Serum vitamin D level in school going adolescent girls in urban and rural area

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ARTICLE INFO

Received: 12 May 2026
Accepted: 26 May 2026
Published Online: 8 June 2026

DOI: 10.5281/zenodo.20586253

Volume: 9, Number: 4, Page: 30-34

e-ISSN: 2789-5912
ISSN: 2617-0817

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ABSTRACT

Background: Adequate vitamin D is necessary for optimum calcium metabolism and bone mineralization during adolescence. Adolescent girls attending school are at heightened risk of vitamin D insufficiency. A comparison analysis is necessary because urbanization and rural living may have distinct effects on vitamin D levels. **Methods & Materials:** This cross-sectional study was conducted from January 2024 to December 2024 in the in the Department of Biochemistry at Sylhet MAG Osmani Medical College, Sylhet. The study design was cross-sectional. The study population included of school going adolescent girls aged 11 to 17 years from Government Agragami Girls' High School in Sylhet and Lazzatunnessa High School in Biswanath, Sylhet. All participants had a thorough physical examination. Seventy (70) participants from Luzzatunnesa High School, Biswanath, were classified as group A, while another seventy (70) participants from Government Agragami Girls' High School, Sylhet, were classified as group B. A sample was selected from class seven to ten at these two schools utilizing a lottery method. Height and weight were assessed. The body mass index (BMI) was calculated. Five milliliters of venous blood were collected for biochemical examination. **Results:** The status of vitamin D was normal in 2 (2.9%) subjects in both group A and group B. But vitamin D insufficiency was significantly more frequent in group A (57.7%, n=39) compared to group B (18.6%, p<0.001). Whereas vitamin D deficiency was significantly less frequent in group A (44.4%) compared to group B (78.6%; p<0.001). There was no significant correlation between vitamin D level and age (r=0.044; p=0.715) and body mass index (r=0.003; p=0.984) in group A (p>0.0.05) and body mass index (p>0.05) in group B. **Conclusion:** This study indicates a significant incidence of hypovitaminosis D among school going adolescent girls in rural and urban areas, with a normal vitamin D status observed in only a small percentage of participants. Vitamin D insufficiency was more common among rural adolescent girls, whereas vitamin D deficiency was significantly greater among urban adolescent girls. No significant correlation was found between serum vitamin D levels and age or body mass index in either group.

Keywords: *vitamin D, correlation, adolescent, school going.*

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INTRODUCTION

Vitamin D is a lipid-soluble vitamin essential for the regulation of calcium and phosphorus balance, bone mineralization, and general skeletal integrity [1]. In addition to its traditional function in bone metabolism, vitamin D is increasingly acknowledged for its immunomodulatory, anti-inflammatory, and metabolic roles [2]. Optimal vitamin D levels during adolescence are crucial, as this phase is essential for attaining optimum bone mass, which significantly influences the prevention of osteoporosis and fractures in later life [3]. Despite enough sunlight in numerous areas, vitamin D insufficiency has arisen as a worldwide public health issue impacting both industrialized and developing countries [4]. Adolescence represents a critical phase for vitamin D deficiency, particularly among female students [5]. Accelerated physical development, hormonal fluctuations, heightened dietary requirements, and lifestyle elements like diminished outdoor activities elevate the risk of insufficient vitamin D levels [6]. Vitamin D insufficiency in adolescent girls is particularly concerning due to its correlation with delayed skeletal maturity, monthly irregularities, compromised bone health, and an elevated future risk of metabolic and autoimmune illnesses [7]. Additionally, sociocultural behaviors, such as dress customs and restricted sun exposure, may further predispose girls to diminished vitamin D levels. Urbanization has profoundly transformed living patterns, affecting sun exposure, food practices, and physical activity levels [8]. Urban adolescents frequently spend excessive time indoors due to scholastic demands, screen-related activities, and restricted access to open spaces, leading to diminished sunshine exposure, the principal natural source of vitamin D synthesis [9]. Conversely, teenagers in rural regions may experience enhanced opportunities for outdoor activities and sun exposure; yet, issues such as nutritional deficiencies, reduced consumption of vitamin D–rich foods, and insufficient health knowledge may still lead to insufficiency [9]. Consequently, both urban and rural people may be impacted, albeit via distinct means. Studies have indicated a significant frequency of vitamin D deficiency among adolescents globally, with notable disparities between urban and rural environments [4]. But, data specifically concerning school-attending adolescent girls is limited, especially in underdeveloped countries. Comprehending the differences in vitamin D levels across urban and rural teenage females is crucial for recognizing at-risk groups and customizing specific public health initiatives. The evaluation of serum vitamin D levels in school-aged teenage girls might yield significant insights into the extent of deficiency and its possible drivers, such as geographic location, lifestyle factors, and dietary status. Hence, this study aimed to assess and compare serum vitamin D levels in school-aged adolescent girls from urban and rural locations, thereby aiding in the formulation of evidence-based policies for adolescent health promotion and illness prevention.

METHODS & MARERIALS

This study was conducted From January 2024 to December 2024 in the Department of Biochemistry, Sylhet MAG Osmani Medical College, Sylhet. Study design was cross-sectional. Ethical approval was obtained from the ethical council of same medical college. The study population

comprised school-going adolescent females aged 11-17 years from Government Agragami Girls' High School, Sylhet and Lazzatunnessa High School in Biswanath Sylhet. Participants who met the inclusion and exclusion criteria were selected as the study sample. Convenience multistage sampling was utilized for data collection. All subjects underwent a thorough physical checkup. Individuals who met the inclusion criteria were selected as the study sample. Seventy (70) subjects from Luzzatunnesa High School, Biswanath, were designated as group-A, while another seventy (70) subjects Government Agragami Girls' High School, Sylhet, were designated as group-B. A sample was recruited from classes seven to ten at these two schools using a lottery approach. Height and weight were measured. Body mass index (BMI) was calculated. Five ml of venous blood was obtained for biochemical analysis. All the biochemical tests was done at the same department. The levels of vitamin D and serum calcium were assessed using the enzymatic colorimetric technique. The statistical package for the social sciences, or SPSS, version 24, was used to analyze all of the data. Results were presented in tables and figure.

RESULTS

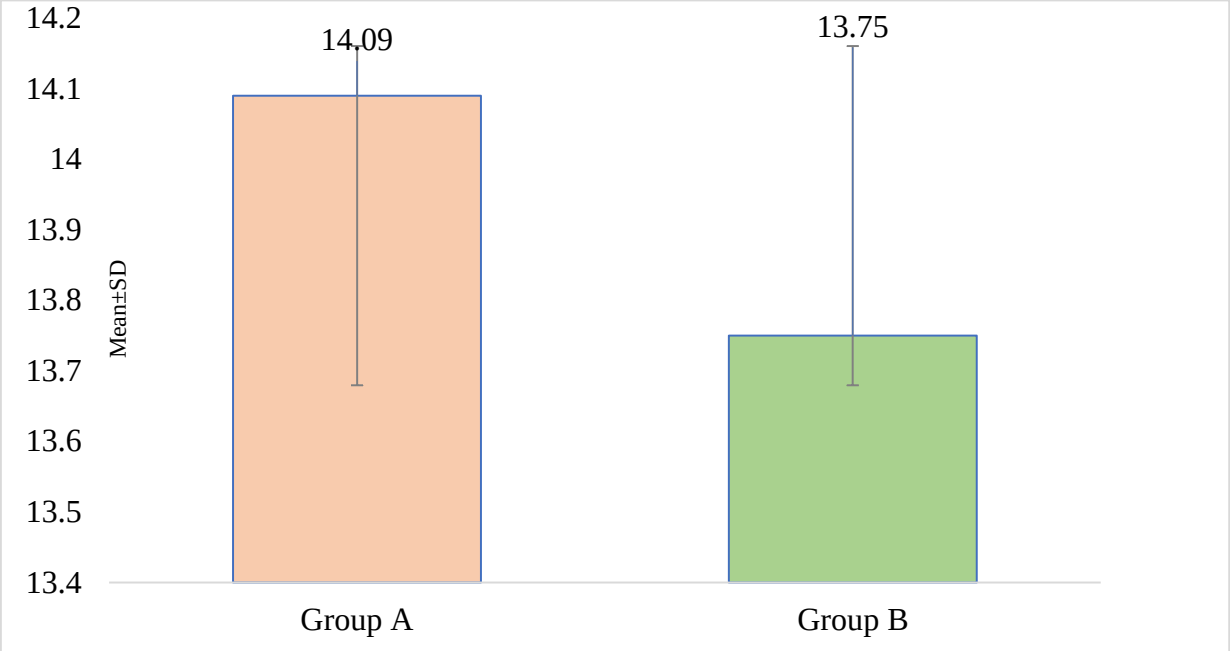

Figure 1 Mean age of the study subjects (*n*=140).

Statistical analysis was done by independent sample 't' test; Group A: rural adolescent girl; Group B: urban adolescent girl; N= total number of subjects.

The mean age of the group A subjects was 14.09±1.55 years and group B was 13.75±1.61 years. There were no age differences between study groups (p>0.05) *Figure 1*.

Serum vitamin D level was significantly higher in Group A (20.67±5.54 ng/ml) compared to Group B (16.45±5.42 ng/ml) with a statistically significant difference (p=0.001). However, no significant difference was observed in BMI between Group A (20.36±2.81 kg/m²) and Group B (21.14±3.54 kg/m²) (p=0.151) *Table I*.

Table I
Comparison of vitamin D and BMI among study subjects (*n*=140).

Variables	Group A (n=70)	Group B (n=70)	p value
Vitamin D (ng/ml)	20.67±5.54	16.45±5.42	0.001***
BMI (Kg/m2)	20.36±2.81	21.14± 3.54	0.151

*Statistical analysis was done by independent sample 't' test; Group A: rural adolescent girl; Group B: urban adolescent girl; N= total number of subjects; n= number of subjects in each group; ***-highly significant.*

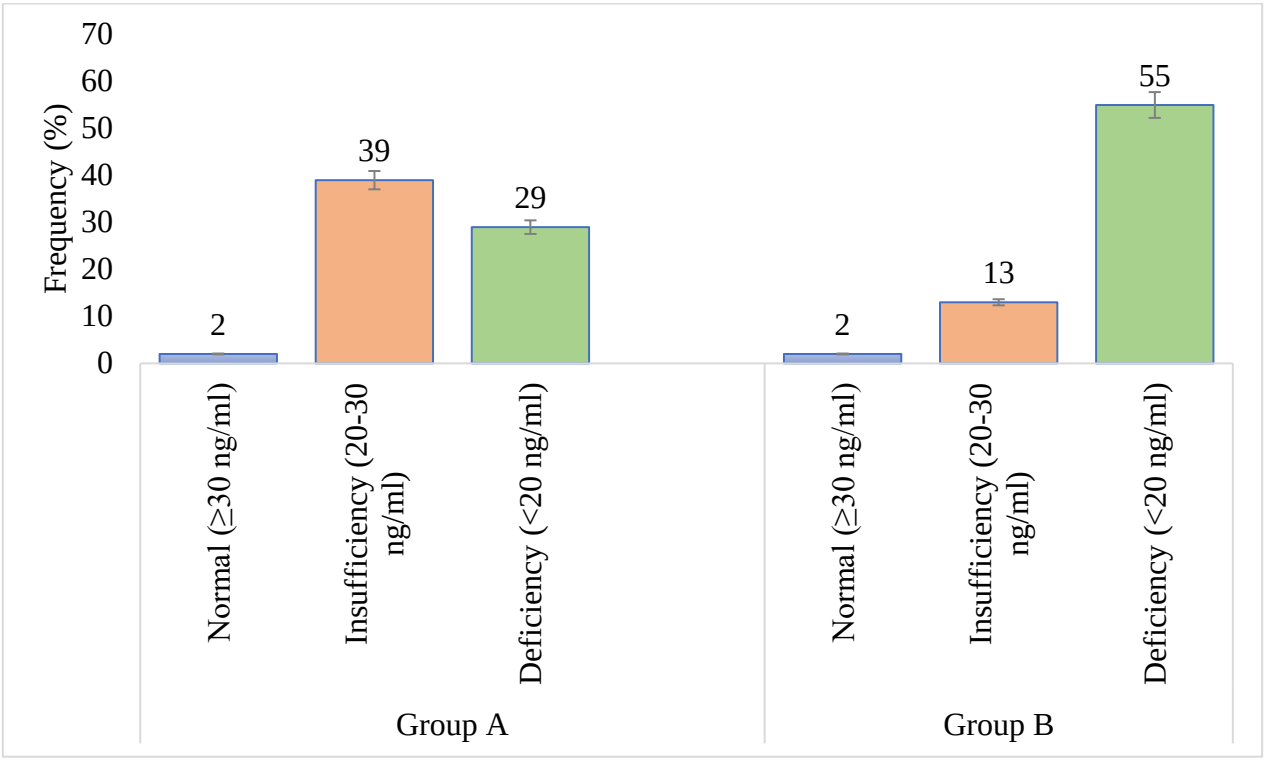

Figure 2 Comparison of vitamin D status of the study groups (*n*=140)

Statistical analysis was done by chi squire (χ^2) test. Data were presented as frequency (%). Group A: rural adolescent girl; Group B: urban adolescent girl; N= total number of subjects; n= number of subjects in each group; ***-highly significant.

The figure shows the distribution of vitamin D status among the study groups. In Group A, 2% participants had normal vitamin D levels (>30 ng/ml), 39% had vitamin D insufficiency (20–30 ng/ml), and 29% had vitamin D deficiency (<20 ng/ml). In Group B, 2% participants had normal vitamin D levels, 13% had insufficiency, while the majority (55%) had vitamin D deficiency. Vitamin D deficiency was markedly higher in Group B compared to Group A (*Figure 2*).

There was no significant correlation between vitamin D level and age (r=0.044; p=0.715) and body mass index (r=0.003; p=0.984) in group A. There was no significant correlation between vitamin D level and age (r=-0.050; p=0.681) and body mass index (r=0.076; p=0.531) in group B (*Table II*).

Table II
Correlation of serum vitamin D with age and BMI (*n*=140).

Parameters	Vitamin D in rural adolescent girl (n=70)		Vitamin D in urban adolescent girl (n=70)	
	r	p	r	p
Age (years)	0.044	0.715	-0.050	0.681
BMI (Kg/m2)	0.003	0.984	0.076	0.531

Pearson's correlation coefficient test was done to analyze the data. N= total number of subjects; n= number of subjects in each group.

DISCUSSION

Vitamin D deficiencies is currently a quiet, overlooked global public health concern. Vitamin D deficiency or inadequacy affects almost one billion people worldwide [10]. Sunlight exposure, geographic latitude, dairy and fish eating, and vitamin supplementation all have an impact on vitamin D levels [11]. According to this study, the mean age of rural adolescent females was 14.09±1.55 years and urban adolescent girls was 13.75±1.61 years. Adolescent girls in rural areas did not substantially differ from those in urban areas in terms of mean age (p=0.221). The study revealed that the rural adolescent girls had mean BMI of 20.36±2.81 Kg/m², whereas urban adolescent girls had a mean BMI of 21.14±3.54 Kg/m². The mean body mass index (BMI) of rural and urban adolescent girls did not exhibit a significant difference (p=0.151). This study indicated that 2.9% of subjects had normal vitamin D levels, 37.1% exhibited insufficiency, and 60.0% were deficient. The findings correspond with a study conducted in Bangladesh, which revealed that 46.75% of children were vitamin D deficient, 51.95% were insufficient, and only 1.30% were sufficient [12]. The mean serum vitamin D level was 20.67±5.54 ng/dl in rural adolescent girls and 16.45±5.42 ng/dl in urban adolescent girls. The mean serum vitamin D level in rural teenage females was significantly higher than that in urban adolescent girls ($p < 0.001$). Akhter et al. discovered that rural students spend more time to outdoor activities than their urban students, potentially resulting in greater exposure to sunlight, a primary source of vitamin D [13]. In contrast, Du et al. discovered that vitamin D levels were considerably lower in rural teenage girls compared to their urban counterparts ($p < 0.05$) [14]. The study indicated that vitamin D levels were adequate in 2.9% of both rural and urban adolescent girls. Vitamin D deficiency was markedly more prevalent among rural adolescent girls (57.7%) than urban girls (18.6%); ($p < 0.001$). Vitamin D deficiency was markedly less prevalent in rural teenage girls (44.4%) than in urban adolescent girls (78.6%); ($p < 0.001$). In this background, Longmei et al. discovered that 59.5% of urban children exhibited normal vitamin D levels, 14.3% experienced insufficiency, and 26.2% suffered from

vitamin D deficiency. They discovered that 27% of rural children exhibited normal vitamin D levels, 25% demonstrated insufficiency, and 48% were deficient in vitamin D. Zaman et al. conducted a study in Bangladesh revealing that 46.75% of children aged 12-16 years were vitamin D deficient, 51.95% were insufficient, and only 1.30% were sufficient [11,12,15]. This finding aligns with Al-Taiar et al., who observed that 81% of teenagers were vitamin D-deficient and 15% were vitamin D-insufficient.[15] Our discovery is comparable to that documented in Saudi Arabia (95.6%), India (85%–98%), and Korea, where merely 2.3% of adolescents were identified as vitamin D-sufficient [16-19]. Our results align with the persistently high frequency documented among adult populations in Kuwait and other Gulf nations, including Saudi Arabia, Bahrain, and Qatar [20-23]. In this study, 60% of adolescent girls exhibited Vitamin D deficiency; nevertheless, none had clinical symptoms or signs of this deficiency, and the mean serum calcium levels for both rural and urban adolescent girls remained within the normal range. The current study found no significant correlation between serum vitamin D levels and age or body mass index in adolescent girls. This suggests that fluctuations in vitamin D levels in adolescent females were unaffected by age or nutritional status, as indicated by BMI, implying the influence of alternative environmental or lifestyle factors.

LIMITATION

The study had several limitations, including a relatively small sample size and inclusion of participants from only two schools, which may limit the generalizability of the findings. As a cross-sectional study, causal relationships could not be established. Additionally, factors such as dietary habits, sunlight exposure, physical activity, and seasonal variation were not assessed.

CONCLUSION

This study reveals a significant prevalence of hypovitaminosis D among school-aged adolescent females in both rural and urban areas, with a normal vitamin D status found in only a minimal percentage of participants. Vitamin D insufficiency was more prevalent among rural adolescent girls, while vitamin D deficiency was much higher among urban adolescent girls, reflecting distinct patterns of inadequacy based on residential location. No significant correlation was found between serum vitamin D concentrations and age or body mass index in either cohort. The findings emphasize vitamin D deficiency as a prevalent public health issue among adolescent females, indicating the necessity for focused preventative measures, nutritional education, and suitable supplementation in both rural and urban environments.

RECOMMENDATION

To enhance the generalizability and depth of these findings, future research should prioritize large-scale multicenter studies across diverse regions of Bangladesh and utilize longitudinal designs to establish definitive causal relationships. Clinically, regular vitamin D screening is recommended for adolescent girls, particularly in high-risk urban areas. These efforts should be supported by public health initiatives, including awareness programs for families regarding sunlight and nutrition, alongside school-based interventions and supplementation strategies to combat the high prevalence of hypovitaminosis D.

FUNDING

No funding sources

CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee

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