

Original Research Article

Vitamin D status in exclusively breastfed infants and their mothers

C. R. Vignesh Kumaran¹, K. V. Sivakumar¹, R. Suresh Kumar^{2*}

¹Department of Paediatrics, Government Medical College, Omandurar, Government Estate, Chennai, Tamil Nadu, India

²Department of Paediatrics, KGH, Madras Medical College, Chennai, Tamil Nadu, India

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*Correspondence:

Dr. R Suresh Kumar,

E-mail: drsureshkumarr@gmail.com

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ABSTRACT

Background: The prevalence of hypovitaminosis D in exclusively breastfed infants was found to be 82%, 52% and 20 % from UAE, Pakistan and China respectively but there is a paucity of data from India regarding the same.

Methods: Prevalence of subclinical Hypovitaminosis D in exclusive breastfed babies and their mothers. This study was a descriptive study conducted among breastfed infants and their mothers to reconnoitre the vitamin D level status. All exclusively breast fed healthy term babies with birth weight >2.5 kg who are less than 6 months of age and its mothers. The existence of correlation in the mean vitamin D level between the exclusively breastfed mothers and its infants.

Results: The infants status of vitamin D deficiency and insufficient was 91.9% and 8.1% respectively. The mothers status of vitamin D deficiency and insufficient was 78.3% and 21.7% respectively.

Conclusions: Hypovitaminosis D was highly prevalent among mothers living in tropical area irrespective of diet habits or socioeconomic group. There was a significant positive correlation in the mean Vitamin D level of the mothers and their exclusively breastfed infants.

Keywords: Hypovitaminosis D, Vitamin D deficiency, Breastfeeding, rickets

INTRODUCTION

Hypovitaminosis D is a predominant infant related public health problem even among breastfed infants. Subclinical hypovitaminosis D was seen among new-born infants born to vitamin D replete mothers were at higher risks. Such infants were to be protected from vitamin D deficiency in first few months of life. The 25-hydroxyvitamin D crosses the placenta readily and its neonatal concentration approximately equals two-third concentration of mother's 25-OHD source.¹

Serum 25-OHD has a half-life of approximately 3 weeks, thus providing some protection against vitamin D deficiency for the first two months even if the young infant does not receive vitamin D, whereas an infant who is exclusively breast fed and who gets minimal sunlight exposure or an infant who is on a non-fortified milk the

risk of developing vitamin D deficiency rickets by 4-6 months of age is very high.²⁻⁴

Exclusive breastfeeding is recommended up to 6 months of age with all its beneficial effects on child survival. Globally as many as 1.45 million lives are lost due to suboptimal breastfeeding in developing countries.⁵ World Health Organization (WHO) analysis of childhood deaths has listed suboptimal breastfeeding as one of the most important shared risk factors and estimated that 1.3 million deaths can be prevented in 42 high mortality countries by increasing the level of breastfeeding amongst infants.

The increase in the practice of breastfeeding associated with the belief that "breast is best" and that breast milk does not require supplementation because it is a baby's "perfect food".^{6,7} The prevalence of hypovitaminosis D in exclusively breastfed infants was found to be 82%, 52%

and 20% from UAE8, Pakistan9 and China respectively but there is a paucity of data from India regarding the same.¹⁰

It has been estimated that breast milk from a vitamin D replete mother contains between 20 and 60 IU/l of vitamin D and hence adequate intake of vitamin D cannot be met with human milk as the sole source of vitamin D in a breastfeeding infant.^{11,12}

There is a paucity of data from India regarding Vitamin D status of their mothers and their new-born infants. This study aimed to find the prevalence of subclinical hypovitaminosis D in exclusive breastfed babies and their mothers in a tertiary care hospital.

METHODS

All Mothers and their new-borns visiting the vaccination clinic were approached for study participation. A prospective study was conducted in the department of paediatrics and neonatology in a Sree Balaji Medical College Hospital, in Chennai, India. The study was approved by the Institutional Ethics Committee and carried out between June 2014 and July 2015. The Parental consent was taken to involve both mothers and their infants in the study after taking written informed consent and the mother's relevant informations were recorded in the pre structured questionnaire.

The calculated sample size for an anticipated prevalence of Vitamin D deficiency of 80 % to fall within 10 percent of true prevalence with 95% confidence was 128. However, because of logistic constraints it was planned to enroll 37 infants and 37 mother's dyads.

The inclusion criteria for study participation was, healthy term babies of age less than 6 months on exclusive breast feeding and their mothers and singleton mothers

The exclusion criteria for study participation were, Infants who are not exclusively breast fed; Mothers and infants who had other illnesses; Infants on vitamin D, Multivitamin or any other supplementation (Calcium, Phosphorus); Mothers who are receiving Vitamin D, Calcium or other mineral supplementation; Infants suffering from any illness; Mothers suffering from any illness and mothers and infants from multiple pregnancy.

Data regarding the socio-demographic details like education, occupation and income were obtained. Details regarding the mode of feeding of infants, supplementation of any Vitamin or Calcium to infants, mother's intake of Calcium and Vitamin D supplementation during lactation were enquired. Anthropometric measurements such as length, weight and head circumference of the infants were measured. Clinical examination of the mother and infant to rule out systemic illness and status was classified as per the modified Kupuswamy scale of classification (2013).

4 ml of whole Blood was drawn from both the mother and infant for estimation of 25(OH) D3 (Vitamin D). The Estimation was done using VIDAS total KIT. The measurement range extends from 8.1 ng/ml upto 126 ng/ml. Values below the lower limit of the measurement range are reported as <8.1 ng/ml. Values above the upper limit of the measurement range are reported as >126.0 ng/ml.

Statistical analysis

Statistical analysis was done by using Chi-square test, One-way Anova f-test and Student independent t-test. Correlations were studied using Karl Pearson correlation coefficient by using Statistical package for social sciences (SPSS) 20.0 statistical software.

RESULTS

There were 37 infants and 37 mothers involved in the study. Deficient of Vitamin D and insufficient of Vitamin D in both groups i.e. infants and mothers were 34 (91.8%) and 3 (8.2%) and 29 (78.3%) and 8 (21.7%) respectively. (Table 1)

Table 1: Infants versus mother - vitamin D status.

Vitamin D Status	Number of infants (n= 37)	Number of mothers (n= 37)
Deficient	34 (91.8 %)	29 (78.3 %)
Insufficient	03 (8.2 %)	08 (21.7 %)

Table 2: Infants vitamin D status (n=37).

	Mean vitamin D ng/ml	SD	One way ANOVA F-test / t-test
Age (in months)			
0-1	12.58	5.68	F=1.16 p=0.34 not significant
1-2	10.75	3.84	
2-3	10.14	2.66	
3-4	14.04	4.03	
4-5	9.45	9.45	
Gender			
Male	10.67	3.42	F=0.83 p=0.40 not significant
Female	11.75	11.75	
Infants weight (in kg)			
3.0-3.5	11.32	5.00	F=1.26 p=0.30 not significant
3.6-4.0	10.00	2.54	
4.1-4.5	11.84	2.89	
4.6-5	13.80	13.80	

The number and percentage of infants based on age were 0-1 month in 5 (13.5%), 1-2 months in 16 (43.2%), 2-3 months in 9 (24.3%), 3-4 months in 5 (13.5%) and 4-5 months in 2 (5.4%).

The number and percentage of infants based on weight were 3.0 to 3.5 kg in 13 (35.1%), 3.6-4.0 kg in 14 (37.8%), 4.1-4.5 kg in 5 (13.5%) and 4.6-5.0 kg in 5 (13.5%).

Table 3: Mothers vitamin- D status (n=37).

	Mean Vit D ng/ml	SD	One way ANOVA F-test/t-test
Mothers age and vitamin D mean levels (years)			
18-20	18.20	7.39	F=3.66 p=0.05* significant
21-25	17.88	5.60	
26-30	13.08	4.70	
Mother's weight and vitamin D levels (kg)			
<60	16.43	5.64	F=0.79 p=0.50 not significant
61-65	14.66	5.57	
66-70	14.22	5.73	
>70 kg	11.13	3.72	
Mothers diet and vitamin D mean levels			
Mixed	15.50	5.32	t=3.06 p=0.001*** significant.
Vegetarian	8.77	0.73	
Mothers socio economic status and their Vitamin D mean levels			
Lower	11.25	7.00	F=3.65 p=0.05* significant
Lower middle	12.82	5.54	
Upper lower	17.59	5.69	

Table 4: Correlation between mothers vitamin D level and baby's vitamin D Level.

Vitamin D level	Mean Vit D ng/ml	SD	Correlation relation
Mothers	14.41	5.47	r=0.73
Infants	11.22	3.89	P=0.001***

The mean vitamin D level of the infants were 12.58 ng/ml, 10.75 ng/ml, 10.14 ng/ml, 14.04 ng/ml and 9.45 ng/ml found infants of 0-1 month, 1-2 months, 2-3 months, 3-4 months and 4-5 months respectively. There is no association between the age of infant and the mean Vitamin D levels (p=0.34, not significant).

Out of 37 infants the female and male were 19 (51.4%) and 18 (48.6%) respectively. The mean Vitamin D level in female and male infants were 11.75 ng/ml and 10.67 ng/ml respectively. There was no association between the gender of the infants and the mean Vitamin D levels. (p=0.40 and is not significant).

The mean Vitamin D level based on infant's weight of 3 to 3.5 kg, 3.6 to 4 kg, 4.1 to 4.5 kg and 4.6 to 5.0 kg were 11.32 ng/ml, 10 ng/ml, 11.84 ng/ml and 13.80 ng/ml respectively. There is no association between the weight of the infants and the mean Vitamin D levels. (p=0.30 and is not significant). (Table 2)

Total number of mothers in between age groups 18-20, 21-25 and 26-30 years were 4 (10.8%), 17 (45.9%) and 16 (43.2%) respectively.

The mean Vitamin D levels of mothers between age 18-20, 21-25 and 26-30 years were 18.20 ng/ml, 17.88 ng/ml, and 13.08 ng/ml respectively. The teen age mothers (18-20 years) had a higher Vitamin D levels compared to age groups 21-25 and 26-30 years which is statistically significant (p=0.05).

The mean vitamin D levels against mothers weight groups <60 kg, 61-65 kg, 66-70 kg and >70 kg were 16.43 ng/ml, 14.66 ng/ml, 14.22 ng/ml and 11.13 ng/ml respectively. There was no association between the mean vitamin D levels and weight of the mothers, (p=0.50 and is not significant).

Among 37 mothers, 7 (18.9%) and 30 (81.1%) mothers followed vegetarian diet and mixed diet, respectively. The former and later diet habit mothers had 8.77ng/ml and 15.5ng/ml of mean vitamin D level respectively. The mothers following mixed diet had a higher levels of vitamin-D level than vegetarian mothers. (p=0.001 and is significant).

The socio-economic status of 37 mothers were, 2 (5.4%), 11 (29.7%) and 24 (64.9%) of lower, upper lower, and lower-middle class respectively. None of the mothers belonged to upper and upper middle socio-economic status. (Table 3)

The mean vitamin D level based on mothers economic was 14.25 ng/ml, 14.82 ng/ml and 15.59ng/ml among lower economic, lower middle and upper lower class. The mean Vitamin D levels of the mothers belonging to the lower class is lower than the rest of the economic classes (p=0.05 is significant).

There is a significant, substantial, positive correlation between the mean Vitamin D of mothers and their infants. Karl Pearson Correlation coefficient (r=0.73). Mother's Vitamin D level with mean 14.41 / SD 5.47 and Baby's Vitamin D level with mean 11.22 / SD 3.89. (Table 4)

In our study we have included all exclusively breastfed infants <6 months of age and their mothers. Male and female distribution was almost equal (48.6% - male infants, 51.4% - female infants). In our study the youngest age was 15 days and the oldest age was 4 months 25 days. 18.9% of the mothers were vegetarian and the remaining 81.1% of them were on mixed diet. Regarding the socioeconomic status 29.7% of them belongs to Upper lower socioeconomic group, 64.9% of them belongs to lower middle class 5.4% of them belongs to lower socioeconomic group. None of them were from upper and upper middle socioeconomic group.

In our study 78.3% of the mothers were Vitamin D deficient and 21.7% of the mothers were Vitamin D

insufficient. Regarding the Vitamin D status of the infants, we found that 91.9% of the infants were Vitamin D deficient and 8.1% of the infants were Vitamin D insufficient.

DISCUSSION

Infants who are exclusively breastfed but who do not receive supplemental Vitamin D3 or adequate sunlight exposure are at high risk of developing Vitamin D deficiency and rickets. Infants with darker pigmentation are at greater risk of Vitamin D deficiency due to the increased melanin pigmentation which prevents the absorption of ultraviolet rays.¹⁴ There is also decreased Vitamin D content in the milk from mothers who are themselves deficient.¹⁵

The reduced outdoor activity, pigmented skin and excessive clothing such as purdah were responsible for hypovitaminosis D.

In our study the mean serum 25 OHD concentration in mothers were 14.41 ng/ml and infants were 11.22 ng/ml. So there is a definite positive correlation between the maternal and infants Vitamin D levels. The infant's Vitamin D level is lower than that of maternal's Vitamin D level.

But in our study we found that the mean Vitamin D levels of mothers belonging to lower socioeconomic status is lower than the mean Vitamin D levels of mothers belonging to the other socioeconomic statuses. There was a strong association between socioeconomic status and serum levels of vitamin D.¹⁶

The most important finding in our study is the unexpectedly high prevalence of hypovitaminosis D among lactating mothers and their babies. The physiologic relevance of the finding is substantiated by the positive correlation with the exclusively breast fed infant's 25-OHD level.

Western countries may have a low availability of overhead sun may have coupled the effect of hypovitaminosis D among lactating women. On the other side the south Asia women have a widely reported hypovitaminosis D among pregnant and lactating women.¹⁷

Mothers should be advised to have adequate sunlight exposure to increase their Vitamin D levels. This will in turn help to increase the fetal Vitamin D levels.

It is important to note that women with increased skin pigmentation or who have little exposure to sunlight are at a greater risk of Vitamin D deficiency and may need additional Vitamin D supplements, especially during pregnancy and lactation.

Hypovitaminosis D is an emerging public health problem. It is prevalent in all over the world even in the people living in the tropical regions.¹⁸

In India hypovitaminosis D is highly prevalent. It is in fact equally prevalent both in North and South India. This study was done in Chennai, South India in a limited population of mothers and their infants.¹⁹

All the Vitamin D deficient cases in the study were asymptomatic. Some larger studies may be needed to assess the magnitude of the problem in this part of the country.

In view of the positive correlation between the Vitamin D status of the mother and exclusively breastfed infants, improving the Vitamin D levels of the mothers may also improve the Vitamin D levels of the infants.

Larger studies and meta-analysis should be conducted to confirm the findings of the present study. The findings of our study indicate that urgent steps need to be taken to implement a program and consider Vitamin D fortification of foods, like milk which is commonly consumed by the pregnant and lactating women and their infants.

Mothers should also be encouraged to get adequate sunlight exposure. All these measures will go a long way in preventing hypovitaminosis D in this vulnerable segment of the population.

The study shall be conducted in larger population consisting both the rural and the urban population, which is the limitation of the study.

CONCLUSION

Hypovitaminosis D is highly prevalent in Chennai though a tropical zone. It is prevalent in all segments of population (all socioeconomic group, mothers consuming vegetarian or non-vegetarian diet). There is no association between the gender, age and weight of the infant and the mean Vitamin D levels. There is a significant, substantial positive correlation between the mean Vitamin D level of the mothers and their exclusively breastfed infants.

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