Original Article

Prevalence of Vitamin D deficiency in children aged 02–12 years attending outpatient service in a hospital in North East India

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ABSTRACT

Objective: This study was done to assess the Vitamin D status in children between age group of 2 and 12 years attending outpatient department (OPD) services. **Materials and Methods:** This cross-sectional observational study was done from September 2017 to August 2018 in a hospital in Tezpur, Assam. A total of 281 children were included in the study and serum 25-hydroxy vitamin-D (25(OH)D), calcium, phosphorus, and alkaline phosphatase were measured in the fasting state. Deficiency was defined as 25(OH)D values <20 ng/mL (50 nmol/L) with insufficiency as values 21–29 ng/mL (52.5–72.5 nmol/L) and sufficiency as values >30 ng/mL. **Results:** The prevalence of Vitamin D deficiency was found to be 21.1% and that of Vitamin D insufficiency to be 12.2%. We did not find any significant association between serum 25(OH)D and other factors such as duration of sunlight exposure or other biochemical parameters such as serum calcium, phosphorus, and alkaline phosphate levels. **Conclusion:** There was a high prevalence of biochemical hypovitaminosis D (deficiency and insufficiency) in children attending OPD in a hospital in northeast India.

Key words: 25-hydroxy vitamin-D levels, Alkaline phosphatase, Children, Prevalence, Sunlight exposure, Supplementation, Vitamin D deficiency

The role of Vitamin D in the skeletal development has long been emphasized and there is no dearth of scientific evidence over this subject [1]. In fact, the volume of scientific literature on Vitamin D; especially in adults and its implication in extra-skeletal diseases such as respiratory tract infection and skin ailments, has probably surpassed all studies done on any other vitamin deficiency [2-4]. In children, the focus has mainly been on infants and toddlers presenting with features of rickets [5,6]. However, there have been very few studies assessing the prevalence of Vitamin D deficiency in school children and preadolescent age group [7-10].

Indians have been found to have high prevalence of Vitamin D deficiency despite adequate sunlight exposure. The reasons behind such observation have been thought to be due to modern day lifestyle, more time spent indoors, cloud cover, and pollution [11]. Furthermore, genetic factors such as higher prevalence of certain polymorphisms in the Vitamin D binding protein associated with low Vitamin D levels, darker skin tone, low calcium and high fiber diet, and lack of fortification of food with Vitamin D may additionally contribute to prevalence of deficiency states [12,13].

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Tezpur has a geographical location of 26.6 N and 92.7 E. The average duration of cloud-free sunshine in this region is around 8–10 h/day throughout the year. Winter is short with a lowest temperature of 08°C and highest of 22°C. There is a little seasonal variation of the peak intensity of sunlight. With this background, the present study was carried out in children between the ages of 02 and 12 years attending outpatient department (OPD) services of our hospital in the city of Tezpur, Assam and also analyzes the correlation of various factors affecting the Vitamin D levels as mentioned in previous studies on this subject [7-10].

MATERIALS AND METHODS

This study was a cross-sectional observational study done from September 2017 to August 2018 in a hospital in Tezpur, Assam, involving children aged 02–12 year attending the outpatient services of our hospital. Children included in the study were those who presented to the OPD for various childhood ailments such as in any other normal pediatric OPD mostly including respiratory system issues, fever, acute gastroenteritis, pain abdomen, failure to thrive, reduced appetite, and inadequate growth. Blood samples for Vitamin D levels were collected along with other blood samples depending on case to case basis. Children were enrolled in the study as per Fig. 1.

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Inclusion criteria – all children in the age group of 2–12 years with no features of Vitamin D deficiency and rickets on examination and not on any medications which are likely to alter Vitamin D levels such as Vitamin D supplements, multivitamins, anti-tubercular drugs, steroids, and antiepileptic drugs. Children with comorbid conditions that affect Vitamin D synthesis and metabolism such as nephrotic syndrome, chronic renal failure, and rickets were excluded from the study. The study was approved by the institutional ethics committee. Informed consent was taken from parents before enrolment of children into the study.

A detailed general physical examination was carried out for all the children before enrollment into the study to rule out chronic disease conditions and congenital abnormalities or any existing features of vitamin deficiency such as genu varum or genu valgum. Anthropometric measurements included height, weight, and body mass index (BMI). Sunlight exposure was assessed as per validated questionnaire given to parents [12].

Fasting venous blood sample was collected for estimation of serum Vitamin D 25-hydroxy 25(OH)D using standard kits (VIDAS, intra-assay coefficient of variation [CV] 5%; interassay CV 6.9%). Furthermore, samples were taken for assessment of serum calcium, phosphorus, and alkaline phosphate levels. Classification of Vitamin D status was done as per US Endocrine Society classification [14]. Deficiency was defined as 25(OH)D values <20 ng/mL (50 nmol/L) with insufficiency as values 21–29 ng/mL (52.5–72.5 nmol/L) and sufficiency as values >30 ng/mL.

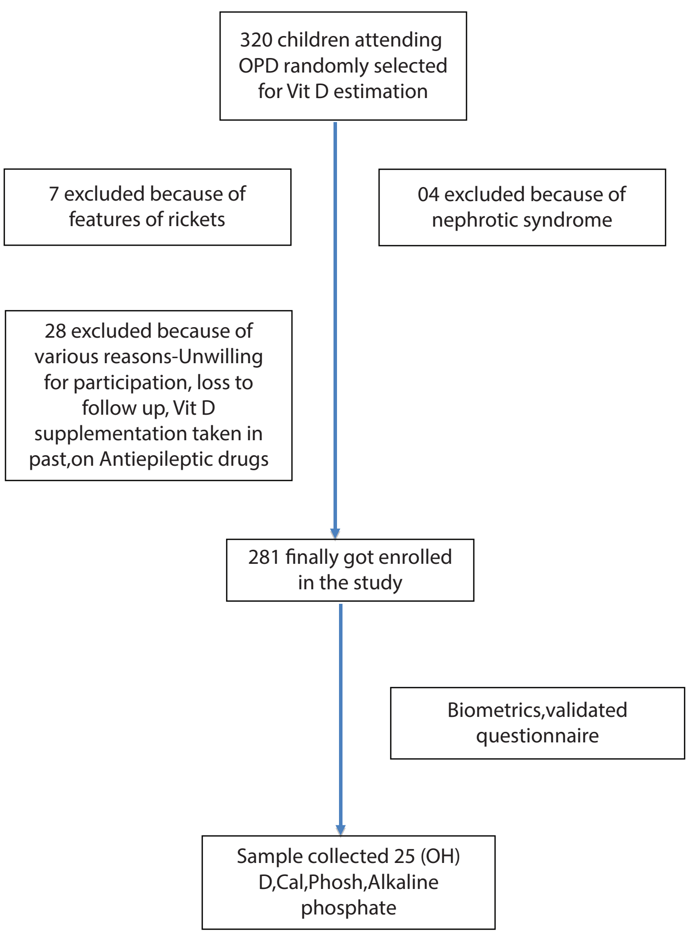

Figure 1: Flow chart for inclusion of children into the study group

Sample size was calculated based on prevalence of Vitamin D deficiency found in previous studies with confidence interval of 95% and alpha error of 5%. However, the limitation factor was number of Vitamin D level measuring kits. Statistical software SAS 9.3 was used to analyze the data. Quantitative data are presented as mean±standard deviation. Association of 25(OH) D with different variables was analyzed with the Chi-square test and the pattern of correlation was determined by the Pearson correlation. A $p<0.05$ was considered as statistically significant.

RESULTS

The general characteristics of the children enrolled in the study were similar between both genders with no significant differences in age, height, weight, BMI, and sunlight exposure (Table 1). The mean serum 25(OH)D concentration for the children was 31.6±2.9 ng/ml. In boys, the mean serum 25(OH)D levels was 34.1±3.5 ng/ml compared to 32.5±2.8 ng/ml in girls. No significant difference was seen between the two genders on comparison of serum calcium, phosphorus, and alkaline phosphate.

The prevalence of Vitamin D deficiency in our study was 21.1% and that for Vitamin D insufficiency was 12.2%. Out of the total 66.3% children included in our study were found to have sufficient levels of 25(OH)D (Fig. 2). Pearson correlation analysis showed no significant positive or negative correlation of 25(OH)D levels with height, weight, BMI, serum calcium, serum phosphorus, alkaline phosphate, or duration of sun exposure (Table 2).

DISCUSSION

The abundance of scientific literature on Vitamin D done mostly in adults and its various possible implications had prompted us to undertake this study to actually asses the prevalence of Vitamin D in children attending OPD services of our hospital and asses its impact on the health of growing children.

In the study done by Basu *et al*., the prevalence of hypovitaminosis D across a pediatric population residing in city

Table 1: General characteristics of children

Parameter (Mean±SD)	Boys (152)	Girls (129)	Total (281)
Age (year)	7±1.3	6.9±1.1	7±1.3
Height (cm)	116±6.3	112±5.3	113±5.2
Weight (kg)	18±3.2	17±3.2	17.6±2.8
BMI kg/m^2	12.5±1.2	12.2±1.1	12.4±1.1
Duration of sun exposure (h)	2±0.5	1.5±0.25	1.76±0.33
Calcium levels (mg/dl)	9.2±1.3	9.1±0.6	9.2±1.1
Phosphate levels (mg/dl)	4.3±0.6	4.2±0.3	4.3±0.3
Alkaline phosphate (IU/dl)	443±154	420±169	434±151
Vitamin D levels	34.1±3.5	32.5±2.8	31.6±2.9

Table 2: Pearson's correlation with Vitamin D levels and parameters

Parameter	Correlation coefficient	p-value
Height (cm)	0.22	0.43
Weight (kg)	–0.03	0.34
BMI (kg/m^2)	0.14	0.78
Calcium (mg/dl)	0.06	0.12
Phosphorus (mg/dl)	–0.11	0.09
Alkaline phosphate (IU/L)	0.06	0.18
Duration of sun exposure (h)	0.2	0.11

of Kolkata was found to be 53% [7]. Marwaha *et al*. found in their study done in Delhi that over 90% of school going children were Vitamin D deficient [8]. Harinarayan *et al*. found in their study done in rural and urban children residing in Andhra Pradesh a prevalence of 81.5% in urban male children and 76.5% in those living in rural areas [2]. In a study done in the Guwahati city of Assam, the prevalence of Vitamin D deficiency was 8.4% and Vitamin D insufficiency was 14.2% in school children. However, they found no significant difference in mean 25(OH)D levels and sun exposure between rural and urban children.

While investigating the various determinants of Vitamin D levels, we did not find any significant association with duration of sunlight exposure which was found out to be one of the most significant factors according to previous studies. Mandlik *et al*. in their study done in Maharashtra on school children between 6 and 12 years of age reported a prevalence of Vitamin D insufficiency in 71% despite a sun exposure of 2 h [9]. Furthermore, they found that the duration of sunlight exposure positively influenced Vitamin D status, while body fat% negatively influenced 25(OH)D concentrations in these children. However, in spite of an average of 2 h of sunlight exposure, a majority of the children had insufficient 25(OH)D concentrations, according to the classification by the Endocrine Society Clinical Practice Guidelines [14].

Some studies have mentioned the role of environmental pollution as a contributory factor in such a finding. The study done by Aggarwal *et al*. has shown significantly lower concentrations of 25(OH)D in infants living in a part of New Delhi with considerably higher pollution (Mori Gate) as compared to infants from Gurgaon, a lesser polluted part of National Capital Region [11]. However, with our hospital located in Tezpur city which is among the lowest polluted cities in the country, contribution of pollution primarily in low Vitamin D levels is less likely. However, we did not directly asses the role of pollution in our study.

This paper further lays stress upon the high prevalence of Vitamin D deficiency in school going children. Hence, we emphasize the need for food fortification with Vitamin D, increase in physical activity in school going children and dietary modifications. At the same time, we also like to question the guidelines laid down by Indian Academy of Pediatrics (IAP) on prolonged supplementation of Vitamin D in healthy children till 18 year [15]. First, it seems impractical and non-feasible to keep supplementing these children for over years without actually being sure of benefits. As seen in our study, those children found to be have insufficient Vitamin D levels were apparently healthy and thriving well with no apparent ill effects in general health and growth despite having low Vitamin D levels. The arbitrary cutoff values used to define deficiency and sufficiency have also been put to question in many studies. We do not intend to question the role of Vitamin D in skeletal health of growing children especially infants and toddlers. However, the benefits need to be clearly defined in children beyond infancy. Furthermore, this continued supplementation in prepubertal children is also fraught with risks of hypercalcemia. There is a need to question the labeling of Vitamin D as a megavitamin and its role in multiple other ailments involving the respiratory system or skin as brought out by various studies on this topic.

Our study did have some limitations. Our study was a cross-sectional study with a small sample size done in a single center, the results of which cannot be generalized for other children across the country. The use of questionnaire only for sunlight exposure without objective assessment though has been validated in previous studies could also serve as a limitation [9,12].

CONCLUSION

The prevalence of Vitamin D deficiency was found out to be 21.1% and that of Vitamin D insufficiency was 12.2% children attending OPD of our hospital. Unlike previous studies, we did not find any significant correlation between known determinants of serum Vitamin D concentration like serum calcium, duration of sun exposure with the serum 25(OH) levels. Furthermore, further evidence needs to be brought out to emphasize the need for prolonged Vitamin D supplementation in apparently healthy pre-pubertal children as mentioned in IAP guidelines.

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