

Cord Blood Vitamin D Status and Its Anthropometric Correlation in Term, Appropriate-for-Gestational-Age Newborns: A Cross-sectional Study

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ABSTRACT

Introduction: Hypovitaminosis D is highly prevalent worldwide, including in India. Vitamin D deficiency during pregnancy can also lead to deficiency in the foetus. This deficiency can have a negative impact on foetal growth, as vitamin D is essential for calcium and bone homeostasis, as well as skeletal growth.

Aim: To determine the cord blood vitamin D status and evaluate the correlation between cord blood vitamin D levels and neonatal anthropometric measurements in term, appropriate-for-gestational-age newborns at birth.

Materials and Methods: A cross-sectional study was conducted at a tertiary care centre. Two hundred term, appropriate-for-gestational-age newborns were included in the study. Cord blood

25(OH)D levels and anthropometric measurements were taken at birth. The data were analysed statistically, and significance was determined using the Analysis of Variance (ANOVA) test.

Results: Vitamin D levels were deficient (<12 ng/dL) in 80 (40%) samples, insufficient (<20 ng/dL) in 93 (46.5%) samples, and sufficient in 27 (13.5%) samples of cord blood. No significant relationship was found between cord blood vitamin D concentrations and neonatal weight, length, and head circumference at birth ($p>0.05$).

Conclusion: A very high level of vitamin D deficiency or insufficiency was observed in cord blood samples. There was no association between maternal vitamin D concentrations and neonatal anthropometric measurements in the infants.

Keywords: Hypovitaminosis D, Neonates, Pregnancy, Sunshine vitamin

INTRODUCTION

Vitamin D is a steroid hormone with multiple actions on most tissues in the body. The main source of vitamin D is sunlight. Solar Ultraviolet (UV)-B radiation on the skin leads to the synthesis of vitamin D from 7-dehydrocholesterol, which accounts for approximately 90 percent of the body's total need [1]. Despite India being a tropical country, there are multiple articles reporting a high prevalence (40-90%) of vitamin D deficiency [2-4]. Vitamin D insufficiency in the mother results in neonatal insufficiency [5,6], which may negatively affect the anthropometric parameters in the neonate [7]. Apart from its role in bone health, vitamin D seems to influence the hepatic secretion of Insulin-like Growth Factor 1 (IGF-1) and Insulin-like Growth Factor Binding Protein 3 (IGFBP-3) and the expression of IGF-1 receptors in various tissues [8,9]. Thus, an optimal level of vitamin D can promote good health and better physical growth [10].

The American Academy of Paediatrics (AAP) recommends a serum concentration of more than 32 ng/mL in pregnant mothers for optimal growth and development of the newborn [11]. The Indian Academy of Paediatrics in 2017 recommended serum vitamin D concentrations of <12 ng/mL as deficient, 12-20 ng/mL as insufficient, and >20 ng/mL as sufficient, which was reinforced in the revised guidelines in 2021 [12,13]. On the other hand, the US Endocrine Society defines serum levels of 25(OH)D less than 20 ng/mL, 21-30 ng/mL, and >30 ng/mL as deficiency, insufficiency, and sufficiency, respectively [14].

Whether high cord blood vitamin D leads to better physical growth in the foetus is not known. Various studies have reported

positive, negative, or no relationship between cord or maternal vitamin D and the anthropometry of neonates at birth [15-17]. Hence, the aim of this study was to determine the cord blood vitamin D status and evaluate the correlation between cord blood vitamin D levels and neonatal anthropometric measurements of term, appropriate-for-gestational-age neonates at birth. The present study only included term, appropriate-for-gestational-age, exclusively breastfed, healthy infants, thus making it a more homogeneous cohort.

MATERIALS AND METHODS

A cross-sectional study was conducted at Smt Kashibai Navale Medical College, Pune, Maharashtra, India, from October 2018 to March 2020. Parental consent and institutional ethical committee clearance were obtained (IEC No.-Institutional Ethical Committee letter No- SKNMC/Ethics/App/2018/46 dated 05 Oct 2018).

Inclusion criteria: Two hundred term (born on or after 37 completed weeks) and appropriate-for-gestational-age (birth weight=2.5 kg) neonates at the chosen study centre from October 2018 to March 2020 were included in the study.

Exclusion criteria: Neonates requiring resuscitation or instrumental delivery, neonates having cephalo-hematoma, neonates born with major congenital anomalies, or those admitted to the NICU for any reason were excluded from this study.

Procedure

Neonatal anthropometric measurements were recorded within 24 hours of life. The baby's weight was measured using an

electronic weighing scale with an accuracy of ± 10 grams. Length was measured using an infantometer with an accuracy of 0.5 centimeters. Head circumference was measured using a flexible, non-stretchable measuring tape with an accuracy of 0.5 centimeters. A 3cc sample of umbilical cord blood was collected by trained nursing staff immediately after birth. The serum was separated and stored at -20°C until processing for 25(OH)D analysis was done using automated chemiluminescent immunoassay.

Vitamin D deficiency was defined as per the IAP guidelines, with cord blood vitamin D concentrations of <12 ng/mL considered deficient, 12-20 ng/mL considered insufficient, and >20 ng/mL considered sufficient.

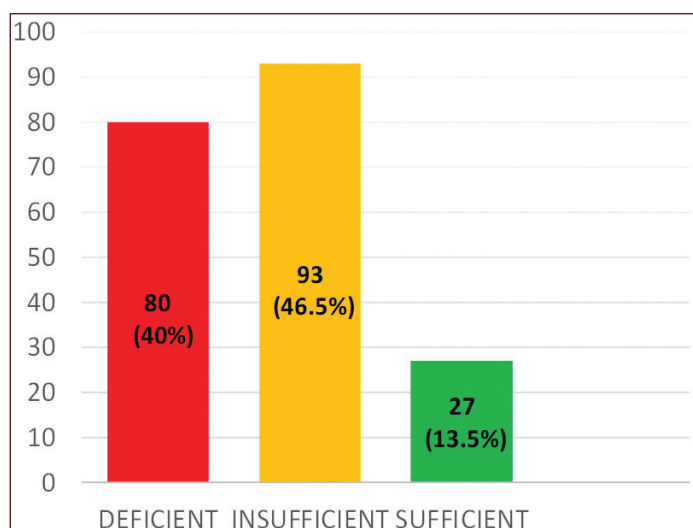
STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS statistical software version 28, with a p-value of <0.05 considered statistically significant. ANOVA analysis was used to establish significance.

RESULTS

The study enrolled a total of 200 babies, of which 116 (58%) were male neonates and 84 (42%) were female neonates. The mean weight of the babies at birth was 2898.85 ± 240.4 grams, the mean length was 51.74 ± 1.74 centimeters, the mean head circumference was 35.9 ± 0.77 centimeters, and the mean Vitamin D levels were 14.98 ± 6.08 ng/mL. The median weight of the babies was 2855 grams (interquartile range: 2710-3055), median length 52 centimeters (IQR: 50.5-54), median head circumference 36 centimeters (IQR: 35.5-36.5), and median Vitamin D 12.9 ng/dL (IQR: 11.3-17.5).

Vitamin D levels were deficient (<12 ng/dL) in 80 (40%) of cord blood samples, insufficient (<20 ng/dL) in 93 (46.5%), and sufficient in 27 (13.5%) [Table/Fig-1]. The mean birth weight, length, and head circumference of neonates with deficient levels of Vitamin D in cord blood were 2882.50 ± 222.79 grams, 51.75 ± 1.97 centimeters, and 35.80 ± 1.05 centimeters, respectively. Similarly, the mean birth weight in the insufficient and sufficient groups was 2917.18 ± 259.96 grams and 2880.74 ± 223.93 grams, respectively. Anthropometric parameters at birth were not related to cord blood vitamin D levels, with p-values for each anthropometric parameter being >0.05 [Table/Fig-2].



[Table/Fig-1]: Distribution of cord blood Vitamin D levels. Deficient: <12 ng/dL, Insufficient: 12-20 ng/dL, Sufficient: >20 ng/dL

Growth parameters	Vitamin D levels			p-value
	Deficient (n=80)	Insufficient (n=93)	Sufficient (n=27)	
Weight (Kg)	2882.50 ± 222.79	2917.18 ± 259.96	2880.74 ± 223.93	0.248
Length (cm)	51.75 ± 1.97	51.77 ± 1.62	51.62 ± 1.46	0.240
Head circumference (cm)	35.80 ± 1.05	36.00 ± 1.12	36.00 ± 1.09	0.287

[Table/Fig-2]: Association of Vitamin D with anthropometry.

DISCUSSION

The current study included only term, healthy, and appropriate for gestational age term babies. Despite the fact that most mothers had low vitamin D levels, as reflected in maternal cord vitamin D levels, the average anthropometric birth parameters of neonates were similar to those reported by other studies in the Indian sub-continent [18-20].

The present study found that 173 (86.5%) mothers had low vitamin D levels (<20 ng/mL) in their cord blood, as per IAP guidelines. The mean cord blood vitamin D level was 14.98 ± 6.08 ng/mL. Similar low levels of vitamin D deficiency in cord blood have been reported in most Indian studies. Mohapatra JN et al., reported vitamin D deficiency in 86.69% of cord blood samples with a mean value of 18.39 ± 10.82 ng/mL [21]. Sachan A et al., reported a mean cord blood 25(OH)D level as low as (8.4 ± 5.7 ng/mL) and found that 95.7% of mothers had cord blood vitamin D levels <20 ng/mL [22].

Although multiple studies have reported a positive relationship between cord blood vitamin D and anthropometry at birth [23-25], the authors did not find any significant relationship in the present study. Wierzejska R et al., reported vitamin D deficiency in 89.6% of mothers and found no relationship between maternal and neonatal cord blood vitamin D concentrations and neonatal weight, length, head circumference, and chest circumference at birth ($p > 0.05$) [26]. Loudyi FM et al., reported vitamin D deficiency (<20 ng/mL) in 90% of mothers and found no association between maternal vitamin D status and neonatal weight at birth [27]. Rodriguez A et al., in their study on the Spanish population, found that neonates with higher cord blood vitamin D tended to have smaller head circumference, but no significant association was found for length and weight [28]. Eggemoen AR et al., in their multi-ethnic study on 719 pregnant women, found no connection between neonatal anthropometric parameters and maternal vitamin D levels [29]. Farrant HJW et al., in their study on Indian mothers, found that neonatal body measurements were not related to maternal vitamin D status [30].

Limitation(s)

This study did not consider maternal nutrition and maternal serum vitamin D levels during pregnancy, which could affect the physical growth and anthropometry of newborns.

CONCLUSION(S)

This study revealed a significant prevalence of vitamin D deficiency in cord blood, even in a tropical country like India. There was no statistically significant association between cord blood vitamin D levels and anthropometric parameters (weight, length, and head circumference) at birth. As multiple individual studies have found conflicting results on the association between cord blood vitamin D levels and growth outcomes of neonates, a comprehensive, well-planned prospective study or meta-analysis is recommended to provide clear and conclusive results.

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