

ORIGINAL ARTICLE

Vitamin D Deficiency among Children Visiting Outpatient Department in Bangladesh Shishu Hospital & Institute

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ABSTRACT

Background: Vitamin D plays a crucial role in bone mineralization, immune function, and overall growth. Deficiency is a widespread public health concern, particularly among children in South Asia, including Bangladesh. Limited sun exposure and dietary insufficiency are recognized contributors, but the prevalence and associated risk factors remain underreported in pediatric outpatient populations. **Aim of the study:** To determine the prevalence, risk factors, and clinical impact of vitamin D deficiency among children attending outpatient departments of Bangladesh Shishu Hospital & Institute. **Methods & Martials:** A cross-sectional study was conducted from From January 2024 to December 2024 on 210 pediatric patients (<18 years) using purposive sampling. Demographic, clinical, and lifestyle data were collected via structured questionnaires. Serum 25-hydroxyvitamin D [25(OH)D] was measured using chemiluminescent immunoassay and classified as deficient (<20 ng/mL), insufficient (20–29 ng/mL), or sufficient (≥30 ng/mL). Associations with age, sex, BMI, sunlight exposure, and season were analyzed using chi-square tests and multivariable logistic regression. **Result:** Vitamin D deficiency was observed in 59.5% of participants, and 26.2% had insufficient levels. Deficiency was most prevalent during winter and spring and was significantly associated with limited sunlight exposure (<2 hours/day). Age, sex, and BMI were not independent predictors of deficiency. **Conclusion:** Vitamin D deficiency is highly prevalent among children attending outpatient departments in Dhaka. Environmental and lifestyle factors, particularly inadequate sunlight exposure and seasonal variation, are key contributors. Routine screening, safe sun exposure, and dietary or supplemental interventions are recommended to prevent adverse musculoskeletal and immune outcomes.

Keywords: Vitamin D deficiency, Pediatric, Sunlight exposure, Bangladesh, 25-hydroxyvitamin D.

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INTRODUCTION

Vitamin D, often dubbed the sunshine vitamin, is a fat-soluble vitamin critical for maintaining calcium and phosphorus homeostasis and ensuring proper bone mineralization [1]. Globally, vitamin D deficiency affects about 40–50% of the population, while insufficiency and deficiency combined impact nearly 1 billion people worldwide [2]. Bangladesh the pooled prevalence of vitamin D deficiency is about 67% among adults [3]. It is synthesized in the skin upon exposure to ultraviolet-B (UVB) radiation from sunlight, and it is also obtained from dietary sources such as fatty fish, fortified foods, egg yolks, and supplements [1]. Vitamin D deficiency

arises from a combination of environmental, biological, and lifestyle factors. The foremost cause is insufficient exposure to sunlight, as ultraviolet-B rays are required for cutaneous vitamin D synthesis. Densely populated urban environment, children often have limited access to open outdoor spaces due to high-rise buildings, traffic, and safety concerns, which reduce sun exposure opportunities [4]. Dietary insufficiency is another major contributor. Traditional Bangladeshi diets are heavily cereal-based, with limited intake of vitamin D-rich foods. Since Bangladesh currently lacks a nationwide vitamin D fortification program, dietary sources alone are inadequate for most children [5]. The consequences of vitamin D deficiency

extend far beyond bone health, affecting multiple organ systems and overall quality of life. In children, one of the most recognized outcomes is rickets, a disorder characterized by impaired bone mineralization leading to skeletal deformities, delayed growth, and, in severe cases, permanent disability. In adults, deficiency contributes to osteomalacia and accelerates the risk of osteoporosis, both of which increase susceptibility to fractures and chronic musculoskeletal pain [6,7]. Beyond the skeletal system, vitamin D plays a crucial role in immune regulation. Deficient individuals are more vulnerable to acute respiratory infections, autoimmune disorders, and delayed wound healing. Associations between low vitamin D levels and metabolic and cardiovascular conditions, including insulin resistance, hypertension, and obesity-related complications, have been increasingly documented, suggesting that vitamin D deficiency may contribute to the development and progression of these disorders [8]. Vitamin D deficiency with muscle weakness, fatigue, and mood disorders such as depression and anxiety, which can affect school performance and social development in children [5]. There are potential drawbacks if deficiency is addressed improperly. Over-supplementation can lead to hypervitaminosis D, resulting in hypercalcemia, kidney damage, and soft tissue calcification. Encouraging sun exposure may conflict with cultural norms, skin cancer precautions, or environmental limitations, while dietary fortification and supplementation programs require monitoring, resources, and adherence to avoid toxicity [9]. The aim of this study was to determine the prevalence, risk factors, and clinical impact of vitamin D deficiency among patients visiting the outpatient departments of Dhaka Shishu Hospital.

METHOD & MATERIALS

This was a cross-sectional observational study conducted from January 2024 to December 2024 at the Outpatient Departments (OPD) of Bangladesh Shishu Hospital & Institute, a tertiary care pediatric hospital in Dhaka, Bangladesh. A total of 210 pediatric patients (<18 years) visiting the OPDs were consecutively enrolled using a purposive sampling technique during the study period. Participants were recruited as they presented to the OPD and were screened against the study's inclusion and exclusion criteria.

Inclusion criteria:

- Children attending OPDs for routine check-ups or minor illnesses.
- Consent provided by parents or guardians.

Exclusion criteria:

- Children with chronic liver, kidney, or gastrointestinal diseases affecting vitamin D metabolism.
- Those receiving vitamin D supplementation within the previous three months.
- Critically ill patients requiring hospitalization.

Data Collection

Data were collected using a pre-designed structured questionnaire administered by trained research staff. Information gathered included demographics (age, sex), clinical features (fatigue, muscle pain, recurrent infections, growth delay), and lifestyle factors, such as daily sunlight exposure and dietary habits. Anthropometric measurements, including height and weight, were obtained using standardized instruments, and BMI was calculated according to WHO pediatric growth standards. Age was recorded in years, and BMI was categorized into underweight, normal, and overweight/obese for analysis.

Laboratory Analysis

A 5 mL venous blood sample was collected from each participant under aseptic conditions. The blood was allowed to clot and centrifuged to separate serum, which was then stored at -20°C until analysis. Serum 25-hydroxyvitamin D [25(OH)D] concentrations were measured using chemiluminescent immunoassay (CLIA) on [specify instrument/model]. Vitamin D status was classified according to the Endocrine Society guidelines: deficient (<20 ng/mL), insufficient (20–29 ng/mL), and sufficient (≥ 30 ng/mL). All laboratory procedures followed standard operating protocols to ensure accuracy and reliability.

Definitions of Variables

Sunlight exposure was defined as the average hours per day spent outdoors between 10:00 am and 4:00 pm. BMI categories were defined as underweight (<18.5 kg/m²), normal (18.5–24.9 kg/m²), and overweight/obese (≥ 25 kg/m²). Seasons were categorized based on local climatic data: Winter (Dec–Feb), Spring (Mar–May), Summer (Jun–Aug), and Autumn (Sep–Nov).

Statistical Analysis

Data were analyzed using SPSS version 26 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation (SD), and categorical variables as frequency (n) and percentage (%) with two decimal places. Differences in mean serum 25(OH) D across seasons were assessed using ANOVA, with post-hoc Tukey tests for pairwise comparisons. Associations between categorical variables (age group, sex, BMI, sunlight exposure, season) and vitamin D deficiency were evaluated using the Chi-square test. Binary logistic regression was performed to identify independent predictors of vitamin D deficiency (<20 ng/mL), adjusting for age, sex, BMI, sunlight exposure, and season. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were reported, and a two-tailed $p < 0.05$ was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Review Board of Dhaka Shishu Hospital. Written informed consent was obtained from parents or guardians, and confidentiality and anonymity of participants were strictly maintained throughout the study.

RESULT

A total of 210 children attending the outpatient department were enrolled in the study. The age distribution showed that 22.86% were under 5 years, 31.43% were 5–10 years, 24.76% were 11–15 years, and 20.95% were above 15 years. The study population included 112 males (53.33%) and 98 females (46.67%). Regarding BMI status, 22.86% were underweight, 62.86% had normal BMI, and 14.29% were overweight or obese (Table 1). Table 2 presented that clinically, fatigue was the most common symptom (42.86%), followed by muscle pain (26.67%), recurrent infections (17.14%), and growth delay (13.33%). In terms of sunlight exposure, 43.81% of participants received less than 1 hour per day, 36.19% received 1–2 hours, and 20% received more than 2 hours daily. Vitamin D deficiency was observed in 59.52% of participants, insufficiency in 26.19%, and sufficient levels in only 14.29%, with a mean serum 25(OH)D of 18.9 ± 7.0 ng/mL (Table 3). Table 4 showed that seasonal analysis of serum 25(OH)D levels demonstrated marked variation across the year. The highest prevalence of vitamin D

deficiency was observed in winter (76.92%) and spring (78.26%), with mean serum levels of 14.9 ± 6.2 ng/mL and 15.3 ± 6.5 ng/mL, respectively. In contrast, summer and autumn showed lower deficiency rates of 50.0% and 37.5%, with corresponding mean levels of 19.3 ± 7.0 ng/mL and 20.7 ± 6.5 ng/mL. Bivariate analysis of demographic and behavioral factors revealed that sunlight exposure was significantly associated with vitamin D deficiency ($p=0.002$). Children receiving less than 1 hour of sunlight per day had the highest deficiency (75.0%), compared to 50.0% in those exposed for 1–2 hours and 42.86% in those with >2 hours of daily exposure. Age, sex, and BMI categories were not significantly associated with deficiency (all $p > 0.05$) (Table 5). Multivariable logistic regression identified reduced sunlight exposure (<1 hour/day: aOR 3.12, 95% CI 1.54–6.33; 1–2 hours/day: aOR 2.98, 95% CI 1.46–6.07) and winter (aOR 2.5, 95% CI 1.10–5.68) and spring seasons (aOR 2.72, 95% CI 1.18–6.25) as independent predictors of vitamin D deficiency. Age, sex, and BMI were not significant predictors in the adjusted model (Table 6).

Table – I: Baseline demographic characteristics of the study population (n = 210)

Variable	Frequency (n)	Percentage (%)
Age (years)		
<5	48	22.86
5–10	66	31.43
11–15	52	24.76
>15	44	20.95
Gender		
Male	112	53.33
Female	98	46.67
BMI (kg/m²)		
Underweight (<18.5)	48	22.86
Normal (18.5–24.9)	132	62.86
Overweight/Obese (≥ 25)	30	14.29

Table – II: Clinical features and sunlight exposure among study population

Variable	Frequency (n)	Percentage (%)
Clinical feature		
Fatigue	90	42.86
Muscle pain	56	26.67
Recurrent infections	36	17.14
Growth delay	28	13.33
Sunlight exposure (hours/day)		
<1 hour	92	43.81
1–2 hours	76	36.19
>2 hours	42	20.00

Table – III: Vitamin D status among the study population

Vitamin D status	Serum 25(OH)D (ng/mL) — category	Frequency (n)	Percentage (%)
Deficient	< 20	125	59.52
Insufficient	20–29	55	26.19
Sufficient	≥ 30	30	14.29
Mean $\pm$ SD		18.9 ± 7.0	

Table – IV: Seasonal variation in serum 25(OH) D and deficiency prevalence among the study population

Season	n (participants)	Mean 25(OH)D $\pm$ SD (ng/mL)	Deficient n (%)
Winter	52	14.9 ± 6.2	40 (76.92)
Spring	46	15.3 ± 6.5	36 (78.26)
Summer	56	19.3 ± 7.0	28 (50.00)
Autumn	56	20.7 ± 6.5	21 (37.50)

Table – V: Association of vitamin d deficiency with age, sex, BMI, and sunlight exposure

Factor	Deficient <i>n</i> (%)	Non-deficient <i>n</i> (%)	Total	p-value
Age group (years)				
<5	30 (62.50)	18 (37.50)	48	0.41
5–10	42 (63.64)	24 (36.36)	66	
11–15	28 (53.85)	24 (46.15)	52	
>15	25 (56.82)	19 (43.18)	44	
Gender				
Male	67 (59.82)	45 (40.18)	112	0.92
Female	58 (59.18)	40 (40.82)	98	
BMI category (kg/m ²)				
Underweight (<18.5)	28 (58.33)	20 (41.67)	48	0.76
Normal (18.5–24.9)	80 (60.61)	52 (39.39)	132	
Overweight/Obese (≥25)	17 (56.67)	13 (43.33)	30	
Sunlight exposure (hours/day)				
<1 hour/day	69 (75.00)	23 (25.00)	92	0.002 *
1–2 hours/day	38 (50.00)	38 (50.00)	76	
>2 hours/day	18 (42.86)	24 (57.14)	42	

Table – VI: Multivariable logistic regression for predictors of vitamin D deficiency

Predictor (reference)	Adjusted OR	95% CI	p-value
Age (years, continuous)	0.99	0.96–1.02	0.45
Sex (female vs male)	0.99	0.57–1.73	0.97
BMI (Overweight/Obese vs Normal)	0.92	0.42–2.03	0.85
BMI (Underweight vs Normal)	0.92	0.44–1.93	0.82
Sunlight exposure (1–2 h/day vs >2 h/day)	2.98	1.46–6.07	0.003*
Sunlight exposure (<1 h/day vs >2 h/day)	3.12	1.54–6.33	0.002*
Season (Winter vs Autumn)	2.5	1.10–5.68	0.029*
Season (Spring vs Autumn)	2.72	1.18–6.25	0.019*
Season (Summer vs Autumn)	1.7	0.80–3.60	0.16

DISCUSSION

Vitamin D deficiency, a prevalent yet often underrecognized nutritional disorder, manifests in various forms ranging from mild insufficiency to severe deficiency depending on serum 25(OH)D levels [10]. In our study, more than half of the participants were male (53.33%), with the majority aged 5–10 years. The mean BMI distribution showed that 22.86% were underweight and 14.29% overweight/obese. These demographic findings align with previous reports, where undernutrition and overnutrition coexist in pediatric populations due to the ongoing nutritional transition [11]. Previous studies in Dhaka have similarly shown high rates of both underweight and overweight among urban children, reflecting the dual burden of malnutrition [12]. Fatigue (42.86%) and muscle pain (26.67%) were the most common clinical features in children with hypovitaminosis D, consistent with the well-established musculoskeletal manifestations of deficiency [13]. Recurrent infections (17.14%) and growth delay (13.33%) were also notable, supporting evidence that vitamin D plays a role in immune modulation and linear growth [14]. Low sunlight exposure was striking—43.81% reported <1 h/day outdoors—mirroring patterns described in South Asian urban children, where sun avoidance, indoor schooling, and cultural clothing practices markedly reduce cutaneous vitamin D synthesis [15]. We found a deficiency prevalence of 59.52% and insufficiency of 26.19%, with a mean 25(OH)D level of 18.9 ± 7.0 ng/mL. These values are comparable to prior Bangladeshi studies. For example, a Dhaka study reported Vitamin D deficiency was affecting 50.00% of children aged 1–3 years [16]. Our results reinforce this paradox of deficiency in sunny climates, also

observed in Pakistan [17]. We observed lowest mean 25(OH)D in winter (14.9 ± 6.2 ng/mL, 76.92% deficiency) and spring (15.3 ± 6.5 ng/mL, 78.26% deficiency), with improvement in autumn (20.7 ± 6.5 ng/mL, 37.50% deficiency). This seasonal variation has been consistently reported worldwide, with nadirs in winter and peaks in summer/autumn [18]. Chinese pediatric cohort also demonstrated similar patterns, where serum 25(OH)D concentrations were significantly lower during winter months [19]. These fluctuations reflect reduced ultraviolet-B availability in cooler months, coupled with behavioral changes such as less outdoor play and heavier clothing. Deficiency prevalence did not differ significantly by age, gender, or BMI in our study. Previous studies reported female sex and higher BMI as predictors of deficiency, but these associations were not evident here—possibly due to sample homogeneity or cultural differences in sun exposure practices [20]. Conversely, sunlight exposure showed a robust association: children with <1 h/day exposure had significantly higher deficiency (75.00%) compared to those with >2 h/day (42.86%). Similar findings were reported in an urban Bangladeshi study, where reduced outdoor activity and covered clothing were the strongest correlates of hypovitaminosis D [21]. On adjusted analysis, low sunlight exposure (<1 h/day and 1–2 h/day) and winter/spring season remained significant predictors of deficiency. These results highlight that environmental and behavioral factors outweigh intrinsic demographic variables in determining vitamin D status. Comparable multivariable models in South Asian populations identified reduced sun exposure, clothing coverage, and seasonality as independent predictors, rather than sex or BMI [22]. Our findings therefore underscore the

need for targeted interventions—promoting safe outdoor activity and considering supplementation or food fortification during high-risk seasons.

Limitations of the Study

This study was conducted at a single tertiary care hospital, which may limit the generalizability of the findings to the broader pediatric population in Bangladesh. The cross-sectional design precludes assessment of causal relationships between vitamin D deficiency and clinical outcomes. Dietary intake of vitamin D and adherence to supplementation were not quantitatively measured, and sun exposure was self-reported, introducing potential recall bias. Seasonal variations were considered, but other environmental factors, such as air pollution, were not assessed.

CONCLUSION

Vitamin D deficiency was highly prevalent among pediatric patients attending the outpatient departments of Dhaka Shishu Hospital, affecting nearly 60% of the study population, with an additional 26% having insufficient levels. Deficiency was most pronounced during winter and spring and was strongly associated with limited sunlight exposure, whereas age, sex, and BMI were not significant independent factors. These results indicate that environmental and lifestyle factors play a dominant role in determining vitamin D status in children. Routine screening, promotion of safe sun exposure, and dietary or supplemental interventions are warranted to address this widespread deficiency and reduce its potential impact on growth, musculoskeletal health, and immune function in Bangladeshi children.

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REFERENCES

1. Tabassum N, Anwar KS, Sarkar PK, Kabir AL, Mollah MA, Saha D, Alam MJ, Chisti MJ. Vitamin D [Serum 25 (OH) cholecalciferol] Insufficiency is Associated With Childhood Asthma: Recent Case-Control Findings From Bangladesh. *Global Pediatric Health*. 2024 Apr;11:2333794X241240574.
2. Cui A, Zhang T, Xiao P, Fan Z, Wang H, Zhuang Y. Global and regional prevalence of vitamin D deficiency in population-based studies from 2000 to 2022: A pooled analysis of 7.9 million participants. *Frontiers in Nutrition*. 2023 Mar 17;10:1070808.
3. Siddiquee MH, Bhattacharjee B, Siddiqi UR, MeshbahurRahman M. High prevalence of vitamin D deficiency among the South Asian adults: a systematic review and meta-analysis. *BMC public health*. 2021 Oct 9;21(1):1823.
4. Holick MF. Vitamin D deficiency. *New England journal of medicine*. 2007 Jul 19;357(3):266-81.
5. Majumder MM, Rahman H, Ahmed M, Uddin MN, Ahmed T, Mahadi AR. Prevalence of Vitamin D Deficiency among Patients Attending Tertiary Level Hospitals in Bangladesh: Hospital-Based Cross-Sectional Study. *Medicine Today*. 2024 May 8;36(1):17-22.
6. Das S, Hasan MM, Mohsin M, George DH, Rasul MG, Khan AR, Gazi MA, Ahmed T. Sunlight, dietary habits, genetic polymorphisms and vitamin D deficiency in urban and rural infants of Bangladesh. *Scientific reports*. 2022 Mar 7;12(1):3623.
7. Das S, Hasan MM, Mohsin M, George DH, Rasul MG, Khan AR, Gazi MA, Ahmed T. Sunlight, dietary habits, genetic polymorphisms and vitamin D deficiency in urban and rural infants of Bangladesh. *Sci Rep*. 2022 Mar 7;12(1):3623. doi: 10.1038/s41598-022-07386-7
8. Farzana N, Biswas R, Rahman N, Yeasmin S, Akhter N. Spectrum of Paediatric Endocrine Disorders: Experience from Bangladesh Shishu Hospital & Institute. *Dhaka Shishu (Children) Hospital Journal*. 2023;39(2):106-14.
9. Sheuly AH. Profile of vitamin D in patients attending at tertiary care hospital, Bangladesh. *American Journal of Internal Medicine*. 2021;9(2):83-6.
10. Giustina A, Bilezikian JP, Adler RA, Banfi G, Bikle DD, Binkley NC, Bollerslev J, Bouillon R, Brandi ML, Casanueva FF, Di Filippo L. Consensus statement on vitamin D status assessment and supplementation: whys, whens, and hows. *Endocrine reviews*. 2024 Sep 12;45(5):625-54.
11. Ara UN, Chowdhury T, Sultana T, Manik ZA. Vitamin D deficiency in healthy children and associated factors. *The Planet*. 2023;7(01):233-40.
12. Tariqujjaman M, Sheikh SP, Smith G, Hasan AR, Khatun F, Kabir A, Rashid MH, Rasheed S. Determinants of double burden of malnutrition among school children and adolescents in Urban Dhaka: a multi-level analyses. *Frontiers in Public Health*. 2022 Jul 15;10:926571.
13. Poudel N, Dhakal SS, Sukhupayo R, Karki DB. Vitamin D deficiency among patients visiting a tertiary care hospital: a descriptive cross-sectional study. *JNMA: Journal of the Nepal Medical Association*. 2020 Nov 30;58(231):839.
14. Mandlik R, Mughal Z, Khadilkar A, Chiplonkar S, Ekbote V, Kajale N, Patwardhan V, Padidela R, Khadilkar V. Occurrence of infections in schoolchildren subsequent to supplementation with vitamin D-calcium or zinc: a randomized, double-blind, placebo-controlled trial. *Nutrition Research and Practice*. 2020 Apr 1;14(2):117-26.
15. Das S, Hasan MM, Mohsin M, George DH, Rasul MG, Khan AR, Gazi MA, Ahmed T. Sunlight, dietary habits, genetic polymorphisms and vitamin D deficiency in urban and rural infants of Bangladesh. *Scientific reports*. 2022 Mar 7;12(1):3623.
16. Pervin S, Akhter R, Farzana N, Khanom T. Assessment of Inflammatory Markers (CBC and CRP) and their Impact on Severity and Recurrence of Pneumonia in Under-Five Children. *Sch J App Med Sci*. 2024 Oct;10:1391-6.
17. Riaz H, Finlayson AE, Bashir S, Hussain S, Mahmood S, Malik F, Godman B. Prevalence of Vitamin D deficiency in Pakistan and implications for the future. *Expert review of clinical pharmacology*. 2016 Feb 1;9(2):329-38.
18. Hays H, Flores LE, Kothari V, Bilek L, Geske J, Skinner A. Vitamin D status and seasonal variation: A retrospective single institution database study of patients pursuing metabolic/bariatric surgery. *Clinical Nutrition Open Science*. 2022 Feb 1;41:1-9.
19. Zhu Z, Zhan J, Shao J, Chen W, Chen L, Li W, Ji C, Zhao Z. High prevalence of vitamin D deficiency among children aged 1 month to 16 years in Hangzhou, China. *BMC public health*. 2012 Feb 14;12(1):126.
20. Mustafa A, Shekhar C. Factors associated with vitamin D deficiency and their relative importance among Indian adolescents: An application of dominance analysis. *International Journal of Endocrinology*. 2023;2023(1):4209369.
21. Chowdhury PK, Dutta PK, Dutta AK, Chowdhury A, Mahanta J, Chowdhury P. Risk Factors Predicting Hypovitaminosis D in Children in South-East Region of Bangladesh. *Journal of Biosciences and Medicines*. 2022 Mar 1;10(3):44-55.
22. Ali M, Uddin Z. Factors associated with vitamin D deficiency among patients with musculoskeletal disorders seeking physiotherapy intervention: a hospital-based observational study. *BMC Musculoskeletal Disorders*. 2022 Aug 30;23(1):817.