Cord blood Vitamin D levels in newborns and its correlation with anthropometric indices of baby: A cross-sectional study

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ABSTRACT

Objectives: The objectives were to study the cord blood Vitamin D levels in term neonates and the association of Vitamin D deficiency with birth weight and crown-heel length. **Materials and Methods:** This cross-sectional study was performed in the department of pediatrics at the tertiary care center. All term singleton infants were included in the study. A detailed history from the mothers was taken, and complete anthropometric assessment of babies was done. Cord blood was collected, transported, and analyzed for Vitamin D levels. Data were analyzed using SPSS software. **Results:** A total of 202 children were enrolled. The median cord Vitamin D level was 16.0 ng/dl (interquartile range 13–18.8 ng/dl). Deficiency of Vitamin D was noted in 162 babies (80.6%) and insufficiency in 26 (13%) neonates. A total of 92.6% (151) of Vitamin D-deficient babies were low birth weight (LBW) ($p<0.001$) and 96.5% (157) of babies of the Vitamin D-deficient babies had crown-heel length <50 cm ($p<0.001$). **Conclusion:** Majority of the studied newborns were deficient in Vitamin D, and a positive correlation was found between Vitamin D deficiency and LBW and decreased crown-heel length.

Key words: *25(OH)D3, Cord blood, Neonates, Vitamin D*

Vitamin D is increasingly been found to be deficient in Indian population. The effect of Vitamin D insufficiency starts right from the intrauterine period. Vitamin D plays a significant role in the development of fetal nervous system, fetal lung maturation, and fetal skeletal maturation [1-3]. Hypovitaminosis D increases the risk of respiratory infections, wheezing, and hypocalcemic seizures in infants [4,5]. Vitamin D deficiency in pregnancy causes an increased risk of pre-eclampsia.

Poor Vitamin D status, as indicated by low serum concentrations of 25 hydroxy D3, has been shown to be prevalent in South Asia including India, in spite of abundant sunshine in the region [6]. Multiple reasons have been cited for the same including prevalent social and cultural practices in India like purdah system that precludes the adequate exposure of the adolescent girls and young women to sunshine. Increasing urbanization with a resultant decrease in outdoor activity and greater pollution leading to insufficient exposure of the skin to UV-B further exacerbate the problem. The poor dietary intake and malabsorption in some cases may also add to the underlying Vitamin D deficiency.

There is wide variation in the prevalence of Vitamin D deficiency in neonates and their mothers in tropical countries such as Saudi Arabia (42%), Iran (93.3%), and Pakistan (52%) [7,8]. There are very few studies from India [9] where neonatal Vitamin D levels have been assessed to evaluate the Vitamin D deficiency. It is essential to provide more epidemiological data from various states to know the overall deficiency status in India and further formulate the recommendations on Vitamin D supplementation in newborns in India. Therefore, we planned this study to assess the cord blood Vitamin D levels in term neonates and to study the association of Vitamin D deficiency with birth weight and crown-heel length of the newborn.

MATERIALS AND METHODS

The study was a cross-sectional study conducted in the inpatient department of pediatrics at a tertiary care center in Delhi. All term singleton infants were included in the study. Baby, whose mother had taken Vitamin D supplementation during pregnancy, had chronic liver or kidney disease, were on treatment with antitubercular or antiepileptic drugs during last 3 months, and were excluded from the study. The sample size was calculated using the formula N=4PQ/L2, where P stands for prevalence, Q=1-P, and L=allowable error. A minimum of 157 cases were required keeping prevalence of 74% as per the previous studies done by Maghbooli *et al*. [7]. Newborns were enrolled after the institutional ethical committee clearance and written informed consent.

A detailed history was taken from mother, and all the babies underwent a complete anthropometric assessment. Birth weight was recorded with an electronic weighing machine to the nearest

5 g. Length was taken in the supine position using an infantometer and recorded to the nearest 0.1 cm. Low birth weight (LBW) was defined as birth weight <2500 g; decreased length was defined as length <10th centile for the gestation, according to the WHO standards. Cord blood was collected and transported for the Vitamin D level assessment. Cord blood was collected at delivery in citrate containing vials and transported in wrapped black paper. Plasma was then separated by centrifuging the sample at 3000 rpm for 20 min and stored at −70°C in deep freezer for analysis. Vitamin D levels were analyzed using 25-OH-D3 Elisa kits of DLD Diagnostika GMBH.

Vitamin D deficiency was defined as levels <20 ng/ml, insufficiency as <30 ng/ml, and optimal levels as 30–50 ng/ml [10,11]. Data were analyzed using SPSS software, and statistical significance of qualitative variable was determined using Chi-square test.

RESULTS

A total of 202 babies were enrolled, of which 104 were males and 98 were females. The mean weight of babies was 2.47±0.530 kg, the mean length was 48.03±0.74 cm, and mean Vitamin D levels were 18.39±10.82 ng/ml (Table 1). The median weight of the babies was 2.4 kg (interquartile range [IQR] 2.25–2.47), median length 48 cm (IQR 47.0–49.0), and median Vitamin D 16 ng/ml (IQR 13.0–18.85). The frequency distribution of cord blood Vitamin D levels is shown in Fig. 1. Almost 163 (80%) babies were Vitamin D deficient (<20 ng/ml), 27 (13.4%) babies were Vitamin D insufficient (20–30 ng/ml), and only 3% (12 babies) had optimal Vitamin D levels.

Table 2 shows the association between proportion of vitamin-deficient babies and LBW. Among the Vitamin D-deficient babies, 92.64% (151/163 babies) had LBW in comparison to 5.13% among those with Vitamin D sufficiency (p<0.001). Similarly, the association between Vitamin D deficiency and length of the babies was significant. Among the Vitamin D-deficient babies, 96.52% (157/163) had length <50 cm in comparison to 7.69% among those with Vitamin D sufficiency (p<0.001). The association between Vitamin D deficiency and number of abortions, gravida, and parity were not found to be statistically significant.

DISCUSSION

Our study is one of the few studies, done from northern India, to study the prevalence of Vitamin D in cord blood and its association with birth weight and length. The deficiency of Vitamin D was noted in 80.6% and insufficiency in 13% neonates with the mean Vitamin D level of 18.39±10.82 ng/ml. The results were in accordance to a previous study conducted in Southern India where cord blood samples of 50 babies were deficient in 94% of babies [12]. Our study showed the lesser number of Vitamin D-deficient newborns probably because of geographical variation between the two zones.

The present study also found a significant correlation between Vitamin D deficiency and LBW (p<0.001) and lesser length (p<0.001). Similar results were noted in some of the previous studies. Song *et al*., in a study conducted on 70 healthy nulliparous women and their newborns, reported Vitamin D deficiency (<25 ng/ml) in 54.5% of the mothers and 46.6% of the newborns [13]. They also reported a lower birth weight, length, and head circumference in newborns with severe Vitamin D deficiency [13].

Leffelaar *et al*. in the Amsterdam Born Children and their Development cohort including 3730 pregnant women demonstrated that women with Vitamin D deficiency (<29.9 nmol/l) had higher number of infants with LBW (weight - 114.4 g, 95% confidence interval [CI]: 151.2–77.6) and a higher risk of small for gestational age (odds ratio [OR] 2.4, 95% CI: 1.9–3.2) [14]. Another large cohort study done by Gernand *et al*. in the USA found a positive correlation between maternal Vitamin D status and birth weight and length. They noted that mothers with 25 (OH)D of 37.5 nmol/L or greater had newborns with 46 g [95% CI: 9–82 g] higher birth weights and 0.13 cm (95% CI: 0.01–0.25 cm) larger head circumferences compared with mothers with <37.5 nmol/L of Vitamin D levels [15].

The possible cause of LBW and low length in babies with low cord blood Vitamin D levels may be reduced intrauterine long bone growth [16] and poor fetal skeletal mineralization [17], which has been shown to be associated with Vitamin D deficiency. In contrast, some other studies have found no such correlation [18-20]. Such differences may

Table 1: Details of weight, length, cord blood Vitamin D, and age of mother

Variables	*n*	Mean±SD	Median (IQR)
Weight (kg)	202	2.47±0.530	2.40 (2.25–2.47)
Length (cm)	202	48.03±0.74	48.0 (47.0–49.0)
Vitamin D level (ng/ml)	202	18.39±10.82	16.0 (13.0–18.85)
Age of mother (years)	202	24.12±3.71	24.0 (21.0–26.25)

SD: Standard deviation, IQR: Interquartile range

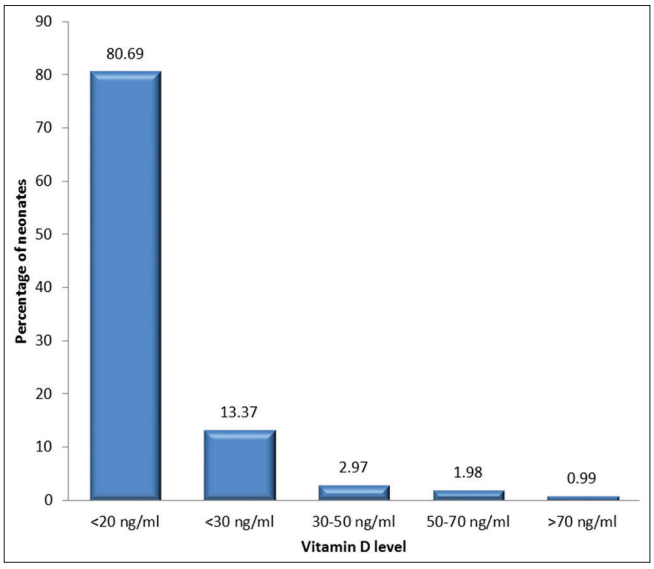

Figure 1: Distribution of cord blood Vitamin D level

Table 2: Association of Vitamin D level with weight and length category

Vitamin D level	Weight, *n* (%)		Chi-square, *P* value	Length, n (%)		Chi-square. *P* value
	<2500 g	≥2500 g		<10th centile	≥10th centile	
<20 ng/ml	151 (92.64)	12 (7.36)	131.17, <0.001	157 (96.32)	6 (3.68)	150.09, <0.001
≥20 ng/ml	2 (5.13)	37 (94.87)		3 (7.69)	36 (92.31)	

be due to methodology, varied population characteristics, and possible differences in the vitamin measurement techniques. Furthermore, studies suggest that Vitamin D receptor gene polymorphisms of infant or mother may have alter effect of maternal Vitamin D status on fetal size [21]. There was no statistically significant association between sex of the baby and Vitamin D levels in cord blood.

Keeping our study and all previous studies in mind, we conclude that ensuring normal levels of Vitamin D may prevent LBW, low birth length, and inadequate growth in intrauterine life as well as in the postnatal period. It is important that all pregnant females, especially those showing intrauterine growth retardation, should have their Vitamin D levels checked. Furthermore, babies with LBW or length <10th centile with no obvious cause should be screened for Vitamin D levels to prevent further compromise of growth during infancy and childhood.

CONCLUSION

In our study, majority of the newborns were Vitamin D deficient and a positive correlation was found between Vitamin D deficiency and LBW and decreased crown-heel length.

REFERENCES

1. Perez-Lopez FR. Vitamin D: The secosteroid hormone and human reproduction. Gynecol Endocrinol 2007;23:13-24.
2. Nguyen TM. Evidence for a Vitamin D paracrine system regulating maturation of developing rat lung epithelium. Am J Physiol 1996;15:L392.
3. Valimaki VV, Alfthan H, Lehmuskallio E, Loyttyniemi E, Sahi T, Stenman UH, *et al*. Vitamin D status as a determinant of peak bone mass in young finnish men. J clin Endocrinol Metab 2004;89:76-80.
4. Belderbos ME, Houben ML, Wilbrink B, Lentjes E, Bloemen EM, Kimpen JL, *et al*. Cord blood Vitamin D deficiency is associated with respiratory syncytial virus bronchiolitis. Pediatrics 2011;127:e1513.
5. Mehrotra P, Marwaha RK, Aneja S, Seth A, Singla BM, Ashraf G. Hypovitaminosis D and hypocalcemic seizures in Infancy. Indian Pediatr 2010;47:581-6.
6. Joshi SR. Vitamin D paradox in plenty sunshine in rural India-an emerging threat. J Assoc Physicians India 2008;56:749-52.
7. Maghbooli Z, Nehzad AH, Shahfaei AR, Karimi F, Madani F, Larijani B. Vitamin D status in mothers and their newborns in Iran. BMC Pregnancy Childbirth 2007;7:1.
8. Vandevijvere S, Amsalkhir S, Oyen HV, Moreno-Reyes R. High prevalance of Vitamin D deficiency in pregnant women: A national cross sectional survey. PLoS One 2012;7:e43868.
9. Sanchan A, Gupta R, Das V, Agarwal A, Awasthii PK, Bhatia V. High prevalence of Vitamin D deficiency among pregnant women and their new borns in Northern India. Am J Clin Nutr 2005;81:1060-4.
10. Holick MF. Vitamin D deficiency. N Engl J Med 2007;357:266-81.
11. Gupta A, Ritu G. Vitamin D deficiency in India: Prevalence, causalities and interventions. Nutrients 2014;6:729-75.
12. Naik KD, Preetha R, Ramachandran AM, Nath D. Cord blood Vitamin D levels in term neonates. Indian Pediatr 2016;52:75-6.
13. Song SJ, Si S, Liu J, Chen X, Zhou L, Jia G. Vitamin D status in Chinese pregnant women and their newborns in Beijing and their relationships to birth size. Public Health Nutr 2013;16:687-92.
14. Leffelaar ER, Vrijkotte TG, van Eijsden M. Maternal early pregnancy Vitamin D status in relation to fetal and neonatal growth: Results of the multi-ethnic Amsterdam born children and their development cohort. Br J Nutr 2010;104:108-17.
15. Gernand AD, Simhan HN, Klebanoff MA, Bodnar LM. Maternal serum 25-hydroxyvitamin D and measures of new born and placental weight in a U.S. multicenter cohort study J Clin Endocrinol Metab 2013;98:398-404.
16. Morley R, Carlin JB, Pasco JA, Wark JD. Maternal 25-hydroxyvitamin D and parathyroid hormone concentrations and offspring birth size. J Clin Endocrinol Metab 2006;91:906-12.
17. Namgung R, Tsang RC. Factors affecting newborn bone mineral content: *In utero* effects on new born bone mineralization. Proc Nutr Soc 2000;59:55-63.
18. Gale CR, Robinson SM, Harvey NC, Javaid MK, Jiang B, Martyn CN, *et al*. Maternal Vitamin D status during pregnancy and child outcomes. Eur J Clin Nutr 2008;62:68-77.
19. Farrant HJ, Krishnaveni GV, Hill JC, Boucher BJ, Fisher DJ, Noonan K, *et al*. Vitamin D in sufficiency is common in Indian mothers but is not associated with gestational diabetes or variation in newborn size. Eur J Clin Nutr 2009;63:646-52.
20. Weiler H, Fitzpatrick-Wong S, Veitch R, Kovacs H, Schellenberg J, McCloy U, *et al*. Vitamin D deficiency and whole-body and femur bone mass relative to weight in healthy newborns. CMAJ 2005;172:757-61.
21. Morley R, Carlin JB, Pasco JA, Wark JD, Ponsonby AL. Maternal 25-hydroxyvitamin D concentration and offspring birth size: Effect modification by infant VDR genotype. Eur J Clin Nutr 2009;63:802-4.

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