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Original Article

Prevalence of Vitamin D Deficiency in Term Gestation Women and Its Feto-Maternal Outcome

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ABSTRACT

Background: Vitamin D is essential for calcium metabolism, placental function, and fetal skeletal development. Despite adequate sunlight, vitamin D deficiency is highly prevalent among pregnant women in India and has been associated with adverse maternal and neonatal outcomes.
Aim: To determine the prevalence of vitamin D deficiency in term gestation women and its association with feto-maternal outcomes.
Methods: This prospective observational study was conducted at a tertiary care hospital in Telangana over 18 months. A total of 107 antenatal women with gestational age ≥37 weeks were included. Serum vitamin D levels were estimated and categorized as deficient (<20 ng/ml), insufficient (20–30 ng/ml), and sufficient (>30 ng/ml). Maternal outcomes and neonatal parameters were recorded and analyzed.
Results: Vitamin D deficiency or insufficiency was observed in 79.4% of participants. Deficiency was significantly associated with gestational diabetes mellitus, hypertensive disorders of pregnancy, and increased cesarean section rates ($p<0.001$). Low birth weight was significantly more common among infants born to vitamin D deficient mothers ($p<0.001$).
Conclusion: Vitamin D deficiency is highly prevalent among term pregnant women and is significantly associated with adverse maternal and neonatal outcomes. Routine screening and supplementation during pregnancy may help improve feto-maternal health.

Keywords: *Gestational diabetes; Hypertensive disorders; Low birth weight; Feto-maternal outcome.*

INTRODUCTION

Vitamin D, also known as calciferol, is a group of fat-soluble secosteroids that play a fundamental role in the absorption of essential minerals like calcium, magnesium, and phosphate [1]. Beyond these well-established roles, vitamin D is crucial for supporting pregnancy, underscoring its extensive and pleiotropic functions [1,2]. It is indispensable for supporting the rapid fetal skeletal development that occurs during gestation, as well as facilitating overall fetal growth and development. Vitamin D actively participates in regulating a diverse range of biological processes, including immune function, cellular growth and differentiation, neuromuscular function, and the intricate processes involved in placental function [1]. The placenta, which serves as the lifeline between mother and fetus, relies on adequate vitamin D levels to ensure efficient nutrient and oxygen supply to the developing infant. Scientific evidence suggests that neonatal vitamin D levels are directly and substantially influenced by maternal vitamin D status, implying the critical importance of ensuring sufficient vitamin D levels in expectant mothers [3].

An increasing body of evidence links vitamin D deficiency during pregnancy to a range of adverse maternal and fetal outcomes, including serious complications such as preeclampsia, gestational diabetes mellitus (GDM), preterm labor (before 37 weeks of gestation), and the birth of infants with low birth weight (LBW), which is associated with increased risks of infant morbidity and mortality [4]. Maternal vitamin D deficiency has been implicated in the abnormal fetal skeletal homeostasis, congenital rickets, and even an elevated risk of fractures in newborns. The profound and potentially long-lasting consequences of maternal vitamin D deficiency hint at the critical need for further research to determine the

optimal vitamin D levels during pregnancy and to rigorously evaluate the effectiveness of vitamin D supplementation strategies in improving both maternal and fetal health outcomes [4]. In the Indian context, the situation is particularly concerning due to factors such as limited sun exposure, dietary restrictions, and urbanization, leading to a high prevalence of vitamin D deficiency among pregnant women. Dietary calcium intake is often low in India, further exacerbating the problem, as vitamin D and calcium are crucial for bone health and fetal development In term gestations (above 37 weeks), vitamin D deficiency can have profound effects on both maternal and fetal health. Maternal outcomes include increased risks of cesarean delivery, gestational diabetes, and preeclampsia, while neonatal outcomes encompass LBW, SGA, and potential long-term developmental delays [4] The rationale for this study came from the need to understand the prevalence of vitamin D deficiency in term gestation women and its impact on feto-maternal outcomes in the Indian context. Despite the growing body of evidence linking vitamin D deficiency to adverse pregnancy outcomes, there remains a paucity of comprehensive studies focusing specifically on term gestations in India. This study aims to bridge this knowledge gap by investigating the prevalence of vitamin D deficiency and its association with maternal and neonatal outcomes in term gestations. By addressing the knowledge gap and highlighting the need for targeted interventions, this research can inform strategies to improve pregnancy outcomes and reduce the burden of vitamin D deficiency in India.

AIM AND OBJECTIVES

Aim: To study the occurrence of vitamin D deficiency in antenatal women and its feto-maternal outcomes.

Objectives:

- To assess the levels of vitamin D in antenatal women
- To determine the effects of vitamin D deficiency on maternal outcomes
- To determine the effects of vitamin D deficiency on fetal outcomes

METHODS & MATERIALS

This is a prospective observational study conducted in the outpatient wing of the Department of Obstetrics and Gynaecology in a government tertiary care teaching hospital in Telangana, a southern state of India, done over a period of 18 months from June-2023 to December 2024. All antenatal women with gestation above 37 weeks, presenting to the Obstetrics and Gynecology out-patient department and who gave informed consent were included in the study. Those excluded were women with multiple gestation, women with chronic renal disease, women with liver disease, women on anti-epileptics or anti-tubercular drugs, women with albinism, women with endocrinopathies affecting vitamin D metabolism. The required sample size for this study was determined using the formula: $\mathbf{n= Z^2pq/d^2,}$ where, Z = 1.96 (Z-score at 95% confidence interval) p =79 (prevalence of vitamin D deficiency in a previous study), q = (100-p) = 21,d = relative error = 10% of p, n = (1.96 x 1.96 x 79 x 21) / (7.9 x 7.9)= **107.**

Vitamin D levels were estimated from venous samples taken from the study subjects. Levels < 30 ng/ml were considered to be insufficient, and those < 20 ng/ml were categorized under vitamin D deficiency. The women were then followed up in each consequent visit for any complications (pre-eclampsia, gestational diabetes, etc.) and in each visit their vitals and hematological investigations were recorded. Fetal outcomes like birth weight, APGAR scores, need for admission to NICU, etc. were also recorded.

RESULTS

Age distribution: The mean age of the women was 26.33 ± 3.63 years. The age distribution among the study subjects followed a near normal distribution with majority of them aged between 24 and 28 years.

Rural vs Urban: Majority of the study subjects were from rural areas (64, 59.8%) followed by urban areas (43, 40.2%).

Literacy: Nearly 92.5% of the study subjects were literate while only 7.5% were illiterate.

Diet: Most of the study subjects reported taking a mixed diet (74, 69.2%) while only 33 (30.8%) consumed vegetarian diet.

GESTATIONAL DIABETES was present in 13 (12.1%) subjects.

HYPERTENSION: About 21 (19.6%) study subjects had hypertension in pregnancy

Among those who had hypertensive disorders of pregnancy, 11 were diagnosed with pre-eclampsia, 7 had gestational hypertension and 3 had eclampsia.

WEIGHT GAIN IN PREGNANCY

Majority of the study subjects reported 5 – 10 kg of weight gain in pregnancy (74, 69.2%) followed by <5 kg (18, 16.8%) and >10 kg (15, 14%).

Level of serum Vitamin D

Majority of the study subjects had insufficient levels (20 to 30 ng/ml) of Vitamin D (68, 63.5%), while 17 (15.9%) showed gross deficiency (<20 ng/ml). Meanwhile, 22 (20.6%) study subjects had sufficient levels (>30 ng/ml) of Vitamin D. This suggests that the prevalence of vitamin D deficiency was nearly 80% among this study sample.

MODE OF DELIVERY

Nearly two-thirds (66, 61.7%) of the study subjects underwent caesarean section,while the remaining 41 (38.3%) had normal vaginal deliveries.

CLASSIFICATION OF BIRTH WEIGHT OF THE CHILD

Majority (82, 76.6%) of the babies born to the study subjects had a normal birth weight while 25 (23.4%) of the babies were born with low birth weight.

Table 1: Vitamin D levels versus type of Diet 90 (row percentages)

Diet	Serum Vit D			Total	Chi^2 test (p-value)
	<20	20-30	>30		
Vegetarian	7 (21.2%)	25 (75.7%)	1 (3.1%)	33	**<0.001**
Mixed	10 (13.5%)	43 (58.1%)	21 (28.3%)	74	
Total	17	68	22	107	

It was noted that 7 (21.2%) of the subjects taking vegetarian diet had serum Vitamin D < 20 ng/ml, as compared to 10 (13.5%) of the subjects taking mixed diet. Similarly, the proportion of subjects with serum Vitamin D between 20 to 30 ng/ml were higher among vegeterians (75.7%) as compared to those consuming a mixed diet (58%). This association between serum vitamin D levels and type of diet consumed by the study subjects was found to be statistically significant.

Table 2 : Vitamin D levels versus Parity

Parity	Serum Vit D			Total	Chi^2 test (p-value)
	<20	>30	20-30		
0	10	14	35	59	0.096
1	4	7	31	42	
2	3	1	2	[2]	
Total	17	22	68	107	

The proportions of study subjects with lower levels of serum Vitamin D were higher among multiparous women as compared to primiparous women. However, this association was not found to statistically significant.

Table 3: Vitamin D levels versus Weight gain in pregnancy

	n	Mean	SD	ANOVA (p-value)
<20	17	8.11	3.01	0.287
20-30	68	9.16	2.80	
>30	22	9.45	2.36	
Total	107	9.05	2.76	

The mean weight gain in pregnancy was highest among women with serum Vitamin D

>30 ng/ml, followed by women with serum Vitamin D between 20 to 30 ng/ml, and lowest among those with serum Vitamin D < 20 ng/ml. However, this association was not found to be statistically significant.

Table 4: Vitamin D levels versus Gestational Diabetes (column percentages)

Gestational Diabetes	Serum Vit D			Total	Chi^2 test (p-value)
	<20	20-30	>30		
Present	8 (61.5%)	3 (23.1%)	2 (15.4%)	13	**<0.001**
Absent	7 (7.4%)	67 (71.3%)	20 (21.3%)	94	
Total	17	68	22	107	

It was seen that higher proportions of women with gestational diabetes had lower ranges of serum vitamin D (61.5% had <20 ng/ml of serum vitamin D), as compared to those without gestational diabetes (7.4% had <20 ng/ml). This association was found to be statistically significant.

Table 5 : Vitamin D levels versus Hypertensive disorders of pregnancy (row percentages)

Hypertensive disorders of pregnancy	Serum Vit D				Chi2 test (p-value)
	<20	20-30	>30	Total	

Eclampsia	2 (66.7%)	1 (33.3%)	0 (0%)	3	**<0.001**
Pre-eclampsia	6 (54.5%)	3 (27.3%)	2 (18.2%)	11	
Gestational Hypertension	4 (57.2%)	3 (42.8%)	0 (0%)	7	
None	5 (5.8%)	61 (70.9%)	20 (23.3%)	86	
Total	17	68	22	107	

Distribution of the study subjects based on hypertensive disorders and their serum vitamin D levels showed higher proportions of women with eclampsia, pre-eclampsia and gestational hypertension having lower levels of serum vitamin D. This association was found to be statistically significant.

Table 6: Vitamin D levels versus mode of delivery (column percentages)

Mode of delivery	Serum Vit D			Total	Chi2 test (p-value)
	<20	20-30	>30		
LSCS	14 (82.4%)	45 (66.2%)	7 (31.8%)	66	**<0.001**
NVD	3 (17.6%)	23 (33.8%)	15 (68.2%)	41	
Total	17	68	22	107	

Higher proportions of women with lower levels of serum vitamin D underwent LSCS as compared to those with sufficient vitamin D. This association was found to be statistically significant.

Table 7 : Vitamin D levels versus birth weight of child (column percentages)

Birth weight category	Serum Vit D			Total	Chi2 test (p-value)
	<20	20-30	>30		
Low	14 (82.4%)	6 (8.8%)	5 (22.7%)	25	**<0.001**
Normal	3 (17.6%)	62 (91.2%)	17 (77.3%)	82	
Total	17	68	22	107	

Assessment of fetal outcomes showed that higher proportions of women with deficient or insufficient levels of serum vitamin D had low birth weight babies as compared to those with sufficient levels of serum vitamin D. This association was also found to be statistically significant.

DISCUSSION

Vitamin D deficiency during pregnancy has emerged as a significant public health concern worldwide, particularly in developing countries where nutritional deficiencies are prevalent. The present study aimed to investigate the prevalence of vitamin D deficiency among antenatal women at term (≥37 weeks gestation) and to evaluate its potential impact on maternal health and fetal outcomes.

The prevalence and implications of vitamin D deficiency observed in this study are consistent with findings from other regions. Globally, vitamin D deficiency in pregnancy ranges widely but is particularly high in South Asia, the Middle East, and parts of Africa. A meta-analysis encompassing multiple studies reported that vitamin D deficiency is associated with increased risks of preeclampsia, GDM, preterm birth, and LBW.

Regional studies in India have similarly documented deficiency rates exceeding 70% among pregnant women, emphasizing the need for public health interventions. The biological plausibility of vitamin D's role in pregnancy complications is supported by its involvement in placental development, immune tolerance, and calcium regulation.

Prevalence of Vitamin D Deficiency in Pregnancy

The present study revealed a notably high prevalence of vitamin D deficiency and insufficiency among pregnant women beyond 37 weeks gestation, with approximately 79.4% of participants exhibiting suboptimal vitamin D levels (deficient or insufficient). This finding is consistent with a growing body of evidence indicating that vitamin D deficiency during pregnancy is a widespread global health issue. A large-scale study from China [5]. reported that 57.1% of pregnant women were deficient, and 97.4% had insufficient vitamin D levels Similarly, Indian studies have documented alarmingly high deficiency rates: [6] found nearly 80% ofpregnant women deficient, [7] reported only about 13% had adequate vitamin D levels, and [8] observed deficiency in over 93% of third- trimester women. These consistent findings

across diverse populations underscore the critical need for increased awareness, screening, and intervention strategies to combat vitamin D deficiency during pregnancy **.**

Influence of Maternal Age and Sociodemographic Factors

In this study, no statistically significant relationship was observed between maternal vitamin D status and factors such as age, place of residence (rural vs. urban), literacy level, or employment status. This lack of association could be attributed to the relatively homogeneous sample or limited sample size. Comparable findings have been reported in some Indian cohorts where maternal age did not significantly influence vitamin D levels by [9]. However, other studies by [10] have suggested that urban dwelling and lower socioeconomic status may correlate with higher deficiency rates, potentially due to reduced sun exposure and dietary differences. The absence of significant sociodemographic correlations in the current study suggests that vitamin D deficiency transcends these variables and may be more universally prevalent among pregnant women in this region.

Dietary Patterns and Vitamin D Status

A significant association emerged between dietary habits and vitamin D deficiency, with vegetarian women exhibiting higher deficiency rates (21.2%) compared to those consuming mixed diets (13.5%). This aligns with the well-established understanding that vitamin D-rich foods are predominantly animal-based, including fish, eggs, and fortified dairy products, which vegetarians may consume less frequently. Indian studies have similarly reported that vegetarianism increases vulnerability to vitamin D deficiency [6 ,7]. This finding highlights diet as a critical, modifiable risk factor and suggests that nutritional counseling and supplementation strategies should be tailored to address dietary restrictions to improve maternal vitamin D status.

Vitamin D Deficiency and Gestational Diabetes Mellitus (GDM)

The study found a robust and statistically significant association between vitamin D deficiency and the presence of gestational diabetes mellitus. Specifically, 61.5% of women diagnosed with GDM were vitamin D deficient, compared to only 7.4% of non-diabetic women. This finding resonates strongly with prior research, including a meta-analysis [5], which demonstrated that vitamin D deficiency increases the risk of developing GDM. [7] also reported lower vitamin D levels among women with GDM. While some studies have shown inconsistent results, the preponderance of evidence supports the hypothesis that vitamin D plays a role in glucose metabolism and insulin sensitivity during pregnancy, making deficiency a potential contributor to GDM pathogenesis.

Association with Hypertensive Disorders of Pregnancy

Our findings indicate a significant correlation between vitamin D deficiency and hypertensive disorders in pregnancy, including pre-eclampsia and eclampsia. This is consistent with multiple studies that have documented higher rates of vitamin D deficiency in women suffering from these conditions [6,7] However, some intervention trials, such as [10], have not demonstrated clear benefits of vitamin D supplementation in reducing hypertensive complications, indicating that while deficiency is associated with these disorders, the therapeutic implications require further investigation.

Impact on Mode of Delivery

The current study observed a significantly higher rate of cesarean section deliveries among vitamin D deficient women (82.4%) compared to those with sufficient vitamin D levels (31.8%). This observation aligns with findings from [6,7], that suggest low vitamin D status may be linked to increased cesarean delivery rates. The underlying mechanisms could involve vitamin D's role in muscle function and labor progression. Nonetheless, some studies have reported inconsistent results regarding the effect of vitamin D supplementation on cesarean rates, implying that other confounding factors may contribute to this association [10]

Impact of Maternal Vitamin D Levels on Neonatal Birth Weight

A striking association was found between maternal vitamin D deficiency and low birth weight (LBW) infants, with 82.4% of LBW babies born to mothers with deficient vitamin D status. This relationship is well-documented in the literature.[6] have reported significant links between low maternal vitamin D and adverse fetal growth outcomes, including small-for-gestational-age infants. Additionally [11] highlighted increased neonatal intensive care admissions among infants born to vitamin D deficient mothers. However, some studies like [9] found no significant differences in birth weight, suggesting that population differences, timing, and severity of deficiency may modulate these outcomes.

Other Maternal and Neonatal Outcomes

No significant associations were identified between vitamin D levels and parity, maternal weight gain, or preterm labor in the current study. This is consistent with some reports [9]), whereas other research, including studies by [12], demonstrated that severe vitamin D deficiency could increase risks of preterm birth and neonatal complications such as respiratory distress and sepsis. These discrepancies may be due to differences in study populations, definitions of deficiency, or sample sizes. It is plausible that the severity and timing of vitamin D deficiency during pregnancy critically influence these outcomes.

The findings of this study reinforce the critical public health concern of vitamin D deficiency among pregnant women

and its association with adverse maternal and neonatal outcomes. The strong links observed between vitamin D deficiency and gestational diabetes, hypertensive disorders, cesarean delivery, and low birth weight are supported by a robust body of international and Indian research. While some associations with other outcomes remain inconclusive, the overall evidence underscores the importance of routine screening for vitamin D deficiency during pregnancy and the implementation of targeted nutritional interventions. Addressing dietary habits, particularly among vegetarians, and considering supplementation strategies could substantially improve pregnancy outcomes and neonatal health. Future research should focus on elucidating the causal pathways and evaluating the efficacy of vitamin D supplementation in reducing pregnancy complications.

LIMITATIONS OF THE STUDY:

The study has a few limitations too. The relatively small sample size limits the ability to perform detailed subgroup analyses and adjust for potential confounders. Vitamin D levels were measured only once, preventing assessment of temporal changes during pregnancy. The study did not capture data on vitamin D supplementation, sun exposure, or dietary intake, which are important determinants of vitamin D status. The single-center setting may limit generalizability to other populations.

CONCLUSIONS

- Vitamin D deficiency and insufficiency are highly prevalent among term pregnant women, affecting nearly 80% of the study population.
- Low vitamin D levels may be linked to increased incidence of maternal complications such as hypertensive disorders (including preeclampsia and eclampsia) and gestational diabetes.
- Maternal vitamin D deficiency is associated with adverse fetal outcomes, including a higher proportion of low birth weight infants and increased cesarean section rates.
- Routine screening for vitamin D status during pregnancy is essential to identify and manage deficiency early.
- Vitamin D supplementation could potentially reduce the risk of pregnancy-related complications and improve neonatal health, though further research is needed to establish definitive guidelines.

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