Assessment of Vitamin D Levels in Healthy Infants: A Cross-Sectional Survey Highlighting the Relationship of Vitamin D with Feeding Habits

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Abstract

Objective: To know and assess the levels of Vitamin D in healthy infants without having the signs of Vitamin D deficiency on radiological and clinical aspects.

Methods: This was a cross-sectional study carried out at Baqai Medical University Hospital Karachi. The sampling technique used was non-probability consecutive. Total 145 infants were included in this cross sectional study that were apparently healthy and showed no features of Vitamin D deficiency clinically and radiologically within the age of two to six month. Sample size calculated was 145. Infants on Vitamin D supplementation, with renal, hepatic or congenital heart disease, gastrointestinal problems, low birth weight and intrauterine growth retardation were excluded from the study.

Results: The feeding habits were breast feeding, formula feeding and mixed feeding as 62 (72.7%), 41 (28.3%) and 42 (29%) respectively. Vitamin D level were defined in three categories in which 57 (39.3%) were deficient, 39 (27%) were insufficient and 49 (33.8%) were found to be sufficient. Vitamin D levels were compared with weight to know the significance. It was discovered that Vitamins D and weight had a significant association with p-value of 0.02. There was no difference observed in length and Vitamin D levels with a p-value of 0.155 and OFC (occipital-frontal circumference) and Vitamin D levels with p-value of 0.491.

Conclusion: Frequency of Vitamin D deficiency and insufficiency is quite common even in apparently healthy infants. The levels of Vitamin D in normal healthy infants of two to six month of age were deficient. Furthermore, Vitamin D deficiency was related to the feeding habits of the infants. The infants on breast feeding had sufficient Vitamin D levels in most cases whereas it was deficient in formula and mixed feed of infants.

Keywords: Vitamin D levels, infants, feeding behavior, breast feeding, infant formula.

IRB: Approved by Ethics Committee of Baqai Medical University. **Dated:** 11th July 2017.

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Introduction

Vitamin D is included in group of fat soluble prohormone that is steroid in nature; the two main forms of which are ergocalciferol or Vitamin D2 and cholecalciferol or Vitamin D3. Vitamin D2 comes from plant sources while Vitamin D3 is mainly synthesized in the skin when skin is exposed to ultraviolet rays in natural sunlight. The dietary sources of Vitamin D3 include fatty fish, whole egg, beef liver, mushrooms and supplements[1].

Vitamin D has been documented for its action on calcium regulation by acting at the levels of the kidney, intestine, and bone. Thus, modifying the calcium levels[2,3].

Vitamin D plays a significant role in preserving an acceptable level of serum calcium and phosphorus. In the absence of Vitamin D, only 10% to 15% of nutritional calcium and about 60% of phosphorus is absorbed, thus producing an important influence

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on formation and maintenance of stronger bones. The biological effect of Vitamin D on mineral metabolism is regulated by the recent discovery of Vitamin D receptors that existed in variety of cells[4-6].

The existing everyday recommendation for Vitamin D is 400 IU in all age groups. However, it is projected that Vitamin D deficit occurs in 50% of children and adolescents. Therefore, the maintenance of virtuous bone strength and hindrance of osteoporosis is secondary to the adequate levels of Vitamin D and its deficiency can lead to osteoporosis in adults and rickets in children[7-9].

However, the dominance and substantial consequences for the prevalence of disorders of calcium, phosphorus and bone metabolism are related to the insufficiency of Vitamin D levels in such a large proportion of population[10,11].

The Vitamin D deficiency and rickets were primarily observed as complications of industrialised countries at northern latitudes in the previous century due to the inadequate contact to sunlight and consumption of Vitamin D were related to in sufficient intestinal absorption of calcium causing unbalanced mineralisation of skeleton[12]. The causative mechanism and potential hazards of Vitamin D insufficiency can be identified by the information of the Vitamin D status of young children and infants.

Acute Respiratory Infection is a leading cause of deaths in Asian population. Research suggests that Vitamin D deficiency puts children at high risk of acute lower respiratory tract infections due to decreased immunity. Vitamin D supplementation may decrease the susceptibility of decreased respiratory tract infections[13-15]. This study was intended to know and evaluate the levels of Vitamin D in healthy infants without having the signs of Vitamin D deficiency on radiological and clinical aspects. These levels will assist the physicians to provide supplements and diet therapy to the infants who are deficient.

Patients and Methods

This was a cross-sectional study carried at Baqai Medical University Hospital, Karachi, for six months from January 2015 till December 2015. Ethical approval was taken from the Baqai Medical University. One of the study Jorden Catherile M et al. study was published in 2008 in Pediatric & Adolescence General, according to this study the prevalence of Vit-D deficiency among healthy infants was found 12.1% with 95% confidence interval (C-I) 5% level of significance and 5.5% margin of error (d) final sample size was 136 number of healthy infants but due to lack of compliance a size 145[16-17] was included. The sampling technique used was non probability consecutive. Total 145 infants who were healthy and showed no features of Vitamin D deficiency with the age of two to six month were included in the study. Demographic variables like age, weight, and height and occipital-frontal circumference were recorded. The history of vaccination, illness, jaundice, and hospitalisation at birth was documented. Three millilitre blood samples were drawn in a gel tube to assess the Vitamin D levels which was done through radioimmunoassay technique with Diasorin SRH kits being used[18-19]. A verbal consent was taken from the infants' parents and Vitamin D levels were classified as <20 gm/dl, between 21-30 gm/dl and more than 30 gm/dl as deficient, insufficient and sufficient respectively. The x-rays of wrists were also done to exclude the features of Vitamin D deficiency. The feeding habit of the infant was asked and documented into three categories including breast, formula and mixed feeding. The infants on Vitamin D supplementation, having renal hepatic or congenital heart disease and gastrointestinal problems, low birth weight, intrauterine growth retardation were excluded from the study.

Data was entered and analysed by SPSS version 19. Quantitative variables like age, weight, height and occipital-frontal circumference (OFC) were analysed as mean and standard deviation. Frequencies and percentages were expressed for qualitative variables. Chi-square was used to test

Table 1. Comparison with anthropometric parameters and Vitamin D level

Vitamin D Category			Statistic	p-value
Weight (Kg)	<20 Deficient	Mean	6.27	
		Std. Deviation	1.12	
	21-30 Insufficient	Mean	5.61	
		Std. Deviation	1.120	0.020
	>30 Sufficient	Mean	5.92	
		Std. Deviation	1.16	
Height (cm)	<20 Deficient	Mean	60.77	
		Std. Deviation	3.48	
	21-30 Insufficient	Mean	59.13	
		Std. Deviation	4.17	0.155
	>30 Sufficient	Mean	59.99	
		Std. Deviation	4.59	
Occitpito frontal diameter (cm)	<20 Deficient	Mean	40.74	
		Std. Deviation	3.53	
	21-30 Insufficient	Mean	39.99	
		Std. Deviation	3.21	0.491
	>30 Sufficient	Mean	40.75	
		Std. Deviation	3.23	

*One way ANOVA was for statistical significance.
p<0.05 considered to be statistically significant.

Table 2. Comparison of Vitamin D levels with FH

	Feeding Habit			Total	p-value
Vitamin D Levels	Mother Feeding	Formula Feeding	Mixed Feeding		
<20 Deficient	16	11	30	57	0.001
	11.0%	7.6%	20.7%	39.3%	
21-30 Insufficient	13	22	4	39	
	9.0%	15.2%	2.8%	26.9%	
>30 Sufficient	33	8	8	49	
	22.8%	5.5%	5.5%	33.8%	
Total	62	41	42	145	
	42.8%	28.3%	29.0%	100.0%	

*Chi square test applied to see the significance. p<0.05 considered to be statistically significant.

any difference between the categories. p-value of less than 0.05 was taken as significant

Results

A total of 145 infants were enlisted for this study for the assessment of Vitamin D levels. Mean age of infants was found to be 3.6 ± 1.3 months. Mean weight was found to be 5.97 ± 1.15 kg, mean height was 60.0 ± 4.09cm; mean OFC observed was 40.5 ± 3.33 cm (Figure 1).

The feedings habit infants between two to six months of age group were mother feeding, formula feeding and mixed feeding as 62 (42.75%), 41 (28.3%) and 42 (29%) respectively.

Vitamin D levels was defined in three categories in which 57 (39.3%) were deficient 39 (27%) were insufficient and 49 (33.8%) were found to be sufficient.

Vitamin D levels were compared with weight to know the significance. It was discovered that Vitamins D and weight had a significant association with p-value of 0.020. The infants weight was proportionate to the Vitamin D levels if Vitamin D was low weight would not increase according to the age. There was no difference observed in height and Vitamin D levels with a p-value of 0.155 and OFC and Vitamin D levels with p-value of 0.491 (Table1).

Out of 43% of mother feeding pattern 11% were deficient 9% were insufficient and 22% were having sufficient Vitamin D levels with a significant P-value 0.001. In formula feeding 8% were deficient, 15% were insufficient and 6% were sufficient. In mixed feeding 20% were deficient 31% were insufficient and 6% sufficient with a significant p-value 0.001 (Table 2).

The comparison that 23% of mother feeding; 6% of formula feeding; and 6% of mixed feeding had sufficient Vitamin D levels and 50% were having deficient and insufficient Vitamin D levels. About 9% of babies on mother feed, 15% on formula feed and 3% with mixed feeding pattern, infants had insufficient Vitamin D levels. About, 11% of babies fed

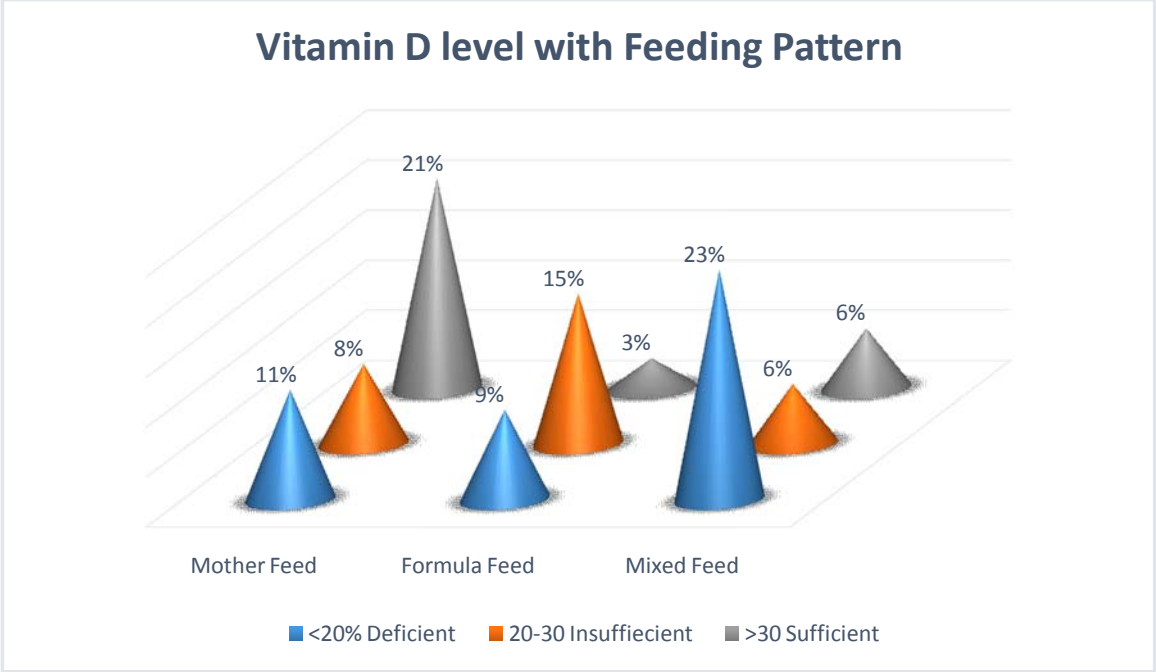

Fig 1. Chart showing Vitamin D Sufficiency, Insufficiency and Deficiency levels (in %) in Mother Feed, Formula Feed and Mixed Feed Pattern.

mother's milk, 8% formula feed and 21% with mixed feeding had deficient Vitamin D levels (Figure 1).

Discussion

This study implies the importance of Vitamin D for the prevention of nutritional rickets which is much more common in our country. Being a part of third world, one of the major problems is maternal and child health and the burning issue of child health include nutrition and nutritional rickets. Vitamin D deficiency can develop early in infancy and initially without clinical symptoms and its supplements may offer promising results in reducing its deficiency and associated morbidity, without risk of any serious adverse effects. The lactating mothers and pregnant females who are previously deficient in Vitamin D must be supplemented as breastfeeding does not prevent rickets in this condition. American Academy of Paediatrics recommends that all infants and those who are absolutely breastfed should have a minimum intake of 400 IU Vitamin D per day beginning as early as the first two months of life[20-21]. However, there are few studies suggesting that 400 IU is inadequate[22].

Studies revealed that two third of healthy infants were having Vitamin D levels below normal. The deficiency of Vitamin D (rickets and osteomalacia) and its prevalence is epidemic and very high worldwide[23-24]. The prevalence of Vitamin D deficiency among 12 to 24 month old infants was found to be 65.3% in China[25], which is in accordance with our study in which 66% of infants were having insufficient to deficient Vitamin D levels (the study population is different) regardless of the feedings pattern. The storage of Vitamin D in newborns depend on the mother stores, consequently

the mother with deficiency of Vitamin D will be expected to give birth to the new-born lacking in Vitamin D due to reduction in transfer during pregnancy[26].

One of the study established that breast feeding is related with the confidence that breast is best and perfect food does not require Vitamin D supplements may lead to reduced 25-hydroxy Vitamin D (25-OHD) consumption from additional sources and thus triggering rickets. In this assessment, it was attempted to debate the explanations for Vitamin D deficiency in entirely breast-fed infants and summarise the clinical manifestations, management and strategies for prevention of this nutritional disorder. This is in accordance with our study in which 50% of the infants were having deficient Vitamin D levels. Breast feeding is best, should be initiated immediately, after birth, and mothers should be encouraged to feed and also supplementation of Vitamin D to mothers and baby during lactation should be done. The need for supplementation of the Vitamin D must be encouraged and promoted through public education by primary health care providers and emphasis on the notion of "breast is best" should not dominate the exposure to sunlight and regular supplementations.

Very few studies have been done which have co-related the level of Vitamin D of mother and baby, a study done has shown a positive correlation between Vitamin D levels in maternal and cord blood[27]. However, further studies are needed with follow up for at least 3 to 6 months of both mother and newborn.

Conclusion

Frequency of Vitamin D deficiency and insufficiency is quite common even in healthy infants. The levels of Vitamin D in normal healthy infants of two to six month of age are deficient. Furthermore, it is related to the feeding habits of the infants. The infants on breast feeding had sufficient Vitamin D levels in most cases whereas it was deficient in formula and mixed feed infants. Our limitations include observer bias and a cross-sectional design. Other limitations include lack of case and control study design, mother levels of Vitamin D were not taken and matched with the babies due to resource constraint. We were unable to document the socioeconomic strata of the family, which may play a part in Vitamin D deficiency in our population especially if the families are from low socioeconomic strata. Also, most importantly we were not able to document whether the baby was already being given Vitamin D.

Reflecting the deficiency of Vitamin D and to what variety they are consistent with the clinical features of Vitamin D deficiency would be informative and important to homogenise the misconceptions about levels of Vitamin D in infants.

It is recommended that it is essential to reflect execution of a Vitamin D Supplementation programme in infancy at the community level to improve the Vitamin D levels in infants to the optimum levels.

Conflict of Interest

Authors have no conflict of interests and no grant/funding from any organisation for this study.

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