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Vitamin D and Calcium Status in Pregnant Women in Western-Libya

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Abstract

Vitamin D deficiency is common during pregnancy especially among high-risk groups, including vegetarians, women with limited sun exposure. Severe maternal vitamin D deficiency has been associated with biochemical evidence of disordered skeletal homeostasis. The present study aims to evaluate the status of vitamin D and calcium ions in pregnant women in Western-Libya. A total of 79 pregnant women were included in the present study. 21, 34, and 24 pregnant women were in the 1st trimester, the 2nd trimester, and the 3rd trimester of pregnancy, respectively. A complete data record was obtained including name, age, duration of pregnancy, weight, height, healthy diet, and family history of chronic diseases using standardized questionnaire. Blood samples were obtained from all subjects for measurement of serum vitamin D and calcium. Venous blood was drawn in plain blood tube containing clot activator and immediately centrifuged at 3000 rpm for 5 minutes to obtain serum and immediately analyzed. A significant decrease in vitamin D level was recorded in pregnant women as compared with a non pregnant woman. The highest level of serum calcium was found in the 2nd trimester and the highest level of vitamin D was found in the 3rd trimester. 84.8% of study group had a vitamin D level less than 20ng/ml and 46.8% had a calcium level less than 8.4mg/dl. The levels of vitamin D were less than 20ng/ml in the 1st, 2nd, and the 3rd trimesters of pregnancy as 95.2%, 91.2%, and 66.7%, respectively. And calcium levels were less than 8.4 mg/dl in the 1st, 2nd, and the 3rd trimesters of pregnancy as 61.9%, 35.3%, and 50%, respectively. Also, the study revealed a significant correlation between vitamin D and serum calcium levels, but no correlation between vitamin D and BMI or between serum calcium and BMI were observed in pregnant women. Despite the large amount of sunshine in Libya, these results show that pregnant women in our region are at high risk for vitamin D deficiency. So, we need to focus our emphasis on maternal nutrition, especially adequate vitamin D and calcium intake, which may pave way in the long run for prevention of future bone health related conditions like osteoporosis.

Keywords

Calcium Status, Vitamin D Status, Pregnant Women, Western Libya

1. Introduction

Vitamin D is a fat-soluble vitamin obtained largely from consuming fortified milk or juice, fish oils, and dietary supplements. It also is produced endogenously in the skin with exposure to sunlight. Vitamin D that is ingested or produced in the skin must undergo hydroxylation in the liver to 25-hydroxyvitamin D (25-OH-D), then further hydroxylation primarily in the kidney to the physiologically active 1,25-dihydroxyvitamin D. This active form is essential to promote absorption of calcium from the gut and enables normal bone mineralization and growth. During pregnancy, severe maternal vitamin D deficiency has been associated with biochemical evidence of disordered skeletal homeostasis, congenital rickets, and fractures in the newborn [1, 2]. However, according to the vitamin D Council, pregnancy is a known risk factor for vitamin D deficiency. Previous research has suggested that vitamin D deficiency during pregnancy

may lead to gestational diabetes, increased risk of infections and cesarean section, and low offspring birth weight [3].

Maternal vitamin D deficiency, defined as serum 25-hydroxyvitamin D (25OHD) <20 ng/ml [4-6] is the most important risk factor for congenital/infantile rickets and neonatal hypocalcemia [7]. Recent studies have suggested that vitamin D deficiency in infancy may persist throughout life, potentially causing a reduction of bone mineral density and extraskeletal health problems such as a low birth weight, immunologic problems, eczema, and wheezing [8-10]. The risk factors for maternal vitamin D deficiency are: low availability of overhead sun, darker skin pigmentation, low amounts of outdoor activity, and excessive skin coverage by clothing. As a result, the prevalence of maternal vitamin D deficiency worldwide is variable and ranges from 18% in the UK [11] to 80% in Iran [12]. In Turkey, the prevalence of vitamin D deficiency during pregnancy varies between 27 and 94.8% [13-16]. Recent evidence suggests that vitamin D deficiency is common during pregnancy especially among high-risk groups, including vegetarians, women with limited sun exposure (eg, those who live in cold climates, reside in northern latitudes, or wear sun and winter protective clothing) and ethnic minorities, especially those with darker skin [17-19].

For the individual pregnant woman thought to be at increased risk of vitamin D deficiency, the serum concentration of 25-OH-D can be used as an indicator of nutritional vitamin D status. Although there is no consensus on an optimal level to maintain overall health, most agree that a serum level of at least 20 ng/mL (50 nmol/L) is needed to avoid bone problems [20-23].

Based on observations of biomarkers of vitamin D activity, such as parathyroid hormone, calcium absorption, and bone mineral density, some experts have suggested that vitamin D deficiency should be defined as circulating 25-OH-D levels less than 32 ng/mL (80 nmol/L) [24]. An optimal serum level during pregnancy has not been determined and remains an area of active research.

2. Objectives

The present study aims to evaluate the status of vitamin D and calcium ions in pregnant women in Western-Libya.

3. Materials and Methods

3.1. Study Population

This study was conducted during August 2018. A total of 79 pregnant women were included in the present study and 21, 34, and 24 pregnant women were in the 1st trimester, the 2nd trimester, and the 3rd trimester of pregnancy, respectively. A complete data record was obtained including name, age, duration of pregnancy, weight, height, healthy diet, and family history of chronic diseases using standardized questionnaire.

3.2. Blood Samples

Blood samples were obtained from all subjects for measurement of vitamin D, and serum calcium. Venous blood was drawn in plain blood tube containing clot activator and immediately centrifuged at 3000 rpm for 5 minutes to obtain serum and immediately analyzed.

3.3. Body Mass Index (BMI)

$$BMI = Weight\ (kg)/Height\ (m)^2$$

3.4. Laboratory Analysis

For serum calcium, a photometer 4040 which manufactured by Robert Riele GmbH & Co KG in Berlin- Germany (December 2013) was used. Test kit for calcium (OCC) from Centronic (Germany) was used.

For vitamin D we used i-CHROMA device Made in Korea 2016**.** I-CHROMA™ Reader is a compact Point-of-Care test system for fluorescence detection to determine different analysis in whole blood, plasma, serum or urine. Vitamin D tests generally assess the total volume of 25-Hydroxyvitamin D (25OHD), which is the form of vitamin D circulating in blood. vitamin D tests may also provide information on the levels of vitamin D2 and D3, which comprise total vitamin D levels.

3.5. Statistical Analysis

Statistical analysis was assessed by using SPSS software version 21.0 (IBM SPSS, NY, USA)

4. Results

4.1. The Study Groups

Total of 79 pregnant women were conducted in this study, they were regularly attend to OPD in Zawia teaching hospital for follow-up. The study group was divided to three sub-groups, sub-group1 (n, 21) were in the first trimester of pregnancy and sub-group 2 (34) were in the second trimester of pregnancy and sub group 3 (n, 24) were in the third trimester of pregnancy. On the other hand, a group of 27 healthy non pregnant volunteers also studied as control group. The mean age of study group was 29.88±5.87year (15 to 45year), as a mean age of control group was 32.00±7.83year (Figure 1).

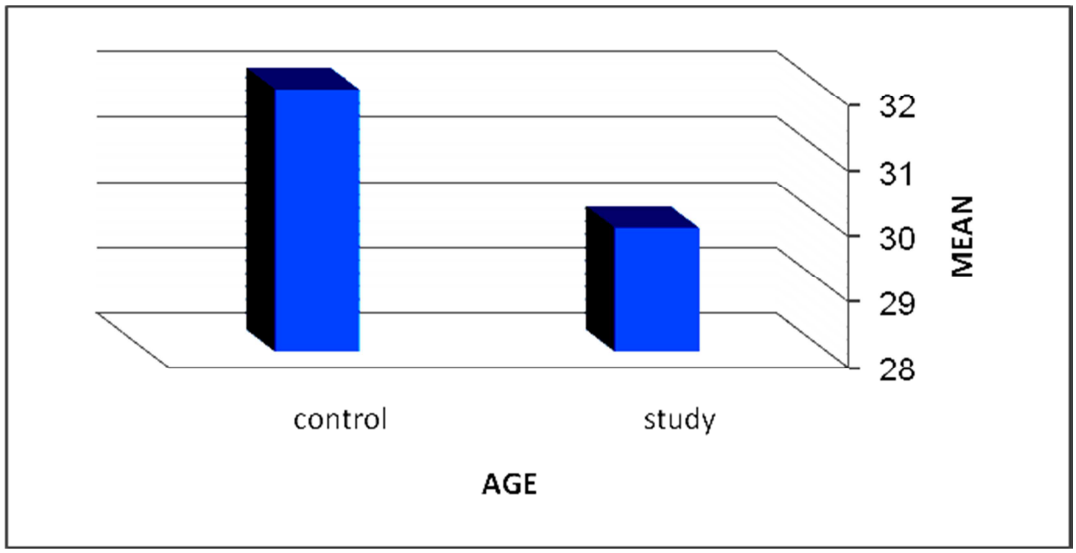

Figure 1. *Age of study and control groups.*

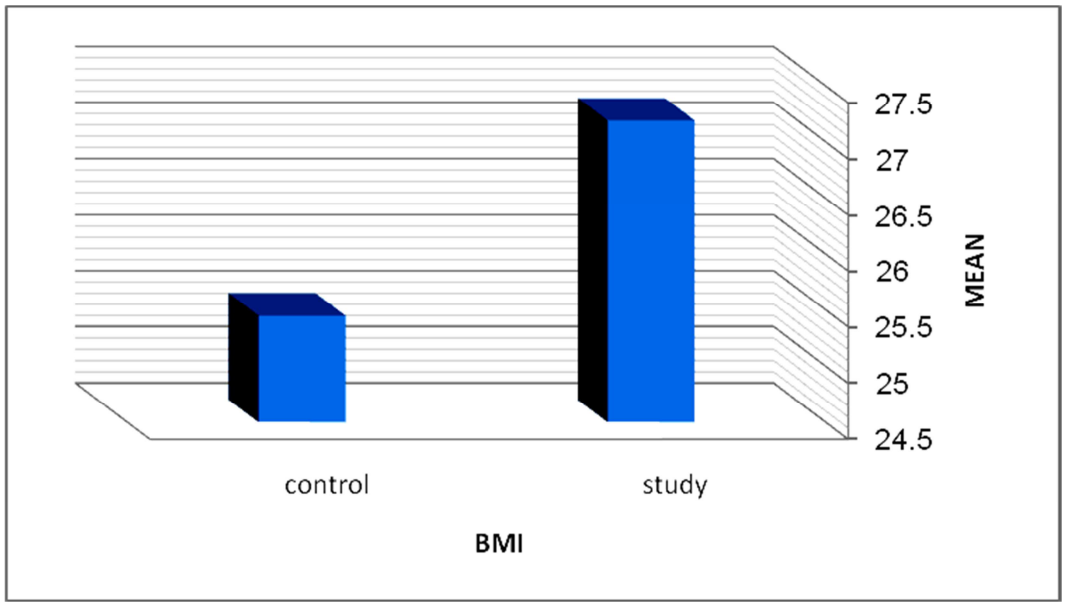

Figure 2. *BMI in study and control groups.*

4.2. BMI in Study and Control Groups

The result showed a non significant difference in body mass index in the study group and the control group (Table 1 & Figure 2).

Table 1. *BMI in study groups.*

Groups Parameters	Control group (n=27)	Study group (n=79)
BMI	27.19±4.40	**25.45±4.78**

4.3. Serum Calcium Ions and Vitamin D levels in Various Pregnancy Stages

Table 2. & figure 3. showed the means of serum calcium ions and vitamin D in various pregnancy stages. The highest level of S. calcium was found in the 2nd trimester (mean=8.61mg/dl) and the highest level of vitamin D was found in the 3rd trimester (mean=16.42 ng/ml).

Table 2. *Serum calcium ions and vitamin D levels in various pregnancy stages.*

Groups Parameters	1st.trimester (n=21)	2nd.trimester (n=34)	3rd.trimester (n=24)
Serum calcium ion	8.18±0.78	8.61±1.09	8.40±0.66
Vitamin D	9.56±4.88	9.62±6.38	16.43±10.65

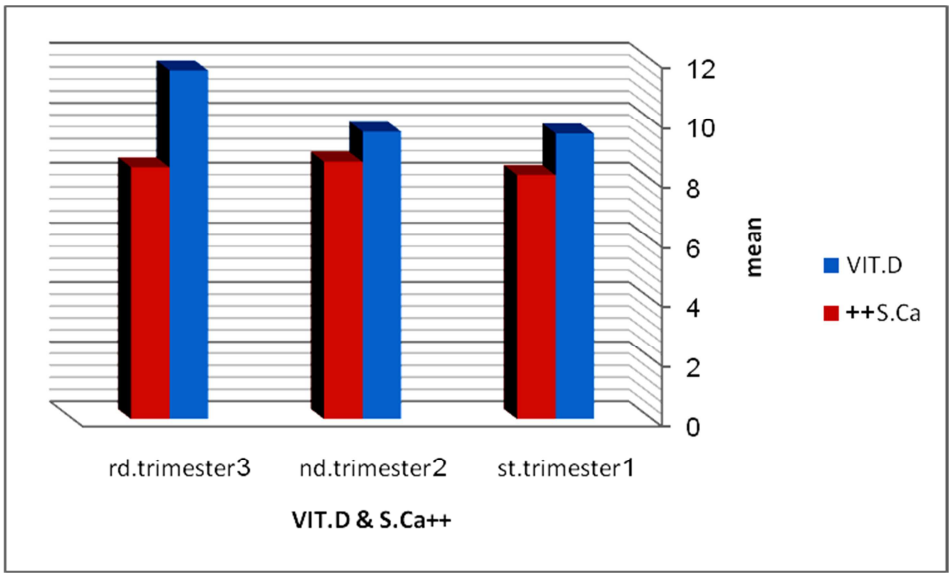

Figure 3. *Serum calcium ions and vitamin D levels in various pregnancy stages.*

4.4. Frequency and Percent of Vitamin D and S. Calcium According to Lower limit of Normal Values

84.8% (n, 67) of study group had a vitamin D level less than 20ng/ml and 46.8% (n, 37) had a calcium level less than 8.4mg/dl (Table 3). In sub groups 1, 2, 3 vitamin D level less than 20ng/ml was reported in 95.2%, 91.2%, and 66.7% of each sub group respectively. And calcium level less than 8.4 mg/dl was reported in 61.9%, 35.3%, and 50% of each sub group respectively (Table 4).

Table 3. *Frequency and percent of S. calcium and vitamin D according to lower limit of normal values.*

Parameters	Frequency	Percent (%)
Serum calcium ion <8.4 mg/dl	37	46.8
Vitamin D <20 ng/ml	67	84.8

Table 4. *Frequency and percent of S. calcium and vitamin D levels less than lower limit of normal values in various pregnancy stages.*

Groups Parameters	1st trimester (n=21)		2nd trimester (n=34)		3rd trimester (n=24)	
	Frequency	Percent (%)	Frequency	Percent (%)	Frequency	Percent (%)
Serum calcium ion <8.4 mg/dl	13	61.9	12	35.3	12	50
Vitamin D <20 ng/ml	20	95.2	31	91.2	16	66.7

4.5. Serum Calcium Ions and Vitamin D Levels in Pregnant and Pregnant Non Women

Table 5 & figure.4 showed no difference in serum calcium ion level in pregnant women compared to non pregnant women (P=0.247).

Table 5 & figure 5 showed a significant decrease in vitamin D level in pregnant women compared to non pregnant women (P=0.003).

Table 5. *Serum calcium ions and vitamin D levels in study & control.*

Groups Parameters	Control group (n=27)	Study group (n=79)
Serum calcium ion	8.18±0.78	8.44±0.91
Vitamin D	16.85±13.19	11.67±8.17**

**: Significant difference as compared to control group (P=0.003)

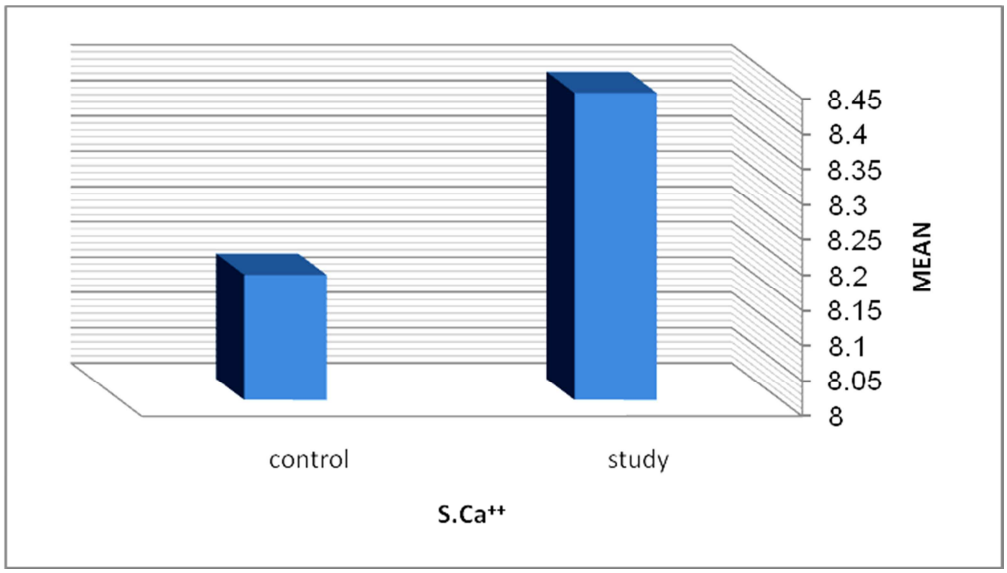

Figure 4. *Serum calcium ion levels in study & control.*

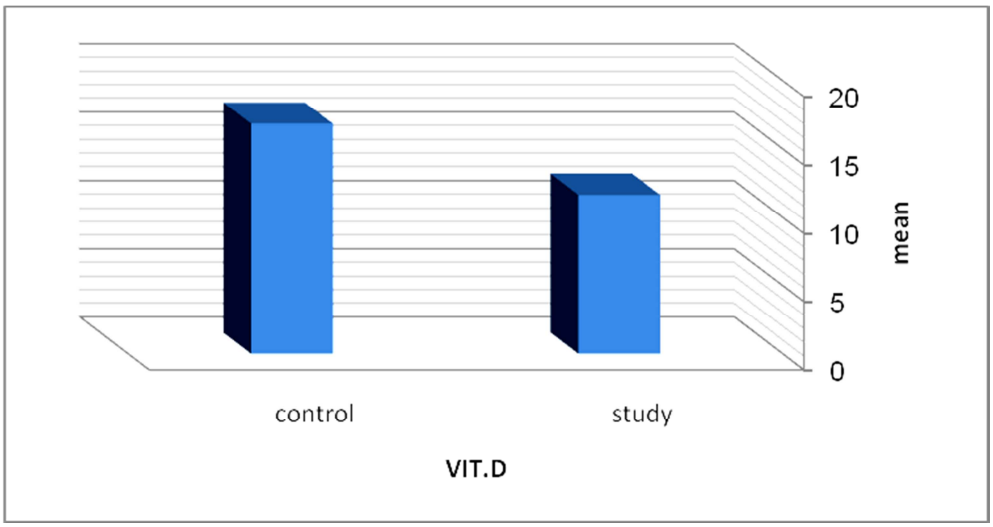

Figure 5. *Serum vitamin D levels in study & control.*

4.6. Correlation Between Vitamin D, S. Calcium, and BMI

In correlations study, the study revealed a significant correlation between vitamin D and S. calcium levels (P=0.046). No correlation between vitamin D and BMI or between S. calcium and BMI (Table 6).

Table 6. *Correlation between vitamin D, S. calcium, and BMI.*

Pearson correlation		Vitamin D (n=79)	S. calcium (n=79)	BMI (n=79)
Correlation of vitamin D	r	-	0.046	0.114
	P value	-	0.689	0.318
Correlation of Serum calcium ion	r	0.046	-	0.108
	P value	0.689	-	0.346
Correlation of BMI	r	0.114	0.108	-
	P value	0.318	0.346	-

5. Discussion

Prevalence of vitamin D deficiency varies widely across various populations. International comparison of the prevalence of vitamin D deficiency is difficult because of variation in the definition of vitamin D deficiency in reported studies. Also prevalence of vitamin D deficiency is influenced by ethnicity, food habits, clothing, climate and exposure to sun [25].

According to the Vitamin D Council, pregnancy is a known risk factor for vitamin D deficiency. Previous research has

suggested that vitamin D deficiency during pregnancy may lead to gestational diabetes, increased risk of infections and cesarean section, and low offspring birth weight [3]. Aim of this study, to evaluate the effect of pregnancy on serum vitamin D levels.

In this study, 84.8% (n, 67) of study group had a vitamin D level less than 20ng/ml and 46.8% (n, 37) had a calcium level less than 8.4mg/dl. Maternal vitamin D deficiency, defined as serum 25-hydroxyvitamin D (25OHD) <20 ng/ml [4-6] is the most important risk factor for congenital/infantile rickets and neonatal hypocalcemia [7]. As a result, the prevalence of maternal vitamin D deficiency worldwide is variable and ranges from 18% in the UK [11] to 80% in Iran [12]. In Turkey, the prevalence of vitamin D deficiency during pregnancy varies between 27 and 94.8% [13-16]. Using the 20ng/L cut point, however, studies from around the world show high percentages of VD deficiency during pregnancy: 100% of Somali immigrants in Sweden, 98% of Omani women, 96% of urban Indian women, 89% of urban Japanese women, 69% of urban Chinese women, 54.7% of UK women in the first trimester, 50% of Baltimore teens, 46% of laboring women from Pakistan, 41% of South Carolina women, 41% of U.S. women in a national database, 35-46% of Australian women, 24% of Western Canadian women, and 7% of North Carolina women [26-31].

In our study, 84.8% of the participants had insufficient vitamin D status. Despite the large amount of sunshine in Libya, these results show that our region is at high risk for vitamin D deficiency.

In present study, a significant decreasing in vitamin D level in pregnant women compared to non pregnant women (P=0.003). Recent evidence suggests that vitamin D deficiency is common during pregnancy especially among high-risk groups, including vegetarians, women with limited sun exposure (eg, those who live in cold climates, reside in northern latitudes, or wear sun and winter protective clothing) and ethnic minorities, especially those with darker skin [17-19]. Also there is a very short list of foods that contain vitamin D. These foods are egg yolk, salmon and cod liver oil, however, most vitamin D is consumed through fortified foods like milk. For the 75% of the population that is lactose intolerant, fortified milk products are not a reliable source of vitamin D consumption.

This study, showed no difference in S. calcium level in pregnant women compared to non pregnant women (P=0.247). In previous study, total calcium level is decreased during pregnancy due to hemodilution associated low albumin. Albumin-corrected calcium and ionized calcium values remain normal throughout pregnancy. Increased intestinal absorption of calcium during pregnancy and skeletal resorption of calcium during lactation form the main maternal adaptive mechanisms to meet the raised requirement [32].

In our study, we found that the highest level of vitamin D detected in 3rd trimester (mean=16.42 ng/ml). A same result in study conducted in 2011, noted that during pregnancy, serum levels of 1.25 (OH) D increase up to 2-fold starting at 10-12 weeks of gestation and reaching a maximum in the third trimester [26]. Adversely, Ginde *et al.* [33] noted that it is unclear whether 25 (OH) D levels increase during pregnancy. However, given an increase in the active form of VD, pregnant women likely have a higher cellular exposure to VD during the second and third trimesters suggesting a role for VD in obstetric well being. This rise in 1,25 $(OH)_2D$ level is largely PTH independent and is mainly due to elevated 1-alpha hydroxylase activity in the maternal kidneys. High PTHrP, estrogen, prolactin and human placental lactogen may also augment the enzyme activity. Placenta and fetal kidneys may also be additional sources [26, 34, 35].

This study, revealed a significant correlation between vitamin D and S. calcium levels (P=0.046). Much of the calcium conservation observed during pregnancy is due to increased intestinal absorption of calcium. This occurs mainly due to the increased generation of 1,25 $(OH)_2D$ [36].

6. Conclusion

Despite the large amount of sunshine in Libya, these results show that our region is at high risk for vitamin D deficiency. So, it can be concluded that a significant decrease in vitamin D level was recorded in pregnant women. Also, a significant correlation between vitamin D and serum calcium levels was observed in pregnant women. Currently, in our population, we need to focus our emphasis on maternal nutrition, especially adequate vitamin D and calcium intake, which may pave way in the long run for prevention of future bone health related conditions like osteoporosis.

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