E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.48047/ijprt/16.01.295

Research Article

Frequency of Vitamin D Deficiency in Mothers and Neonates at a Tertiary Care Hospital

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Received: 09.03.26, Revised: 26.04.26, Accepted: 02.05.26

ABSTRACT

Objective: To determine the frequency of vitamin D deficiency among mothers and their neonates at a tertiary care hospital and to assess the association between maternal and neonatal vitamin D status.
Methodology: This descriptive cross-sectional study included 220 mother–neonate pairs admitted for delivery at a tertiary care hospital. Maternal venous blood was collected before delivery, and neonatal cord blood was collected immediately after birth. Serum 25-hydroxyvitamin D [25(OH)D] levels were measured using chemiluminescence immunoassay. Vitamin D status was classified as severe deficiency <10 ng/mL, deficiency 10–19.9 ng/mL, insufficiency 20–29.9 ng/mL, and sufficiency ≥30 ng/mL. Data were analyzed using SPSS version 25. Frequencies, percentages, mean ± standard deviation, chi-square test, and Pearson correlation were applied.
Results: The mean maternal age was 27.4 ± 4.9 years. Mean maternal vitamin D level was 17.8 ± 8.1 ng/mL, while mean neonatal vitamin D level was 14.2 ± 7.0 ng/mL. Overall maternal vitamin D deficiency <20 ng/mL was present in 165 mothers (75.0%), while neonatal deficiency was present in 177 neonates (80.5%). Severe deficiency was found in 47 mothers (21.4%) and 61 neonates (27.7%). Neonatal deficiency was significantly higher among babies born to vitamin D-deficient mothers (91.5%) compared with babies of non-deficient mothers (47.3%) ($p<0.001$). A positive correlation was observed between maternal and neonatal 25(OH)D levels ($r=0.64$, $p<0.001$).
Conclusion: Vitamin D deficiency was highly frequent among both mothers and neonates. Neonatal vitamin D status was strongly associated with maternal vitamin D status, supporting the need for antenatal risk assessment, dietary counselling, safe sunlight exposure advice, and appropriate supplementation during pregnancy.
Keywords: Vitamin D deficiency; pregnancy; neonate; 25-hydroxyvitamin D; cord blood; tertiary care hospital.

INTRODUCTION

Vitamin D is essential for calcium and phosphate homeostasis, skeletal mineralisation, immune function, and neuromuscular health. Its circulating marker, serum 25-hydroxyvitamin D [25(OH)D], is widely used to assess vitamin D status because it reflects vitamin D obtained from sunlight exposure, diet, and supplementation [1,2]. During pregnancy, maternal vitamin D demand increases because fetal skeletal development depends on maternal calcium and vitamin D metabolism. Inadequate maternal vitamin D can therefore affect both maternal bone health and neonatal vitamin D stores [3].

Pregnant women are particularly vulnerable to vitamin D deficiency because of limited sun exposure, indoor lifestyle, darker skin pigmentation, veiled clothing, poor dietary intake, obesity, low socioeconomic status, and inadequate antenatal supplementation [4]. ACOG notes that newborn vitamin D levels largely depend on maternal vitamin D status, and infants of deficient mothers are at increased risk of deficiency [5]. WHO also recognises vitamin D deficiency as common in some pregnant populations, although it does not recommend

universal vitamin D supplementation for all pregnant women as a blanket policy because evidence on clinical outcomes remains mixed [6]. Globally, maternal and neonatal vitamin D deficiency remains common. A systematic review reported substantial regional variation, with high deficiency rates among pregnant women and newborns in South Asia and the Eastern Mediterranean region [7]. A more recent meta-analysis confirmed a strong positive association between maternal vitamin D concentration during pregnancy and cord blood vitamin D concentration, supporting the biological dependence of neonatal vitamin D stores on maternal reserves [8]. In Pakistan, Rabbani et al. reported maternal vitamin D deficiency in 61.5% of pregnant women and neonatal deficiency in 99.5%, with a strong positive association between maternal and newborn levels [9]. Earlier Pakistani studies also reported high rates of deficiency among mothers and newborns in Karachi [10].

Despite abundant sunlight in South Asian countries, vitamin D deficiency remains widespread. This paradox is likely explained by cultural clothing practices, limited outdoor exposure, air pollution, poor diet, low intake of fortified foods, and insufficient supplementation. Therefore, this study was designed to determine the frequency of vitamin D deficiency among mothers and neonates at a tertiary care hospital and to assess the relationship between maternal and neonatal vitamin D status.

METHODOLOGY

Study design and setting

This was a descriptive cross-sectional study conducted at MSPH Abbottabad, International Medical College Abbottabad during from Sep 2025 to Feb 2026.

Study population

A total of 220 mother–neonate pairs were included. Mothers admitted for delivery with singleton pregnancies were enrolled after informed consent.

Inclusion criteria

Mothers aged 18–40 years with singleton pregnancies at ≥37 weeks of gestation were included. Both normal vaginal deliveries and caesarean sections were included.

Exclusion criteria

Mothers with chronic kidney disease, chronic liver disease, thyroid or parathyroid disease, malabsorption syndrome, anticonvulsant therapy, multiple pregnancy, congenital fetal anomalies, or incomplete blood samples were excluded.

Data collection

Maternal demographic data, parity, booking status, vitamin D supplementation history, sunlight exposure, clothing pattern, mode of delivery, gestational age, neonatal sex, birth weight, and Apgar score were recorded.

Laboratory method

Maternal venous blood was collected before delivery. Neonatal cord blood was collected immediately after birth. Serum 25(OH)D was measured using chemiluminescence immunoassay.

Operational definition

Vitamin D status was categorised as:

Category	Serum 25(OH)D level
Severe deficiency	<10 ng/mL
Deficiency	10–19.9 ng/mL
Insufficiency	20–29.9 ng/mL
Sufficiency	≥30 ng/mL

For main analysis, vitamin D deficiency was defined as serum 25(OH)D <20 ng/mL.

Statistical analysis

Data were analyzed using SPSS version 25. Mean ± standard deviation was calculated for continuous variables. Frequency and percentage were calculated for categorical variables. Chi-square test was used to assess associations. Pearson correlation was used to assess the relationship between maternal and neonatal vitamin D levels. A p-value <0.05 was considered statistically significant.

RESULTS

The mean maternal age was 27.4 ± 4.9 years, indicating that most mothers were in the reproductive age group. Most participants were multigravida, 148 (67.3%), while 72 (32.7%) were primigravida. A majority of mothers, 154 (70.0%), were booked antenatal cases, whereas 66 (30.0%) were unbooked. Only 62 mothers (28.2%) reported vitamin D supplementation during pregnancy, while 158 (71.8%) did not receive supplementation. Limited sunlight exposure was common, as 156 mothers (70.9%) had less than 30 minutes of sun exposure per day, and 130 (59.1%) reported covered clothing or limited skin exposure. Regarding delivery, 134 mothers (60.9%) had normal vaginal delivery and 86 (39.1%) underwent caesarean section.

The mean gestational age was 38.1 ± 1.3 weeks. Among neonates, 116 (52.7%) were male and 104 (47.3%) were female. The mean birth weight was 2.91 ± 0.48 kg, and 32 neonates (14.5%) had low birth weight. Overall, the table suggests that poor supplementation and limited sunlight exposure were common among the study population.

Table 1. Baseline characteristics of mothers and neonates

Variable	Frequency / Mean	Percentage / SD
Total mother–neonate pairs	220	100%
Maternal age	27.4 years	±4.9
Primigravida	72	32.7%
Multigravida	148	67.3%
Booked antenatal cases	154	70.0%
Unbooked cases	66	30.0%
Vitamin D supplementation during pregnancy	62	28.2%
No vitamin D supplementation	158	71.8%
Sun exposure <30 minutes/day	156	70.9%
Sun exposure ≥30 minutes/day	64	29.1%
Covered clothing / limited skin exposure	130	59.1%
Normal vaginal delivery	134	60.9%
Caesarean section	86	39.1%
Mean gestational age	38.1 weeks	±1.3
Male neonates	116	52.7%
Female neonates	104	47.3%
Mean birth weight	2.91 kg	±0.48
Low birth weight <2.5 kg	32	14.5%

The frequency of vitamin D deficiency was higher among neonates than mothers. Only 7.7% of mothers and 5.5% of neonates had sufficient vitamin D levels.

Table 2. Frequency of maternal and neonatal vitamin D status

Vitamin D status	Mothers n (%)	Neonates n (%)
Severe deficiency <10 ng/mL	47 (21.4%)	61 (27.7%)
Deficiency 10–19.9 ng/mL	118 (53.6%)	116 (52.7%)
Insufficiency 20–29.9 ng/mL	38 (17.3%)	31 (14.1%)
Sufficiency ≥30 ng/mL	17 (7.7%)	12 (5.5%)
Total deficiency <20 ng/mL	**165 (75.0%)**	**177 (80.5%)**

Maternal deficiency was significantly associated with lack of supplementation, limited sunlight exposure, and covered clothing pattern. Parity was not significantly associated with deficiency

Table 3. Association of maternal vitamin D deficiency with selected factors

Factor	Deficient n/N (%)	Non-deficient n/N (%)	p-value
No vitamin D supplementation	135/158 (85.4%)	23/158 (14.6%)	<0.001
Vitamin D supplementation	30/62 (48.4%)	32/62 (51.6%)	
Sun exposure <30 min/day	134/156 (85.9%)	22/156 (14.1%)	<0.001
Sun exposure ≥30 min/day	31/64 (48.4%)	33/64 (51.6%)	
Covered clothing / limited skin exposure	112/130 (86.2%)	18/130 (13.8%)	<0.001
Adequate skin exposure	53/90 (58.9%)	37/90 (41.1%)	
Primigravida	50/72 (69.4%)	22/72 (30.6%)	0.21
Multigravida	115/148 (77.7%)	33/148 (22.3%)	

There was a statistically significant association between maternal and neonatal deficiency ($p<0.001$). Babies of vitamin D-deficient mothers had markedly higher frequency of neonatal deficiency. Pearson correlation showed a positive correlation between maternal and neonatal 25(OH)D levels ($r=0.64$, $p<0.001$).

Table 4. Relationship between maternal and neonatal vitamin D deficiency

Maternal vitamin D status	Neonatal deficient n (%)	Neonatal non-deficient n (%)	Total
Maternal deficient	151 (91.5%)	14 (8.5%)	165
Maternal non-deficient	26 (47.3%)	29 (52.7%)	55
Total	**177**	**43**	**220**

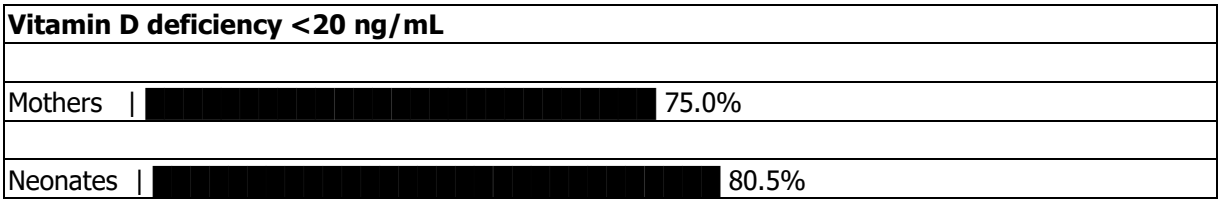

Figure 2. Frequency of vitamin D deficiency

DISCUSSION

This study found a high frequency of vitamin D deficiency among mothers and neonates at a tertiary care hospital. Maternal deficiency was present in 75.0% of participants, while neonatal deficiency was present in 80.5%. These findings are consistent with earlier South Asian and Pakistani studies showing that vitamin D deficiency remains common among pregnant women and newborns despite abundant sunlight [11,12]. The high neonatal deficiency rate in this study is clinically important because neonatal vitamin D stores largely depend on maternal vitamin D status during pregnancy.

The present study also showed a significant positive correlation between maternal and neonatal vitamin D levels. This agrees with Rabbani et al., who reported a strong positive association between maternal and neonatal 25(OH)D levels in Pakistan [9]. Similarly, Hossain et al. found a positive correlation between maternal and cord blood vitamin D levels among Pakistani mothers and newborns [11]. A large systematic review and meta-analysis also confirmed that maternal vitamin D concentration during pregnancy is strongly associated with cord blood vitamin D concentration [8]. This means neonatal deficiency is not an isolated neonatal problem; it usually reflects poor maternal vitamin D reserves during pregnancy.

In this study, only 7.7% of mothers and 5.5% of neonates had sufficient vitamin D levels. Comparable findings have been reported from Karachi, where Karim et al. found high vitamin D deficiency among pregnant women and newborns at a tertiary care centre [12]. Studies from India and Turkey have also reported high deficiency rates among pregnant women and infants [13-15]. These findings suggest that vitamin D deficiency in pregnancy is not limited to one hospital or region but is a broader maternal and child health issue in many low- and middle-income settings.

Limited sunlight exposure was significantly associated with maternal vitamin D deficiency in this study. This is biologically plausible because cutaneous synthesis after ultraviolet-B exposure is a major source of vitamin D. However, sunlight availability alone does not guarantee adequate vitamin D status. Cultural clothing, indoor lifestyle, heat avoidance, air pollution, skin pigmentation, and low outdoor activity can all reduce effective ultraviolet exposure [13,16]. This explains why vitamin D deficiency remains common in sunny countries.

Lack of antenatal vitamin D supplementation was another significant factor associated with deficiency. Mothers who did not receive supplementation had a much higher frequency of deficiency than those who received supplementation. Evidence from Cochrane reviews suggests that vitamin D supplementation during pregnancy improves maternal vitamin D levels, although the effect on clinical outcomes varies across studies [17,18]. The 2024 Endocrine Society guideline suggests empiric vitamin D intake during pregnancy but advises against routine 25(OH)D testing in generally healthy pregnant individuals without specific indications [3]. This creates a practical message: hospitals should not blindly test everyone without policy, but they also should not ignore deficiency in high-risk populations.

The neonatal findings are important because vitamin D deficiency in early life may contribute to hypocalcaemia, impaired bone mineralisation, and nutritional rickets in severe cases. Kozgar et al. found that vitamin D deficiency was common in neonates of high-risk mothers, although neonatal hypocalcaemia at birth was relatively uncommon [16]. This means not every deficient neonate will show immediate biochemical complications, but the high burden still supports preventive maternal and neonatal care.

The study has limitations. First, it was conducted at a single tertiary care hospital, so findings may not represent the general population. Second, seasonal variation was not analysed, even though vitamin D levels can vary by season. Third, dietary intake, body mass index, and

socioeconomic status were not deeply quantified. Fourth, because this was a cross-sectional study, it can show association but not causation. Still, the strong association between maternal and neonatal vitamin D status supports the need for improved antenatal counselling and prevention.

The findings support practical changes: antenatal clinics should identify high-risk mothers, counsel women about diet and safe sunlight exposure, ensure appropriate prenatal supplementation, and consider targeted testing where clinically indicated. For neonates, supplementation policies should follow local paediatric guidelines, especially for exclusively breastfed infants and babies born to deficient mothers.

CONCLUSION

Vitamin D deficiency was highly frequent among both mothers and neonates at the tertiary care hospital. Neonates born to vitamin D-deficient mothers had a significantly higher frequency of deficiency, and maternal and neonatal 25(OH)D levels showed a positive correlation. Lack of supplementation, limited sunlight exposure, and covered clothing pattern were significantly associated with maternal deficiency. Strengthening antenatal counselling, targeted supplementation, safe sunlight exposure education, and neonatal follow-up may help reduce the burden of vitamin D deficiency among mothers and newborns.

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