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Prevalence and Risk Factors of Vitamin D Deficiency in Pregnant Women and Its Association with Maternal and Neonatal Outcomes

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Abstract

Background: Background: Vitamin D deficiency (VDD) is common among pregnant women globally and is associated with adverse maternal and neonatal outcomes. This study aimed to estimate the prevalence of VDD in pregnant women, evaluate associated risk factors, and assess its impact on maternal complications and neonatal outcomes in a cohort of 100 patients. ***Methods***: A cross-sectional observational study was conducted on 100 pregnant women presenting for antenatal care at a tertiary care hospital. Serum 25-hydroxyvitamin D (25(OH)D) levels, obstetric history, sociodemographic data, and outcomes were recorded. VDD was defined as 25(OH)D <20 ng/mL. Associations with maternal factors (BMI, sunlight exposure, dietary intake) and outcomes (preeclampsia, gestational diabetes mellitus [GDM], preterm delivery, low birth weight [LBW]) were analyzed. ***Results***: Prevalence of VDD was 69%. Significant risk factors included limited sunlight exposure ($p<0.01$), higher BMI ($p=0.02$), and low dietary intake of vitamin D ($p<0.01$). Women with VDD had higher rates of preeclampsia (35% vs 11%, $p=0.01$), GDM (28% vs 9%, $p=0.02$), preterm delivery (24% vs 6%, $p=0.01$), and LBW infants (31% vs 13%, $p=0.03$). Tables 1–4 summarize demographic characteristics, risk factors, maternal complications, and neonatal outcomes. ***Conclusions***: VDD is highly prevalent in pregnancy and is associated with modifiable risk factors and adverse outcomes. Screening and interventions (supplementation, nutritional counseling) should be integrated into antenatal care.

Keywords: Prevalence, Vitamin D, Pregnant, Maternal, Neonatal & Outcomes.

INTRODUCTION

Vitamin D plays a crucial role in calcium homeostasis and bone metabolism. Beyond skeletal effects, vitamin D exerts immunomodulatory roles and is implicated in vascular health, glucose metabolism, and placental function (1,2). Pregnant women are at heightened risk of vitamin D deficiency (VDD) due to increased metabolic demands and often inadequate dietary intake and sunlight exposure (3). Global prevalence among pregnant cohorts varies widely, with reports ranging from 30% to >80% in different populations (4).

Deficiency has been linked with maternal complications such as preeclampsia, gestational diabetes mellitus (GDM), and cesarean delivery, and neonatal outcomes including preterm birth, low birth weight (LBW), and impaired skeletal development (5–7). Identifying high-risk women and understanding associated factors can inform targeted preventive strategies.

Despite growing recognition of its importance, routine assessment of vitamin D status in pregnancy is not universally practiced, especially in resource-limited settings (8). This study aimed to determine the prevalence of VDD in a cohort of 100 pregnant women, identify associated risk factors, and examine its relationship with selected maternal and neonatal outcomes.

MATERIALS AND METHODS

Study Design and Population

This cross-sectional observational study was conducted over 12 months at the Department of Obstetrics and Gynecology. One hundred pregnant women between 14 and 40 weeks gestation attending routine antenatal clinics were enrolled after written informed consent. Ethical approval was obtained from the institutional review board.

Inclusion Criteria
- Singleton pregnancy
- Gestational age ≥14 weeks
- Attending routine antenatal care

Exclusion Criteria
- Pre-existing chronic liver or renal disease
- Known parathyroid disorders
- Use of vitamin D supplementation >400 IU/day before enrolment

Data Collection
Sociodemographic data (age, educational status), obstetric history, BMI, lifestyle and nutritional history (sunlight exposure, dietary intake of dairy and fortified foods) were recorded through structured questionnaires. Sunlight exposure was categorized as adequate (≥30 minutes/day) and inadequate (<30 minutes/day). Dietary intake was estimated using a validated food frequency questionnaire.

Biochemical Assessment
Fasting blood samples were collected to measure serum 25-hydroxyvitamin D (25(OH)D) using enzyme-linked immunosorbent assay (ELISA). Deficiency was defined as 25(OH)D <20 ng/mL, insufficiency as 20–30 ng/mL, and sufficiency as >30 ng/mL (9).

Outcomes Assessed
Maternal complications evaluated included preeclampsia (BP ≥140/90 mmHg after 20 weeks with proteinuria), GDM (based on WHO criteria), and preterm delivery (<37 weeks). Neonatal outcomes included birth weight, Apgar score, and admission to neonatal intensive care unit (NICU).

Statistical Analysis
Data were analyzed with SPSS version 25. Continuous variables were presented as means ± SD and categorical variables as frequencies and percentages. Chi-square or Fisher's exact tests were used to compare categorical variables; t-test compared continuous variables. Multivariate logistic regression identified independent predictors of VDD. A p-value <0.05 was considered significant.

RESULTS

Patient Characteristics
Of the 100 pregnant women, mean age was 26.5 ± 4.8 years, and 69% were vitamin D deficient. Table 1 shows demographic and baseline characteristics.

Table 1: Baseline Demographic and Clinical Characteristics of Participants (n=100)

Variable	Total (n=100)	VDD (n=69)	Non-VDD (n=31)	p-value
Age (years), mean ± SD	26.5 ± 4.8	26.7 ± 4.5	26.0 ± 5.4	0.55
BMI (kg/m²), mean ± SD	26.1 ± 3.9	27.0 ± 3.7	23.8 ± 3.4	0.02*
Education (≥12th grade)	56 (56%)	35 (51%)	21 (68%)	0.12
Sunlight exposure <30 min/day	44 (44%)	39 (57%)	5 (16%)	<0.01*
Dietary vitamin D intake low	62 (62%)	55 (80%)	7 (23%)	<0.01*

*Significant at p<0.05

Prevalence of Vitamin D Status
The prevalence of VDD (<20 ng/mL) was 69%. Twenty-four percent had insufficiency, and only 7% were sufficient.
Risk Factors Associated with VDD
Several factors were significantly associated with VDD (Table 2). In multivariate analysis, limited sunlight exposure (OR 3.4, 95% CI 1.5–7.8) and low dietary intake (OR 4.1, 95% CI 1.8–9.1) remained independent predictors**.**

Table 2: Risk Factors Associated with Vitamin D Deficiency

Risk Factor	VDD (n=69)	Non-VDD (n=31)	OR (95% CI)	p-value
Sunlight exposure <30 min/day	39 (57%)	5 (16%)	6.9 (2.3–20.5)	<0.01*
BMI ≥25 kg/m²	41 (59%)	10 (32%)	3.0 (1.2–7.6)	0.02*
Low dietary vitamin D intake	55 (80%)	7 (23%)	12.1 (4.2–34.9)	<0.01*
Multiparity	36 (52%)	15 (48%)	1.2 (0.5–2.7)	0.68

*Significant at p<0.05

Maternal Outcomes

Maternal outcomes differed significantly between VDD and non-VDD groups (Table 3). Preeclampsia and GDM were more common in the VDD group.

Table 3: Maternal Complications by Vitamin D Status

Outcome	VDD (n=69)	Non-VDD (n=31)	p-value
Preeclampsia	24 (35%)	3 (10%)	0.01*
Gestational Diabetes Mellitus	19 (28%)	3 (9%)	0.02*
Cesarean delivery	31 (45%)	10 (32%)	0.20
Preterm delivery (<37 weeks)	17 (24%)	2 (6%)	0.01*

*Significant at $p<0.05$

Neonatal Outcomes

Neonatal outcomes were less favorable in the VDD group, with higher rates of LBW and NICU admission (Table 4).

Table 4: Neonatal Outcomes by Maternal Vitamin D Status

Neonatal Outcome	VDD (n=69)	Non-VDD (n=31)	p-value
Birth weight <2500 g	21 (31%)	4 (13%)	0.03*
5-min Apgar score <7	12 (17%)	3 (10%)	0.36
NICU admission	22 (32%)	6 (19%)	0.18

*Significant at $p<0.05$

DISCUSSION

This study found a high prevalence (69%) of vitamin D deficiency among pregnant women, consistent with prior reports in similar populations (10). Despite geographical differences, VDD remains a global concern due to lifestyle practices that limit sunlight exposure and nutritional inadequacies (3,11).

Risk Factors

Limited sunlight exposure was a strong predictor of VDD. Cultural clothing practices, urban dwelling with indoor occupations, and sunscreen use are contributory factors (12). Low dietary intake of vitamin D–rich or fortified foods further compounded deficiency risk. While BMI showed an association with VDD, its effect diminished in multivariate modeling, suggesting complex interplay with lifestyle variables (13).

Maternal Outcomes

The association of VDD with preeclampsia and GDM aligns with mechanistic hypotheses where vitamin D influences vascular endothelial function and insulin sensitivity (14). Preeclampsia complicates pregnancy via dysregulated placental angiogenesis and inflammation—processes in which vitamin D is implicated (15). Our findings reinforce the need for early identification and management of deficiency to mitigate risks.

Neonatal Outcomes

Infants born to deficient mothers exhibited higher rates of LBW, an outcome associated with long-term morbidity (16). Although differences in NICU admission and Apgar scores were not statistically significant, trends suggest potential clinical relevance requiring further investigation with larger cohorts.

Strengths and Limitations

Strengths of this study include direct measurement of serum 25(OH)D and comprehensive assessment of dietary and lifestyle factors. However, limitations include its single-center design and lack of longitudinal follow-up to assess long-term infant development.

CONCLUSION

Vitamin D deficiency is highly prevalent among pregnant women and is associated with modifiable risk factors and adverse maternal and neonatal outcomes. Routine screening of vitamin D levels and targeted interventions—such as supplementation, dietary counseling, and promotion of safe sunlight exposure—should be integrated into antenatal care protocols.

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