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Correlation of Serum Vitamin D Levels with Demographic and Anthropometric Factors in Children in a Tertiary Care Centre in Southern Assam: A Cross-Sectional Observational (Non-Interventional) Study

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ABSTRACT

Background: According to the Endocrine Society, vitamin D deficiency and insufficiency are defined as serum 25-hydroxyvitamin D [25(OH)D] levels of 20 ng/mL as sufficient. This study aimed to estimate serum vitamin D levels in children and assess their association with demographic, dietary, environmental, and anthropometric factors, including age and body weight.

Methods: This 6-month hospital-based cross-sectional observational study included 50 children aged <18 years with clinical features of vitamin D deficiency, selected by purposive sampling. Serum vitamin D was measured using an autoanalyser, and body weight was recorded using a digital paediatric scale. Demographic, dietary, sun-exposure, and lifestyle data were collected through a structured questionnaire. Data were analysed using SPSS and MS Excel. Pearson's correlation and the independent-samples t-test were applied, with $p<0.05$ considered statistically significant.

Results: Of the 50 children (mean age 5.66 ± 3.05 years; 80.0% male), 39 (78.0%) had sufficient and 11 (22.0%) had insufficient serum vitamin D levels; no child was vitamin D deficient. Serum vitamin D showed weak, statistically non-significant negative correlations with age ($r = −0.093$, $p = 0.52$) and body weight ($r = −0.154$, $p = 0.29$).

Conclusion: Most children in this sample had sufficient serum vitamin D levels, while about one-fifth were insufficient. Serum vitamin D was not significantly correlated with age or body weight. As bone health parameters were not assessed, no inference regarding bone health can be drawn; larger, adequately powered studies with direct assessment of bone health are recommended.

Key-words: 25-Hydroxyvitamin D; Vitamin D deficiency; Child; Body weight; Cross-sectional studies; India

INTRODUCTION

According to the Endocrine Society, vitamin D deficiency and insufficiency are defined as serum 25-hydroxyvitam-in D [25(OH)D] levels of <20 ng/mL and 21–29 ng/mL, respectively [1]. Vitamin D deficiency is associated with various comorbidities such as cardiovascular diseases including hypertension and congestive heart failure, diabetes mellitus, autoimmune diseases such as rheumatoid arthritis, multiple sclerosis and Crohn's disease, various forms of cancer, mental health disorders such as schizophrenia and depression, and impaired quality of life (QoL) [2].

The Indian Academy of Paediatrics guidelines and the Global Consensus on Prevention and Management of Nutritional Rickets recommend that 25(OH)D

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concentrations over 50 nmol/L (20 ng/mL) are sufficient, between 30 and 50 nmol/L (12–20 ng/mL) are insufficient, and below 30 nmol/L (12 ng/mL) are in the deficiency range in children and adolescents [3].

A systematic review published in 2014 suggested that vitamin D deficiency and insufficiency are a major public health problem globally irrespective of age, even in populations residing in countries where ultraviolet radiation is assumed to be adequate and in industrialised countries where fortification has been implemented for years [4]. It is estimated that about 1 billion people across all ethnicities and age groups have low vitamin D concentrations worldwide [3].

Vitamin D deficiency is relatively common in the paediatric population and is relevant to the paediatric orthopaedic surgeon as it relates to bone health. Children with underlying vitamin D deficiency may present in the form of rickets and limb deformity. There is also evidence of higher rates of vitamin D deficiency in the paediatric fracture population than in controls. Fractures are common in childhood and account for 25% of injuries, with about a third of boys and girls sustaining at least one fracture before the age of 17 years [5]. About 66% of all paediatric fractures occur in children who fracture on more than one occasion, suggesting an intrinsic predisposition to fracture in this population, perhaps indicating an alteration in bone health [6]. The study aimed to estimate serum vitamin D levels in children and assess their association with demographic, dietary, environmental and anthropometric (age and body weight) factors, without directly evaluating bone health outcomes.

MATERIALS AND METHODS

Study design and setting- This was a hospital-based observational (non-interventional) cross-sectional study. Each participant was assessed once; no treatment was administered and no follow-up measurements formed part of the study. Children attending the outpatient department and inpatient wards of Silchar Medical College and Hospital (SMCH), Silchar, Assam, were studied over a period of 6 months.

Study population

Inclusion criteria- Paediatric patients aged less than 18 years with clinical features of vitamin D deficiency whose parents/guardians were willing for them to participate in the study.

Exclusion criteria- Children with any of the following were excluded:

- Malignancy, known autoimmune disease or chronic steroid use
- Malabsorption
- Current intake of vitamin D or calcium supplements
- No complaint of low back ache (LBA)
- Unwillingness to participate in the study

Sample size and sampling technique- A small sample of 50 children attending SMCH during the study period and willing to participate was included by purposive sampling. No formal sample-size calculation was performed; the findings are therefore preliminary (see Limitations).

Data collection

Clinical assessment: Detailed history and physical examination of all participants.

Questionnaire: A structured questionnaire captured demographic details (age, gender, skin colour, socio-economic status, family history), dietary habits, type of milk consumed, passive smoking exposure, physical activity and sun exposure.

Anthropometry: Body weight was recorded using a standardised digital paediatric weighing scale. Height was not measured; therefore, BMI was not calculated.

Biochemical analysis: Serum vitamin D levels were measured using an autoanalyser. Serum vitamin D was measured once for each participant at enrolment; no treatment was administered and no follow-up measurements were taken as part of this study.

Statistical analysis- Data were entered into Microsoft Excel and analysed using SPSS. Continuous and categorical variables were expressed as mean ± SD and frequency (%), respectively. Male and female body weights were compared using the independent-samples t-test, while Pearson's correlation assessed associations of vitamin D levels with age and body weight. Regression analysis was not performed due to the absence of

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deficiency cases and only 11 insufficient cases. A two-tailed $p < 0.05$ was considered significant.

Ethical considerations- The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from the parents or guardians of all participants.

RESULTS

A total of 50 children were enrolled, with a mean age of 5.66 ± 3.05 years. Male participants constituted the majority (40, 80.0%), while females accounted for 10 (20.0%). The mean body weight was 13.70 ± 7.54 kg. Height was not measured; hence, height and BMI are not reported. Dark brown skin was the most common (26, 52.0%), followed by brown (9, 18.0%), fair (8, 16.0%) and pale (7, 14.0%). Most participants consumed a non-vegetarian diet (46, 92.0%) and belonged to the lower middle-class socio-economic group (40, 80.0%). Exposure to passive smoking was reported in only 4 (8.0%) participants. Cow milk was consumed by 33 (66.0%) children. A paternal and maternal family history was reported in 15 (30.0%) participants each, whereas 20 (40.0%) had no family history or the information was unavailable (Table 1).

Table 1: Baseline characteristics of the study participants (n = 50)

Characteristic	Value
Age (years), mean ± SD	5.66 ± 3.05
Gender, n (%)	Male: 40 (80.0); Female: 10 (20.0)
Weight (kg), mean ± SD	13.70 ± 7.54
Skin colour, n (%)	Dark brown: 26 (52.0); Brown: 9 (18.0); Fair: 8 (16.0); Pale: 7 (14.0)
Dietary habits, n (%)	Non-vegetarian: 46 (92.0); Vegetarian: 4 (8.0)
Socio-economic status, n (%)	Lower middle: 40 (80.0); Upper middle: 5 (10.0); Upper lower: 3 (6.0); Lower: 2 (4.0)
Passive smoking, n (%)	Yes: 4 (8.0); No: 46 (92.0)
Milk type, n (%)	Cow milk: 33 (66.0); Non-cow milk: 17 (34.0)
Family history, n (%)	Father: 15 (30.0); Mother: 15 (30.0); None/not available: 20 (40.0)

SD: standard deviation. Height was not measured; hence, height and BMI are not reported.

Of the 50 children, 39 (78.0%) had sufficient vitamin D levels, whereas 11 (22.0%) were vitamin D insufficient. No participant had vitamin D deficiency (Table 2).

Table 2: Distribution of serum vitamin D status (n = 50)

Vitamin D status	n	%
Sufficient	39	78.0
Insufficient	11	22.0
Deficient	0	0.0

Cut-off values used for classification: Sufficient, >20 ng/mL; insufficient, 12–20 ng/mL; deficient, <12 ng/mL, according to the Indian Academy of Paediatrics and Global Consensus criteria

The mean body weight was slightly higher among females (14.80 ± 8.79 kg) than among males (13.70 ± 7.54 kg); this difference was compared using the independent-samples t-test ($p = 0.69$) (Table 3).

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Table 3: Body weight by gender

Variable	Female (n = 10), mean ± SD	Male (n = 40), mean ± SD	p-value
Weight (kg)	14.80 ± 8.79	13.70 ± 7.54	0.69

SD: standard deviation. p-value from independent-samples t-test.

Both correlations of baseline serum vitamin D with age and body weight were weak and negative (age: r = −0.093, p = 0.52; body weight: r = −0.154, p = 0.29), and neither was statistically significant, indicating no meaningful linear relationship between these variables and serum vitamin D levels in the study population (Table 4).

Table 4: Correlation of age and body weight with baseline serum vitamin D level (n = 50)

Variable	Correlation coefficient (r)	p-value
Age (years)	−0.093	0.52
Weight (kg)	−0.154	0.29

Pearson's correlation coefficient; two-tailed p-values.

DISCUSSION

The present study evaluated the demographic characteristics, anthropometric profile and vitamin D status of the study participants. The study population predominantly comprised young children, with males constituting the majority. Most children belonged to lower middle-class families, consumed a non-vegetarian diet, had dark brown skin, were not exposed to passive smoking and consumed cow milk. Body weight showed wide variability among the participants [3,4].

Assessment of vitamin D status revealed that 78% of the participants had sufficient vitamin D levels, while 22.0% had vitamin D insufficiency. Notably, no participant was found to have vitamin D deficiency, indicating that the overall vitamin D status of the study population was satisfactory, although a considerable proportion remained at risk due to insufficient levels [5].

Gender-wise comparison showed that female participants had a slightly higher mean body weight than male participants; this difference was small (independent-samples t-test, p = 0.69).

Correlation analysis demonstrated weak, statistically non-significant negative relationships between baseline serum vitamin D levels and age (r = −0.093, p = 0.52) and body weight (r = −0.154, p = 0.29), indicating that these characteristics alone were not predictors of vitamin D status in the present study.

Overall, although the majority of participants had adequate vitamin D levels, vitamin D insufficiency remains a concern in a subset of children.

Demographic and anthropometric characteristics showed only limited association with vitamin D status, emphasising the need to consider additional factors such as dietary intake, sunlight exposure, lifestyle and supplementation when evaluating vitamin D status in children [7].

A multicentre Indian study found that the western state of Maharashtra had the highest prevalence of deficient and insufficient children and adolescents, while those from the southern state of Tamil Nadu and the central state of Chhattisgarh were the most vitamin D sufficient [7]. In that study, the prevalence of vitamin D deficiency was significantly higher in girls than boys (28.4% vs 23.9%) and in the urban than the rural population (30.2% vs 21.6%). The same study also reported that younger age, female gender, overweight and urban residence were significant factors contributing to vitamin D deficiency, while socio-economic status, sunlight exposure, dietary calcium intake, dietary calcium-to-phosphorus ratio and triceps skinfold thickness did not have a significant impact on vitamin D status [7,8].

LIMITATIONS

The sample size (n = 50) was small and was obtained by purposive sampling from a single centre without a formal sample-size calculation, which limits statistical power and generalisability; the findings should therefore be regarded as preliminary. Height was not measured, so BMI could not be assessed. Bone health parameters (e.g., fracture history, clinical or radiological signs of rickets, or bone mineral density by DEXA) were not

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evaluated; hence, no conclusions regarding bone health can be drawn. Larger, adequately powered studies incorporating direct bone health assessment are recommended.

CONCLUSIONS

In this hospital-based cross-sectional study, most children had sufficient serum vitamin D levels, while 22.0% had vitamin D insufficiency; no child was found to have vitamin D deficiency. Serum vitamin D levels showed weak, negative, and statistically non-significant correlations with age (r=−0.093, p=0.52) and body weight (r=−0.154, p=0.29). Although the findings suggest a generally satisfactory vitamin D status among the participants, the proportion with insufficient levels highlights the importance of assessing vitamin D status in children. The results should be interpreted cautiously because of the small sample size, purposive sampling, and single-centre design. Furthermore, height and BMI were not assessed, and direct bone health parameters were not evaluated. Therefore, no conclusions regarding bone health can be drawn. Larger, adequately powered studies involving diverse paediatric populations and direct assessment of bone health are recommended to clarify the determinants and clinical implications of vitamin D insufficiency.

CONTRIBUTION OF AUTHORS

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