



ORIGINAL RESEARCH ARTICLE

PREVALENCE OF VITAMIN D DEFICIENCY/INSUFFICIENCY AMONG CHILDREN AND ADOLESCENTS

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ABSTRACT

Background: Vitamin D is an essential prohormone for the normal skeletal and extraskelatal health. Vitamin D deficiency/insufficiency is an unrecognized epidemic among children and adults worldwide. There are growing data from studies of young children and adolescents in other countries, but a limited information are available regarding the prevalence of this nutritional deficiency/insufficiency among the Nepalese children and adolescents. Thus this study was aimed to find out the prevalence of vitamin D deficiency/insufficiency among children and adolescents, who has attended in Chitwan Medical College (CMC). **Methods:** This was a retrospective hospital based study in children between 2 months and 19 years of age, conducted in CMC from April 2015 to December 2016. **Results:** Among 108 total studied, overall 74.1% (80) patients had 25(OH) D levels lower than 30 ng/ml with 27.8% having severe deficiency (< 10 ng/ml), 28.7% deficiency (10-19 ng/ml) and 17.6% insufficiency (20-29 ng/ml) category. The prevalence was found higher in females (95.2%), though the difference in prevalence between sexes was not statistically significant (P –value 0.243). **Conclusion:** Our study concluded that a high prevalence of low Vitamin D status (deficiency/insufficiency) found among the paediatric population (all paediatric age groups) indicates a need for further national level study to find out the actual prevalence of this nutritional deficiency, as well as the need for vitamin D supplementation to all children and adolescents.

Key words: Children, Deficiency, Insufficiency, Vitamin D

INTRODUCTION

Vitamin D is a fat soluble organic compound, was discovered by McCollum and co-workers in 1922.^{1, 9} Vitamin D is a pro-hormone, during childhood, adolescence and adults, it is important for normal calcium absorption from the gut, bone growth and accretion.²

Vitamin can be synthesized in skin epithelial cells and therefore technically is not vitamin. Cutaneous synthesis is normally the most important source of Vitamin D and depends on conversion of 7-dehydrocholesterol to Vitamin D₃ (cholecalciferol) by ultraviolet B radiation from the sun.^{3, 8} Dark-skinned infants and children, exclusively breastfed beyond 6 months of age, premature infants, born to vitamin D deficient mothers are in risk of decreased vitamin D level leading to skeletal as well as extra skeletal problems.¹⁹ The status of deficiency is

estimated reliably by measuring the level of 25-hydroxycholecalciferol (25 (OH)D) in the serum.³

MATERIALS AND METHOD

This was a hospital based retrospective study conducted in the department of pediatrics, Chitwan Medical College (CMC), Chitwan, Nepal from April 2015 to December 2016.

Ethical clearance of the study was taken from the hospital institutional review committee (IRC). Data were retrieved from the hospital clinical laboratory and analyzed for the study. Children ranging from 2 months up to 19 years of age of either sex, clinically suspected as vitamin D deficiency/insufficiency were included in this study. During the study period 747 subjects were suspected clinically from different departments of CMC and submitted for laboratory

examination. Among them 108 were in pediatric age group, enrolled in the study. Neonates (infants <28 days), age > 19 years and chronically ill patients were excluded from this study.

LABORATORY MEASUREMENTS

Fasting venous blood sample (5 ml) was obtained from each patient and immediately transported to CMC TH biochemistry laboratory. Serum 25(OH) D levels were determined at the same laboratory using a Chemiluminescent Immunoassay (CLIA). The patient were divided into 5 diagnostic categories, according to serum 25(OH) D levels. Vitamin D status were grouped as, severe deficiency (<10 ng/ml), deficiency (10-19 ng/ml), insufficiency (20-29ng/ml), sufficiency (30-80 ng/ml), toxicity (>100 ng/ml). In total, any value <30 ng/ml is regarded as deficiency/ insufficiency in this study.

Data were analyzed by statistical package for the social sciences (SPSS) version 20

Overall, 74.1% (80) of patients had 25(OH)D levels lower than 30 ng/ml. Among them 30 (27.8%) were having severe deficiency (<10 ng/ml), 31 (28.7%) having deficiency (10-19 ng/ml) and 19 (17.6%) in insufficiency (20-29 ng/ml) levels, whereas 1 (0.9%) child had toxicity (>80 ng/ml).

Table 2: Percentage of vitamin D level according to age group

Age in yr	Severe deficiency	Deficiency	Insufficiency	Sufficiency	Toxicity	Total
≤5	10(32.2)	7(22.6%)	3(9.7%)	10(32.2%)	1(3.2%)	31
6-10	10(47.6)	4(19%)	6(28.6%)	1(4.8%)	-	21
11-15	3(9.4%)	13(40.6)	5(15.6%)	11(34.4%)	-	32
≥16	7(29.1%)	7(29.7%)	5(20.8%)	5(20.8%)	-	24
Total	30(27.8)	31(28.7)	19(17.6%)	27(25%)	1(0.9%)	108

Among the severe deficiency category, 47.6% belongs to the age group of 6-10 yrs, whereas 9.4% was in 10-15 yrs age group. 27(25%) children were having sufficient (30-80 ng/ml) level of Vitamin D. The prevalence of Vitamin D in this study among adolescents (10-19 yr) was 51.8% (n=56).

Table 3: Vitamin D status and age group

Age in years	*Deficiency/insufficiency	Sufficiency	Toxicity	Total	p-value	Chi-square
≤5	20(64.5%)	10(32.3%)	1(3.2%)	31		
6-10	20(95.2%)	1(4.8%)	-	21	0.187	8.767
11-15	21(65.6%)	11(34.4%)	-	32		
≥ 16	19(79.2%)	5(20.8%)	-	24		
Total	80(74.1%)	27(25%)	1(0.9%)	108		

*Deficiency/insufficiency includes severe deficiency, deficiency and insufficiency.

RESULTS

We retrospectively reviewed the laboratory records of a total of 108 children and adolescents aged between 2 months and 19 years of age. Out of them, 61(56%) were males and 47 (44%) were females. Study population consists of 25.9% patients of 5 and less years, 21.3% between 6 - 10 years, and 52.7% adolescent's age group (11 – 19 years).

Table 1 shows the age and sex distribution of the study population.

Table 1: Age and sex distribution

Sex	Frequency among age Groups in year				Total
	≤ 5	6-10	11-15	≥ 16	
Male	16	14	13	18	61(56.2)
Female	12	9	16	10	47(43.8)
Total	28(25.9)	23(21.2)	29(26)	28(25.9)	108(100)

Deficiency/insufficiency is defined, as anyone who has serum 25(OH) D level is <30 ng/ml. So in our study, among 31 who were 5 or <5yrs had 64.5%, 6-10 yr age group (21) had 95.2%, 11-15 yr age group (32) had 65.6%, and >16 yr age group (24) had 79.2%. The relation between Vitamin D status and age group is not statistically significant (p-value, 0.187).

Comparison of Vitamin D by age group with mean SD

The mean value of presence of vitamin D in age group, less or equal to five years was 26.84±23.78

SD, in 6-10 years age group, it was 15.90±12.36 SD, in 11 to 15 age group, it was 25.25±15.51 SD and in 16 and plus age group, it was 20.25±15.60 SD. There was no statistically significance difference of presence of vitamin D among different age groups with mean SD (p-value = 0.127).

The prevalence of Vitamin D deficiency/insufficiency among female was 80.9%, and among male, it was 68.9%, however the association between either sex is not statistically significant with a p-value 0.243 (Table 4).

Table 4: Association of status of Vitamin D and sex of patients

Sex	Deficiency/insufficiency	Sufficiency	Toxicity	Total	Chi-Square	p value
Male	42(68.9%)	19(31.1%)	-	61(100.0%)	2.831	0.243
Female	38(80.9%)	8(17.0%)	1 (2.1%)	47(100.0%)		

Comparison of vitamin D values by sex with mean SD

The mean value of vitamin D among the males and females was 23.69 ±16.75 SD and 21.59 ±19.76 SD respectively. The association of Vitamin D deficiency/insufficiency with sex is not statistically significant with p- value of 0.552.

DISCUSSION

The overall prevalence of vitamin D deficiency/insufficiency in our study was 74.1%, which is similar to that recorded by Mansour et al. in Saudi Arabia where 72.55% was reported.¹⁸

An Indian study by J. Basu Devan et al. reported a prevalence of 62.2% among children and adolescents.⁵ Similarly an overall prevalence of 40%, with a higher (64.8%) deficiency status among the adolescent girls, was reported in a study with 110 children in Ankara, Turkey ² Prevalence is almost similar to a study by S Shrestha et al. in Lalitpur Nepal, and they have reported prevalence of 78.2% among the young adults.¹²

McGillivray et al. reported 87% prevalence in East African immigrants living in Melbourne ²¹ and 90.8% prevalence reported by an Indian study among school aged girls is higher than the Shrestha's series ^{5,20}

In our study, the comparisons between age groups in terms of Vitamin D levels revealed a very high 95.2% prevalence of vitamin deficiency/insufficiency among school aged children (6-10 yr) followed by 79.2% in adolescents(11-19yr). The cause behind such a high rate may be due to enrollment of entire symptomatic children, more indoor engagement, less sun exposure, air pollution and lack of vitamin supplementation. However due to small sample size of our study, there was no statistically significant difference in the prevalence rate among the age groups, (p- value 0.187), which is not compatible to other studies reported from India, China and Turkey.^{16, 17, 18}

The youngest infant enrolled in our study was 2 months old female, surprisingly having a Vitamin D, in toxicity level (106 ng/ml). The reason for hypervitaminosis D in this infant may be due to an increased level of Vitamin D in the mother (either due to excessive supplementation during pregnancy, or some preexisting health problems) ¹⁵ that may cross the placenta, as newborn Vitamin D status correlates with mother's level. ^{1,2,13} Excessive supplementation to the infant may be the other explanation.

In our study, the percentage of low vitamin D level in

females (80.9%) is higher than males (68.9%). This result is similar to many other studies from different countries^{2, 6, 7, 11} According to them the prevalence in asymptomatic female children and adolescents vary from 15.6% to 59.4% among Turkish girls.² In this study, the numbers of females are less than males, but the difference between male and female is not statistically significant for both p value (0.243) and mean SD (p-value 0.552).

Limitations of our study:

1. We were not able to correlate the Vitamin D levels with other clinical as well as biochemical parameters such as obesity (BMI), anthropometric measurements, serum calcium, serum phosphorus, and parathyroid hormones.^{6, 7, 13}
2. Another weak point in our study was that the prevalence was determined on hospital based symptomatic children. Hence we believe that a population based nationwide study would give more accurate and precise results on the true prevalence.

CONCLUSION

We concluded that Vitamin D deficiency/insufficiency is highly prevalent in children aged 2 months to 19 years in Chitwan situated in Central Nepal. In our study the high prevalence of Vitamin D deficiency/insufficiency is recorded in all age groups of children and more prevalent in female. The cause behind this Hypovitaminosis D may be due to low intake of Vitamin D, less sunshine exposure, skin pigmentation, less skin exposure, air pollution & increasing use of sunscreen by adolescents.

RECOMMENDATION

It is virtually hard to predict the magnitude of Vitamin D deficiency/insufficiency in Nepalese children and adolescents due to absence of national level data. The results shown by this study may represent only the tip of the iceberg of the so called hidden epidemic of Vitamin D deficiency, hence there is a need to conduct more studies in Nepal to find out the actual prevalence of Vitamin D deficiency/insufficiency among children and adolescents. We strongly recommend the need for Vitamin D supplementation to all infants, children and adolescents.

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