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Vitamin D Status among Women of Childbearing Age Attending Primary Health Care Centers in Al-Najaf Governorate, Iraq

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ABSTRACT

Background: *Vitamin D is crucial for metabolism and various health consequences, including immune function and bone mineralization. Adequate vitamin D levels are critical throughout pregnancy and lactation.* ***Purpose:*** *To determine vitamin D status and its associated determinants among childbearing age women in Al Najaf, Iraq.* ***Methods:*** *A cross-sectional study was conducted from April 1, 2024, to May 1, 2025. This study was conducted among women of reproductive age attending primary healthcare centers. Ninety women who attended primary health care centers were involved in this study if they fulfilled the inclusion criteria and agreed to participate. Information was gathered through same-day interviews and blood draws. Data on age, body measurements, smoking status, and duration of breastfeeding were collected using a questionnaire. Vitamin D levels in the blood were assessed using an immunofluorescence assay.* ***Results:*** *The results were considered significant if the P-value was equal to or less than 0.05. Implications: It was found that 61 women (67.8%) and 23 (25.6%) were 25(OH) D deficient and insufficient, respectively, whereas only 6 (6.7%) were sufficient. Vitamin D deficiency was found in 45.9% of pregnant women and 44.3% of lactating women. 25-hydroxyvitamin D deficiency was more common in obese individuals (40.6%) ($p<0.001$), urban residents (59%) ($p=0.013$), older than 25 years (59%) ($p=0.013$), and those with lower educational levels (49.2%) ($p=0.012$).* ***Conclusion:*** *Vitamin D deficiency and insufficiency are more common among pregnant and lactating women. Low educational levels, older age, obesity, and living in urban areas are all significant factors for vitamin D deficiency.*

Keywords: 25-hydroxyvitamin D; Lactation; Pregnant; Vitamin D.

Article Information

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INTRODUCTION

Vitamin D, a fat-soluble nutrient, plays a vital role in metabolism and impacts health outcomes like bone density and immune function. Vitamin D can be obtained through dietary intake and synthesized through skin exposure to ultraviolet radiation from sunlight [1]. Among pregnant and lactating women, low vitamin D status is increasingly being documented as a global public health issue, according to data from epidemiological studies [2]. Getting enough vitamin D is particularly important during pregnancy and lactation. In response to foetal demands, calcium absorption increases during pregnancy; as a result, the amount of vitamin D in the body increases [3]. The vitamin D stores of newborns are depleted during the first two months of life .If vitamin D deficiency persists throughout lactation, the danger of rickets in breastfeeding infants increases. Vitamin D deficiency in infants is not only associated with rickets but also with delayed motor development, craniotabes, and reduced linear growth [4].

Vitamin D is crucial for the absorption and metabolism of calcium and phosphorus during pregnancy, particularly in the third trimester. Changes in the mother's vitamin D and calcium metabolism enable up to 250 mg of calcium to be transferred to the foetal skeletal bones per day. If maternal levels are insufficient, this process may be impaired, leading to lower foetal bone mass and shorter gestation durations. Intestinal calcium absorption doubles in the first trimester of early human pregnancy and continues to increase during pregnancy [5]. A shorter duration of gestation is related to this vitamin deficiency and consequently reduced growth of long bones in newborns [6].

A deficiency of vitamin D is known to increase the risk of osteoporosis and several other illnesses in adults, including depression and extreme myopathy, as well as autoimmune disease and rickets [7].

Insufficient maternal 25(OH)D has been linked to poor maternal and neonatal outcomes [2], such as eclampsia, preeclampsia, type 1 diabetes, postpartum depression, low birth weight infants, small for gestational age, and stunted children [6]. It is also related to long- and short-term effects on bone health, neoplastic disorders, infections, and inflammatory diseases [8].

Internationally, breast milk is recognized as a superior nutrient source for optimal development [9]. Mothers during lactation require much higher levels of vitamin D so that the amount of 25(OH)D in their breast milk is adequate for their breastfeeding infant [10]. Therefore, breastfeeding mothers and infants must be supplemented with vitamin D to maintain an optimum amount of 25(OH)D in their babies [11].

Vitamin D status has been linked to sun exposure, BMI, skin tone, and dietary intake. Adults obtain vitamin D mostly from sun exposure. Vitamin D status is also linked to lifestyle factors such as clothing and outdoor activities [12]. Despite Iraq's sunny climate, conservative dress styles, indoor lifestyles due to extreme heat, and cultural practices lead to inadequate UVB exposure and widespread vitamin D deficiency [13]. Studies in Iraq have shown vitamin D deficiency prevalence rates as high as 76% among women, particularly in urban and southern governorates [14-16].

This study aimed to determine the vitamin D status among women of childbearing age attending primary health care centers in Al-Najaf Governorate, due to a lack of sufficient data on this issue in Iraq

METHODS

This comparative cross-sectional study was conducted at four primary health care centers (PHCCs) in AL Najaf Governorate. These centers included two from the northern sector (Alnaser and Al hayderiyha) and two from the southern sector (15th Shaabban and Alridawiha) from the 1st of April 2024 to the 1st of May 2025.

Ninety women who attended primary health care centers for routine antenatal care or health issues were involved in this study if they fulfilled the inclusion criteria and agreed to participate. A simple random method was used for the selection of primary health care centers: two centers from urban areas and two from rural areas. The 90 women included 30 pregnant, 30 breastfeeding, and 30 age- and season-matched nonpregnant nonlactating women (NPNL) from primary healthcare centers.

This comparative cross-sectional study of pregnant and lactating participants was conducted at different times during pregnancy (20–37 weeks) and postpartum (from 2 weeks to 12 months postpartum). The blood samples were collected at specific points throughout pregnancy and breastfeeding for all the participants. Additionally, a control group of 30 women (NPNL) was chosen from the same PHCCs. These women were matched with the participants based on age and the season when their blood was drawn.

Inclusion criteria:

This study included women aged 18 to 40 years, pregnant at gestational weeks 20 to 37, with singleton pregnancies, and who were breastfeeding their babies. All included women declared themselves healthy and had no prior history of vitamin D supplementation.

Exclusion criteria:

Pregnant women who had a history of abortion after the 12th week of pregnancy during the last 15 years, who were lactating in the previous year before the present pregnancy, who had a twin pregnancy, who had developed gestational diabetes, or who had preeclampsia were excluded. Any woman who currently has mastitis, any infectious diseases, metabolic diseases such as diabetes, cardiovascular diseases, mental disorders, cancers, or other malignant degenerative diseases was excluded.

Information was gathered through same-day interviews and blood draws. A questionnaire collected data on age, body measurements (height and weight), skin colour (light or dark), smoking status, and duration of breastfeeding. For pregnant women, BMI was calculated using self-reported pre-pregnancy weight and measured height, as recommended for evaluating nutritional status during pregnancy. In contrast, for lactating and non-pregnant, non-lactating (NPNL) women, both weight and height were measured at the time of data collection and used to compute BMI.

Data about lactation habits were gathered from all lactating participants, including the number of breastfeeding sessions and the number and amount of formula feedings per day. To assess breastfeeding duration, participants were requested to report the date of their last breastfeeding experience. "Total lactation" encompassed any level of breastfeeding, while "full lactation" was described as providing at least ninety percent of the infant's daily energy needs through breast milk [17]. Housing condition was classified according to the degree of natural sunlight access. “Closed” housing refers to dwellings with limited sunlight due to structural layout (e.g., few windows, shaded buildings, or enclosed spaces), while “open” housing refers to homes with good sunlight access, such as those with multiple windows, balconies, or open courtyards. Sun exposure was estimated based on sun or shade preference in summer as (always sun, mixed, or always shade). The cold months included December to February, and the hot months included September to October.

Serum 25(OH)D levels were measured in the laboratory. A 3 mL sample of venous blood was drawn from each participant at the antecubital fossa. The samples were then placed in gel tubes, centrifuged at 5000 rpm for 5 minutes, stored in an ice bag, and transferred to the main laboratory. On the same day, the 25(OH)D level was evaluated by dispensing 200 µL of serum using a micropipette. The 25(OH)D level was measured with a mini VIDAS device based on the principle of “the immunofluorescence technique enzyme immunoassay competition method with final fluorescent detection (ELFA)."

Ethical statements

This research has been approved by the Faculty of Medicine's Ethics Committee at the University of Kufa (#MEC-25). The researcher will inform all participants about the research goals before they give their consent to take part.

Statistical analysis

While there's debate about ideal vitamin D, researchers use these ranges to categorize adult vitamin D status [18].” Vitamin D sufficiency was defined as a 25(OH)D level greater than 20 ng/mL (50 nmol/L). Vitamin D insufficiency was set as a 25(OH)D level of 12 to 20 ng/mL (30–50 nmol/L). Vitamin D deficiency was set as a 25(OH)D concentration <12 ng/mL (30 nmol/L). A "risk" of vitamin D toxicity is set as a 25(OH)D level of more than 100 ng/mL (>250 nmol/mL).

The study compared the vitamin D levels (serum 25(OH)D) of pregnant and breastfeeding women to those of non-pregnant and non-breastfeeding participants (NPNB). Recognizing that various factors can affect vitamin D levels, the researchers also analysed the influence of potential confounding variables: (a) “season at the time of blood collection” with the categorization of respondents in summer (September to October) and winter (December to February); (b) “residence” (i.e., urban and rural area); (c) “skin colour" (light/dark); (d) "age"; (e) "body mass index" (BMI); (f) "smoking"; and (g) "duration of breastfeeding", (h) " sun exposure" and (i) "housing conditions".

Data analysis was done using IBM SPSS version. 22.0 (IBM Corp., Armonk, NY, USA). Categorical variables are illustrated as the frequency (n) and percentage (%), while continuous variables are illustrated as the mean, median, standard deviation (SD), and range. Shapiro-Wilk test indicated a non-normal distribution of Vitamin D data ($p < 0.05$), confirming that the data were skewed; non-parametric Kruskal-Wallis testing was employed to analyse significant differences between pregnant/lactating women and the non-pregnant/non-lactating group. Additionally, Chi-square tests were used to assess discrepancies in categorical data presented as tables and figures. A threshold of 12 ng/mL was used to define vitamin D deficiency (<12 ng/mL) and non-deficiency (≥12 ng/mL). The analysis included season, skin type, and smoking status as potential explanatory variables. These variables were entered into the model as categorical data, with their significance assessed using *p*-values.

RESULTS

A total of 90 women were involved in this study. The sociodemographic features of the participants are summarized in Table 1. Age and residence did not significantly differ between pregnant, breastfeeding, and NPNL women ($p>0.05$). However, BMI, educational level, parity, job, and skin tone significantly differ between pregnant, lactating, and non-pregnant non-lactating women ($p<0.05$).

Table 1. Distribution of the studied women according to their sociodemographic data (n=90).

Sociodemographic Variables	Pregnant No. (%)	Lactating N0. (%)	NPNL* No. (%)	Total N0. (%)	P-value[$]
Educational level					
Illiterate	6 (20.0)	6 (20.0)	0 (0.00)	12(13.3)	0.013
Primary	18(60.0)	14(46.7)	3 (10.0)	35(38.9)	
Secondary	6 (20.0)	6 (20.0)	12(40.0)	24(26.7)	
University	0 (00.0)	4 (13.3)	15(50.0)	19(21.1)	
Residence					
Urban	15(50.0)	15(50.0)	15(50.0)	45(50.0)	1.000
Rural	15(50.0)	15(50.0)	15(50.0)	45(50.0)	
Parity					
0	10(33.3)	0 (00.0)	6 (20.0)	16(17.8)	0.005
1,2	14(46.7)	17(56.7)	18(60.0)	49(54.4)	
3,4	6 (20.0)	6 (20.0)	3 (10.0)	15(16.7)	
≥5	0 (00.0)	7 (23.3)	3 (10.0)	10(11.1)	
Age groups					
≥25 years	18(60.0)	9 (30.0)	18(60.0)	45(50.0)	0.270
<25 years	12(40.0)	21(70.0)	12(40.0)	45(50.0)	
BMI groups					
Normal	10(33.3)	5 (16.7)	24(80.0)	39(43.3)	<0.001
Overweight	6 (20.0)	13(43.3)	6 (20.0)	25(27.8)	
Obesity	14(46.7)	12(40.0)	0 (00.0)	26(28.9)	
Skin color					
Dark	12(40.0)	11(36.7)	0 (00.0)	23(25.6)	<0.001
Light	18(60.0)	19(63.3)	30(100)	67(74.4)	
Job					
Employee	2 (06.7)	4 (13.3)	12(40.0)	18(20.0)	0.003
Housewife	28(93.3)	26(86.7)	18(60.0)	72(80.0)	
Total	30(100.0)	30(100.0)	30(100.0)	90(100.0)	

NPNL nonpregnant nonlactating, [$]Chi-square test.

Table 2. Distribution of pregnant, lactating, and NPNL* women according to several vitamin D [25(OH) D]-related factors(n=90)

Variable	Pregnant No. (%)	Lactating No. (%)	NPNL* No. (%)	Total No. (%)	P-value$
Season					0.641
Hot	14(46.7)	13(43.3)	15(50.0)	42(46.7)	
Cold	16(53.3)	17(56.7)	15(50.0)	48(53.3)	
Lactation history					0.113
Yes	20(66.7)	23(76.7)	15(50.0)	58(64.4)	
No	10(33.3)	7 (23.3)	15(50.0)	32(35.6)	
Sun exposure					0.001
Yes	24(80.0)	19(63.3)	9 (30.0)	52(57.8)	
No	6 (20.0)	11(36.7)	21(70.0)	38(42.2)	
Duration of daily sun exposure					0.032
≥15 min.	22(73.3)	13(43.3)	12(40.0)	47(52.2)	
<15 min.	8 (26.7)	17(56.7)	18(60.0)	43(47.8)	
Housing type					0.245
Closed	12(40.0)	13(43.3)	18(60,0)	43(47.8)	
Opened	18(60.0)	17(56.7)	12(40.0)	47(52.2)	
Total	30(100.0)	30(100.0)	30(100.0)	90(100.0)	

****NPNL: nonpregnant nonlactating women, $ Chi-square test.***

Table 1. Distribution of the studied women according to their sociodemographic data (n=90).

Status		Mean ±SD	Median	Minimum	Maximum	P value*
25(OH) D Ng/ml	**Pregnant**	8.8±2.9	8.00*	5.00	18.40	<0.001
	Lactating	8.7±1.8	8.00*	8.00	13.90	
	NPNL	17.5±7.09	16.00	8.00	39.00	

****Kruskal-Wallis test***

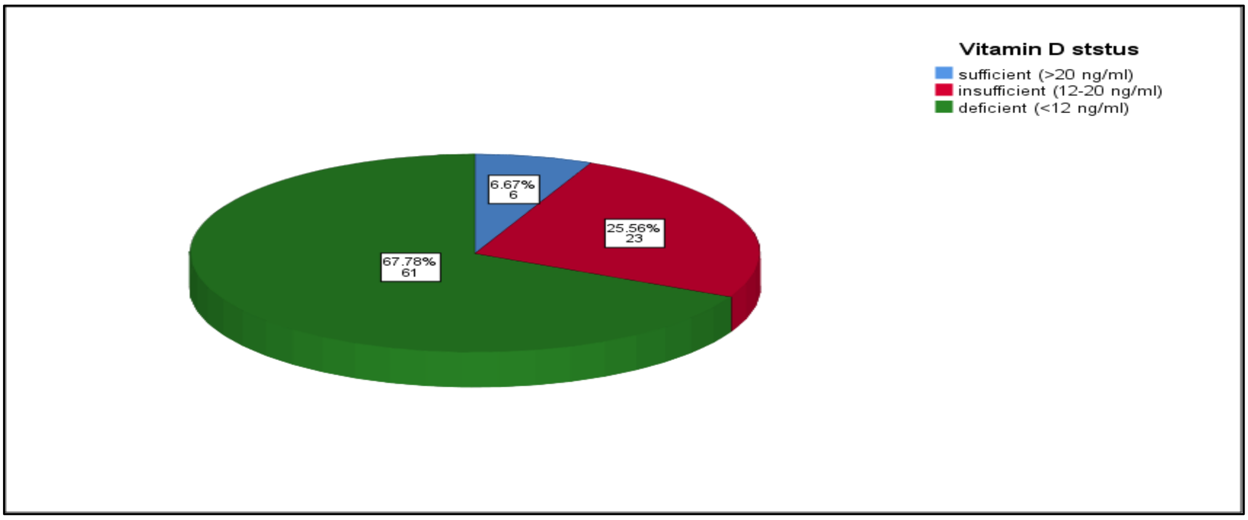

Figure 1. Distribution of the participants according to their vitamin D status.

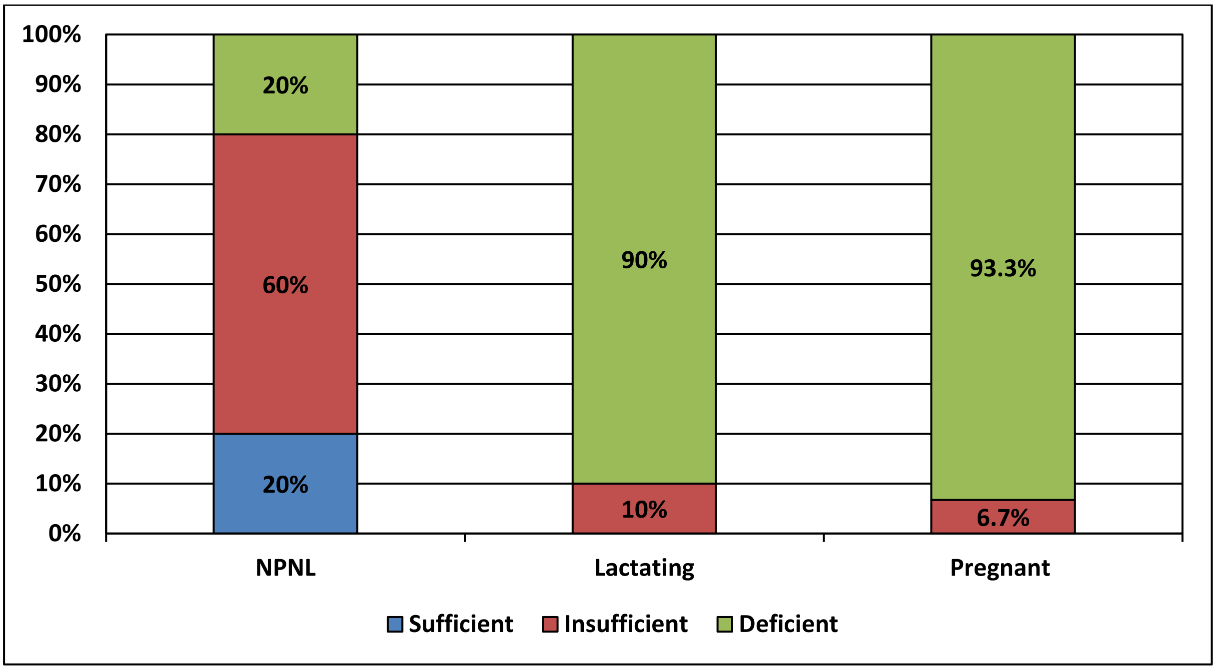

Figure. 2. Classification of vitamin D status among pregnant, lactating, and NPNL women.

Table 4. Association between vitamin D levels of the studied groups and their sociodemographic data.

Sociodemographic Variable		Vitamin D level		Total	P Value*
		≥12 ng/mL	<12 ng/mL		
Educational Status	Illiterate	3	9	12	0.012
		10.3%	14.8%	13.3%	
	Primary school	5	30	35	
		17.2%	49.2%	38.9%	
	Secondary school	9	15	24	
		41.4%	19.7%	26.7%	
	University	9	10	19	
		31.0%	16.4%	21.1%	
Residence	Urban	9	36	45	0.013
		31.0%	59.0%	50.0%	
	Rural	20	25	45	
		69.0%	41.0%	50.0%	
Parity Group	0	8	8	16	0.331
		27.6%	13.1%	17.8%	
	1-2	15	34	49	
		51.7%	55.7%	54.4%	

Sociodemographic Variable		Vitamin D level		Total	P Value*
		≥12 ng/mL	<12 ng/mL		
	3-4	3	12	15	
		10.3%	19.7%	16.7%	
	≥5	3	7	10	
		10.3%	11.5%	11.1%	
Age Group	<25years	20	25	45	0.013
		69.0%	41.0%	50.0%	
	≥25years	9	36	45	
		31.0%	59.0%	50.0%	
Skin colour	Dark	5	18	23	0.212
		17.2%	29.5%	25.6%	
	Light	24	43	67	
		82.8%	70.5%	74.4%	
Job	Employee	9	9	18	0.071
		31.0%	14.8%	20.0%	
	Housewife	20	52	72	
		69.0%	85.2%	80.0%	
Total		29	61	90	
		100.0%	100.0%	100.0%	

***** *Chi-square test*

Table 5. Distribution of study subjects according to their vitamin D levels and related factors.

Variable		Vitamin D level		Total	*p* Value*
		≥12 ng/mL	<12 ng/mL		
Season	Hot weather	11	31	42	0.252
		37.9%	50.8%	46.7%	
	Cold weather	18	30	48	
		62.1%	49.2%	53.3%	
Lactation History	Yes	15	43	58	0.082
		51.7%	70.5%	64.4%	
	No	14	18	32	

Variable		**Vitamin D level**		**Total**	***p* Value***
		≥12 ng/mL	<12 ng/mL		
		48.3%	29.5%	35.6%	
Sun Exposure	**Yes**	14	38	52	0.208
		48.3%	62.3%	57.8%	
	No	15	23	38	
		51.7%	37.7%	42.2%	
Duration Of Sun Exposure	**≥15 Min.**	15	28	43	0.983
		51.7%	45.9%	47.8%	
	<15 Min.	14	33	47	
		48.3%	54.1%	52.2%	
Housing Condition	**Closed**	12	31	43	0.402
		41.4%	50.8%	47.8%	
	Opened	17	30	47	
		58.6%	49.2%	52.2%	
Total		29	61	90	
		100.0%	100.0%	100.0%	

***** Chi-square tes***

Table 2 summarizes differences in the distribution of vitamin D-related factors among the studied women (pregnant, lactating, and NPNL). A total of 57.8% of the study sample was exposed to the sun, whereas the rest (42.2%) were not exposed to the sun; a high percentage of pregnant and lactating women (80% and 63.3%, respectively) were exposed to the sun, and only 30% of the NPLNLs were exposed to the sun. There was a highly significant difference (*p*=0.001). More than half (54%) of the studied women were exposed for ≥15 minutes, while the rest (46%) were exposed for <15 minutes. Nearly three-quarters of the women (73.3%) were pregnant, and less than half of the lactating and NPNL women (43.3% and 40.0%, respectively) were exposed for ≥15 minutes (p = 0.032); these differences were statistically significant.

According to 25(OH) D levels, the studied sample was divided into three groups (vitamin D sufficiency, insufficiency, and deficiency). It was found that 61 women (67.8%) and 23 (25.6%) were 25(OH) D deficient and insufficient, respectively, whereas only 6 (6.7%) were sufficient, as shown in Fig. 1.

Fig. 2 shows that 90% of pregnant and 93.3% of lactating women had 25(OH)D deficiency, which was higher than that of NPNL women (20%), whereas 25(OH)D insufficiency was greater among NPNL women (60%) than among pregnant (6.7%) and lactating (10%) women. However, only 20% of the NPNL women had sufficient 25(OH)D (*p*<0.001), which was highly statistically significant.

Table 3 summarizes the descriptive statistics of vitamin D levels in the three studied groups. The median 25(OH) D concentration of pregnant and breastfeeding women (8.00 ng/mL) was significantly lower than that of NPNL women (16.00 ng/mL), and statistical analysis revealed highly significant differences in vitamin D levels between lactating and NPNL women (*p*<0.001). Table 4 describes the distribution of the studied women's vitamin D levels according to their sociodemographic data. According to educational level, nearly half (49.2%) of the 25(OH) D-deficient women were primarily educated, whereas less than half of the 25(OH) D-nondeficient women were secondary educated; statistically, there was a significant association between educational level and vitamin D deficiency (*p*=0.012). Vitamin D deficiency was significantly more common among older women ≥25 years old (59%) (*p*=0.013). Regarding residency, more than half (59%) of the studied women who had 25(OH) D deficiency lived in urban areas, whereas the remaining 41% lived in rural areas (*p*=0.013).

Table 5 describes the classification of the 25(OH)D levels among the women regarding several related factors. There was no statistical difference for all related factors (*p*>0.05).

DISCUSSION

Vitamin D deficiency is a prevalent public health issue affecting people of all ages, particularly women during pregnancy and lactation [2]. The blood circulating form of vitamin D is serum 25(OH) D. It is now considered the most reliable marker for assessing an individual's vitamin D level [19]. However, the ideal serum level of 25(OH) D for optimum health is unknown. Most researchers agree that measurements of 12 to 20 ng/mL and 12 ng/mL report vitamin D insufficiency and deficiency, respectively [18]. The current results showed a high 25(OH) D deficiency and insufficiency percentage between participants (67.78% and 25.56%, respectively). Only 6.67% of women had sufficient vitamin D status. A previous study conducted among Iraqi women of reproductive age showed vitamin D deficiency in 76% and insufficiency in 18% of them [19]. These findings are in line with other Iraqi studies [14-16], where similar high deficiency levels have been reported due to limited sun exposure, indoor lifestyles, and cultural clothing practices [13]. According to reports, up to 25% to 84% of women in Lebanon [20] and the United Arab Emirates (UAE) [21] have serum 25(OH)D concentrations below 10 ng/ml. The current prevalence of inadequate vitamin D (deficiency and insufficiency) among pregnant women (100%) was much higher than that found in previous studies among pregnant women in other countries, such as 18% in the United Kingdom [22] and 25% in the United Arab Emirates [23]. This finding could be attributed to a lack of knowledge among Iraqi women about specific issues related to Vitamin D, such as dietary sources and the optimal season for obtaining vitamin D [24].

Other studies have reported a high rate of vitamin D deficiency among lactating mothers [25]; however, this rate was lower than the current prevalence of vitamin D deficiency and insufficiency (90% and 10%, respectively). In a global survey involving the United States and Mexico, 43% of lactating women had vitamin D insufficiency at 4 weeks postpartum. In both earlier studies, 18% [26] and 22% [27] of the women were supplemented with vitamin D, in contrast to our non-supplemented study sample. Vitamin D loss in breast milk may be one reason for lower vitamin D levels in breastfeeding women [26]. The current findings could be due to women in our society already having inadequate vitamin D status, which was supplemented by increasing demand for vitamin D for the skeletal composition and development of the foetus during pregnancy. In addition, vitamin D is secreted from breast milk during lactation [27].

Although endogenous vitamin D synthesis from sun exposure is an important source of vitamin D, significant seasonal fluctuations in serum 25(OH) D levels in adults and infants have been observed [28]. In this study, 46% of the participants were exposed to sunshine for less than 15 minutes per day. Despite Al-Najaf's sunny climate, conservative clothing styles, restricted outdoor activity due to heat, and architectural housing factors (e.g., shaded buildings, few windows) may severely limit effective UVB exposure, as also reported in similar studies from Kuwait and Saudi Arabia [13,29].

Although a definitive relationship between vitamin D deficiency and obesity has yet to be established, there is strong evidence that vitamin D plays a role in fat accumulation [30]. There were no obese women with nondeficient 25(OH) D (12 ng/mL), but the majority (88.46%) of those with sufficient 25(OH) D levels had a normal BMI (p=0.001), which was statistically significant. Vitamin D deficiency has been associated with increased body weight, body fat, and BMI in studies of obese women [31]. This relationship is particularly concerning during pregnancy, where vitamin D demands increase and excess maternal fat may further reduce bioavailability. Consistent with previous findings, an opposite relationship was observed between total body fat and serum 25(OH)D levels in the current study [32]. A considerable limitation of the present study was the sample size. It was inadequate for identifying potential differences between subgroups. In addition, the study has a cross-sectional design, so a causal relationship cannot be established. However, this study is one of the few studies investigating changes in 25(OH)D serum status during pregnancy and postpartum.

CONCLUSION

This study identifies a significant public health concern: a high prevalence of inadequate vitamin D among women. Notably, pregnant and lactating women showed a higher risk of deficiency compared to NPNL. Additionally, the study reveals features related to vitamin D deficiency, including lower education levels, younger age, obesity, and living in urban areas. Therefore, universal screening of vitamin D status during pregnancy and lactation is recommended.

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Ethical approval

The present study, which was conducted by the authors, was approved by the Ethics Committee of the Faculty of Medicine, University of Kufa (Approval No. MEC-25). All participants were informed about the study's objectives before providing their written informed consent to participate.

Statement of Permission and Conflict of Interests

The authors declare that there are no conflicts of interest regarding this study.

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