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PREVALENCE OF VITAMIN D DEFICIENCY RELATED LABORATORY PARAMETERS AMONG PREGNANT WOMEN IN POTHERI, SOUTH INDIA

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ABSTRACT

Vitamin D deficiency is known to cause complications in pregnancy. There is sparse data on the prevalence of hypovitaminosis D in pregnancy, in India. Our study was undertaken to fill this lacuna. 148 pregnant women were enrolled from SRM Medical College and Research Centre, Kattankulathur, India. Serum concentrations of 25-hydroxyvitamin D [25(OH)D_3] and related laboratory parameters were measured. The mean 25(OH)D_3 level in pregnant women was 19.05 ng/mL. Only 8 subjects (5.4%) had >30 ng/mL (sufficient). 47 (33.7%) had 20-30ng/mL (insufficiency), 79 (53.4%) had <20ng/mL (deficiency) and, 14 (9.4%) had <10ng/mL (severe deficiency). We also found that maternal 25OH-D was associated positively to calcium (r= 0.6951, p<0.001) and phosphorus (r= 0.6211, p<0.001) and negatively to alkaline phosphatase (r= –0.4086, p<0.001) and parathyroid hormone (r=0.7856, p<0.001) by Pearson's correlation coefficient method. Thus, in our study, we found an alarming total prevalence of 94.6% of vitamin D deficiency and insufficiency, among pregnant women. There is a definite need for vitamin D supplementation, in pregnant women.

KEYWORDS: **Hypovitaminosis D, Calcium, Parathyroid hormone, pregnancy complications.**

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INTRODUCTION

It is estimated that nearly one billion people in the world suffer from vitamin D deficiency or insufficiency [1]. In many of the Asian countries, Vitamin D deficiency has emerged as a significant public health problem. Southern India, due to its geographic location has abundant sunshine for at least ten months in a year. Given the number of days, the sun shine in South Asia, one would expect the region to be free from vitamin D deficiency. On the contrary, there is a high prevalence. Many attribute this, to the lack of proper diet, poor calcium intake, and indoor stay [2]. Vitamin D belongs to a group of fat-soluble prehormone. It encourages the absorption and metabolism of calcium and phosphorous. Vitamin D is the building block of the hormone calcitriol which works synergistically with parathyroid hormone. It is mainly produced in the skin from 7-dehydrocholestrol by the action of sunshine. Dietary supplements also may serve as a source viz. fatty fish, cod liver oil, organ meat, egg yolk and milk products[3]. Vitamin D deficiency is a risk factor for many disorders, right from conception to entire life span. During pregnancy, approximately 30 g of calcium is transferred to the foetal skeleton, most of it during the last trimester. During pregnancy, calcium is needed for foetal bone-mineral accretion. Deficiency of vitamin D reduces the aggregation of calcium in the developing bones. Vitamin D deficiency has also been linked to a number of other problems including infertility, preeclampsia, gestational diabetes and an increased rate of caesarean section[4,5]. Though studies from different parts of our country have shown widespread vitamin D deficiency in all age groups, there are a few studies from India, on serum 25 (OH) vitamin D concentrations and the prevalence of osteomalacia among pregnant women[6].The aim of our study was to determine the status of vitamin D, in pregnant women in our region. Additionally, the corresponding changes in the levels of Calcium, Phosphorus, Alkaline phosphatase and Parathyroid hormone were studied and analysed.

MATERIALS AND METHODS

Approval from the institutional ethical committee was obtained. 148 pregnant women, attending the SRM Medical College Hospital and Research Centre, Kattankulathur, Kanchipuram District of Tamilnadu state (India) were included in the study, with their informed consent.

(i) Biochemical analysis

Maternal blood was collected in plain vacutainer tube. The serum was separated by centrifuging at 6000 rpm at 4°C for 10 minutes. The levels of Calcium, Phosphorus and Alkaline phosphatase were measured within 24hrs. Olympus AU400 autoanalyser was used to measure total serum calcium, phosphorus and alkaline phosphatase with Beckman Coulter reagents kit according to the instruction manual. Two ml of the separated serum was stored at minus twenty degrees centigrade. The 25(OH) D_3 and Parathyroid hormone levels were determined within three weeks. Serum 25(OH) D_3 was analysed by High Performance Liquid Chromatography (Waters, USA), according to the protocol of Turpeinen *et al.*[7] The parathyroid hormone levels were determined by ELISA micro plate reader (Biorad USA model 680), with Beckman Coulter reagent kits, according to the instruction manual. Subjects were grouped into different categories, based on the serum level of 25(OH)D_3, as per the guidelines of Institute of Medicine (IOM). The IOM defines 25(OH)D_3 serum level of <10 ng/mL as severe deficiency, <20 ng/ml as deficiency, 20-30 as insufficiency and >30 ng/mL as sufficiency [8].

(ii)Statistical Analyses

Statistical analysis was performed using SPSS version 16.0 for Windows (SPSS, Chicago, IL). Data was presented as mean (±SD). Descriptive statistical method was used for proportion analysis. Correlations were studied by using Karl Pearson's correlation coefficient.

RESULTS

The demographic characteristics of the 148 pregnant women included in the study are shown in Table 1. The age of participant

pregnant women ranged between 18 yrs and 42 yrs (mean ± SD, 29.45 ± 7.97). Their Body Mass Index (BMI, calculated as weight in kilograms divided by height in metres squared) ranged from 16.4 to 34 (mean±SD, 24.16 ± 5.63). The period of gestation at the time of sampling, ranged from three to 34 weeks (mean±SD, 16.47 ± 8.32). Among the 148 participants, 68 subjects (45.95%) were in the first trimester of pregnancy, 43 (29.05%) were in the second and 37 (25%) were in the third trimester. The serum levels of 25 (OH) D levels of the study subjects are shown in Table 2. The mean serum 25(OH) D level in pregnant women was 19.05 ng/mL. The 148 pregnant women, were categorised as per the guidelines of IOM into sufficient, insufficient, deficient and severely deficient categories. Only 8 (5.4%) had >30 ng/mL (sufficient level), while 47 (33.7%) had 20-30 ng/mL (insufficiency), 79 (53.4%) had <20 ng/mL (deficiency) and, 14 (9.4%) had <10 ng/mL (severe deficiency). Thus, among the pregnant women in our study, we found an alarming total prevalence of 94.6% of vitamin D deficiency and insufficiency. We also determined the serum levels of Calcium, Phosphorus, Alkaline phosphatase and Parathyroid hormones. The serum Calcium and Phosphorus levels in our subjects were found to be either lower or in the lower range of the normal population values (Table 3). The mean of Serum Calcium levels in our subjects was 7.5 ± 1.04 mg/dL (normal range 8.5-10.2 mg/dL). The mean of the serum Phosphorus levels was 2.08 ± 0.65 mg/dL (normal range 2.4 - 4.1 mg/dL). On statistical analysis by Karl Pearson's correlation coefficient method, we found that both calcium and phosphorus levels in our subjects were positively associated with 25(OH) D_3 levels. For Calcium, the Pearson's correlation coefficient value 'r' was 0.6951, $p<0.001$. For Phosphorus, the value of 'r' was 0.6211, $p<0.001$ (Figures 1 and 2). The serum levels of Alkaline phosphatase and Parathyroid hormone in our subjects, were found to be significantly elevated than the normal population values (Table 3). The mean of the Alkaline phosphatase levels in our subjects was 186.60 ± 88.12 IU/L (normal range 44-147 IU/L). The mean of the Parathyroid hormone levels in our subjects was 121.13 ± 55.46 pg/mL (normal range 10-55 pg/mL). The levels of both these parameters were found to be negatively associated with the corresponding levels of 25 (OH) D_3. For Alkaline phosphatase, the Pearson's correlation coefficient value 'r' was –0.4086, $p<0.001$. For Parathyroid hormone, the value of 'r' was –0.7856, $p<0.001$ (Figures 3 and 4).

Table1

Baseline characteristics of pregnant women (n=148)

S No	Characteristic	Range	Mean ± SD
1	Age (years)	18 - 42	29.45 ± 7.97
2	BMI (Weight in kg / Height in metres^2)	16.4 - 34.0	24.16 ± 5.63
3	Gestational age at the time of sampling (weeks)	3 - 34	16.47 ± 8.32

Table 2

Serum levels of 25(OH)D, in the study subjects (n=148)

S.No	Vitamin D Categories, as per IOM guidelines 1997	Range of serum levels (ng/mL)	No. of patients n=148 (%)
1	Sufficiency	>30	8 (5.4 %)
2	Insufficiency	21-30	46 (33.1%)
3	Deficiency	<20	79 (53.4%)
4	Severe deficiency	<10	14 (9.4%)

Table 3
The association of Ca, P, ALP and PTH with 25 (OH) D levels

S.No	Variables	Mean±Std. Deviation	Normal range	Pearson Correlation coefficient (r value)	p value
1	Calcium	7.5±1.04	8.5-10.2 mg/dL	0.6951	<0.001*
2	Phosphorus	2.08±0.65	2.4-4.1 mg/dL	0.6211	<0.001*
3	Alkaline phosphatase	186.60±68.12	44-147 IU/L	-0.4086	<0.001*
4	Parathyroid hormone	121.13±55.46	10-55 pg/mL	-0.7856	<0.001*

Association exists at 0.05 level of significance

Figure 1
Positive correlation of calcium with vitamin D level in pregnant women (n=148)

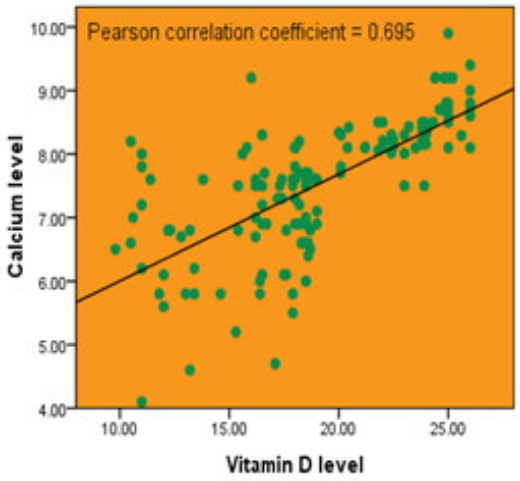


Figure2
Positive correlation of calcium with vitamin D level in pregnant women (n=148)

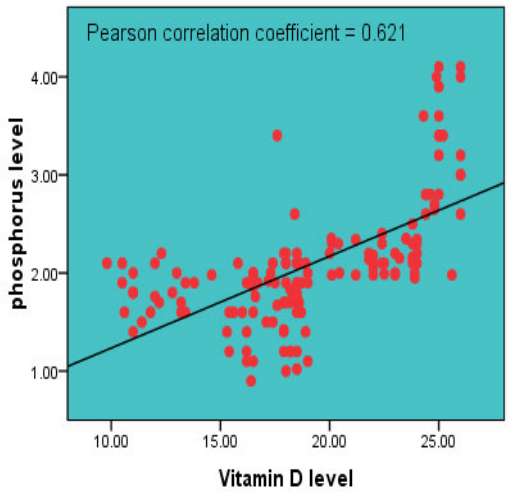


Figure 3
Negative correlation of alkaline phosphatase and parathyroid hormone with vitamin D levels (n=148)

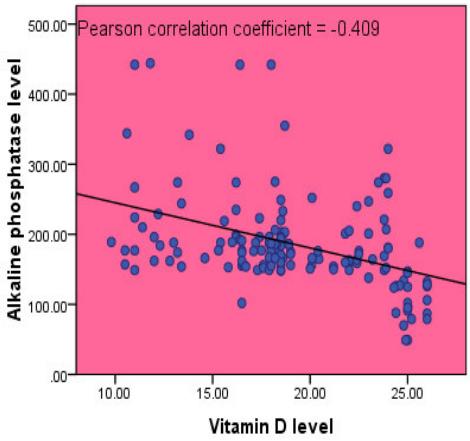
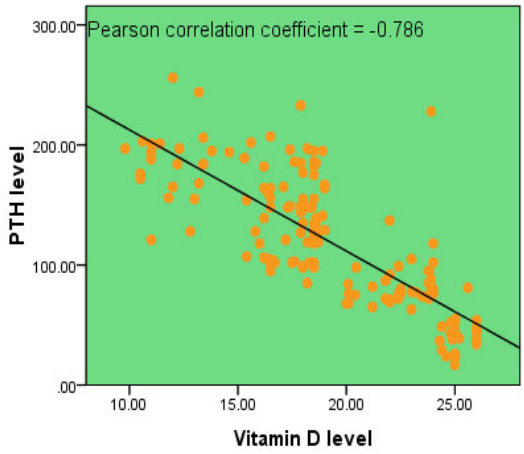


Figure 4
Negative correlation of alkaline phosphatase and parathyroid hormone with vitamin D levels (n=148)



DISCUSSION

In our study, we ascertained the serum levels of 25(OH)D_3, Calcium, Phosphorus, Alkaline phosphatase and Parathyroid hormone in pregnant women in a tertiary level hospital in Potheri, Tamilnadu state in South India. Humans get vitamin D (cholecalciferol) from exposure to sunlight, from diet and from dietary supplements. Ninety percent of vitamin D is formed in the skin through the action of the sun. It interacts with specific receptors in the intestine and in the bones and regulates the serum calcium levels and the normal development of a healthy skeleton[9]. During pregnancy, vitamin D is transported from mother to foetus through the placenta. Maternal vitamin D deficiency is mirrored by neonatal vitamin D deficiency. Vitamin D status during pregnancy appears to play a role in foetal skeletal development, tooth enamel formation, and general foetal growth and development. Globally, there are several reports of vitamin D deficiency among pregnant women. Among pregnant women, 18% in the United kingdom, 25% in the United Arab Emirates, 80% in Iran, 42% in Northern India, 61% in New Zealand, 89.5% in Japan, and 60–84% of non-western women in Netherlands had serum 25(OH)D concentrations of less than 10 ng/mL (25 nmol/L) [10]. In South India, in a recent study of hospital patients of all ages in Mangalore city in South India, Nandini *et al.,* found the overall prevalence of vitamin D deficiency to be 60% [11]. This study was a retrospective one and

included 711 patients who had their of vitamin D levels checked in the previous six months. In another chart study of one hundred third trimester pregnant women in Porur, Tamilnadu state, using Chemiluminescence (CLIA) method, the vitamin D levels of less than 20 ng/mL were found in 97 subjects (97%)[12]. In both these studies, being an expensive test, vitamin D estimation would have been ordered only for selected patients. Hence, the possibility of a selection bias exists. On the contrary, our study is a prospective one, consisting of unselected pregnant women, of all trimesters. Additionally it is noteworthy that our study indicates that the deficiency spans all the trimesters. The most alarming finding in our study is the unexpectedly high prevalence of vitamin D deficiency among pregnant women i.e. 94.6 percent. In our study, we found there is a positive association between the 25 (OH)D levels and serum Calcium levels. Such a positive association is seen in our study, in respect to Phosphorus, also. Similarly, many studies have reported that vitamin D inversely related to parathyroid hormone [10]. Our study also shows the same negative correlation of vitamin D with parathyroid hormone. In our study, we found that alkaline phosphatise also shares the same negative correlation with 25 (OH) D. Several global studies report that women- including pregnant women, with a BMI greater than 30, are at increased risk of vitamin D deficiency. The adipose tissue serves as a repository for vitamin D and, to that extent, does not allow the vitamin D to get into the blood circulation [10]. Hence, we should expect the 25 (OH) D levels to be low, in subjects with high BMI. However, in our study subjects, we did not find any association between vitamin D levels and the body mass index.

CONCLUSION

Our study found that only 5.4 percent of pregnant women have sufficient levels of 25(OH) D. The rest have reduced levels of vitamin D. There is increasing evidence that vitamin D fortification or supplementation has a low risk of toxicity and is cost-effective. Public health initiative is necessary.

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CONFLICT OF INTEREST

No conflict of interest.

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