Section: Obstetric and Gynaecology

Original Research Article

ASSESSING THE CORRELATION BETWEEN MATERNAL SERUM VITAMIN D LEVELS AND THE INCIDENCE OF PRETERM VERSUS TERM DELIVERIES IN LOW-RISK PREGNANCIES

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ABSTRACT

Background: Vitamin D deficiency is traditionally associated with conditions such as rickets and osteomalacia, but the clinical spectrum of hypovitaminosis D extends beyond bone health. It is increasingly linked to a heightened risk of preeclampsia, gestational diabetes, and preterm labor. Preterm labor is defined as the onset of labor before 37 completed weeks of gestation (259 days), counting from the first day of the last menstrual period. Preterm birth is the leading cause of perinatal morbidity and mortality, with significant impacts on maternal health and the emotional and socioeconomic well-being of families. This study aims to evaluate maternal vitamin D status and its association with preterm delivery. **Objective:** To assess whether there is an association between low serum vitamin D levels and preterm delivery.

Materials and Methods: This case control study was done among patients admitted in hospitals attached to Bangalore Medical College and Research Institute with the approval from the institutional ethical committee. Duration of study was February 2021 to August 2022.

Results: In the current analysis controlling for age, parity, level of education, religion, booking status and skin color as confounding variables, women with low vitamin D levels had an approximately higher likelihood of preterm delivery as compared with women with normal vitamin D levels It was also observed that 13% of babies born to vitamin D deficient mothers required NICU admission and 4% babies born to vitamin D deficient mothers were still born. There was also no association between maternal vitamin levels and age, parity, gestational age, booking status, clothing or skin colour.

Conclusion: Preterm births were associated with higher rates of serum 25-hydroxyvitamin D deficiency than term births. To lessen this unfavourable pregnancy outcome, it is crucial for women to have optimal serum vitamin D levels during pregnancy. To further confirm the contribution of standard prenatal vitamin D supplementation in enhancing maternal and perinatal outcomes, including preterm birth, a sizable, well-designed, multicenter, randomised control trial is needed.

Keywords: Parturients, Preterm, Term deliveries, Correlation, Maternal Serum Vitamin D3 Levels.

INTRODUCTION

Despite the availability of ample sunlight in many areas, vitamin D deficiency remains prevalent. Several factors contribute to this issue, even in regions with adequate sun exposure. Shifts in dietary habits have led to reduced calcium and vitamin D intake, while diets high in phosphates and phytates increase calcium demands and deplete vitamin D stores. Additionally, genetic factors, such as increased activity of 25(OH)D-24-hydroxylase, which converts 25(OH)D into inactive forms, and variations in the Vitamin D binding protein, can influence how serum 25(OH)D levels respond to supplementation.

Modern lifestyles, particularly in urban areas, result in more time spent indoors, reducing sun exposure. This is especially notable in American cities where children and adults alike spend peak vitamin D production hours (10 AM to 3 PM) inside. Increased pollution further impairs the skin's ability to synthesize vitamin D. Moreover, cultural practices such as wearing sun-protective clothing or using sunscreen with a high SPF, which blocks UV-B rays more effectively than UV-A rays, can reduce vitamin D synthesis by up to 95-98%. Women with poor nutrition, coupled with frequent or closely spaced pregnancies, are also at greater risk of deficiency, which can impact both maternal and fetal health.

Since vitamin D crosses the placenta and is often low in breast milk, even with sufficient maternal intake, this study seeks to explore the relationship between low maternal serum vitamin D levels and preterm birth outcomes by comparing women who have experienced preterm deliveries to those with full-term deliveries.

MATERIAL AND METHODS

This study was carried out at Department of obstetrics and gynecology, Vanivilas hospital and Gosha hospital attached to BMCRI, Bangalore.100 pregnant women fulfilling the inclusion and exclusion criteria were included in the study. Ethical approval of study was taken from the institutional ethical committee. Duration of study was February 2021 to August 2022

Inclusion Criteria

1. Patients willing to give informed written consent. (Annexure 1)
2. Case-preterm delivery control-term delivery
3. Women with singleton gestation
4. Women with >28weeks of gestation
5. No known comorbidities
6. No habits of smoking / alcohol

Exclusion Criteria

1. Patients not willing to give informed consent.
2. Women with less than 28 week of gestation.
3. Women with previous preterm delivery
4. Women with multifetal gestation
5. Known medical condition before or during pregnancy
6. Women with uterine anomalies
7. Women with smoking/ alcohol habits/ drug abuse

Sample Size

The sample size was estimated on the basis of previous studies,[7,8] conducted by Oluwole et al,

$$N = \frac{(Z\alpha\text{-}Z1\text{-}\beta)^2\,[P1(100\text{-}P_1) + P_2\,(100\text{-}P_2)]}{d^2}$$

$$= \frac{(1.96+0.84)^2\,(1787.11+465.99)}{(13)^2}$$

$= 51.19$

Therefore the sample size is calculated to be 50 in each group would be required to ensure at least 80% power to detect the anticipated between-group differences, allowing for an attrition or non-response rate of 10%.

Methodology

the patients fulfilling the inclusion criteria will be enrolled for the study after obtaining informed consent. Case record form with follow up chart will be filled for each.

Procedure of study

1. A structured interviewer-administered questionnaire will be used for data collection.
2. Gestational age will be based on the participants' last normal menstrual period, and confirmed or modified by a first- or early second-trimester ultrasound.
3. Maternal socio demographic data and characteristics such as skin color and clothing type among others will be obtained at presentation and from medical records
4. Thorough clinical examination including General Physical Examination, vitals, systemic examination will be done
5. Patients routine investigations such as CBC, RBS, USG etc will be collected
6. A venous blood sample will be collected immediately after delivery and sent to the laboratory
7. The samples will then be centrifuged, and the serum will stored at −20oC until analysis. The level of total 25-hydroxyvitamin D in each serum sample was measured by using a CLIA (Chemiluminiscent immunoassay).
8. Vitamin D levels obtained. Low serum vitamin D will be defined as a level below 30 ng/mL.

Since the sample size was 100, normality was checked using Kolmogorov-Smirnov test. Kolmogorov-Smirnov test showed $p < 0.05$ and > 0.05 for some variables. Hence both parametric tests and non-parametric tests were used in the study.

RESULTS

The mean age of women was 24.32 ± 3.88 years for those with preterm delivery 24.30 ± 3.9 years for those with term delivery (P=0.980). There was no significant difference in parity (P=0.841), BMI (P=0.104), religion (P=0.86), booking status (P=1), skin color (P=0.361) or dressing style (P=0.841) between the preterm and term groups.

There were, however, significant differences in vitamin D levels (P<0.001), NICU admission and stillbirth between the two groups of parturients. [Table 3]

Overall, 85 (85%) of the 100 study women had vitamin D deficiency. 49 (49%) women with preterm delivery had low serum vitamin D level as compared with 36 (36%) women with term delivery (P<0.001). [Table 4]

Table 1: Distribution according to frequency

Frequency distribution		
	Frequency	**Percent**
Case	50	50.0
Control	50	50.0
Total	**100**	**100.0**

Table 2: Distribution according to age

Mean age distribution				
	N	**Mean**	**SD**	**SE**
Case	50	24.30	3.934	0.556
Control	50	24.32	3.883	0.549

Table 3: Distribution according to booking status

Group		Booking status		Total	P-value
		Booked	**Unbooked**		
Case	**Count**	26	24	**50**	**1**
	%	48.0%	52.0%	**50.0%**	
Control	**Count**	26	24	**50**	
	%	48.0%	52.0%	**50.0%**	
Total	**Count**	**52**	**48**	**100**	
	%	**100.0%**	**100.0%**	**100.0%**	

Table 4: Distribution according of vitamin D levels

Group		Age category		Total	P-value
		< 35yrs	**> 35yrs**		
Case	**Count**	49	1	**50**	**1**
	%	98.0%	2.0%	**50.0%**	
Control	**Count**	49	1	**50**	
	%	98.0%	2.0%	**50.0%**	
Total	**Count**	98	2	**100**	
	%	100.0%	100.0%	**100.0%**	

Table 5: Binary Logistic regression between various characteristics and preterm delivery

Binary Logistic regression between various characteristics and preterm delivery				
Characteristic		**B**	**P-value**	**AOR with 95% CI**
Maternal age	< 35yrs[a]	**-1.224**	**0.925**	0.294
	>35yrs			
Parity	Primi[a]	**-0.076**	**0.931**	0.927 (0.169 – 5.091)
	Multi			
Religion	Hindu[a]		**0.917**	-
	Muslim	**-0.495**	**0.860**	0.609 (0.002 – 148.85)
	Christian	**-0.825**	**0.769**	0.438 (0.002 – 108.05)
Booking status	Booked[a]			1.313 (0.240 – 7.166)
	Unbooked	**0.272**	**0.753**	
Skin colour	Light[a]			0.391 (0.052 – 2.936)
	Dark	**-0.939**	**0.361**	
Vit D levels	< 30ng/ml[a]			0.303 (0.014 – 6.364)
	≥ 30ng/ml	**-1.193**	**0.0001***	

DISCUSSION

In this study, the overall prevalence of vitamin D deficiency was found to be 85%, which is nearly three times higher than the 29% reported in a similar prospective study conducted in Lagos. The participants in both studies were mostly less educated and likely to consume diets deficient in vitamin D and other nutrients, especially when compared to women who delivered outside healthcare facilities. Research from the United States and China has also shown high rates of vitamin D deficiency, with prevalence rates of 70% and 50%, respectively. Studies have consistently shown that serum 25-hydroxy vitamin D deficiency is more common in women with darker skin tones compared to those with lighter skin. This is because melanin in darker skin provides protection from ultraviolet B radiation, which reduces vitamin D synthesis. The results of the present study may differ from other studies due to the fact that it was conducted in India, where many women wear full-coverage clothing, limiting their exposure to sunlight, the main natural source of vitamin D.

This study also found that vitamin D deficiency was more common among women who experienced preterm delivery compared to those who had term deliveries. This finding is consistent with a previous meta-analysis, which concluded that vitamin D deficiency is a significant risk factor for preterm birth. Several other studies comparing preterm and term deliveries have also noted a higher prevalence of vitamin D deficiency in women with preterm births. However, some research, such as studies by Gbadegesin in Lagos, Nigeria, and Yang in Guangdong, China, did not find a clear association between vitamin D deficiency and pregnancy complications, including preterm delivery.

There are some limitations to this study. While it aligns with previous research showing a greater prevalence of vitamin D deficiency in preterm births, the study design does not allow for a definitive cause-and-effect relationship to be established. Another limitation was the challenge of obtaining reliable information from participants regarding their consumption of vitamin D-rich foods, which may have influenced the observed associations. Additionally, the small sample size limits the statistical power of the study.

Despite these limitations, the study confirmed that vitamin D deficiency was more prevalent among women who experienced preterm deliveries. It is therefore important for pregnant women to maintain optimal vitamin D levels to reduce the risk of preterm birth. However, further research in the form of large, well-designed, multicenter randomized controlled trials is needed to better understand the role of routine prenatal vitamin D supplementation in improving maternal and perinatal outcomes, including the prevention of preterm births.

CONCLUSION

The mean age of women in the preterm and term delivery groups was similar, with 24.32 ± 3.88 years for those with preterm deliveries and 24.30 ± 3.9 years for those with term deliveries (P=0.980). There were no significant differences between the two groups in terms of parity (P=0.841), BMI (P=0.104), religion (P=0.86), booking status (P=1), skin color (P=0.361), or clothing style (P=0.841). However, significant differences were observed in vitamin D levels (P<0.001), NICU admissions, and stillbirth rates between the preterm and term groups.
Overall, 85% of the women in the study were vitamin D deficient. Among the women who delivered preterm, 49% had low serum vitamin D levels, compared to 36% of women who delivered at term (P<0.001). After adjusting for confounding factors such as age, parity, education level, religion, booking status, and skin color, women with low vitamin D levels were found to have a significantly higher likelihood of preterm delivery. Additionally, NICU admissions and stillbirths were more common in preterm infants.
In conclusion, preterm births were associated with higher rates of serum 25-hydroxyvitamin D deficiency compared to term births. Ensuring optimal vitamin D levels during pregnancy is crucial for reducing the risk of adverse outcomes such as preterm birth. To further validate the benefits of prenatal vitamin D supplementation, especially in improving maternal and perinatal outcomes, large, multicenter, randomized controlled trials are needed.

REFERENCES

1. Khadilkar AV.VitaminD deficiency in Indian Adolescents.Indian Paediatr 2010;4 7:756-57.
2. Awumey EM, MitraDA, Hollis BW,etal.Vitamin D metabolism is altered in Asian Indians in the southern United states: a clinical research center study.J Clin Endocrinol Metab1998;83:169-73.
3. Fu L,Yun F, Oczak M, et al. Common genetic variants of the vitamin D binding protein(DBP)predict differences in response of serum25-hydroxyvitami nD[25(OH)]to vitamin D supplementation.Clin Biochem2009;42:1174-7.
4. Babu S, Calvo S. Modern India and the vitamin D dilemma: evidence for the need of a national food fortification program.MolNutrFood Res2010;54:1134-47.
5. DelucaHF. Overview of general physiologic features and functions of vitamin D. AMJ Clin Nutr2004; 80:1689s-1696s.
6. Nibbelink KA et al: 1,25 (OH)2-vitamin D3 actions on cell proliferation, size, geneexpression, andreceptorlocalization, intheHL-1cardiacmy ocyte, JSteriodBiochem Mol Biol2007;103:533-537.
7. Thota C, Menon R, Fortunato SJ et al. 1,25-Dihydroxyvitamin D deficiency is associated with preterm birth in African American and Caucasian women. Reprod Sci. 2014 Feb;21(2):244-50.
8. Zhu, T., Liu, T. J., Ge, X., et al (2015). High prevalence of maternal vitamin D deficiency in preterm births in northeast China, Shenyang. International journal of clinical and experimental pathology, 8(2), 1459–1465
9. Flood-Nichols SK, Tinnemore D, Huang RR, Napolitano PG, Ippolito DL. Vitamin D deficiency in early pregnancy. PLoS One 2015;10(4): e0123763.
10. Al-Waria H, Abo-Ouf N. Prevalence of vitamin D deficiency in mother-infant pairs in a tertiary hospital in the west coast of Saudi Arabia. J clin Neonatol 2016; 5: 243–246
11. Merewood A, Mehta SD, Grossman X, Chen TC, Mathieu JS, Holick MF, Bauchner H. Widespread vitamin D deficiency in Urban Massachusetts newborns and their mothers. Paediatrics 2010; 125(4): 640–647
12. Deluca H Overview of general physiologic features and function of vitamin D. Am J. Clin Nutria 2004; 80: 1689–96
13. Saigal, Saroj; Doyle, Lex W. An overview of mortality and sequelae of preterm birth from infancy to adulthood. The Lancet, Volume 371, Issue 9608, 19–25 January 2008, Pages 261– 269.
14. Holick MF. Sunlight and vitamin D for bone health and prevention of autoimmune disease, cancer and cardiovascular disease. Am J. Clin Nutri 2004; 80(6): 1678–1688.