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Original Article

High Prevalence of Hypovitaminosis D among Schoolchildren of Shimla in Himachal Pradesh

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ABSTRACT

Title of the article: High prevalence of hypovitaminosis D among schoolchildren of Shimla in Himachal Pradesh. **Context:** Acquisition of optimal bone mineral health in childhood and adolescence is essential for adequate bone mass during adulthood and old age, as 40-50% of total skeletal mass is accumulated so early in life. **Aims:** To estimate the prevalence of vitamin D deficiency among the school children of Shimla **Settings and Design:** A total of 300 children and adolescents of class V1 to X11 of various schools in Shimla were enrolled during July 1, 2015 to September 30, 2015. **Methods and Material:** After written informed consent, blood samples for 25(OH) D were collected and measured by radioimmunoassay. **Statistical analysis:** Data analyzed the data using EpiInfo 7.0.9.7 for windows. **Results:** Among all enrolled cases, 151(50.33%) were girls and 149 (49.76%) boys. Serum 25(OH) D level was significantly lower in girls 11.70± 4.03ng/ml as compared to boys 13.57 ±7.06ng/dl (p=0.0000001). Hypovitaminosis D was present in 98.66% cases, out of which 93.33% had deficient and 5.33% had insufficient 25 (OH) D levels. A total of 34.33% children had severe deficiency, however 4 (1.33%) had sufficient levels and were boys. **Conclusions:** Prevalence of hypovitaminosis D in apparently healthy schoolchildren in India is high. Awareness needs to be generated about benefits accrued by direct sunlight exposure.

INTRODUCTION

Hypovitaminosis D has re-emerged as a major pediatric health issue with complications including hypocalcaemia seizure, rickets, limb pains and fracture.[1] Vitamin D plays an important role in maintaining bone health through regulating calcium concentrations in the body. The development of vitamin D deficiency is associated with deteriorating bone health and in severe cases may lead to hypocalcaemic rickets and osteomalacia in children and adults.[1] However, recently there has also been piquing interest in vitamin D in pediatric patients due to the recent epidemiologic reports suggesting that vitamin D may protect against autoimmune diseases and plays a role in innate immunity.[2,3] Moreover, many observational studies have shown adequate vitamin D concentrations in childhood plays an important role in protecting the body against wide range of diseases later in life including diabetes, cardiovascular disease, stroke, certain type of cancers, autoimmune disorders, multiple sclerosis, depression, schizophrenia and adverse pregnancy outcome.[4,5,6] The high prevalence of hypovitaminosis D globally has been attributed to reduced synthesis of vitamin D (skin pigmentation, sun avoiding behaviors and wearing clothes covering whole of the body) and low dietary intake.

Optimal bone mineral health during childhood and adolescence is essential for adequate bone mass in adult and old age, as 40-50% of total skeletal mass is accumulated during this period.[7] Given the high rate of bone development early in life, adequate serum concentrations of vitamin D and calcium favours bone mineral accrual.[8] Vitamin D and calcium states correlate with a increased bone mineral density and have the potential to increase the peak bone mass.[9,10,11] Therefore, it is precisely during this period that any nutritional deficiency (vitamin D and calcium) is likely to have greatest impact on the bone mass and susceptibility to develop osteoporosis and fractures later in life. Hypovitaminosis D being widespread throughout world, it is routine practice in the industrialized nations in the west to fortify milk and other food products with vitamin D. However, India being a tropical country with abundant sunshine, fortification of milk and other food products are considered unnecessary.

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Shimla is the capital of Himachal Pradesh. It is situated at an altitude of 2,206 (7,238 feet) meters and its location is between latitude 31.1048^0 N and longitude 77.1734^0 E. It falls in sub temperate climatic zone and winter extends from November to March. People in temperate and sub-temperate climatic zone keep their bodies covered with clothes most of time and are less likely exposed to be the sun light. Moreover, Women and girls often have much of their skin covered for cultural reason. Shimla is covered by dense forest hampering access to direct sun light. Moreover, the town remained covered with thick clouds and fog from July through September with limited access to direct sun light. Due to the mountainous terrain, the city lacks the playground facilities both in the schools and in the residential areas and children got restricted from outdoor activities. Therefore, we conducted this study to estimate the prevalence of vitamin D deficiency among the schoolchildren of Shimla town.

SUBJECTS AND METHODS

It was a cross section study. The study was conducted among children of class V1 to X11 of government and private schools of Shimla town; who gave consent to participate in the study. There is seasonal variation in the serum 25 (OH) D status with the highest serum levels seen at the end of summer and lowest serum levels at the end of winter.[12] Weather had direct impact on average vitamin D level, it was more in summer season as compared to winter season (40 ng/ml (100 nmol/l) Vs 20 ng/ml (50 nmol/L)[12] Therefore, the study was conducted at the end of summer from July 1, 2015 through September 30, 2015 to know the vitamin D states among the school children of Shimla. Operational Definitions: We categorize the level of Serum 25 (OH) D levels[4,5] as: 1) Sufficient≥ 30 ng/ml 2) Hypovitaminosis< 30 ng/ml 3) Insufficiency- 20-29ng/ml 4) Deficiency 0-19 ng/ml. We prepared a sampling frame of all students of Shimla city and take systematic random sample of 300 children. We obtained a written informed consent of all study participants who are ≥ 18 years of age. In case of minors, we obtained informed consent of parents/guardians. We used sterile equipment to obtain blood samples of the participants. All care taken to transport the specimen to avoid biohazards. Those children unwilling to participate were free to do so at any stage. In addition to collect data on socio-demographic and general physical profile of the study participants, we collected morning sample from the consenting participants to estimate 25(OH) D. Samples for 25(OH) D were stored at -20^0 C until analysis and were measured by radioimmunoassay (RIA).We analyzed the data using EpiInfo 7.0.9.7 for windows. We calculated prevalence of different grades of vitamin D deficiency and considered p-value of 0.05 and below as statistically significant for association with different predictors of vitamin deficiency.

RESULTS

We surveyed 300 children from three schools (one government school and two private schools). Among these 151(50.33%) were girls (112 girls from government school and 39 girls from private school) and 149 (49.76%) were boys (All boys from private school only). Participants from government school comprised 112 (37.33%) students. The age of study subjects ranged from 10 to 18 years with a mean age of 14.49±1.4 yrs (Table 1).

The serum 25 (OH) D of study subjects ranged from 3.60 ng/ml to 56.56 ng/ml with mean value of 12.63 ±5.8 ng/ml. The mean 25 (OH) D concentrations was significantly lower in girls 11.70± 4.03ng/ml compared to boys 13.57 ±7.06ng/dl (p=0.0000001) and there was no significant difference in vitamin D levels among government school students and private school students.

Prevalence of hypovitaminosis D was present in 98.66%. Out of which 93.33% of children had deficiency and another 5.33% of children demonstrated insufficiency of 25 (OH) D. Of all children, 34.33% had severe deficiency of 25 (OH) D (<10ng/ml). Only four (1.33%) children had sufficient 25 (OH) D levels, all were boys (Table 2). Of 151 girls, none has sufficient levels of 25 (OH) D (Fig-1).

There was a significant association between the boys and girls based on serum 25 (OH) D level, deficient (89.26% vs97.35% p< 0.01), insufficient (8.05% vs 2.64% P =0.047) and sufficient (2.68% vs 0 %; p< 0.024) states (Table-2).

All girl participants were either deficient (97.35%) or insufficient (2.64%) for25 (OH) D concentrations.

DISCUSSION

Serum 25 (OH) D levels is the most reliable indicator of vitamin D adequacy.[1] Levels <20ng/ml is associated with osseous changes and insufficiency levels between 20 to 30 ng/ml is associated with secondary hyperparathyroidism with negative skeletal consequences like increased risk of fractures and low peak bone mass in children.[9-13] High prev-

Table 1. Baseline profile of participants

Variable	Total	Boys	Girls	P Value
Number of participants (n)	300	149 (49.76%)	151(50.33%)	-
Govt. school participants (n)	112	0	112	-
Private school participants (n)	188	149	39	-
Average age (Years)	14.49±1.4	15.33 ±0.77	13.65 ±1.5	-
Average Vitamin D level (ng/ml)	12.63 ±5.8	13.57 ±7.06	11.70± 4.03	0.000001
i) Participants from Govt. Schools	-	-	11.35±6.07	0.78
ii) Participants from Private school	-	13.57 ±7.06	12.68± 7.77	

Table 2. Vitamin D deficiency prevalence among participants

Variable	Total(n=300)	Boys (n=149)	Girls(n=151)	P Value
0-19ng/ml deficiency	280(93.33%) out of which 103(34.33%) severe deficient*	133(89.26%) out of which 46(30.87%) severe deficient*	147(97.35%) out of which 57(37.74%) severe deficient*	0.01
20-29ng/ml insufficiency	16 (5.33%)	12(8.05%)	4(2.64%)	0.0467
≥30 ng/ml sufficiency	4(1.33%)	4(2.68%)	0 (0%)	0.024

*0-9 ng/ml severe deficiency

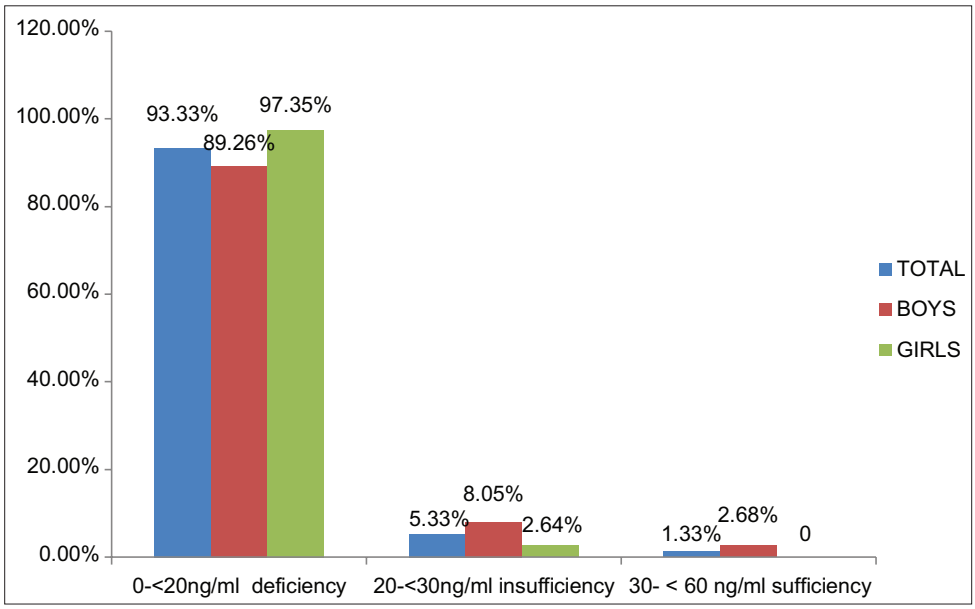

Figure 1. Prevalence of vitamin deficiency among participants

alence (50-90%) of hypovitaminosis D has been recognized across all age groups and both sexes in India.[7,14,15] The present study showed very high prevalence of hypovitaminosis (98.66%) among school children of Shimla. The present study extended the support for the assessment of vitamin D status in children at moderate altitude as no study on vitamin D status in children has been done at his altitude and showed that 93.33% of school children aged between 10 to 18 years have vitamin D deficiency and additional 5.33% had vitamin D insufficiency. The high prevalence of hypovitaminosis D in children and adolescence has been reported globally. In United States, about 70% of children aged 6 to 11 years are vitamin D deficient or insufficient [16] and approximately 80% adolescent in different Europe countries have hypovitaminosis D.[17] In Asian migrants in the in United Kingdom, the prevalence of vitamin D deficiency was 12.5 to 66% in migrant children.[18] In New Zeeland, 50% of children in all age groups have serum 25 (OH) D concentrations <20 ng/ml.[1] Varying (75 to 95%) degree of vitamin D deficiency or insufficiency among children and adolescence has been reported from the different parts of India.[14,19-24] Living at northern altitude, wearing traditional clothes covering whole of the body most time, presence of dense forest hindering access to sunlight, presence of thick clouds and fog most time in autumn (July through September) and lack of playground facilities due to mountainous terrain in addition to the skin pigmentation, intake of diet low in calcium and vitamin D and sunshine avoiding behaviors are the reasons for very high prevalence of hypovitaminosis D even at the end of summer in this study. Fish (richest source of vitamin D) is not frequently consumed in Himachal and diet is also rich in phytates.

Our study confirms the high prevalence of hypovitaminosis D in children across all groups, in India.[14, 19-24] Mean serum concentration of 25 (OH) D in our study was 12.63± 5.80ng/ml and similar to studies on children from other parts of India.[7, 20-22] The serum 25 (OH) D concentrations in our study were lower than reported from the western studies,[25] however marginally higher than that reported from China.[26] Severe hypovitaminosis D (<10ng/ml) was seen in 34.33% in our study, which compares with 37% in the study on children from Northern India,[21] however, higher than that reported from Finland.[27] Contrast to the study from Andhra Pradesh,[22] which demonstrated higher serum 25 (OH) D concentrations in girls compared to boys; the mean serum 25 (OH) D concentrations were significantly lower in girls compared to boys and significantly, more girls were deficient in serum 25 (OH) D states compared to that of boys in present study. No girl demonstrated sufficient concentrations of 25 (OH) D in their sera. This probably due to the dress code (girls are fully dressed in their dress code with only face exposed compared to that boys who have their face, legs and forearms exposed to sunlight in their dress code during summer months) and the duration of exposure to sunlight (overall girls spend less

time in the playground compared to boys; therefore less sunlight exposure).

The mean 25 (OH) levels and the prevalence of vitamin D status as deficient and severe deficient in the present study was very much similar to study among teenage girls from Danish.[28] However, unlike this study, high prevalence of vitamin D deficiency was seen in winter season when serum 25(OH) D levels are lowest[12] and acknowledge that vitamin D deficiency in our children may even be much higher and of much more severity. It probably relates to skin hyper pigmentation, and wearing traditional clothes covering whole body, and lack of playground facilitieswith limited outdoor activities.

Our study has future implications: 1) The low serum 25 (OH) D concentrations in the background of low dietary calcium intake, [21] the peak bone mass achieved is low in the childhood and adolescence, which in turn leads to high risk of fractures in the old age group at a later stage. 2) Fifty percent participants in our study were girls. Adolescent girls are future mothers. The prevalence of hypovitaminosis D in pregnancy ranges between 8 % to 100 % and might prevails from the time of adolescence when vitamin D requirements are higher due to rapid bone growth. Vitamin D deficiency during pregnancy may influence fetal imprinting that may affect chronic disease susceptibility soon after birth as well as later in life. To ensure a healthy motherhood it is important to know the vitamin D status during adolescence so that corrective measures may be instituted. 3) role of vitamin D has been associated in chronic diseases like asthma, cancer, cardiovascular diseases, dementia, autism, type 1 and type 2 diabetes mellitus, SLE, male and female fertility. So, the treatment of vitamin D deficiency at early age should also be desirable in order to reduce the risk of developing chronic diseases in future.[5]

CONCLUSION

There is a high prevalence of hypovitaminosis D in apparently healthy schoolchildren in India. In view of high prevalence of hypovitaminosis D in apparently healthy children because of lifestyle changes and cultural practices, awareness needs to be generated about benefits accrued by direct sunlight exposure.

SPONSORSHIP IF ANY

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ETHICAL ISSUES

Informed consent taken from all participants.

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