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Original Research Article

A Retrospective Study Determining the Levels the Levels of Vitamin D in Mothers and Their Newborns

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Abstract

Aim: Assessing the vitamin D levels in mothers and their newborns in a tertiary care center.

Materials and Methods: This retrospective study was done at the Department of Pediatrics, NMCH, jamuhar, Sasaram, Bihar, India for one year. 100 women and their newborns who were delivered at the hospital were included in this retrospective study. All the subjects gave informed consent for the enrolment. Mothers of Indian origin, between 20-45 years of age with no history of any chronic disease or long-term treatment with drugs in the previous three months were included. Pregnant women with associated medical conditions such as Pregnancy- Induced Hypertension (PIH), Gestational Diabetes Mellitus (GDM), hypothyroidism was excluded from the study. The study included newborns of these mothers with completed 35 weeks of gestation who were healthy and did not require intensive care.

Results: The Mean serum 25 (OH) Vitamin D in mothers was 15.09 ng/mL and Mean serum 25 (OH) Vitamin D in neonates was 13.82 ng/mL. Serum calcium was within normal range in 92% women. Hypercalcaemia was noticed in 3% women and hypocalcaemia in 5% women. In neonates, serum calcium was within normal range in 95% and lower in 5% cases. Serum albumin was normal in 59% of mothers and lower than normal range in 41% of mothers. Almost all i.e., 99% of newborns had low serum albumin levels and 1% had normal serum albumin. About 87% of mothers had a natural conception, whereas 13% had IVF conception. The association between maternal serum 25 (OH) Vitamin D levels and daily hours of sun exposure (up to 2 hours vs >2 hours) was statistically significant. The five mothers who received 3,00,000 IU Vitamin D supplements were all found to be Vitamin D sufficient. The comparison between serum 25 (OH) Vitamin D levels in mothers and gestational age found no statistically significant association.

Conclusion: To conclude, the study results add to the accumulating evidence of a high prevalence of vitamin D deficiency in pregnant mothers and newborns, which needs further evaluation and response.

Keywords: Hypovitaminosis D, 25-hydroxyvitamin D, Pregnancy.

Introduction

Vitamin D is essential for calcium homeostasis and bone metabolism, playing a crucial role in the health of both mothers and their newborns. Deficiency in vitamin D is associated with adverse outcomes such as impaired fetal skeletal development, increased risk of rickets in infants, and potential implications for maternal bone health and immune function. Vitamin D deficiency is a widespread issue, particularly in pregnant women and their newborns, due to factors such as limited sun exposure, dietary insufficiencies, and increased physiological requirements during pregnancy. [1-3] Recent studies have highlighted the prevalence of vitamin D deficiency among pregnant women globally, with significant variations based on geographical location, lifestyle, and cultural practices. Inadequate vitamin D levels during pregnancy can lead to complications such as gestational diabetes, preeclampsia, and low birth weight, while sufficient maternal vitamin D status is crucial for optimal fetal development and health outcomes. [4,5] The transfer of vitamin D from mother to fetus occurs primarily in the third trimester, making maternal vitamin D status a critical determinant of neonatal vitamin D levels. Newborns rely heavily on maternal stores, and insufficient maternal vitamin D can result in newborns being born with low vitamin D levels, predisposing them to a range of health issues including impaired bone growth and susceptibility to infections. [6-9] Assessing the vitamin D status of mothers and their newborns is vital for

implementing appropriate interventions to address deficiencies. Supplementation strategies during pregnancy have been shown to improve both maternal and neonatal vitamin D levels, contributing to better health outcomes for both. [10] This study aims to evaluate the vitamin D status of mothers and their newborns at a tertiary care center, providing insights into the prevalence of deficiency and the effectiveness of current supplementation practices. Understanding these dynamics is essential for developing guidelines and interventions to improve maternal and neonatal health.

Materials and Methods

This retrospective study was done at the Department of Pediatrics, NMCH, jamuhar, Sasaram, Bihar, India for one year. 100 women and their newborns who were delivered at the hospital were included in this retrospective study. All the subjects gave informed consent for the enrolment. Mothers of Indian origin, between 20-45 years of age with no history of any chronic disease or long-term treatment with drugs in the previous three months were included. Pregnant women with associated medical conditions such as Pregnancy- Induced Hypertension (PIH), Gestational Diabetes Mellitus (GDM), hypothyroidism was excluded from the study. The study included newborns of these mothers with completed 35 weeks of gestation who were healthy and did not require intensive care. The demographic history such as name, age, height, weight and religion of mothers was documented. The obstetric history of all mothers included the type of conception, parity, calculated gestational age and number of abortions. The mothers reported whether they received any calcium and vitamin D supplements (apart from that incorporated in routine calcium formulations) during the pregnancy. Mothers also reported about the average daily hours of sun exposure, diet (vegetarian/non-vegetarian). We recorded the birth weight of newborns in kilograms, the length in centimetres, head circumference in centimetres on day 4. The weight was measured with a standard weighing scale and length by infant meter. The head circumference was measured with a measuring tape. Each woman delivered between 35 and 41 weeks of gestation after an uneventful pregnancy and gave birth to a singleton infant by spontaneous vaginal delivery or lower segment caesarean section. Gestational age was estimated by the date of the last menstrual period in weeks and days. A sample of venous blood was taken from each woman at the time of vaginal delivery/lower segment caesarean section for the determination of serum calcium, 25 (OH) vitamin D, albumin concentration. Also, a sample of venous cord blood was taken from the infant for determination of serum calcium, 25 (OH) vitamin D, and albumin concentration. All blood samples were centrifuged within an hour after collection. Plasma was separated and processed for analysis. The serum 25 (OH) Vitamin D was measured with Elecsys and Cobas C (Roche/ Hitachi) immunoassay analyser using Electro-Chemiluminescence Immunoassay (ECLIA) method for assessing Vitamin D level. The measuring range of this method was 3.00-70.00 ng/mL (7.50- 175 nmol/L). Conversion factors are nmol/L×0.40=ng/mL and ng/mL×2.50=nmol/L. Serum calcium, albumin was measured with Roche/Hitachi Cobas c system. The reference ranges and the interpretations of serum 25 (OH) Vitamin D in both mothers and newborns were: (a) Serum 25-OH <20 ng/mL: Vitamin D deficiency; (b) 21-29 ng/mL: Insufficiency, (c) 30 ng/mL: Sufficiency.

Statistical Analysis: Results were presented as frequencies, percentages for categorical variables, or means with Standard Deviations (SD). Chi-square test for association of maternal Vitamin D levels with their sun exposure and newborns birth weight.

Results

The Mean serum 25 (OH) Vitamin D in mothers was 15.09 ng/mL and Mean serum 25 (OH) Vitamin D in neonates was 13.82 ng/mL [Table-1,2]. The distribution of serum 25 (OH) Vitamin D status in mothers was 75% deficient, 13% insufficient and 12% sufficient. In this study, the religion of 79% of mothers was Hindu, 13% Muslim, 7% Christian and 1% Buddhist. Majority of the subjects being Hindu, the culture of purdah could not explain the high frequency of Vitamin D deficiency. The distribution of serum 25 (OH) Vitamin D levels in newborns was 78% deficient, 13% insufficient and 9% sufficient. Serum calcium was within normal range in 92% women. Hypercalcaemia was noticed in 3% women and hypocalcaemia in 5% women. In neonates, serum calcium was within normal range in 95% and lower in 5% cases. Serum albumin was normal in 59% of mothers and lower than normal range in 41% of mothers. Almost all i.e., 99% of newborns had low serum albumin levels and 1% had normal serum albumin. About 87% of mothers had a natural conception, whereas 13% had IVF conception. About 49% of mothers were primigravida, and 51% were multigravida. Primipara mothers were 70% and 30% were multipara. Twenty-six mothers had a prior single abortion; seven mothers had earlier two abortions while two of the mothers had three abortions. Sixty-five mothers had no history of abortion. Only four mothers (4%) had >4 hours/day of daily sun exposure. Fifty- five mothers (55%) reported less than 2 hours/day of sun exposure and 41 mothers (41%) had 2 to 4 hours/day of sun exposure. Around 72% of mothers were non-vegetarian, and 28% were vegetarian. Only 5% of

mothers received the oral Vitamin D Supplements 3,00,000 IU (5 doses of 60,000 IU soft gels) in addition to that incorporated in calcium supplement formulations. The correlation between maternal and newborns serum 25 (OH) Vitamin D levels with a Pearson correlation coefficient value of 0.94 and the p-value of <0.001 which indicates strong and statistically significant correlation (S) [Table3]. The analysis of data reflected the moderate correlation between maternal and newborns serum calcium levels with a Pearson correlation coefficient value of 0.43 and the p-value of <0.001, which shows a statistically significant relationship. The comparison between serum 25 (OH) Vitamin D levels in mothers and birth weight in newborns found no statistically significant association [Table 4]. The association between maternal serum 25 (OH) Vitamin D levels and daily hours of sun exposure (up to 2 hours vs >2 hours) was statistically significant. The five mothers who received 3,00,000 IU Vitamin D supplements were all found to be Vitamin D sufficient. The comparison between serum 25 (OH) Vitamin D levels in mothers and gestational age found no statistically significant association [Table 5].

Table 1: Maternal characteristics and laboratory parameters.

Variables	n	Mothers	
		Mean	SD
Age (years)	100	31.09	4.44
Weight (kg)	100	74.06	10.16
Height (cm)	100	161.03	6.12
Serum calcium (mg/dL)	100	9.09	0.66
Serum 25 (OH) Vitamin D (ng/mL)	100	15.09	6.22
Serum albumin (mg/dL)	100	3.45	0.26

Table 2: Neonatal characteristics and laboratory parameters.

Variables	n	Newborns	
		Mean	SD
Gestational age (days)	100	263.74	9.79
Weight (kg)	100	2.91	0.40
Length (cm)	100	48.59	1.60
Head circumference (cm)	100	33.36	1.21
Serum calcium (mg/dL)	100	10.18	0.99
Serum 25 (OH) Vitamin D (ng/mL)	100	13.82	11.12
Serum albumin (mg/dL)	100	3.55	0.27

Table 3: Comparison of serum 25 (OH) vitamin D levels in mothers and birth weight in newborns.

Serum 25 (OH) Vitamin D	Birth weight		Total
	Low (<2.5 kg)	Normal (>2.5 kg)	
Sufficient	1	11	12
Insufficient	3	10	13
Deficient	17	58	75
Total	21	79	100
p-value			0.517

Table 4: Comparison of daily sun exposure and serum 25 (OH) Vitamin D levels in mothers.

Serum 25 (OH) Vitamin D	Sun exposure		Total
	0-2 hours/day	>2 hours/day	
Sufficient	3	9	12
Insufficient	10	3	13
Deficient	42	33	75
Total	55	45	100
p-value	0.031		

Table 5: Comparison of gestational age and serum 25 (OH) vitamin D levels in mothers.

Serum 25 (OH) Vitamin D	Gestational age		Total
	Late preterm (35-36.6 weeks)	Term (37-41.6 weeks)	
Sufficient	4	8	12
Insufficient	3	10	13
Deficient	25	50	75
Total	32	68	100
p-value	0.761		

Discussion

The study results show a very high percentage of pregnant mothers with hypovitaminosis D as well as lower vitamin D levels in newborns. There was a strong, statistically significant relationship between maternal and neonatal vitamin D levels. These findings from a hospital catering to affluent population from the financial capital of India indicate the gravity of the vitamin D problem in the region. We did not find the birth weight to be related to vitamin D levels; however, the study was not powered for the analysis of this parameter. There has been a strengthening of evidence regarding the impact of vitamin D on maternal and fetal outcomes. Hypovitaminosis D in pregnant mothers has been reported to be associated with increased risk of preeclampsia, gestational diabetes, bacterial vaginosis in mothers; and small for gestational age and low birth weight babies.[6-10] Zheng J et al., study has reported that vitamin D deficiency in mothers can lead to metabolic syndrome in offspring, which may be amenable to the correction of vitamin D deficiency. [11] Maternal vitamin D deficiency adversely affects the musculoskeletal development in the child that can manifest up to early childhood in the form of lower bone mineral content, density and muscle mass. Vitamin D deficiency correction in mother can provide long-term benefit in the prevention of osteoporotic fracture in childhood. [12-16] Thorsteinsdottir F et al., studied Danish case cohorts born between 1992-2002 (D-Tact study). They highlighted the importance of prenatal and neonatal vitamin D status in the healthy immune system and lung development. They suggested that higher vitamin D levels in neonates may reduce the risk of developing asthma at ages 3-9 years in children. [17] Our study results are in line with other Indian studies reporting a high prevalence of vitamin D deficiency in pregnant mothers and correlation with neonatal vitamin D levels.

With the available research data, hypovitaminosis D appears to be a widespread problem in pregnant mothers and neonates across India. Still, there is a lack of clear guidelines for its management. Endocrine society global guidelines state that pregnant and lactating mothers comprise a high risk group that should be screened for vitamin D deficiency and routinely given vitamin D supplementation. [18-22] However, American College of Gynaecologists committee on obstetric practice opines that although severe deficiency of vitamin D in mothers is known to be associated with adverse skeletal outcomes in newborns, currently there is not sufficient evidence to recommend screening of all pregnant women for deficiency of vitamin D. [23] The World Health Organisation (WHO) guidelines (2016) do not recommend vitamin D supplementation in pregnant mothers for improvement in maternal and neonatal outcomes based on a Cochrane review. WHO recommends advising pregnant women for adequate sunlight exposure and proper nutrition, however, pregnant women with documented vitamin D deficiency are recommended to take supplements of 200 IU, i.e., five micrograms per day. [24,25] Sufficient vitamin D via adequate sun exposure in pregnant women is not feasible in India due to cultural issue of clothing, skin pigmentation, scorching uncomfortable heat, use of sunscreens, atmospheric pollution and overcrowding. Dietary intake of vitamin D is also impacted due to choice of food like vegetarianism, high phytate content of food, high caffeine consumption, cooking practices, and low calcium diet. With the lack of guidelines regarding vitamin D screening and supplementation during the antenatal period in India and reports of vitamin D deficiency being a widespread public health concern, there is a need for extensive multicentric studies across the country for proper assessment of the problem and evidence-based recommendations.

Conclusion

To conclude, the study results add to the accumulating evidence of a high prevalence of vitamin D deficiency in pregnant mothers and newborns, which needs further evaluation and response.

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