	6 (14.6)	19 (46.3)	**16 (39.0)**	
Employer	13 (25.0)	25 (48.1)	14 (26.9)	
Physical activity				
Never	28 (28.0)	35 (35.0)	**37 (37.0)**	0.048*
1-2/week	15 (17.9)	42 (50.0)	27 (32.1)	
3-4/week	1 (6.3)	11 (68.8)	4 (25.0)	
Smoking				
Yes	11 (29.7)	17 (45.9)	9 (24.3)	0.283*
No	33 (20.2)	71 (43.6)	**59 (36.2)**	
Marital status				
Single	13 (22.0)	23 (39.0)	**23 (39.0)**	0.659**
Married	25 (20.0)	59 (47.2)	41 (32.8)	
Divorced	3 (33.3)	4 (44.4)	2 (22.2)	
Widow	3 (42.9)	2 (28.6)	2 (28.6)	
Parity				
Nulli para	14 (25.0)	21 (37.5)	**21 (37.5)**	0.826*
Primigravida	9 (22.0)	18 (43.9)	14 (34.1)	
Multigravida	21 (20.4)	49 (47.6)	33 (32.0)	

*Pearson chi-squared and **Fishers' exact tests were performed for statistical analyses. Pearson Chi-squared test was performed for statistical analyses except for Fisher's exact test for marital status

The level of Vitamin D deficiency in individuals with different BMI has been examined in a sample of Hispanic American adolescents. The prevalence of D deficiency in 234 individuals aged 13–19 years was 27.8%. In comparison with our study, they found that most of the individuals with deficient and insufficient Vitamin D were overweight or obese.[19]

The high prevalence of Vitamin D deficiency or insufficiency may back to the clothing styles of the population, especially the female population, such as wearing veils, long sleeves, long skirts, using umbrellas, and sunblock lotion. In Erbil city, most of the women have a hijab in accordance with the religious principles; therefore, it may prevent more exposure of the individuals to sunlight in the region.

The present investigation did not a significant difference in the prevalence of Vitamin D deficiency among patients whose serum Vitamin D was measured in different seasons. It was prevalent in all seasons, but it was less prevalent in autumn. Erbil has a semi-arid climate. It is very hot and dry during summer and wet and cold in winter. In addition, the city has sunny days in four seasons.[2] The population of the city does not spend their time outdoors as reflected in the study findings. Only 2.0% of the patients spent their time outdoors for more than 60 min and 16.0% for between 30 and 60 min. Therefore,

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Table 5: The association of Vitamin D level with outdoor exposure patterns

Characteristic ($n=200$)	Vitamin D measurement			*P*
	Sufficient	Insufficient	Deficient	
Working				
Indoor	23 (21.1)	45 (41.3)	**41 (37.6)**	0.494*
Outdoor	21 (23.1)	43 (47.3)	27 (29.7)	
Spent outdoor (min)				
Never-<10 min	15 (26.8)	22 (39.3)	**19 (33.9)**	0.093**
10-<30	24 (22.2)	42 (38.9)	**42 (38.9)**	
30-60	4 (12.5)	21 (65.6)	7 (21.9)	
>60	1 (25.0)	3 (75.0)	0 (0.0)	
Spent outdoor (min)				
Never-<30	39 (23.8)	64 (39.0)	61 (37.2)	**0.010***
30->60	5 (13.9)	24 (66.7)	7 (19.4)	
Sun exposure				
Face	10 (23.3)	23 (53.5)	10 (23.3)	0.139**
Face and hand	30 (22.4)	53 (39.6)	51 (38.1)	
Both arms	3 (17.6)	11 (64.7)	3 (17.6)	
Both legs	1 (16.7)	1 (16.7)	**4 (66.7)**	
Time examination				
Winter	13 (24.5)	21 (39.6)	19 (35.8)	0.868**
Spring	15 (19.5)	**36 (46.8)**	26 (33.8)	
Sumer	14 (21.5)	30 (46.2)	21 (32.3)	
Autumn	**2 (40.0)**	1 (20.0)	**2 (40.0)**	

The bold number shows a significant difference. *Pearson Chi-squared and **Fisher's exact tests were performed for statistical analyses

it is not expected to have sufficient vitamin D in both male and female genders in this region. The high prevalence of deficient and insufficient Vitamin D in females may back to this fact that most of the females prefer to stay at home and are less likely to be exposed to the sunlight. Therefore, they could be more likely to be referred to serum Vitamin D measurement.

A study conducted in female individuals aged 15 years and older who attended an outpatient clinic in Iran to determine the Vitamin D level based on age.[20] The study showed that the mean serum Vitamin D in females was 20.6 ng/mL including 67% with insufficient level. The mean 25-OHD and proportion of deficiency did not vary across the different seasons with regard to age. However, in the summer and the autumn, the women had significantly lower serum 25-OHD concentrations than the men.

Obesity has been shown to be associated with decreased serum 25(OH)D level.[21-24] The possible reason for this association backs to the characteristics of Vitamin D itself is a fat-soluble Vitamin. Higher body fat decreases the availability of circulating 25(OH)D.[25]

Obese persons have higher fat content, which could block 25(OH)D to be halted into the body and consequently lowers the circulating serum 25(OH)D. The present study did not find the association between obesity and Vitamin D deficiency, but the prevalence of Vitamin D deficiency was more prevalent in overweight and obese patients. Al-Horani *et al*.[26] included Iraqi and Jordanian volunteers to find the associations between Vitamin D level and lipid profile patients. They found that the Vitamin D levels were 20.60 ng/mL for Jordanian and 27.59 ng/mL for Iraqi persons. The concentrations were 25.82 and 21.95 for males and females, respectively. The level of Vitamin D in females with hijab and uncovered females was 20.87 and 23.55 ng/mL. The Vitamin D levels for healthy and hyperlipidemic individuals were 29.78 and 7.93 ng/mL, respectively.

Another study conducted among companions of patients visiting private specialist medical clinics in Karbala city showed the higher hypovitaminosis D (85%) in postmenopausal women and 65.0% in women of childbearing age, more than 60% in young men aged 25–49 years and close to 82% in men aged 50–70 years.[27]

Conclusions

The present investigation showed that the female patients in childbearing age have a high prevalence of insufficient and sufficient Vitamin D, especially among overweight and obese individuals. In addition, Vitamin D deficiency and insufficiency were prevalent in all seasons in this region. It is recommended that the patients be educated to have longer exposure to the sunlight to compensate for the deficiency Vitamin D measurement.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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