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Original Article

Biochemistry Section

Age, Sex and Seasonal Variations of Vitamin D Level in Children of Jammu Region

RACHNA SABHARWAL[1], PALLAVI MAHAJAN[2]

ABSTRACT

Introduction: Vitamin D deficiency is considered as one of the most common undiagnosed medical conditions in the world. Studies from India have reported prevalence of vitamin D deficiency varying from 30 to 100%. Among children, vitamin D deficiency can affect skeletal growth and development. A 25-hydroxyvitamin D (25(OH)D) provides single best assessment of vitamin D status as it has a half life of about 3 weeks, making it suitable indicator of vitamin D status.

Aim: This cross-sectional study was conducted to find out the prevalence of vitamin D deficiency in healthy children ≤ 15 years of age and their relation with seasonal variation.

Materials and Methods: Laboratory data of 25(OH)D was prospectively collected from apparently healthy children aged 7 days to 15 years in the Government Medical College, Jammu, India. Serum vitamin D was analysed by Chemiluminiscent microparticle immunoassay. Serum 25(OH)D level <5 ng/ml was considered severe vitamin D deficiency, 5-10 ng/ml as moderate and 10-20 ng/ml as mild hypovitaminosis. The data was analysed with the help of SPSS version 20.

Results: It was observed that out of total 150 children, prevalence of vitamin D deficiency (25-(OH)-D < 15 ng/ml) was present in 76 (50.67%) and insufficiency in 63 (42%) children. Ten children (6.67%) had severe vitamin D deficiency (< 5 ng/ml), 22 (14.67%) children had moderate hypovitaminosis (5-10 ng/ml) and 107 (71.33%) had mild (10-20 ng/ml). Only 11 (7.33%) children had normal levels of serum 25(OH)D (>20 ng/ml). The mean serum 25(OH)D concentrations were significantly lower from October to March (Winter) as compared from April to September(Summer) in children.

Conclusion: Vitamin D deficiency was observed among the younger age group. Thus adequate awareness among the masses should be done about the exposure of sunlight, dietary rich sources of vitamin D and fortification of foods with vitamin D for prevention and control of vitamin D deficiency.

Keywords: Childhood, Hypovitaminosis D, Insufficiency, Seasonal changes, Sun exposure

INTRODUCTION

Serum 25-hydroxyvitamin D3, is the renowned marker of vitamin D status of the body. Vitamin D deficiency is a common disorder found in all age groups and in both genders [1]. Vitamin D deficiency is related with a large number of chronic diseases like type1 diabetes, hypertension, coronary heart diseases and multiple sclerosis as well as a number of inflammatory and non-inflammatory skeletal diseases. Vitamin D is a main factor responsible for the regulation of bone metabolism. Its role is not only confined to the skeletal system but extend to numerous skeletal organs like brain, heart, prostate, colon and immune cells [2]. The various health consequences of vitamin D deficiency include increased risk of fractures, loss of tooth, rickets and osteomalacia. The identification and treatment of vitamin D deficiency may be particularly important during childhood and adolescence as adequate vitamin D is necessary for skeletal health and bone mass growth [3]. There are various mechanisms that are related to 25-hydroxyvitamin D (25-(OH)-D) deficiency and disparity in lipid profile, but no consensus on the biological plausibility.

The factors which contribute to the production of vitamin D3 in the skin include the amount of pigment in the skin, duration of UV exposure, the season, place of residence, strength of the UV rays, age, intake of vitamin and physical activity [4].

Vitamin D insufficiency is defined as calcidiol (25-OH-D) concentrations <20 ng/mL in the paediatric population by both the American Academy of Paediatrics (AAP) and the Institute of Medicine (IOM). According to AAP 2008, the status of vitamin D is defined as severe deficiency < 5ng/ml, mild to moderate deficiency 5-15 ng/ml, insufficiency 16-20 ng/ml, and sufficiency 21-100 ng/ml [5] whereas, according to both the Endocrine Society and the National Kidney Foundation Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines defines insufficiency as calcidiol concentrations <30 ng/mL. The KDOQI defines deficiency as < 15 ng/mL and Endocrine Society defines deficiency as < 20 ng/mL [6]. It was observed that infants need less sun exposure than adults to produce sufficient vitamin D levels as they have more surface area to volume ratio and better ability to generate vitamin D as compared to older people [7]. In a study conducted by Specker BL et al., it was observed that sun exposure to infants in diapers for 30 minutes maintained weekly Calcidiol concentrations of 11 ng/mL [8]. The AAP recommends that children less than six-month-old should be kept out in direct sunlight to decrease the risks of skin cancer [9]. In the paediatric population, still there are no recommendations present to corroborate the appropriate duration of sun exposure and the unevenness of synthesis of vitamin D in individuals would make such a recommendation difficult [10]. The deficiency of vitamin D does indeed constitute an epidemic in many populations across the world including the healthy populations. In India also, more than 90% of apparently healthy individuals have subnormal 25-(OH)-D levels. In the general population, low dietary intake of vitamin D and poor exposure to sunlight are common causes of vitamin D deficiency [11]. So by keeping these things in mind, the present study was conducted with the aim to estimate the levels of vitamin D in children in summer (April to September) and (October to March) winter seasons.

MATERIALS AND METHODS

The present cross-sectional study was conducted in the Department of Biochemistry, Government Medical College, Jammu, in which the laboratory data of serum 25-(OH)-D was prospectively collected from 150 apparently healthy children, 7 days to 15 years of age coming for the first time to Paediatric OPD of Government Medical College, SMGS Hospital, Jammu for minor ailments including upper respiratory tract infections, fever, diarrhea and children coming to OPD for immunization.

The study was carried out from October 2016 to September 2017. Children with mild, severe or life threatening systemic diseases were not included in the study. Other exclusion criteria were children with a history of chronic illnesses, autoimmune diseases or recurrent fractures, children undergoing diagnostic biopsies, bronchoscopy or endoscopy and children on medication known to affect serum 25-(OH)-D. The study was approved by the institutional ethics committee.

Personal and demographic data of children were collected. Serum 25-(OH)-D was analysed in serum by Abbott Architect autoanalyser by chemiluminiscent microparticle immunoassay [12]. In the present study, children with serum 25-(OH)-D level < 5 ng/ml was considered severe vitamin D deficiency, 5 to 10 ng/ml as moderate hypovitaminosis and 10 to 20 ng/ml as mild hypovitaminosis. According to AAP 2008, the status of vitamin D is defined as severe deficiency < 5ng/ml, mild to moderate deficiency 5-15 ng/ml, insufficiency 16-20 ng/ml, and sufficiency 21-100 ng/ml.

The statistical analysis was conducted using SPSS version 20. Descriptive statistics were used to present the clinical characteristics of the participants. Continuous variables were described using the means and standard deviation. All p-values were two sided and p<0.05 was considered to be statistically significant.

RESULTS

A total of 150 children, 7 days to 15 years of age were enrolled in the study. Serum 25-(OH)-D concentrations were available for all the subjects, of whom 95 (63.33%) were females and 55 (36.67%) were males. The mean age±standard deviation of the study group was 8.11±4.60 years, while mean±standard deviation serum 25-(OH)-D concentration was 14.17±5.13 ng/ml (range 0.1 to 25 ng/ml). Prevalence of vitamin D deficiency (25-(OH)-D < 15 ng/ml) was present in 76 (50.67%) and insufficiency in 63 (42%) children. Ten children (6.67%) had severe vitamin D deficiency (< 5 ng/ml), 22 (14.67%) children had moderate hypovitaminosis (5-10 ng/ml) and 107 (71.33%) had mild (10-20 ng/ml). Only 11 (7.33%) children had normal levels of serum 25-(OH)-D (>20 ng/ml) [Table/Fig-1].

Serum 25(OH)D concentration (ng/ml)		
Deficiency	Insufficiency	Normal
<15 ng/ml Number of children (Percentage of children)	16-20 ng/ml Number of children (Percentage of children)	≥20 ng/ml Number of children (Percentage of children)
76 (50.67%)	63 (42%)	11 (7.33%)

[Table/Fig-1]: Distribution of children according to serum 25(OH)D concentration.

Age group (in years)	Serum 25(OH)D concentration (ng/ml)			
	<5 Number of children (Percentage of children)	5-10 Number of children (Percentage of children)	10-20 Number of children (Percentage of children)	≥20 Number of children (Percentage of children)
0-5	1 (10%)	9 (40.91%)	29 (27.10%)	6 (54.55%)
6-10	6 (60%)	7 (31.82%)	35 (32.71%)	3 (27.27%)
11-15	3 (30%)	6 (27.27%)	43 (40.19%)	2 (18.18%)
Total	10	22	107	11

[Table/Fig-2]: Age wise distribution of children according to serum 25(OH)D concentration.

Sex	Serum 25(OH)D concentration (ng/dl)			
	<5 No. of children (%)	5-10 No. of children (%)	10-20 No. of children (%)	≥20 No. of children (%)
Male	1 (10%)	10 (45.45%)	40 (37.38%)	4 (36.36%)
Female	9 (90%)	12 (54.55%)	67 (62.62%)	7 (63.64%)
Total	10	22	107	11

[Table/Fig-3]: Sex wise distribution of children according to serum 25(OH)D concentration.

Variables	Serum 25 (OH)D Concentration (ng/ml) Mean±standard deviation	Statistical inference (unpaired t-test)
Gender:		
Male (n=55)	14.58±4.72	t= 0.73; p=0.46*
Female (n=95)	13.94±5.36	
Seasonal variations:		
October to March (n=50)	11.27±5.42	t=5.32; p < 0.0001**
April to September (n=100)	15.62±4.32	

[Table/Fig-4]: Comparison of mean serum 25(OH)D concentration levels of children with respect to gender and seasonal variation.
* p-value is more than 0.05, not significant
** p-value is less than 0.05, highly significant

Age wise and sex wise distribution of children according to serum concentration levels are given in [Table/Fig-2,3]. Out of 76 children with vitamin D deficiency, 40.79% were in the age group of 6 to 10 years, while 64.47% were females.

Comparison of mean serum 25-(OH)-D levels of children with respect to gender and seasonal variation is given in [Table/Fig-4]. Mean serum 25-(OH)-D concentration was higher in male children (14.58 ng/ml) as compared to female children (13.94 ng/ml), though the difference between the two was statistically not significant. However, mean serum 25-(OH)-D level from October to March (11.27 ng/ml) was significantly lower as compared from April to September (15.62 ng/ml).

DISCUSSION

It has been observed that out of 150 children, prevalence of vitamin D deficiency (25-(OH)-D < 15 ng/ml) was present in 76 (50.67%) and insufficiency in 63 (42%) children. Only 11 (7.33%) children had normal levels of serum 25 hydroxyvitamin D (>20 ng/ml). Mean serum 25-(OH)-D level from October to March was significantly lower as compared from April to September. There were wide variations in serum 25-(OH)-D across the various seasons in all decades of age. Similar results were observed in other studies [13]. Gordon CM et al., found that during the winter, serum 25-(OH)-D concentrations were significantly lower than the values obtained during summer season [14].

The geography of the region and its latitude affects the amount and quality of solar radiation particularly the intensity of UVB radiation reaching surface of the earth. In regions with high latitude, the intensity of UVB is not sufficient to synthesize adequate amount of vitamin D in the autumn or winter. Also, in the winter season, decrease in the duration of outdoor sunlight exposure and wearing more clothes may affect serum 25-(OH)-D levels. Even with more daily intake of vitamin D, seasonal variations in geographic regions at higher latitudes result in greater vitamin D deficiency [15]. The synthesis of vitamin D depends on number of factors like exposure to UV light, duration of exposure, skin pigmentation, use of sun blocks, climate, and regional variation. Skin pigmentation is one of the limitations associated with lower synthesis of vitamin D by black skins during the summer months [16]. Insufficient daily intake of vitamin D on daily basis can lead to its deficiency in the summer and autumn despite sufficient exposure to sunlight [17].

In our study, it was observed that vitamin D deficiency was present among all the age groups. In another study, it was reported that the prevalence of vitamin D deficiency in 1212 children, aged between 4 and 15 years was 58.6% [18]. It was also observed in our study that the females have decreased vitamin D levels as compared to males [Table/Fig-3]. In a study conducted by Saeidlou et al, the prevalence of vitamin D deficiency was 27.9% in females and 6.9% in males [1]. This can be due to the fact that women especially living in high latitude have less body surface exposure due to clothing [2].

Vitamin D deficiency is prevalent in India, a finding that is unexpected in a tropical country with abundant sunshine [19]. India is located between 8.4ºN and 37.6ºN latitude with majority of its population living in regions experiencing optimum sunlight throughout the year. Despite its sunny environment, hypovitaminosis is common in India [20].

LIMITATION

The results of this study have several limitations in regard to the duration of exposure, physical activity. Even though the responsible variables involved in changes in vitamin D status is reported in this study, may also engross general population but these observations cannot be generalized but can be applied only to children attending medical clinics.

CONCLUSION

In conclusion, this study showed that serum levels of vitamin D can be different in the two seasons regardless of gender variations in children. The serum vitamin D levels are lowest in the winter and highest in the summer months. So while estimating the vitamin D levels, seasonal variation should also be taken into account.

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PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Biochemistry, Government Medical College, Jammu, Jammu & Kashmir, India.
2. Demonstrator, Department of Biochemistry, Government Medical College, Jammu, Jammu & Kashmir, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Pallavi Mahajan,
154 A/D, Green Belt, Gandhi Nagar, Jammu-180004, Jammu & Kashmir, India.
E-mail: pallavi31mahajan@gmail.com

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