Suez Canal University Medical Journal Vol. 26 (7), 2023
Pages 19-27

Prevalence of Vitamin D Deficiency among Pregnant Women

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Abstract

Background: **There is little data on vitamin D levels and related risk factors in pregnant women in low and middle-income countries, despite the fact that optimal vitamin D status during pregnancy is crucial for maternal health and to prevent unfavorable pregnancy outcomes.** ***Aim:*** **To describe the prevalence of vitamin D deficiency among pregnant women in Ismailia.** ***Patients and Methods:*** **A cross-sectional study was conducted in two primary health care units of Ismailia (Elshohadaa and Elsalam primary health care) on 319 pregnant women. Both PHC units were selected for having a regular number of attending pregnant women monthly and covering the most crowded districts in Ismailia city which allowed for recruiting participants. Convenience samples were taken from both units. All women were subjected to a detailed history, examination, dietary description, and vitamin D level assessment.** ***Results:*** **The mean age of the study group was 30.3±5.6 years. More than half of them were multipara 3(56.8%). About 20(18%) were illiterate, 91(82%) were not working, while 86(77.5%) of their husband were employed. 66(59.4%) were overweight in the first trimester and 14(12.7%) were obese. Mean vitamin D intake was (973.1±403.6 IU per week) and 62(55.9%) didn`t take vitamin D supplementation. Among pregnant women with abnormal vitamin D levels (34.8%), 15.4% had vitamin D insufficiency and 19.4% had vitamin D deficiency.** ***Conclusion:*** **Pregnant women in Ismailia City have a high prevalence of hypovitaminosis D. Among pregnant women in this study, about one-third of them with abnormal vitamin D levels.**

Keywords: Pregnancy, Vitamin D, Prevalence

Introduction

Deficiency of vitamin D is defined as serum 25-hydroxyvitamin D 25(OH) D of less than 25 to 50 nmol/l (10 to 20 ng/ml). According to estimates, one billion people globally lack enough vitamin D, with populations in Europe, the Middle East, Japan, and China particularly at risk[1]. This vitamin deficiency is more prevalent in women than in men, predominantly in pregnant women. Deficiency of vitamin D is a result of reduced sun exposure (due to the use of sunscreen), more clothes, and more time spent indoors. This increases the risk of deficiency in pregnant women together with increasing demands during pregnancy [2]**.** Significant changes in the mother's vitamin D and calcium metabolism take place throughout pregnancy and lactation to supply the calcium required for fetal bone mineral accretion. The fetus accumulates 2-3 mg/d in the skeleton during the first trimester; however, this rate of accumulation

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increases during the last trimester. Early in pregnancy, a pregnant woman's body increases calcium absorption to meet foetal needs, reaching its peak in the third trimester. The increased intestinal absorption of calcium is counterbalanced by an increase in urine calcium excretion, keeping serum ionised calcium steady during pregnancy along with the transfer of calcium to the foetus. When compared to pre-pregnancy values, 1,25(OH)2D levels in plasma increased by 2-fold early in pregnancy and peaked in the third trimester[3]. A study was conducted in Egypt and found that deficiency of vitamin D prevalence was about 40% in women of childbearing period and 72% in lactating women [4], and in another study 54% in pregnant women[5]. A recent study found that the deficiency of vitamin D prevalence was 71% among pregnant women[6]. Another study of Morrocan females and males with an average age (20 years) and 1.96 months discovered that deficiency of vitamin D was more prevalent in 79.2 percent of females (n=96), with 72 percent of them in the reproductive stage[7]. Another study found that a large part of healthy Egyptian women had low levels of vitamin D, with the prevalence of deficiency of vitamin D being as follows: 72% of those who are childbearing, 72.6% of those who are lactating, and 54% of those who are pregnant[8]. Multiple studies have confirmed the frequency of deficiency of vitamin D among high-risk groups, but the extent of the problem in pregnant women and effect on neonatal outcomes is still not well understood. Vitamin D insufficiency is also frequently unreported because of a deficiency of knowledge about the scope of the issue in a sunny nation like Egypt. Data and understanding regarding vitamin D status are still poor in North Africa, according to a systematic review of hypovitaminosis D in the North Africa region and Middle East[9]. There are few data on vitamin D level and related risk factors in pregnant women in low and middle income countries, despite the fact that optimal vitamin D status during pregnancy is crucial for maternal health and to prevent unfavourable pregnancy outcomes. The purpose of this research was to describe deficiency of vitamin D prevalence amongst pregnant women in Ismailia.

Subjects and Methods

This cross sectional study design was conducted in two primary health care units of Ismailia (Elshohadaa and Elsalam primary health care). Both PHC units were selected for having regular number of attending pregnant women monthly and covering the most crowded districts in Ismailia city which allowed for recruiting participants. Convenience sample were taken from both units. The study included pregnant women with singleton pregnancy (aged 18 to 49 years) at 28th week [as when compared to pre-pregnancy values, 1,25(OH)2D levels in plasma increased by 2-fold early in pregnancy and peaked in the third trimester[3]]. Women with pregnancy induced hypertension; gestational diabetes mellitus or hypothyroidism[10] were excluded.

Methods

All enrolled patients were evaluated by detailed history and examinations:-

1.-Questionnaire: For obtaining sociodemographic data as age, telephone number, educational level, special habits of medical importance (smoking).

2.-Anthropometric and other measurements: BMI was taken from records according to IOM[11] in the first and measured during third trimester among the study groups. Weight gain was assessed according to IOM among all pregnant women.

Systolic and diastolic blood pressure was measured for all pregnant women.

3.- Dietary description: Regarding the intake of dietary sources that contain vitamin D according to Food Frequency Questionnaire. Sources of high vitamin D content were chosen and were recorded by asking about the frequency and amount of intake per week (Milk, milk products, egg, fish, tuna and liver)[12]. Each type was multiplied in its content of vitamin D according to[13]. Then total dietary intake of vitamin D per week was calculated for each participant. Frequency of intake of vitamin D tablets during pregnancy was recorded as number of tablets intake, ≤6 times/week and ≥1 time/day[14].

4.- Laboratory investigation: Vitamin D level: five ml of blood was collected by technician or nurse assistance by venipuncture from mothers for assessing 25(OH) D at 28th week of gestation. Samples allowed to clot, then sera were separated using centrifugation at room temperature. Sera storage was at-20C till analyzed. 25(OH) D quantification was done using the solid phase enzyme-linked immunosorbent assay (DRG (25OH) vitamin D ELISA kit. The test was performed according to the manufacturer's instructions *(BIOMED Vitamin D Assay, EGY- CHEM for lab technology).* Maternal vitamin D status was classified into: *Deficiency* (25(OH)D <20 ng/ml), . *Insufficiency* (20ng/ml ≥ (25OH)D <32 ng/ml), *Sufficiency* (25(OH) D >32 ng/ml).

Statistical Analysis

Data was presented as appropriate e.g using tabular and graphic presentations. Data was processed using Statistical Package for the Social Sciences (SPSS) version 20.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics was expressed in: number, percentage, mean and standard deviation. For demographic, social, maternal and clinical history profiles frequencies and percentage distribution were calculated for each variable. Shapiro wilks test was used to assess normality of data distribution. A probability value (p-value) < 0.05 was considered statistically significant.

Ethical consideration

Research Ethics Committee of Suez Canal University approved the protocol of this thesis (4024) (13-11-2019).

Results

Amongst 319 women, 208 women had normal vitamin D level. There were 111 women with abnormal vitamin D level (34.8%), 15.4% had insufficiency level and 19.4% had deficiency of vitamin D as shown in figure 1. Women had mean age of 30.3±5.6 years. More than half of them were multipara 3(56.8%). About 20(18%) were illiterate, 91(82%) were not working, while 86(77.5%) of their husband were employed as in table 1. In table 2, 66 pregnant women (59.4%) were overweight in the first trimester and14 pregnant women (12.7%) were obese. This increased to 42(37.8%) obese women in the second trimester. Pregnant women had normal systolic and diastolic blood pressure level as in table 2. In table 3, Mean vitamin D intake was 973.1±403.6 and 62(55.9%) didn`t take supplements of vitamin D. Pregnant women took their major diatery vitamin D intake from milk, milk products and fish.

Discussion

This study was conducted to describe of vitamin D prevalence amongst pregnant women in Ismailia. This study included 319 pregnant women attending primary health care units for routine antenatal visit at 28th week of pregnancy. In the current study women had mean age of (30.3±5.6 years). More than half of them were multipara 3(56.8%). About 20(18%) were illiterate, 91(82%) were not working,while 86(77.5%) of their husband were employed.

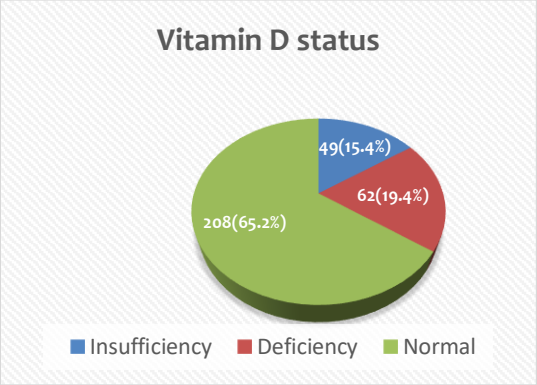

Figure 1: Vitamin D status distribution among pregnant with abnormal vitamin D (n=319).

Table 1:- Basic characteristics of the participants	
Variable	Pregnant with abnormal vitamin D (n= 111)
Age (years) mean± SD	30.3±5.6
Gravidity	
1	28 (25.2%)
2	20 (18.0%)
≥3	63 (56.8%)
Parity	
0	27 (24.3%)
1	21 (18.9%)
≥2	63 (56.8%)
Smoking (n,%)	
Non	50 (45%)
Active	1 (0.9%)
Passive	60 (54.1%)
Educational level (n,%)	
Illiterate	20 (18%)
Primary	19 (17.1%)
Secondary	56 (50.5%)
Higher	16 (14.4%)
Working status (n,%)	
Yes	20 (18%)
No	91 (82%)
Husband working status (n,%)	
Employed	86 (77.5%)
Self-working	25 (22.5%)

This comes in disagreement with Palaniveloo et al. study which used data from a cohort study of pregnant women in Malysia with 259 pregnant women had

available vitamin D data. Age, level of education and monthly income were found to be strongly correlated with vitamin D levels in the study cited[15]. In agreement with another study in which the mean age of mothers with vitamin D deficiency was 30.7 years (minimum of 18 yrs. and maximum of 38 yrs). 61% were multipara[10].

Table 2:- Clinical data of the current pregnancy of the participants (n=111).

Variable	Pregnant with abnormal vitamin D
BMI in first trimester (kg/m2)	
Underweight	0(0%)
Normal weight	31(27.9%)
Overweight	66(59.4%)
Obese	14(12.7%)
BMI in third trimester (kg/m2)	
Underweight	0(0%)
Normal weight	10(9%)
Overweight	59(53.2%)
Obese	42(37.8%)
Weight gain (kg)	
Underweight	0(0)
Normal weight	22(18-27)
Overweight	13(10-21)
Obese	9(7-13)
Systolic B.P (mmHg) mean± SD	110.8±8
Diastolic B.P (mmHg) mean± SD	81.7±5.9

Additionally, 204 pregnant women participated in a study in Switzerland that discovered that women with vitamin D insufficiency had more pregnancies than women with normal vitamin D levels[16]. There were studies in Belgium[17], China[18], the Netherlands[19], the USA [20] and Spain [21] which reported low-educated females have a lower level of vitamin D in comparison with high-educated females because of the use of dietary supplements during pregnancy[22]. Although in this study, Mean vitamin D intake was 973.1±403.6 and 62(55.9%) didn`t take vitamin D supplementation. Similarly studies have reported that lower exposure to sunlight affects level of vitamin D because the synthesis of vitamin D depends predominantly on skin exposure to Ultraviolet B light from direct sunlight[22]. In contrast to Palaniveloo et al. study which found that Compared to pregnant women without jobs, those who were employed had a higher risk of having severe VDD. This might be because women typically work in enclosed spaces with little exposure to sunlight. Additionally, applying sunscreen lotions may reduce the skin's capacity to produce vitamin D[15]. In another study in China, pregnant females who worked inside, with limited exposure to sunlight, had an average vitamin D level (36.7 nmol/L)[23]. The latitude and climate are thought to be the cause for the seasonal change in vitamin D status. The amount of solar UVB rays in the winter at higher latitude regions is insufficient to produce vitamin D because UVB rays are emitted at lower angles from the sun, they travel farther through the atmosphere and are more likely to be absorbed by clouds.

Low relative humidity and low temperature have also been identified as significant risk factors[24]. In this study, pregnancy oc curs in all women in summer and fall. A 147 pregnant Thai women, ages 18-45, cross-sectional research at Siriraj Hospital.

Table 3:- Vitamin D intake during pregnancy of the study participants (n=111).

Total vitamin D2 intake per week (IU)	Pregnant with abnormal vitamin D
Frequency of vitamin D supplementation intake (n,%)	
No	62(55.9%)
≤6 times/week	49(44.1%)
≥1 time/day	0(0%)
Milk (IU)	
Fresh	122.2±33.6
Pasteurized	72.4±16.7
Skimmed	11.7±9.8
Powdered	14.1±1.8
Milk product(IU)	
Yogurt	80.1±11.7
Cheese	23.8±9.5
Butter	4.4±4.3
Others(IU)	
Egg	84.6±16.4
Fish	331.8±38.6
Tuna	36.2±9.9
Liver	23.4±15.5
Total vitamin D intake per week (IU)	973.1±403.6

The research discovered that insufficiency of vitamin D was more common during winter[25]. Deficiency of vitamin D was reported to be more frequent in the rainy season than in the winter in previous studies that were conducted in pregnant women at different gestational age. As a result, there was little to no sun exposure during the rainy season[26,27]. According to institute of medicine, women in each group in the current study were classified according to BMI [11], from records in first trimester pregnancy and third BMI measurement. This study found no that at third trimester pregnant women become more obese (37.8%) more than first trimester. This is in agreement with Pratumvinit et al., study in which pre-pregnancy BMI and third trimester BMI were included in the analysis because pre-pregnancy BMI was considered as an important factor for the predicition of some pregnancy-related conditions[25]. Before becoming pregnant, a women's nutritional status is reflected in their BMI. Several factors, such as gestational edoema and the weight of the feto-placental unit, which are not always indicative of the woman's nutritional health throughout pregnancy might change BMI. The study discovered a link between vitamin D insufficiency and decreased pre-pregnancy body weight and BMI.According to Pratumvinit et al., women with low vitamin D levels had lower pre-pregnancy weight gained more weight during pregnancy. This greater weight gain could be a

factor in the vitamin D levels[25]. Contrary to Bodnar et al. study, which found that pregnant women of normal weight had a higher mean vitamin D content versus obese ones[28]. The difference may be due to Bodnar et al. measured the vitamin D level at the third trimester but not during early pregnancy. Hemodilution and weight gain during pregnancy can affect the vitamin D level[29]. Similar to another study, which reported a significant correlation between maternal serum vitamin D level and maternal vitamin D intake calculated from dietary and prenatal vitamin/mineral supplement frequency data (r=0.26 and r=0.33, respectively). Also, 89.5% of study participants took prenatal vitamins and minerals once per week, and 71.2% did so daily. Participants who took daily prenatal vitamin-mineral supplements had an average intake of vitamin D that was considerably greater (76020 IU/day vs. 45131 IU/day; P 0.0001) than participants who did not[30]. Among women, 15.4% had insufficiency and 19.4% had deficiency of vitamin D among pregnant women with inadequate vitamin D levels (35%). The fact that we were unable to determine the exact timing of the pregnant women who participated in our study beginning to take supplements or their consumption compliance is a crucial necessity. It seems that some women may still be at danger of deficiency of vitamin D even when using vitamin D pills. Recent randomized controlled trials (RCTs) have mostly examined the possibility that maternal vitamin D supplementation may affect neonatal or maternal vitamin D insufficiency[31,32].

Conclusion

Among pregnant women with abnormal vitamin D level (35%), 15.4% had insufficiency and 19.4% had deficiency of vitamin D. Regular adequate supplementation of vitamin D and calcium are needed during pregnancy.

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