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Original Research Article

A cross sectional study of vitamin D status of 5-18 years children in a tertiary care of hospital

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ABSTRACT

Context: High prevalence of Vitamin D deficiency has been reported in pediatric population from different parts of the country. However, this study investigated the prevalence and risk factors associated with vitamin D deficiency in children.
Aims: To assess the serum Vitamin D level and also to find out the prevalence of Vitamin D deficiency among children and adolescents in Gwalior, a major northern city of Madhya Pradesh.
Settings and design: Cross sectional descriptive study
Materials and Methods: The serum 25(OH)D levels of 258 children from age five to below 18 years, attending the out-patient clinics of the hospital were analyzed from June 2021 to Dec 2021.
Statistical analysis used: Data being non-parametric was presented as median and interquartile range. The group differences were computed by Mann Whitney U test. A p value < 0.05 was considered as statistically significant.
Results: 60% of the study population had insufficient levels of Vitamin D, with girls having significantly lower levels of serum vitamin D. Only 27% of adolescents had optimum level of serum Vitamin D.
Conclusion: A high prevalence of vitamin D insufficiency and Vitamin D deficiency was found among the children living in the urban and sub urban areas of Gwalior city in northern Madhya Pradesh India.

1. Introduction

Vitamin D plays a key role in calcium and phosphate metabolism and is an essential micronutrient for bone development in children. It has other non-calcemic functions as well, viz, immune, cardiovascular, endocrine, neuropsychological functions, neuromuscular performance, cellular differentiation, and anticancer actions. Hence Vitamin D deficiency (VDD) is no longer confined to rickets or osteomalacia anymore, but it now comprises more huge hidden problem which is unraveling by the day and making VDD an emerging global threat. VDD has been recognized as a pandemic, but even now it is the most under-diagnosed and under-treated nutritional deficiency in the world.[1,2]

Pediatric subjects are more susceptible to VDD, causing impaired bone mineral metabolism – leading to growth retardation and bone deformities. Consequently, it is relevant to know the vitamin D status in children and adolescence, as the bone accrual is taking place and the peak bone mass is achieved during this period.

Despite receiving abundant sunshine in our country, studies uniformly point to low vitamin D levels in the Indian population.[3] Studies conducted in the northern, western and southern states of India have documented high prevalence (82–98%) of Vitamin D deficiency (VDD) among school age children.[4–8] There is no more data regarding the

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prevalence of VDD status in the pediatric population from the northern MP of India.

With this background this study was conducted with the following aim and objectives: a) to assess the serum Vitamin D level in children and adolescents in Gwalior, a major city of northern MP of India; b) to find out the prevalence of Vitamin D deficiency in children and adolescents in tertiary care hospital of Gwalior.

2. Materials and Methods

2.1. Study design

The present cross sectional descriptive study was approved by the institutional ethical committee and conducted in the department of community medicine with the help of biochemistry department, Gajra Raja Medical College and J A Group of teaching hospital, Gwalior. The serum 25(OH)D levels of children from age 5 to 18 years, attending the out-patient clinics of the hospital were analyzed from June 2021 to Dec 2021.

Demographic data regarding the gender and age of the children and the clinics attended were collected from the department entry register. Exclusion criteria included children who were undergoing treatment for Vitamin D deficiency; suffering from other systemic diseases (like nephrotic syndrome or chronic renal failure) or endocrine diseases (like rickets); having Vitamin D toxicity (serum 25(OH) levels >100 ng/ml). Those cases who were undergoing repeat investigations, the first value of serum 25(OH)D was taken for analysis.

2.2. Measurement of Vitamin D

Estimation of serum total 25(OH) D levels were done by chemiluminescence immunoassay (CLIA) method using Beckmann Coulter Access 2 immunoassay system. This assay detects both 25(OH) vitamin D2 and 25(OH) vitamin D3 levels and has an assay range of 2.0 to approximately 167 ng/ml. Diagnostic cut off criteria according to United States Endocrine Society classification[9] was used for classifying Vitamin D status. The 25(OH) D levels > 30 ng/ml is considered "optimum"; between 20 to 30 ng/ml is considered as "insufficient"; levels < 20 ng/ml is considered as "deficient" whereas levels <10 ng/ml is considered "severely deficient".

2.3. Sample size

The sample size of the study was calculated keeping in view the anticipated prevalence of Vitamin D as 85%, a confidence level of 95%, absolute precision of 5.0 and a design effect of 1.0. A total sample size of 196 was calculated.

2.4. Statistical analysis

IBM Statistical Package for Social Sciences (SPSS) version 20.0, Armonk, NY: IBM Corp was used for statistical analysis of data. Quantitative data i.e., serum (25OH) D values were found to be non-parametric and hence presented as median and interquartile range (IQR). The group differences were computed by Mann Whitney U test. A p value < 0.05 was considered as statistically significant.

3. Result

3.1. General characteristics of study population

The serum 25(OH) D levels of a total of 258 cases were analyzed. Out of this, 57% were males (n= 146) and 43% were females (n= 112). About 35% cases belonged to the pre-school age group of 1 to 5 years (n= 90); 31% belonged to school age group of 6 to 11 years (n= 79); and 34% belonged to the adolescent age group of 12 to 18 years (n= 89).

3.2. Vitamin D status

The mean 25(OH) D levels of the study population was 30.12 + 13.37 ng/ml (Median 28.12, IQR 16.14). Upon segregation, the girls had lower 25(OH) D levels with mean levels 28.23 + 12.61 ng/ml (Median 26.86, IQR 16.39) as compared to boys with mean levels 31.38 + 13.81 ng/ml (Median 29.02, IQR 15.02), which is statistically significant (p value 0.03), as shown in Table 1.

Table 2 shows the age wise distribution of the cases according to the Vitamin D status. The median 25(OH) D levels of the severely deficient (<10 ng/ml) cases were 6.09 (IQR 3.23), 6.14 (IQR 1.73), 4.76 (IQR 6.04) in the age group 5 to 18 years, 5to 10 years and 10 to 14 years respectively. The median 25(OH) D levels of the deficient (10 – 19 ng/ml) cases were 16.58 (IQR 2.98), 18.53 (IQR 2.10), 16.01 (IQR 4.18), 16.58 (IQR 2.52) in the age group 5 to 18 years, 5to <10 years, 10 to 14 years and 15 to 18 years respectively. The median 25(OH) D levels of the insufficient (20 – 29 ng/ml) cases were 25.75 (IQR 5.02), 27.26 (IQR 4.91), 25.54 (IQR 4.67), 25.83 (IQR 5.49) in the age group 5 to 18 years, 5to <10 years, 10 to 14 years and 15 to 18 years respectively. The median 25(OH) D levels of those cases who had optimum levels (> 30 ng/ml) were 39.35 (IQR 11.49), 39 (IQR 8.49), 40.76 (IQR 15.69), 38.24 (IQR 15.29) in the age group 5 to 18 years, 5to <10 years, 10 to 14 years and 15 to 18 years respectively. In the study population, about 6.97% of the subjects were severely deficient; 12.4% were deficient; 40.7% were insufficient; and only 39.9% had optimum levels of 25(OH) D. Among the various age groups, 14.4% of children in 5 to <10 years and 6.3% in 10 to 14 years were severely deficient. About 6.7% in the 5 to <10 years, 16.45% in 10 to 14 years and 14.6% in 15 to 18 years age groups were deficient. Around

Table 1: Distributions of the study subjects by gender

Gender	N (%)	Mean ± SD (ng/mL)	Median, IQR
Male	146(56.6)	31.38 ± 13.81	29.02, 15.02
Female	112(43.4)	28.23 ± 12.61*	26.86, 16.39*
Total	258(100.0)	30.12 ± 13.37	28.12, 16.14

*p value 0.03 versus male (by Mann Whitney U test)

Table 2: Age wise distribution of subjects as per Vitamin D status (N=258)

Age group No (%)	Severely deficient(<10 ng/ml) Median; IQR	Deficient(10 -19 ng/ml) Median; IQR	Insufficient (20 -29 ng/ml) Median; IQR	Optimum (> 30 ng/ml) Median; IQR
5-<10 years (n= 90)	6.14; 1.73	18.53; 2.10	27.26; 4.91	39; 8.49
10-14 years (n= 79)	4.76; 6.04	16.01; 4.18	25.54; 4.67	40.76; 15.69
15-≤18 years (n= 89)	NC	16.58; 2.52	25.83; 5.49	38.24; 15.29
Total (5 - ≤18 Years)	6.09; 3.23	16.58; 2.98	25.75; 5.02	39.35; 11.49

NC not calculable, insufficient data

Table 3: Prevalence of Vitamin D status when classified into different deficiency states.

Ages	Severely deficient(<10 ng/ml) No (%)	Deficient(10 -19 ng/ml) No (%)	Insufficient (20 -29 ng/ml) No (%)	Optimum (> 30 ng/ml) No (%)
5-<10 years (90)	13 (14.4)	6 (6.7)	22 (24.4)	49 (54.4)
10-14 years (79)	5 (6.3)	13 (16.5)	31 (39.2)	30 (37.9)
15 - ≤18 years (89)	NC	13 (14.6)	52 (58.4)	24 (26.9)
Total (5 - ≤18 Years) (258)	18 (6.9)	31 (12.4)	105 (40.7)	104 (39.9)

NC = not calculable, insufficient data

Table 4: Values of serum Vitamin D (ng/ml) by gender and age groups

Age group	Male: No [%](Median (ng/ml); IQR)	Female: No [%](Median (ng/ml); IQR)	p value
5-<10 years	48 [32.9] 37.0; 14.7	42 [37.5] 27.6; 20.5	0.008*
10-14 years	51[34.9] 29.3; 20.4	28 [25.0] 26.1; 15.9	0.15
15- ≤18 years	47 [32.2] 28.3; 14.2	42 [37.5] 23.2; 7.6	0.01*
Total 5- ≤18 years	146 [100.0] 29.0;15.0	112 [100.0] 26.9; 16.4	0.03*

*Significant Statistically p value calculated by Mann Whitney U test.

24.4% in the 5 to <10 years, 39.2% in the 10 to 14 years and 58.4% in the age group of 15 to 18 years had insufficient levels. Only 26 9% of 15 to 18 years, 37.9% of 10 to 14 years and 54.44% of 5 to <10 years had optimum levels ($). When seen across the age groups, females had significantly lower 25(OH) D levels as compared to their male counterparts in the 5 to <10 years and 15 to 18 years age groups. The girls had median 25(OH) D levels of 27.59 (IQR 20.5) in 5 to <10 years; 29.31(IQR 20.5) in 10 to 14 years and 23.21(IQR 7.6) in 15 to 18 years age group. While the males had median 25(OH) D levels of 37.1 (IQR 14.7) in 5 to <10 years; 26.1 (IQR 15.9) in 10 to 14 years and 28.3 (IQR 14.2) in 15 to 18 years age group. (Table 4)

4. Discussion

VDD is now universally acknowledged as a pandemic, still it is under investigated and least attended nutritional deficiency worldwide. But with increased awareness of the widespread prevalence of VDD in various populations of India, Vitamin D level is currently one of the most ordered investigations asked by an Indian clinician. This present study was conducted to provide a cross-sectional view of the biochemical hypovitaminosis D among the childhood inhabitants residing in and around the city of Gwalior of northern Madhya Pradesh India. The study data shows that 60% of children and adolescents had 25 (OH) Vitamin D deficiency (VDD + Vitamin D insufficiency) of which 19% were nutritionally deficient in Vitamin D and 41% had insufficient circulating serum Vitamin D levels. Only 40% had optimum 25 (OH) Vitamin D levels. This is in accord with the findings of different studies across Indian population showing prevalence of VDD as 93% of children living at high altitude regions in Himachal Pradesh;[4] 53 % in up to16 years in Kolkata;[5] 96.9% in adolescents in

Delhi;[6] 92.3% in 10–14 years healthy school children from northern India;[7] 81.5% in urban male children in the southern state of Andhra Pradesh.[8]

The main source of vitamin D in our body is the exposure to sunlight, with diet contributing only 10–15 %. The common risk factors that have been recognized as associated with VDD are insufficient exposure to sun,[10] darker skin pigmentation,[11] atmospheric pollution,[12] low physical activity,[13] indoor confinement of children during the day and high-rise buildings,[10] sunscreen usage.[14] Indians owing to the darker skin color have been said to have reduced cutaneous synthesis of Vitamin D due to increased melanin content in them. This is the Vitamin D paradox in our country that Indian's despite of receiving plenty and abundant sunlight, require greater duration of sun exposure as compared to their light skinned counterparts to synthesize equivalent levels of Vitamin D.

Among the different childhood age groups in this study, 73% of the adolescents had VDD (58% insufficient and 15% deficient), which is the highest among all other age groups. Only 27% of this population had optimum levels of vitamin D. Similar findings were observed in some studies where the 94.4% adolescents from Shimla,[4] 88 % of adolescents in eastern India,[5] 96.9% in adolescents in northern India,[6] and 97% adolescents in Delhi NCR,[14] and were the most deficient in vitamin D levels. This is a perturbing finding as this age is the growth phase where most of the accrual of bone mass takes place and VDD at this stage can cause growth retardation and defect in skeletal mineralization.

This study was also found girls to be more deficient in Vitamin D levels than boys across all the age groups studied. This might be attributed to less exposure to sun among girls due to more clothing as compared to their male counterparts. Also, the wish to look fairer among girls make them use sunscreen and umbrella, furthermore reducing their sun exposure. Similar findings were seen in the studies conducted in the populations of other parts of the country.[4,14,15] Nowadays it has been observed that most adolescents in the urban and sub urban areas are busy with indoor activities like playing with their mobile phones, watching TV or playing video games rather than playing outside in the porch or playgrounds. Due to the need wise lockdowns imposed due to the current Covid 19 pandemic, children have been more confined within their houses. Also due to the recent academic curriculum, students are rather busy in their tuitions and online classes and have very little time to go out of their homes. This has restricted their time of sun exposure all the more and might have contributed to the more prevalence of hypovitaminosis D among children, especially adolescents.

Parents should be made aware to use the safe sun period for adequate exposure of the children to sunlight without sunscreen before 10 am and after 3 pm at least 15 minutes a day. But due to the sun-protective action of epidermal melanin, which is abundant in pigmented skin types of Indian population, sun exposure alone may not be an adequate source of vitamin D in Indian children.[16] Hence food fortification and vitamin D supplementation should be encouraged and used judiciously.

The limitation of the present study is that the study population was the children attending the outpatient department of the hospital. Although the children with major known and recognizable causes of VDD have been excluded, still there may have been influences of other pathologies on the vitamin D levels. As it was conducted in a single center, the results cannot be generalized. Information could not be collected regarding sun exposure, diet, physical activity, sunscreen use or intake of supplements.

5. Conclusion

The present cross-sectional study reveals the high prevalence of vitamin D insufficiency and VDD among the children living in the urban areas of Gwalior city of northern Madhya Pradesh India. The insufficiency was more in adolescents and girls. This adds to the robust reports of soaring deficiency states of vitamin D in India. Action from the national authorities is solicited to create awareness regarding the prevalence of vitamin d deficiency and the importance of adequate sun exposure, dietary recommendations; to ramp up food fortification and judicious vitamin D supplementation.

6. Source of Funding

None.

7. Conflict of Interest

The authors declare that there are no potential conflicts of interest for the authorship and publication of the article.

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