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Prevalence of Vitamin D Deficiency among Pregnant Women in Sulaimaneyah City-Iraq

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ABSTRACT

Hypovitaminosis D during pregnancy has a negative impact on the mother and infant's health status. The main source of Vitamin D is sunshine and ultraviolet B for most humans and food sources are often inadequate. The present work has been carried out to demonstrate the prevalence of Vitamin D deficiency among pregnant women in the Sulaimaneyah City/ Kurdistan Region of Iraq. Serum samples were collected from 261 pregnant women who attended the Teaching Maternity Hospital and met inclusion criteria and were examined for 25-hydroxyvitamin D using the Roche Elecsys Vitamin D_3 assay. Different information included, including sociodemography, body mass index, and obstetric history, was collected using a specific questionnaire form. The study showed a high prevalence of hypovitaminosis D (71.3%) among pregnant women. High socioeconomic classes, blood group A^-, and advanced gestational age have been significantly associated with higher Vitamin D levels. Vitamin D deficiency is prevalent in pregnant women in Sulaimani city. Because of the many risk factors of Vitamin D deficiency and a series of health consequences, the government needs to take a step to address the problem, including raising awareness among the community about the burden of the situation and how to increase obtaining optimum Vitamin D from different sources.

Index Terms: Vitamin D, Pregnant Women, Hypovitaminosis D, Sulaimaniyah

1. INTRODUCTION

Vitamin D is one of the fat-soluble compounds that are divided into two forms ergocalciferol (D_2) and cholecalciferol (D_3) in relation to human health. Vitamin D_2 is derived from the diet, such as Cod liver oil and fatty fish while D_3 is synthesized in the skin from its precursor as exposed to ultraviolet irradiation [1]. Vitamin D in the human body is converted to 25-hydroxy Vitamin D (25(OH)D) which is a storage and circulating form of Vitamin D, and then to an active form (1,25-dihydroxy Vitamin D) by liver and kidney enzymes [2]. The classical function of Vitamin D is enhancing calcium absorption from the gut to maintain optimum calcium and phosphorus concentration in the blood, which is required to maintain many physiological functions such as muscle contraction, blood clotting, and enzyme activation [3]. Other biological activities of Vitamin D have been proposed by different studies, including enhancing insulin production, responding to many immune and inflammatory triggers, and cell growth and differentiation [4].

Over the last decades, huge numbers of articles have been published worldwide, confirming several Vitamin D health benefits [5]. The action of Vitamin D during pregnancy is still under study; however, Vitamin D is an essential element for the development of healthy fetal bone during pregnancy [5]. Vitamin D deficiency in pregnant women increases the risk of gestational diabetes mellitus and pre-eclampsia for the mother and increases the chances of being small for gestational age, neonatal rickets, and tetany

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for offspring [6], [7]. Several studies reported Vitamin D deficiency in countries with plenty of sunshine for the majority of the time of the year such as India and Saudi Arabia [8], [9]. For the majority of people, getting exposure to sunshine between 09.00 AM and 03.00 PM (depending on solar time) can be considered the main source of Vitamin D [10]. Although in high altitudes because of elevation in solar angle and ambient UVB levels are mostly low, getting an optimal Vitamin D from the sunshine is unworkable, especially in the cooler season [11].

A high prevalence of Vitamin D deficiency has been reported among pregnant Chinese women [11]. Vitamin D deficiency occurs as a result of long-term inadequate intake of Vitamin D from food sources, impaired Vitamin D absorption from the intestine, liver, or kidney diseases, which affect the metabolism of Vitamin D to its active form and inadequate sun exposure. The vast majority of these cases can be corrected by determining underpinning factors associated with Vitamin D deficiency during pregnancy [12]. Studies concluded that taking Vitamin D supplementation during pregnancy must be considered to protect pregnant women and offspring from complications due to Vitamin D deficiency, [13]. In some countries, Vitamin D supplementation is offered for free for pregnant women, unfortunately, it is not available for pregnant women in Iraq.

The present study was carried out to explore the prevalence of Vitamin D deficiency among a group of pregnant women who were assumed to be a representative group of pregnant women in Sulaimani city. Moreover, the study also will try to investigate the association between Vitamin D level age, body mass index, and blood groups.

2. METHODS

2.1. Study Design and Population

The design of the present work is a cross-sectional study carried out from December 2018 to February 2019. Pre-specified inclusion criteria include pregnant women with a gestational age of more than 24 weeks and not on Vitamin D supplements even before pregnancy. Furthermore, women with a pre-pregnancy BMI of more than 35 and pregnant age more than 40-years-old were excluded from the study. The study samples were drowned by a systematic random sampling method from all patients who met inclusion criteria and visited the antenatal care unit in the Maternity Teaching Hospital in Sulaimani city. Totally, 261 pregnant women were successfully recruited to participate in the current cross-sectional study.

2.2. Data Collection

Trained persons collected data using face-to-face interviews. The questionnaire was divided into three main parts 1, sociodemographic data such as age, address, occupation, and income. 2, obstetric history, such as gravidity, and parity 3, dietary history, such as the quantity of routine milk and fish consumption recorded. Outdoor activity and exercise were considered. Sun exposure was defined as exposure to sunshine directly with uncovering body parts and not behind windows.

To control some confounding factors, which have an effect on the Vitamin D level, this study excludes pregnant women with high BMI (more than 35 kg/m^2), liver and kidney disease, and fat malabsorption disorders.

The blood sample was taken from the eligible pregnant women and centrifuged at 5000 rpm for 5 min then the serum was separated and stored at −80°C in deep freeze until they were used for analyzing serum 25 dehydroxyl Vitamin D measurement. Serum Vitamin D level was carried out using Roche Cobas e411 immunoassay analyzer using the Roche Elecsys Vitamin D_3 assay (Roche Diagnosis, Mannheim, Germany). A serum level of <20 ng/mL was considered Vitamin D deficiency, between 20 ng/mL and 30 ng/mL was considered insufficiency and more than 30 ng/mL was regarded to be the optimal level. Content validity was determined through a pane; experts were 12 experts; and reliability was measured using the correlation coefficient of (1 = 0.884 = 0.88.4) (statistically adequate). A pilot study was conducted with 20 pregnant women who attended Maternity Teaching Hospital.

3. RESULTS

Totally 261 pregnant women were recruited for the present study. More than 93% of the participants were at an age between 20 and 40-years-old, 3.4% were <20-year-old and the rest were above 40 years (1.3%). More than 44% of the pregnant women had a body mass index of more than 30 kg/m^2, and 32.6% of participants had normal weight Only 16.1% were categorized as obese, and 5% had morbid obesity according to the body mass index category and 1.3% of participants were underweight. The majority of the participants had an O^+ blood group (39.1%). In addition, 25.3% were A^+ and the rest had other blood groups. The majority of the pregnant women (77.8%) identified themselves as a housewife. Nearly half of the participants (46.3%) graduated from secondary school and only 29.1% of the participants had postgraduate degrees. Two hundred

and eighteen (83.5) of the 261 participants were from the urban area of Sulaimani city (Table 1).

Table 1 showed the demographical data expressed as number (%), median; Chi-square was used for categorical variables and *t*-test for continuous variables. Differences were considered statistically significant at $P < 0.05$. BMI: Body mass index.

More than 70% of the cases got married at the ages of 20–29 years. The majority of the participants were in the second (55.9%) and third trimester (43.0%) of the pregnancy and only 1.1% had a gestational age of fewer than 20 weeks. A 170 (65.1%) of the 261 participants practised hijab and 34.9% had partly covering clothes. About 67.5% of the participants had more than one pregnancy and 32.5% were primigravida. The majority of the pregnant women were primipara (77.3%) and 22.7% of the participants had a history of more than one childbirth (Table 2).

Table 2 Distribution of the study sample according to reproductive history. Table 2 showed the reproductive data

TABLE 1: Distribution of the study sample according to sociodemographic characteristics

Variables	Frequency	Percent	Mean±SD
AGE <20 years	9	3.4	28.8±4.96
20–29 years	127	48.6	
30–39 years	122	46.7	
40 years and more	3	1.3	
Blood group A^+	66	25.3	
B^+	50	19.2	
AB^+	21	8.0	
O^+	102	39.1	
A^-	7	2.7	
B^-	4	1.5	
AB^-	0	0.0	
O^-	11	4.2	
BMI Underweight	4	1.5	26.64±4.62
Normal	85	32.6	
Overweight	117	44.8	
Obese	42	16.1	
Morbid obese	13	5.0	
Occupation employee	58	22.2	
Non employed	203	77.8	
Educational status illiterate	6	2.3	
Read and write	12	4.6	
Primary school graduate	44	16.9	
Secondary school	121	46.3	
Graduate			
Postgraduate	76	29.1	
Others	2	0.8	
Residency Urban	218	83.5	
Sub urban	37	14.2	
Rural	6	2.3	

expressed as number (%), and median; Chi-square was used for categorical variables and a *t*-test for continuous variables. Differences were considered statistically significant at $P < 0.05$.

The result of the study showed a high prevalence of Vitamin D deficiency among pregnant women (71.3%). It was concluded that 18.0% were insufficient (mean = 24.46 ng/ml, S. D = 2.80) and 10.7% of the participants had sufficient serum levels of 25-dihydroxy Vitamin D (mean = 48.29 ng/ml, S. D = 20.12) (Table 3).

Table 3 showed the serum 25(OH) levels data expressed as frequency, percent (%) and mean. Vitamin D <20 ng/ml was considered deficient, between 20 ng/ml and 30 ng/ml considered insufficient and optimum levels above 30 Differences were considered statistically significant at $P < 0.05$.

According to (Table 4), the mean Vitamin D level was almost at the same level among different age groups (<20 years = 16.4, 20–29 years = 16.9, 30.39 years = 16.09), with the exception of ages more than 40 years, which was 26.4 ± 23.2. Likewise, positive blood groups had similar mean for serum Vitamin D levels ($A^+ = 19.36$, $B^+ = 15.70$, $AB^+ = 18.70$, $O^+ = 14.60$). Higher Vitamin D levels can be seen among participants with blood group A^- (mean = 33.53 ng/ml, S. D = 38.7). B^- and O^- blood groups had a mean of 8.52 ± 1.60 and 11.58 ± 8.06, respectively. A significant association was found between the blood group and Vitamin D status ($P = 0.009$). Furthermore, the result showed that higher socioeconomic status had higher Vitamin D levels with a significant association ($P = 0.007$). There were no significant differences in Vitamin D status among participants with different BMI. There were no significant differences in Vitamin D levels between pregnant women with different employment states, educational levels, and residency.

Table 4 demonstrates association between serum Vitamin D level and sociodemographic variables. Differences were considered statistically significant at $P < 0.05$.

As shown in Table 5, there was not any significant association found between serum Vitamin D levels among pregnant women of different ages at marriage. A significant association was found between gestational age and Vitamin D status (0.000), higher gestational age had higher Vitamin D levels. Pregnant women with partly covered clothes had significantly higher Vitamin D concentrations (mean = 19.04 ± 18.16, $P = 0.049$). Vitamin D levels between participants with different gravida and para did not show any significant correlation. The type of delivery has no impact on the Vitamin D level.

Table 2: Distribution of the study sample according to reproductive history.

VARIABLES	FREQUENCY	PERCENT	MEAN±SD
AGE AT MARRIEGELess than 20 years	62	23.7	22.18 ± 4.14
20- 29 years	183	70.1	
30 years and over	16	6.2	
GESTATIONAL AGELess than 20 Week	3	1.1	29.6 ± 4.39
20- 29 Week	146	55.9	
30- 39 Week	112	43.0	
DRESSINGPartly covered	91	34.9	
Fully covered	170	65.1	
GRAVIDAEqual to one	85	32.5	
More than one	176	67.5	
PARAOne and less	202	77.3	

TABLE 3: Vitamin D distribution

Vitamin d class	Frequency	Percent	Mean	S. D	95% confidence interval for mean		minimum	maximum
					Lower bound	Upper bound		
Deficient	186	71.3	9.91	4.91	9.20	10.62	0.0	19.80
Insufficient	47	18.0	24.46	2.80	23.64	25.28	20.50	29.8
Sufficient	28	10.7	48.29	20.12	40.49	56.09	30.90	98.0
Total	261	100.0		-	-	-	-	-

TABLE 4: The association of Vitamin D status with sociodemographic data

Variables	Mean±S.D	Std. error	*F*-test	*P*-value	Sig.
AGE <20 years	16.4±9.48	3.16	0.731	0.534	No significance
20–29 years	16.9±16.8	1.49			
30–39 years	16.09±11.8	1.07			
40 years and more	28.4±23.2	13.37			
Blood group A^+	19.36±17.7	2.19	2.910	0.009	Significance
B^+	15.70±12.6	1.79			
AB^+	18.70±12.5	2.72			
O^+	14.60±10.0	0.99			
A^-	33.53±38.7	14.66			
B^-	8.52±1.60	0.80			
AB^-	0	0			
O^-	11.98±8.06	2.43			
Socioeconomic status low class	13.29±10.3	1.52	5.09	0.007	Significance
Middle class	16.63±14.6	1.04			
High class	26.57±19.1	4.78			
BMI underweight	13.42±10.8	5.44	0.468	0.759	No significance
Normal	16.94±17.6	1.91			
Overweight	17.31±14.07	1.29			
Obese	15.95±10.69	1.67			
Morbid obese	12.07±6.56	1.81			
Employment employee	14.08±9.58	1.29	-1.529	0.127	No significance
Non employed	17.38±15.5	1.09			
Educational status Illiterate	17.18±18.7	7.66	0.578	0.717	No significance
Read and write	19.80±9.6	2.77			
Primary school graduate	15.53±17.1	2.58			
Secondary school graduate	16.05±14.0	1.27			
High education	18.01±14.3	1.64			
Others	5.29±0.55	0.39			
Residency Urban	17.24±14.9	1.01	1.862	0.157	No significance
Sub urban	12.56±10.8	1.78			
Rural	20.4±17.7	7.22			

TABLE 5: The association of Vitamin D status with reproductive history

Variable	Mean±S.D	Std-error	*F*-test	*P*-value	Sig.
age at marriage <20 years	18.90±19.6	2.49	0.991	0.373	No significance
20–29 years	15.89±12.7	0.93			
30 years and over	16.64±10.8	2.71			
GESTATIONAL AGE <20 week	8.05±1.85	1.07	2.063	0.000	Significance
20–29 week	17.37±15.8	1.30			
30–39 week	15.93±12.8	1.21			
Clothing partly covered	19.04±18.16	1.90	1.99	0.049	Significance
Fully covered	15.36±12.06	0.92			
Gravida equal to one	16.05±14.9	1.61	-0.460	0.646	No significance
More than one	16.94±14.4	1.08			
Para equal to one	17.40±15.4	1.08	1.550	0.122	No significance
More than one	14.07±10.6	1.39			
Type of delivery Normal vaginal delivery	15.23±10.4	1.17	0.391	0.677	No significance
Assisted delivery	15.24±14.8	3.98			
Caesarean section	16.96±13.6	1.63			

In this group of participants, Vitamin D levels significantly increased as the pregnancy progressed ($P = 0.000$). Likewise, pregnant women with partly covered clothes had a significantly higher amount of Vitamin D ($P = 0.049$) (Table 5).

4. DISCUSSION

Nowadays, Vitamin D attracts the attention of many researchers as many studies have elucidated the role of Vitamin D in various mechanisms in the body. Serum 25(OH)D level can precisely measure Vitamin D status because it is reflective of both exogenous and endogenous Vitamin D production. The work can be regarded as the first study conducted in Sulaimani City in Iraq, focusing on the prevalence of Vitamin D deficiency among pregnant women. The percentage rates of Vitamin D deficiency among pregnant women who were included in the present study were relatively very high (71.3%). Optimal Vitamin D level (25(OH)D 30 ng/ml) was observed in 10.7 percent of pregnant women. Related observations were reported in several studies carried out among South Asian pregnant women [8], [9], [11].

Exposing skin to ultraviolet B can be considered the main source of Vitamin D; therefore, the optimal level of Vitamin D among people who live in countries at or near the equator is expected which is not supported by the result of studies. Despite plenty of sunshine in the region, Vitamin D deficiency has got highly prevalent in this area. There are several factors with significant impacts on Vitamin D synthesis including geographical region, seasons, daytime, weather, air pollution, and skin pigmentation also skin covered with sunscreen [14]. A number of these factors may apply to this region. Because of the impact of cultural and religious beliefs, most of the body parts are covered with clothes, which may partially play a role in limitations of the skin exposure to sunlight that negatively can affect the optimum level of Vitamin D synthesis.

Although there are limited numbers of studies in the region, the observations were reported in Saudi Arabia, which recorded a relatively high prevalence of Vitamin D deficiency among the whole population and women including pregnant and non-pregnant ones [15], [16]. Due to the closeness of the culture and region or beliefs, these results can support our conclusion and interpretations about Vitamin D deficiency in Sulaimani City. This signifies that a tropical climate does not automatically provide optimum Vitamin D for the residents.

In this study, serum Vitamin D levels were significantly higher among pregnant women and those who do not practice hijab (covering all body parts except the face and hand).

In one study, participants were divided into three groups: 1. Receiving only dietary advice for Vitamin D from the health-care professional, 2. taking Vitamin D supplementation along with dietary advice, and 3. receiving a combination of dietary advice, supplementation and exercise in the Sports Centre. The result showed that serum Vitamin D in the first group had a negligible change with a 70% rise in the second group and in the third group vitamin level increased by 300% compared to baseline [16]. Unfortunately, outdoor exercise or activity is not common among women in the region, which may be another critical reason behind widespread Vitamin D deficiency.

A strong adverse relationship was observed between Vitamin D deficiency and obesity [17], [18]. Obesity (BMI ≥30) may increase the risk of Vitamin D deficiency

because increased subcutaneous fat sequesters more Vitamin D and changes its release into the bloodstream [19]. In contrast, the relationship between body mass index and serum Vitamin D concentration did not observe this study. Higher levels of Vitamin D were seen among participants in blood group A^- and lower levels in participants in blood group B^-.

Furthemore, higher socioeconomic status had significantly higher serum levels of Vitamin D. It demonstrated that the diet of women with a low socioeconomic state is high in phytate and low in calcium leading to increase demand for Vitamin D.

The exact time of getting exposed to the sunshine to get optimum levels of Vitamin D is not provided yet because of the differences in the amount of Vitamin D, the person can get from the different latitudes, seasons, skin pigmentation, and age. However, some studies recommend that to get optimal Vitamin D through sunlight, skin (face, arms, legs, or back) should be exposed to direct sunshine twice a week for 30 min from 10:00 am to 03:00 pm [20], [21]. The dietary reference intake of Vitamin D is 400 IU for women during pregnancy.

5. CONCLUSION

Because of the combined risk factors for Vitamin D insufficiency among pregnant women in this region, the government must inform the public about the magnitude of the problem and the impact of Vitamin D deficiency on overall health. This can be accomplished by educating individuals about the benefits of receiving Vitamin D from sunlight and offering free Vitamin D supplementation through pre-conceptional counselling. Because of the high frequency of Vitamin D insufficiency in this region, as well as the huge impact of Vitamin D deficiency on health status, the findings of this study should be regarded more seriously. At present, folic acid is the sole supplement offered to pregnant women in the Sulaimani region's prenatal care facility.

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