Biomedical and Biopharmaceutical Research
Abbreviation: Biomed. Biopharm. Res.
Volume: 22: Issue: 02 |Year: 2025
Page Number: 476-480

Association Between Maternal Vitamin D Deficiency and Low Birth Weight Neonates

Dr. Saswati Sanyal Choudhury[1], Dr. Gitanjali Deka[1], Dr. G. Lansinlu Rongmei[1]
Department of Obstetrics and Gynaecology, Gauhati Medical College and Hospital, Guwahati, Assam

Corresponding Authors
Dr. Saswati Sanyal Choudhury
Dr. Gitanjali Deka
Dr. G. Lansinlu Rongmei
Department of Obstetrics and Gynaecology, Gauhati Medical College and Hospital, Guwahati, Assam

Article Received:29-06-2025

Article Accepted:20-07-2025

ABSTRACT

Background: Vitamin D is essential for calcium homeostasis, fetal skeletal development, and immune modulation during pregnancy. Deficiency in maternal vitamin D is increasingly associated with adverse perinatal outcomes, notably low birth weight (LBW). This study investigates the relationship between maternal and cord blood vitamin D levels and neonatal birth weight among term pregnancies.

Methods: This cross-sectional observational study was carried out at Gauhati Medical College and Hospital between March 2024 and March 2025. A total of 140 term pregnant women were enrolled and divided into two groups: 70 cases (neonates <2.5 kg) and 70 controls (neonates ≥2.5 kg). Maternal and umbilical cord blood samples were analyzed for 25-hydroxyvitamin D using enzyme immunoassay. Statistical analyses were performed using SPSS version 26.

Results:

Among 140 term pregnant women, 70 delivered low birth weight (LBW) neonates (<2.5 kg) and 70 delivered normal birth weight neonates (≥2.5 kg). The mean maternal serum vitamin D3 level was significantly lower in the LBW group (25.53 ± 12.34 ng/mL) compared to controls (34.13 ± 15.84 ng/mL, $p < 0.0001$). Vitamin D deficiency (<20 ng/mL) was more prevalent among mothers of LBW neonates (41.4%) versus controls (27.1%, $p = 0.001$). Similarly, foetal cord blood vitamin D3 deficiency was significantly higher in the LBW group (77.1%) compared to controls (41.4%, $p = 0.003$). Maternal age and parity showed no significant difference between the groups.

Conclusion: The study demonstrates a clear association between maternal vitamin D deficiency and low birth weight in term neonates. Regular screening and correction of vitamin D deficiency in pregnant women may play a crucial role in improving neonatal outcomes.

Keywords: Vitamin D, Low Birth Weight, Maternal Deficiency, Neonatal Health, Cord Blood.

INTRODUCTION

Vitamin D, a fat-soluble vitamin primarily obtained through sunlight exposure and to a lesser extent from dietary sources, plays a pivotal role in calcium and phosphorus metabolism, bone mineralization, and immune function. During pregnancy, its significance increases due to its influence on placental function, fetal skeletal development, and regulation of inflammatory processes. Adequate maternal vitamin D levels are crucial for optimal fetal growth and pregnancy outcomes.

Despite India's tropical geography and ample sunlight, vitamin D deficiency (VDD) is widespread among pregnant women. Factors contributing to this paradox include limited sun exposure due to cultural clothing practices, indoor lifestyles, skin pigmentation, and poor dietary intake of vitamin D-rich foods. Studies indicate that up to 70–90% of Indian pregnant women may have suboptimal vitamin D levels.

Low birth weight (LBW), defined as a birth weight less than 2,500 grams, is a major determinant of neonatal morbidity, mortality, and long-term developmental complications. In India, LBW remains a significant public health concern, affecting approximately 18–20% of all live births. The etiology of LBW is multifactorial, with nutritional status—including micronutrient deficiencies—being a critical component.

Emerging research suggests a strong association between maternal VDD and adverse neonatal outcomes such as LBW, preterm birth, and intrauterine growth restriction (IUGR). However, data from Indian populations, especially in the northeastern region, remain limited. This study aims to assess the association between maternal vitamin D levels and neonatal birth weight in term pregnancies by analyzing both maternal and cord blood samples. The findings may help guide clinical practice and inform policy regarding maternal nutrition and perinatal care.

MATERIALS AND METHODS

Study Design and Setting

This hospital-based, cross-sectional observational study was conducted in the Department of Obstetrics and Gynaecology at Gauhati Medical College and Hospital, Guwahati, Assam, from March 2024 to March 2025.

Study Population

A total of 140 pregnant women with term singleton pregnancies (≥37 weeks of gestation) were enrolled and divided into two groups:

- **Cases**: 70 mothers who delivered neonates with birth weight <2.5 kg.
- **Controls**: 70 mothers who delivered neonates with birth weight ≥2.5 kg.

Inclusion Criteria

- Term singleton pregnancies (≥37 completed weeks)
- Willingness to participate with informed consent
- Neonates with and without low birth weight

Exclusion Criteria

- Multiple pregnancies (twins or more)
- Preterm deliveries
- Pre-eclampsia, eclampsia, gestational diabetes, and other high-risk obstetric conditions
- Maternal comorbidities such as chronic renal, hepatic, endocrine, or autoimmune disorders
- History of vitamin D supplementation during pregnancy
- Neonates with congenital anomalies or syndromes

Data Collection and Procedures

Detailed maternal demographic, obstetric, and clinical data were recorded. Immediately after delivery, 5 ml of maternal venous blood and umbilical cord blood were collected under sterile conditions. Serum was separated and stored at −20°C until analysis.

Vitamin D Analysis

Serum levels of 25-hydroxyvitamin D [25(OH)D] were measured using an enzyme-linked immunosorbent assay (ELISA). Vitamin D status was categorized as:

- Deficient: <20 ng/ml
- Insufficient: 20–30 ng/ml
- Sufficient: >30 ng/ml
- Toxic: >150 ng/ml

Statistical Analysis

Data were analyzed using SPSS version 26. Descriptive statistics were presented as mean ± standard deviation for continuous variables and as frequencies and percentages for categorical variables. The Chi-square test was used for categorical comparisons, and Student's t-test was applied for continuous variables. A p-value <0.05 was considered statistically significant.

RESULTS

Maternal Age :

Table 1: Mean age of cases and control

	Mean age	S.D	P Value
Cases	24.87	3.83	0.21(non-significant)
Controls	25.74	4.36	

The mean maternal age in the low birth weight (LBW) group (cases) was 24.87 ± 3.83 years, while in the normal birth weight group (controls) it was 25.74 ± 4.36 years. The difference was not statistically significant (p = 0.21), suggesting that maternal age did not significantly differ between the two groups.

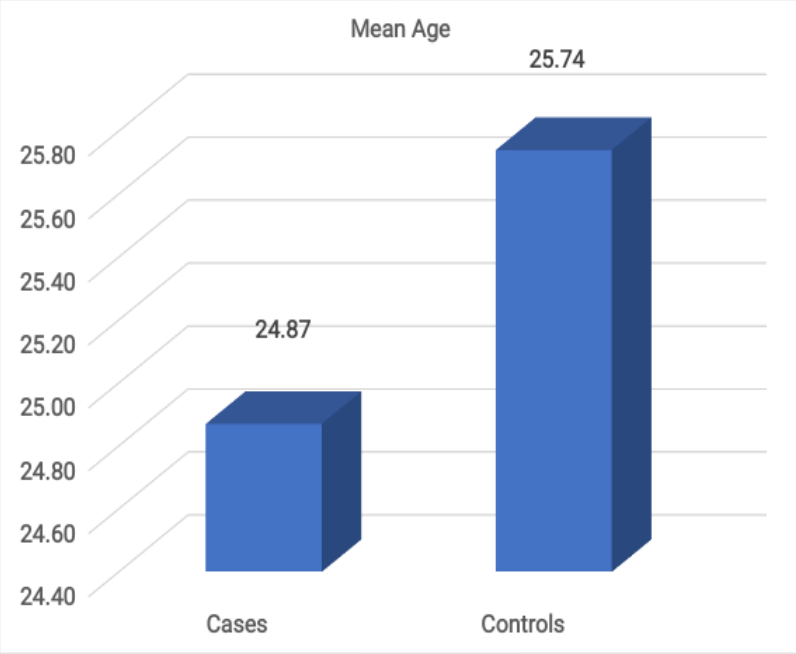

Figure 1: Mean age

Maternal Serum Vitamin D3 Levels:

Table 2 Mean maternal Vitamin D3

	Mean maternal Vitamin D3	**S.D**	**P Value**
Cases	25.53	12.34	**0.0001 (significant)**
Control	34.13	15.84	

Maternal serum vitamin D3 levels were significantly lower in the LBW group (mean: 25.53 ± 12.34 ng/mL) compared to the control group (mean: 34.13 ± 15.84 ng/mL), with a highly significant p-value (< 0.0001). This indicates an inverse relationship between maternal vitamin D levels and neonatal birth weight.

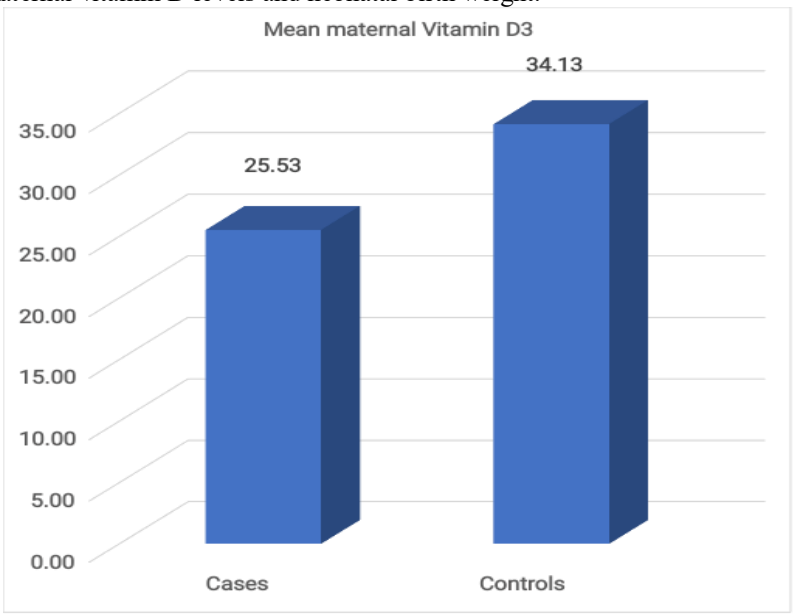

Figure 2: Mean maternal Vitamin D3

Maternal Vitamin D3 Status :

Table 3 Maternal Vitamin D3 and Group

Maternal Vitamin D3	Group		Total	P value
	Cases	Controls		
Deficient	29(41.40%)	19(27.1%)	48(34.30%)	0.001
Insufficient	24(34.3%)	11(15.7%)	35(25.00%)	
Sufficient	17(24.3%)	40(57.2%)	57(40.70%)	
Total	70(50.00%)	70(50.00%)	140(100.00%)	

Among the cases, 41.4% of mothers were vitamin D deficient (<20 ng/mL), 34.3% had insufficient levels (20–30 ng/mL), and only 24.3% had sufficient levels (≥30 ng/mL). In contrast, among the controls, 57.2% had sufficient levels, 15.7% had insufficiency, and 27.1% were deficient. The difference in distribution was statistically significant (p = 0.001), highlighting a significant association between maternal vitamin D status and neonatal birth weight.

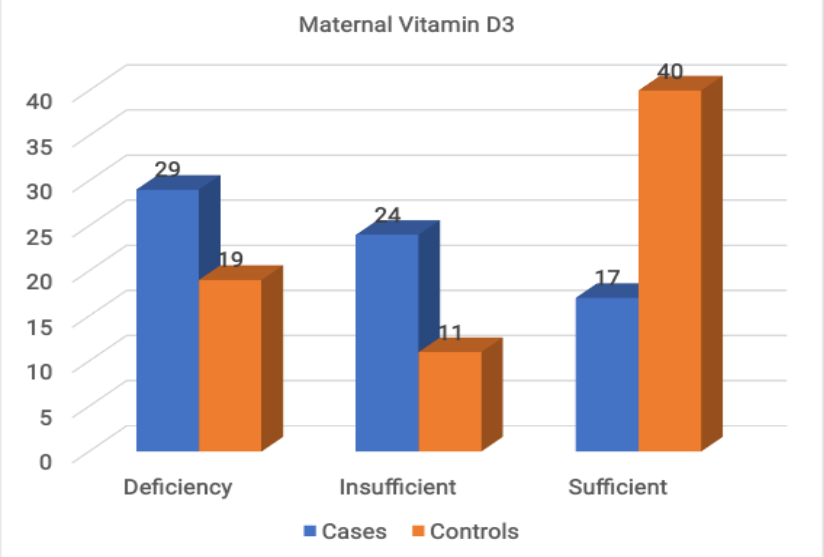

Figure 3: Maternal Vitamin D3 grading and Group

Foetal Cord Blood Vitamin D3 Levels:

Table 4: Foetal cord blood Vitamin D3 Levels

Foetal cord blood Vitamin D3 Levels	Cases	Controls	Total	P value
Deficiency	54(77.10%)	29(41.40%)	83(59.30%)	0.003
Insufficient	10(14.30%)	27(38.60%)	37(26.40%)	
Sufficient	6(8.60%)	14(20.00%)	20(14.30%)	
Total	70(50.00%)	70(50.00%)	140(100.00%)	

Cord blood vitamin D3 levels were deficient in 77.1% of neonates in the LBW group compared to 41.4% in the control group. Insufficient levels were found in 14.3% of cases and 38.6% of controls, while sufficient levels were observed in only 8.6% of cases and 20% of controls. The association between foetal vitamin D status and birth weight was statistically significant (p = 0.003).

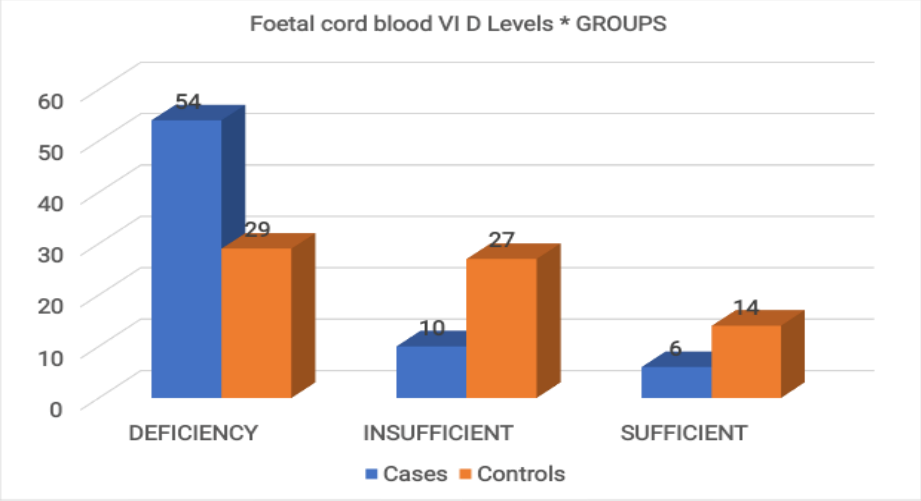

Figure 4: Foetal cord blood VIT D Levels and GROUPS

DISCUSSION

This study demonstrates a significant association between maternal vitamin D deficiency and low birth weight in term neonates. Although maternal age did not significantly differ between groups, vitamin D3 levels were markedly lower in mothers of LBW neonates. These findings are consistent with previous research, including studies by Khalessi et al. (2015) and Alimohamadi et al. (2020), which similarly found a correlation between low maternal vitamin D levels and poor fetal growth outcomes.

The significant difference in the distribution of vitamin D deficiency among cases and controls underscores the clinical relevance of ensuring adequate maternal vitamin D status during pregnancy. The higher prevalence of deficiency and insufficiency among LBW cases suggests that inadequate vitamin D may compromise placental function, calcium metabolism, and fetal bone growth—factors essential for optimal birth weight.

In conclusion, maternal and foetal vitamin D status appear to be closely linked, and vitamin D deficiency in pregnancy may be a modifiable risk factor for low birth weight. Routine screening and supplementation of vitamin D in antenatal care could offer a practical strategy to improve neonatal outcomes.

REFERENCES

1. Alimohamadi S, et al. (2020). Association of vitamin D deficiency with intrauterine growth restriction. *J Matern Fetal Neonatal Med*.
2. Mahfod HS, et al. (2022). Impact of vitamin D deficiency on fetal growth and Doppler indices. *Saudi Med J*.
3. Khalessi N, et al. (2015). Maternal vitamin D deficiency and neonatal anthropometrics. *J Res Med Sci*.
4. Arnan F, et al. (2024). Maternal vitamin D deficiency and intrauterine growth restriction. *Obstet Med*.
5. Dragomir RE. (2024). Correlation between maternal and neonatal vitamin D deficiency. *Romanian J Pediatr*.
6. Abdallah HR, et al. (2024). Cord blood vitamin levels and neonatal outcomes. *Pediatr Int*.
7. Jakubiec-Wisniewska A, et al. (2022). Vitamin D supplementation during pregnancy and fetal weight. *Nutrients*.
8. Wang J, et al. (2022). VDD-induced placental dysfunction in rat models. *Placenta*.
9. Khalaf WM, et al. (2023). Vitamin D deficiency and intrauterine growth restriction. *Med J Islam Repub Iran*.
10. Perez-Lopez FR, et al. (2015). Vitamin D supplementation in IUGR pregnancies. *Maturitas*.
11. Chien MC, et al. (2024). Meta-analysis of vitamin D supplementation and pregnancy outcomes. *Nutrients*.
12. Lee JM, et al. (2007). Maternal and newborn vitamin D deficiency. *Clin Pediatr*.
13. Holick MF. (2007). Vitamin D deficiency: causes and health implications. *NEJM*.
14. Merewood A, et al. (2009). Association between vitamin D deficiency and cesarean section. *JCEM*.
15. Institute of Medicine. (2011). Dietary Reference Intakes for Calcium and Vitamin D. *National Academies Press*.