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Original Research Article

Vitamin D status in 5-15 years old children attending pediatric OPD in tertiary care hospital in Jammu and Kashmir, North India: a cross sectional study

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ABSTRACT

Background: Vitamin D is vital in children mainly because of its profound effect on growth, development, immune system and importantly bone health. Recent evidence suggests maintaining 25 (OH) D levels above 20 ng/ml for maximizing health benefits. Objectives were to assess the vitamin D status in children in the age group of 5-15 years attending a tertiary care teaching institute of North India and to analyze the factors which can contribute to vitamin D deficiency in these children.
Methods: It was a cross-sectional study. 5-15 years old children attending the outpatient department were included in the study. Children with co morbid conditions that affect vitamin D metabolism and those children on chronic drug treatment and on vitamin D supplementation were excluded from the study.
Results: Average age of study population was 8.93±2.02. In the study 170 (18.47%) children among a total of 920 had a normal vitamin D status while the rest 750 children (81.52%) had insufficient vitamin D status (25 hydroxy vitamin D <30 ng/ml). Among these children 190 (26.38%) had suboptimal vitamin D levels, 300 (40%) were deficient, 143 (19.06%) had severe and 117 (15.6%) had very severe deficiency of vitamin D. The average vitamin D level among the study population was 12.33±11.13 ng/ml. There was significant statistical association between vitamin D deficiency and stunting (p=0.003). No statistically significant association was found between outdoor activity.
Conclusions: Vitamin D insufficiency was documented in 81.52% of 5-15 years old children and there was a significant association between stunting and vitamin D deficiency.

Keywords: Hypovitaminosis D, Outdoor activity, Stunting, VDD, Vitamin D status

INTRODUCTION

Vitamin D deficiency is one of the major public health problems in India. Vitamin D deficiency (VDD) is known to have adverse implications right from conception throughout life span. It is important in children mainly because of its profound effect on growth and development. Since approximately 40-60% of total skeletal mass at maturity is accumulated during childhood and adolescence, it has major implications on adult bone health. It regulates calcium and phosphorus balance for bone mineralization and remodeling.[1] Rickets is a severest form of vitamin D deficiency and manifests as bone deformities, bone pain and weakness. It represents only the tip of the iceberg as a part from its conventionally understood actions on bone health and calcium homeostasis, vitamin D is believed to have an effect on body's endocrine system, immune system, cardiovascular system, neuropsychological functioning and neuromuscular performance.[2] The active form of

Vitamin D i.e. 1,25 (OH) 2 D is capable of regulating a wide variety of genes which regulates cell growth and differentiation. Vitamin D is therefore essential not only for skeletal growth, but also for improving immune status in children. Hence early diagnosis and treatment of insufficient vitamin D levels among children is of paramount importance.

Nearly 90% of vitamin D requirement (vitamin D_3) is met by adequate exposure of the skin to sunlight through the action of ultraviolet B radiations (UVR) and rest 10% is said to meet through diet.[3] Skin complexion, poor sun exposure, prolonged winters in Kashmir and lower intake of vitamin D fortified foods could be attributing to the very high prevalence of VDD in Kashmir, North India.[4] Studies conducted in different parts of the country have documented a widespread prevalence of VDD in all age groups including toddlers, school children, pregnant women, neonates, adult males and females residing in rural or urban areas.[5-9] Data on vitamin D deficiency among children and adolescents of Kashmir is scarce. Children in the school going age group are more susceptible to vitamin D deficiency disorders. This is the age group in which there is a tremendous increase in bone growth and high vitamin D requirement. Hence this study was undertaken for estimating the vitamin D status in children of the age group 5-15 years attending the outpatient department of tertiary care hospital in Kashmir.

Aims and objectives

To assess the vitamin D status in children aged 5-15 years. To analyse the factors which can contribute to vitamin D deficiency in these children.

METHODS

This was a tertiary hospital based, cross-sectional, descriptive study. Children aged 5 to 15 years attending the outpatient department of a tertiary care teaching hospital formed the study population. This study took place for a period of one year- from October 2021 to October 2022.

Inclusion criteria

Children in the age group of 5-15 years attending the local outpatient department.

Exclusion criteria

Children with co-morbid conditions that affect vitamin D metabolism like chronic liver disease, chronic kidney disease, heart disease and chronic neurological diseases were excluded from the study. Children on vitamin D supplementation and children on chronic drug treatment including multivitamins, anticonvulsants, steroids, thyroxin, anti-tubercular treatment and anti-metabolites were also excluded from the study.

Sanction of institutional ethical committee was obtained before the commencement of study. Parents and children were interviewed with the help of a detailed questionnaire prepared to assess the personal information of the children. The questionnaire also included their time spent for outdoor and physical activity. The nutritional status of the children was assessed with respect to height, weight and BMI. They were examined for clinical features of vitamin D deficiency. Biochemical investigations including serum calcium, serum phosphorus, serum alkaline phosphatase, serum albumin and 25 hydroxy vitamin D were done. Hypovitaminosis D was defined on the basis of the measurement of serum 25 hydroxy vitamin D concentrations. The kit used for the study was the 25 hydroxy vitamin D ELISA kit manufactured by Biovendor research and diagnostics Products, Hamburg, Germany (Cat No. REA300/96), a monoclonal anti 2 hydroxy vitamin D antibody-based ELISA test. Serum 25 hydroxy vitamin D level more than 80 nmol/l (>30 ng/ml) by enzyme linked immunoassay was considered as optimum level.[9] Concentrations of 20-30 ng/ml, 10-20 ng/ml, 5-10 ng/ml and less than 5 ng/ml 25 hydroxy vitamin D were classified as suboptimal vitamin D, vitamin D deficiency, severe and very severe hypovitaminosis D respectively.[9] 30-50 ng/ml was taken as optimal vitamin D and 50-70 ng/ml as upper normal vitamin D. The data was analysed to find out the factors which affect the vitamin D concentration in the children. Data is presented as mean±SD. The chi-square test was used for the analysis of categorical variables. A p value <0.05 was considered significant. Data was statistically analysed with the use of the Statistical Package for Social Science program (SPSS version 20.0 for Windows).

RESULTS

920 children in the age group of 5-15 years were included in the study, out of which 510 (55.4%) were boys and 410 (44.6%) were girls. 500 children (54.3%) were aged between 5-10 years, while 420 children (45.7%) were aged between 10-15 years.

Table 1: Distribution of cases according to age.

Age (years)	Number	Percentage
5-10	500	54.3
10-15	420	45.7
Total	920	100

Table 2: Distribution of cases according to gender.

Gender	N	%
Boys	510	55.4
Girls	410	44.6
Total	920	100

The mean age of the study group was 8.93±2.02. 720 children, representing 78.3% of the study population were normally nourished, with more than 80% of the weight expected for their age. 133 children (14.4%) had grade 1 and 67 children (7.2%) had grade 2 malnutrition, according to IAP classification. 760 children (82.6%) had normal height, defined as height more than 95% of expected height for their age. 110 children (12%) had 1st degree, 40 children (4.3%) had 2nd degree and 10 children (1.1%) had 3rd degree stunting according to Waterlow classification. 650 (70.6%) children had normal body mass index, while children 183 (19.89%) were underweight, 77 children (8.3%) were overweight and 10 children (1.1%) were obese (Figure 1).

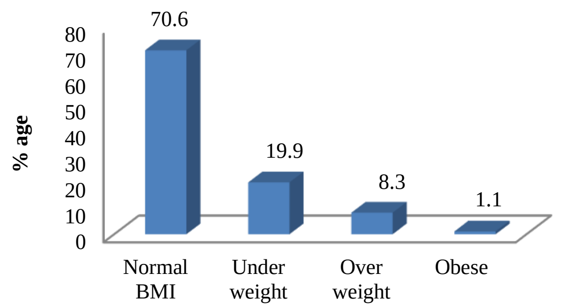

Figure 1: Distribution of cases according to body mass index.

Table 3: Duration of outdoor activity during school-days and weekends.

Activity	Duration	Total frequency	Percentage
Outdoor activity at school in a week	Nil	87	9.4
	<2 hours	294	32
	>2 hours	539	58.5
	Total	920	100
Outdoor activity during weekends	Nil	500	54.34
	<2 hours	302	32.82
	>2 hours	118	12.82
	Total	920	100
Outdoor activity after school hours in school days in a week	Nil	90	9.7
	<2 hours	280	30.4
	>2 hours	550	59.7
	Total	920	100

The mean duration of outdoor activity during school time was 2.3±1.2 hours in a week. 58.5% of children had more than 2 hours of outdoor activity at school in a week. 32% children had less than 2 hours of outdoor activity in school during weekdays. 87 children (9.4%) did not engage in any outdoor play during the school hours. 833 children (90.5%) did some outdoor activity during school hours. Among them 440 children (52.8%) played outdoors between 1-2 pm during the lunch break. 393 children (47.2%) played outdoors between 3-4 pm, during PT hours. The duration of outdoor play after the school time on school days was 1.65±1 hours in a week. 280 children (30.4%) played for less than 2 hours/week and 550 children (59.7%) played for more than 2 hours/week during week days. 90 children (9.7%) did not participate in any outdoor play after the school hours. The mean duration of outdoor activity during weekends was 1.23±1.22 hours. 500 children (54.34%) had no outdoor activities during the weekend. The mean duration of outdoor activity during the whole week was 5.33±2.50 hours. The minimum duration of outdoor activity in a week was 3 hours and maximum duration of outdoor activity in a week was 12 hours. 50% of children had less than 6 hours outdoor activity per week. During weekends, only 30% of children had sun exposure during the period of 10 am to 4 pm, when there is maximum concentration of UV rays in the sunlight. 55.4% of children were exposing only their heads and forearms during outdoor activity. 17% of children had clinical features of rickets. 80 children had genu valgus and 76 children had genu varus. No other skeletal deformity was seen in the study group. Among the study population, 98 children (10.6%) had hypocalcemia, which is defined as serum calcium below 8.5 meq/l. 822 children (89.3%) had normal serum Calcium level. The mean serum calcium level was 9.63±0.81 meq/l. 77 children (8.36%) had hypophosphatemia with serum phosphorus level less than 3.7 meq/l. 843 children had normal serum phosphorus level. The mean Serum Phosphorus level was 4.52±0.69 meq/l. 860 children (93.5%) had serum alkaline phosphatase level in the normal range; between 145-420 U/l in 5-9 years old and 140-560 U/l in 10-15 years old children. 60 children (6.5%) had low alkaline phosphatase levels less than 145 U/l. None of the children in the study group had elevated serum alkaline phosphatase level.

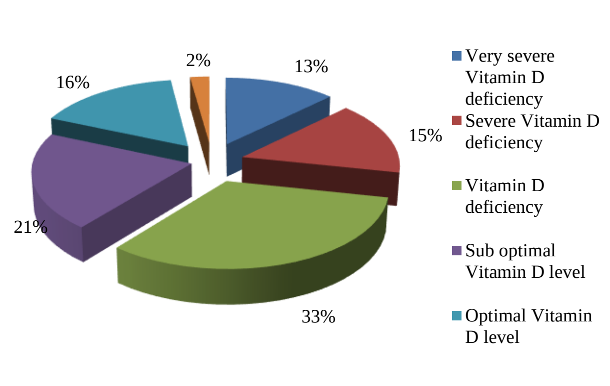

Figure 2: Distribution of cases according to vitamin D status.

170 children (18.47%) had 25 hydroxy vitamin D levels more than 30 ng/ml, which is considered as optimal vitamin D status. 750 children (81.52%) had insufficient vitamin D levels. The mean 25 hydroxy vitamin D level in the study population was 12.33±11.13 ng/ml. The mean 25 hydroxy vitamin D level was 13.13±12.12 ng/ml among boys and 11.98±10.92 ng/ml in girls. The mean 25 hydroxy Vitamin D level in children in the age group 10-15 years was 12.03±13.52 ng/ml. The mean 25 hydroxy

vitamin D level in children in the age group 5-10 years was 13.01±11.93 ng/ml. For statistical comparison, all children with serum 25 hydroxy vitamin D levels less than 30 ng/ml were grouped as vitamin D insufficiency. This group was compared with the group having sufficient levels of vitamin D (≥30 ng/ml). Age (p=0.423) and gender (p=0.559) did not have any statistically significant association with vitamin D insufficiency.

Table 4: Vitamin D insufficiency in children with stunting and wasting.

		Vitamin D status (N)		Total (N)	%	P value
		Insufficiency	Normal			
Stunting	Present	140	20	160	17.4	0.003
	Absent	100	660	760	82.6	
Wasting	Present	150	50	200	21.7	0.227
	Absent	120	600	720	78.3	

Table 5: Vitamin D status versus hypocalcemia, hypophosphatemia and serum alkaline phosphatase levels.

		Vitamin D status (N)		Total (N)	%	P value
		Insufficiency	Normal			
Serum calcium	Normal (≥8.5 meq/l)	164	658	822	89.3	0.894
	Hypocalcemia (<8.5 meq/l)	90	8	98	10.6	
Serum phosphorus	Normal (≥3.7 meq/l)	169	674	843	91.6	0.263
	Hypophosphatemia (<3.7 meq/l)	54	23	77	8.4	
Serum alkaline phosphatase	Normal	146	714	860	93.5	1.000
	Decreased	28	32	60	6.5	
	Elevated	0	0	0	0	

There was a statistically significant relationship between stunting and vitamin D insufficiency in the present study (p=0.003). No relation was found between vitamin D insufficiency and wasting (p=0.227), body mass index (p=0.225) or malnutrition (p=0.823). No statistically significant relationship was found between duration of physical training and vitamin D insufficiency (p=0.446), when children with more than 2 hours of PT class in a week were compared with children with less than 2 hours of PT in a week. No statistically significant relation was found between vitamin D insufficiency and total duration of outdoor activities in a week, when the group with outdoor activity less than 6 hours per week was compared with the group with more than 6 hours of outdoor activity per week (p=0.404). No association was found between vitamin D insufficiency and hypocalcemia (p=0.894) and hypophosphatemia (p=0.263). Elevated serum alkaline phosphatase level was not seen in any of the children in the study group.

DISCUSSION

Vitamin D deficiency has assumed a shape of pandemic, yet it is the most under diagnosed and under treated nutritional deficiency in the world.[10] Vitamin D deficiency has been well documented in children in other parts of the country, but there is scarcity of searchable data on the prevalence of vitamin D deficiency in children of Jammu and Kashmir. This study showed a very dismal picture of alarming high prevalence of vitamin D deficiency in otherwise healthy children in this hilly state of Jammu and Kashmir. In this study, a total of 920 children in the age group of five to fifteen years of age were screened for vitamin D levels in their blood and a total of 750 (81.5%) children were found to have insufficient levels of vitamin D in their blood which is quite alarming. Khadgwat et al, have also reported similar findings, where it was found that 92.3% school going children had vitamin D concentration <20 ngm/ml.[11] Study conducted by Kaur et al in Jammu, North India also found a high prevalence of vitamin D deficiency (87.5%) in school going children.[12] In accordance with this study, many studies have shown that despite having so many sunny days in India throughout the year, vitamin D deficiency is highly prevalent in our country irrespective of their age group and gender.[13-16] In a study conducted in North India (270N), 91% of healthy school girls were found to have hypovitaminosis D, findings similar to the results shown in our study.[17] There was no gender predilection with respect to vitamin D deficiency (p=0.456) in the present study. No difference in 25 hydroxy vitamin D levels were seen in the study by Khadgawat et al, but boys had significantly higher serum 25 (OH) D concentrations (p=0.004) in the study by Marwaha et al.[18,19] There was no statistically significant relationship (p=0.446) between duration of outdoor play during the school hours and vitamin D deficiency. In the present study there was no statistically significant association (p=0.404) between vitamin D deficiency and duration of outdoor activities in a week. The minimum duration of outdoor activity in a week among our study population was 3 hours, which will amount to 25 minutes per day. Puri et al found a significant correlation between 25 hydroxy D concentration and estimated sun exposure and between 25 hydroxy D and percentage of body surface area exposed.[20] Dark skin is a risk factor for low vitamin D in adolescents according to Gordon et al.[21] But vitamin D deficiency was not found to be significantly related to skin colour in infants and toddlers.[22] There was a significant (p=0.002) relationship between stunting and vitamin D deficiency in the present study. Kremer et al also found a positive relation between 25 hydroxy vitamin D levels and height among youngwomen.[23] No significant relationship was found between vitamin D deficiency and hypocalcemia, hypophosphatemia or elevated alkaline phosphatase in our study. The study by Kapil U et al also failed to demonstrate statistically significant relation between vitamin D status and serum calcium, phosphorus and serum alkaline phosphatase levels.[24] Elevated serum alkaline phosphatase activity is considered as a marker of increased osteoclastic activity seen in rickets. But none of the children in the study group showed elevated serum alkaline phosphatase. This finding questions the use of serum alkaline phosphatase as a screening test for vitamin D deficiency.

CONCLUSION

Almost more than two thirds of the children studied had insufficient vitamin D status. Mean level of serum 25 hydroxy vitamin D was 12.33±11.13 ng/ml. The prevalence of vitamin D insufficiency in the present study was very high, alarming and mean 25 hydroxy vitamin D level was very less compared to other studies from India. This may be explained by the geographical position of Kashmir, which is far from the equator than other parts of India, with prolonged winters and people prefer to stay indoors with extreme cold and less sunshine. Vitamin D insufficiency had direct correlation with stunting. Subclinical vitamin D deficiency may be a factor contributing to stunting in children. Future studies are needed in this direction. No statistically significant association was found between vitamin D insufficiency and outdoor activity.

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