

# Vitamin-D deficiency and its association with breast feeding among children at 1 year of age in an urban community in South India

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## ABSTRACT

**Context:** High prevalence of Vitamin D deficiency is reported among healthy infants, children and adolescents. Maternal Vitamin-D deficiency, poor vitamin-D content of breast milk even in Vitamin-D replete mothers, exclusive breastfeeding without Vitamin-D supplementation and inadequate sunlight exposure are important risk factors for Vitamin D deficiency in infants. **Aim:** To determine the prevalence of hypovitaminosis-D and its relation with breast feeding and childhood illness among healthy infants at 1 year of age. **Settings and Design:** A prospective cohort study was conducted among the infants in an urban community in south India. **Methods and Material:** A total of 495 children were followed up at 1 year of age. Clinical history, anthropometric measurements, and serum blood samples for vitamin-D were obtained. The effects of breastfeeding duration and infections on Vitamin-D status were assessed by univariate and multivariate analysis. **Results:** The prevalence of Vitamin D deficiency was 22% in these infants. Univariate analysis showed risk of hypovitaminosis-D in children breast fed for more than 6 months ( $p$  0.02); however, multivariate analysis did not prove an association. Other risk factors analysed were not significantly associated with Hypovitaminosis D. **Conclusion:** The prevalence of hypovitaminosis-D in this study was low compared to previous studies from India. This study emphasizes the issue of hypovitaminosis-D in otherwise normal children. Routine Vitamin-D supplementation for antenatal women and infants may be needed to overcome this public health problem.

**Keywords:** Breast feeding, community, vitamin D deficiency

## Introduction

Vitamin-D deficiency is the most common nutritional deficiency and one of the most common undiagnosed medical conditions in all age groups.<sup>[1]</sup> High prevalence rates are reported in healthy infants, children, and adolescents from all around the world including India.<sup>[2,3]</sup>

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It is a global health concern with high prevalence of vitamin D deficiency in pregnant and lactating women. Various studies have shown prevalence of vitamin D deficiency in 60–90% of the pregnant women in India.<sup>[4,5]</sup> Their Vitamin-D status correlates with their neonates and exclusively breastfed infants. Maternal Vitamin-D deficiency, poor vitamin-D content of breast milk even in Vitamin-D replete mothers, exclusive breastfeeding without Vitamin-D supplementation and inadequate sunlight exposure are important risk factors for Vitamin D deficiency in infants.<sup>[6]</sup>

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Previous studies from India showed that the prevalence of Vitamin-D deficiency among children ranges between 35 and 93%.<sup>[7,8]</sup> A study done in Himachal Pradesh which included 626 children of 6–18 years of age showed a prevalence of 93%.<sup>[7]</sup> In a study done in Delhi by Chowdhury *et al.* on children of 6–30 months age found Vitamin-D deficiency rate of 34.5%.<sup>[8]</sup> A few studies among children correlated Vitamin-D deficiency with its risk factors. In a hospital based study on 230 healthy children between 6 months and 18 years, prevalence was high among the younger children, girls, those belonging to higher socioeconomic status and those with inadequate sunlight exposure.<sup>[9]</sup> Association between malnutrition and Vitamin-D deficiency has also been described.<sup>[10]</sup> The hospital-based studies mainly looked at illness and its implications on Vitamin-D, but information on duration of breast feeding and its effect on Vitamin-D levels in healthy infants from the community are limited.<sup>[11]</sup>

Hence, we undertook this community based descriptive study in South India to determine the prevalence of hypovitaminosis-D among the children at 1 year of age and to assess the association of hypovitaminosis D with breast feeding and childhood illnesses.

## Materials and Methods

This prospective study was conducted in the community in an urban area in Vellore, South India. The participants were healthy children who were recruited from the follow up visit of another study on “Effect of probiotic and zinc supplementation on systemic immune response to oral rotavirus and poliovirus vaccination”. The study had recruited 620 children who were identified from a birth cohort and examined at 35 days of life by a pediatrician and was found to be clinically normal. There was no multivitamin supplementation provided routinely as part of the study.

These children were followed up at 1 year of age for immunological assays and our study was done on these children between November 2013 and February 2014. Out of the 620 children, 125 children were excluded as their guardians did not provide consent or were lost to follow up. We included 495 children after a written informed consent from the guardians. The study was approved by the institutional review board and ethics committee (dated 13.07.2011).

Demographic details including perinatal and neonatal history, vaccination history, breast feeding duration, and history of illnesses were obtained. Weight was measured in kilograms by standard digital infant weighing scale, length was measured in centimeters using infantometer and mid upper arm circumference was measured by standard inch tape. Z scores were calculated for weight for age, height for age, weight for height, and head circumference by WHO anthro software. Z score of –2 to +2 was considered as normal. The infants were examined by a pediatrician for clinical evidence of rickets including wide open anterior fontanelle, widening of wrists, and knock knees.

Venous sample for Vitamin-D was obtained and analysis was performed by the electro Chemiluminescence immunoassay method (ECLIA –Roche E170 immunoassay system). The measurement range of the assay was 3.0 to 70.0 ng/ml. Vitamin D level more than 20 ng/ml was taken as normal, less than 20 ng/ml as deficiency and values less than 5 ng/ml was considered as severe deficiency.<sup>[9]</sup> Statistical analysis was performed using SPSS statistics version 20. Univariate and multivariate analysis were done to assess the effects of various factors on vitamin D levels.

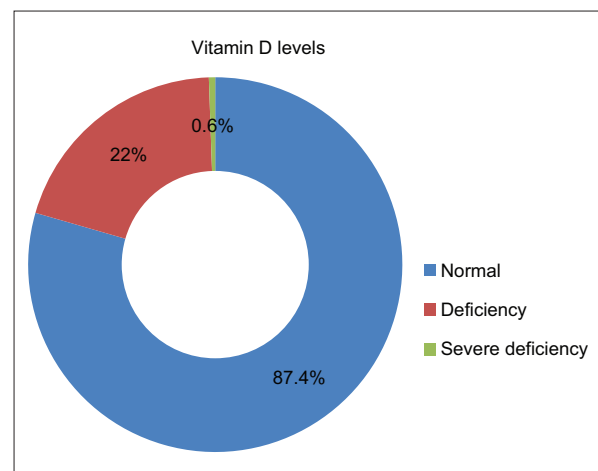
## Results

Out of the eligible 620 children, 495 children were included in the study following parental consent at a mean age of 14.32 months (12–19 months). Girls were 254 (51.3%) and boys were 241 (48.7%). 97% of the infants were born in a hospital. A total of 258 (52%) infants were exclusively breastfed till 6 months of age. Eighty (16%) children were found to be underweight and 5 (1%) children were severely malnourished. None of the children had pedal edema.

Vitamin D deficiency was noted in 22% (n = 109) children among which severe deficiency was noted in 0.6% (n = 3) of the children [Figure 1]. None of them had clinical features of rickets. All 109 children who were detected to have hypovitaminosis-D later received treatment with Vitamin-D.

Among the 258 children who were exclusively breast fed for 6 months or more, 14% (n = 36) were underweight and 17.8% (n = 46) were found to be Vitamin-D deficient; whereas, of the 237 children who were breast fed for less than 6 months, 18% (n = 44) were underweight and 26.6% (n = 63) had low Vitamin-D Levels [Table 1].

On univariate analysis of various factors to explore their association with Vitamin-D deficiency, only exclusive breastfeeding for duration more than 6 months was a significant factor (p 0.02). However, multivariate analysis using ordinal regression after controlling



**Figure 1:** Distribution of Vitamin D levels in the study population

for other factors showed none of the factors were significantly associated with increased risk of Vitamin-D deficiency [Table 2].

## Discussion

Cutaneous vitamin D<sub>3</sub> (cholecalciferol) and the Vitamin D<sub>2</sub> (ergocalciferol) derived from the plant sources are converted into 25(OH) cholecalciferol in the liver. This further undergoes hydroxylation into 1, 25 OH Vitamin D in the kidneys. 25(OH) Vitamin D is the major circulating form of Vitamin D and their levels best indicate the total body Vitamin D status.<sup>[12]</sup> Vitamin D levels in the infants are dependent on the transfer from mother through breast milk, sunlight exposure and dietary sources.

High prevalence of vitamin D deficiency in the community is a major health problem. Vitamin D has an implication on the general wellbeing and the optimal bone growth in children.<sup>[13]</sup> Hypovitaminosis D is associated with various illnesses in children including recurrent respiratory infections, impaired growth, and malnutrition.<sup>[14]</sup> Awareness of the prevalence and consequences of hypovitaminosis D in infants among the primary care providers can assist in curbing the problems of childhood rickets and preventing the adverse effects of hypovitaminosis D. This study is relevant for primary care practitioners as it identifies the

prevalence of Vitamin D deficiency among the healthy infants in the community and increases the awareness on the magnitude of the public health problem caused by hypovitaminosis D.

Our study was a community-based study done among healthy children aged 12–19 months in an urban low income setting in south India. Vitamin-D deficiency was present in 22% of the children with only 0.6% having severe deficiency.

In previous studies, the prevalence of hypovitaminosis-D ranged from 84.9 to 100% among school-going children and 44.3 to 66.7% among infants.<sup>[15]</sup> A high prevalence of Vitamin-D deficiency (86%) in healthy term born infants at the age of 3 months was noted which was more prevalent in exclusively breast fed infants in another study.<sup>[16]</sup>

In a study done in Vellore, Tamil Nadu, prevalence of Vitamin D deficiency was noted to be 64.8% in the antenatal women and prevalence of 72.8% in their infants who were followed up between 10 and 20 weeks of age.<sup>[4]</sup> Our study showed that in our urban community, the prevalence of Vitamin-D deficiency in infants at 1 year of age was lower than the previous studies. Though our study showed lower prevalence than the previous studies, 22% is still a significant burden in the community. Prevalence of more than 20% is considered as high in low- and mid-income countries and warrants food fortification and supplementation policies to be implemented in that community.<sup>[17]</sup>

In an exclusively breast fed infant, the serum Vitamin D levels are dependent on the amount of vitamin D transferred from the breast milk and the duration of sunlight exposure.<sup>[18]</sup> Hypovitaminosis D in infants has been linked to various causes which include poor sunlight exposure, poor dietary intake, obesity, and chronic illness.<sup>[19]</sup> We found that none of the factors assessed were associated with hypovitaminosis-D, though exclusive breast feeding beyond 6 months showed an increased trend towards hypovitaminosis-D. The lack of effect of breast

**Table 1: Demographic details**

Characteristics	Normal Vitamin D (>20 ng/ml)	Low Vitamin D (<20 ng/ml)
Gender		
Male (n=241)	194 (80.5%)	47 (19.5%)
Female (n=254)	192 (75.6%)	62 (24.4%)
Exclusive breastfeeding		
>6 months (n=258)	212 (82.2%)	46 (17.8%)
<6 months (n=237)	174 (73.4%)	63 (26.6%)
Weight for age		
<2 SD (n=80)	65 (81.2%)	15 (18.8%)
Anaemia (n=220)	167 (75.9%)	53 (24.1%)

**Table 2: Effect of studied factors on Vitamin D deficiency**

Characteristics	Normal Vitamin D	Low Vitamin D	Univariate analysis (P)	Multivariate analysis (P)
Gender				
Male (n=241)	194 (80.5%)	47 (19.5%)	0.189	0.197
Exclusive breastfeeding				
>6 months (n=258)	212 (82.2%)	46 (17.8%)	0.020	0.096
Weight for age				
<2 SD (n=80)	65 (81.2%)	15 (18.8%)	0.442	0.252
Anemia (n=220)	167 (75.9%)	53 (24.1%)	0.320	0.471
History of Ear Infection (n=49)	36 (73.5%)	13 (26.5%)	0.423	0.843
History of Skin Infection (n=11)	7 (63.6%)	4 (36.4%)	0.255	0.375
History of Pneumonia (n=9)	7 (77.8%)	2 (22.2%)	0.988	0.973
History of Diarrhoea (n=27)	22 (81.5%)	5 (18.5%)	0.652	0.667

feeding in our study is likely to be because of the lower prevalence of Vitamin-D deficiency in our study.

The limitations of our study include lack of detailed dietary recall, inadequate information on sunlight exposure and assessment of maternal vitamin D levels for correlation. More studies to evaluate the routine child rearing practices and measuring maternal Vitamin D in this community may be useful in determining the cause for lower prevalence of hypovitaminosis-D and the lack of effect of breast feeding on hypovitaminosis-D.

## Conclusion

This study emphasizes the issue of hypovitaminosis-D in otherwise normal children in community as a significant burden and the need for larger studies at community level to consider Vitamin-D supplementation of infants irrespective of duration of breast feeding. Routine Vitamin-D supplementation for antenatal and lactating mothers and their young infants may help to overcome this emerging public health issue.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, parents of the infants have given consent for the clinical information to be reported in the journal. The parents understand that the names will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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