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Original Research Article

Association between schooling pattern and weight with vitamin D status

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ABSTRACT

Background: Vitamin D deficiency affects bone health, immunity, and growth in children. Urbanization, poor diet, and limited sun exposure heighten risks in South-East Asia, including Bangladesh. This study was aimed to evaluate the association between schooling pattern and weight with vitamin D status among different school group children in South-East region of Bangladesh.
Methods: This cross-sectional observational study was conducted in Chittagong Metropolitan City from July 2012 to December 2017 among 524 children aged between 0 to 18 years. Electro-chemiluminescence was used to measure serum 25(OH) D levels. Structured questionnaires were used to collect data. Chi-square tests and logistic regression was done and $p<0.05$ was considered as statistically significant.
Results: Among 524 subjects, 265 (50.57%) had vitamin D levels below 20 ng/dl. The age distribution was 51.3% (1-5 years) and 32.6% (5-10 years), with a mean±SD of 51.87±39.91. Children in kindergarten, primary and high school had a significantly higher risk of deficiency than those who were not educated ($p < 0.01$). Low and high weight-for-age were associated with increased risk of hypovitaminosis D (OR=0.73 and 2.78, respectively). Mean vitamin D levels for English language students were found to be lower than Bengali language students ($p<0.05$). There was no significant difference between government and private school children.
Conclusion: Hypovitaminosis D is highly prevalent among children in South-East region of Bangladesh, influenced by schooling patterns and nutritional status. This requires targeted interventions, such as awareness campaigns and dietary supplementation.

Keywords: Children, Hypovitaminosis D, Schooling patterns, Vitamin D, Weight-for-age

INTRODUCTION

Vitamin D, a necessary vitamin for bones and calcium metabolism, also plays a vital role in immunity and general health, especially in childhood and adolescence. Deficiency of vitamin D, termed as hypovitaminosis D, is increasingly being acknowledged as a global public health issue that has far reaching implications for children's growth and development.[1,2] Studies have shown that in the abundant sunlight regions of South East Asia, much of the population suffers from vitamin D deficiency, which implies that other factors, such as lifestyle, socioeconomic conditions and dietary habits are likely to be significantly involved.[3,4]

Ultraviolet B (UVB) radiation from the sunlight is necessary for Vitamin D synthesis in the skin, but atmospheric pollution, clothing and indoor lifestyle all impede on sufficiency of its production.[5,6] In addition, vitamin D from dietary foods is often insufficient, especially in resource poor settings.[7] Insufficient vitamin D in children correlates with rickets, delayed growth and weakened immunity.[8,9] Vitamin D deficiency prevalence is high in school aged children and region specific studies are necessary to understand contributing factors and put forward preventive measures.[10]

Educational environment plays a critical role in forming health behavior and lifestyle of children. Sun exposure, physical activity, and dietary habits, in turn, affect the vitamin D status; recent studies suggest that schooling patterns might influence these factors.[11] Similarly, weight for age a marker of nutritional status has been associated with vitamin D levels, with undernutrition and overnutrition both putatively associated with hypovitaminosis D.[12] There is however very limited data from the South-East region of Bangladesh regarding the association between these factors and vitamin D status particularly among children from diverse educational backgrounds.[13]

Although significant knowledge advances in international research have been made on schooling patterns, weight-for-age and vitamin D levels among children, there remains a plethora of data about the interplay between schooling patterns, weight-for-age and vitamin D levels among children in Bangladesh. Since there is increasing evidence of hypovitaminosis D as (a) feature in (urban) settings like Chittagong, it is important to explore these associations to plan appropriate interventions.

The purpose of this study was to assess the relationship between schooling patterns, weight for age and vitamin D status in children 0-18 years of age in Chittagong, Bangladesh. The study examines data from a variety of educational settings and nutritional status for vitamin D deficiency and by doing so offers important insights into sociodemographic and behavioral factors that contribute to vitamin D deficiency. The findings from this research will become a cornerstone for public health intervention strategies aimed at reducing hypovitaminosis D in vulnerable pediatric populations and to enhance healthier developmental outcomes. The objective of this study was to evaluate the association between schooling pattern and weight with vitamin D status among different school group children in South- East region of Bangladesh.

METHODS

This cross-sectional observational study was conducted in Chittagong Metropolitan City from July 2012 to December 2017. Total 524 children aged between 0-18 years coming at the investigator's private chamber located in the Chittagong Metropolitan City, whose consent or assent have been obtained to participate in this study.

Inclusion criteria

Children aged between 0-18 years were included.

Exclusion criteria

Patient with vitamin D malabsorption, drugs intake, like anticonvulsants, nephrotic syndrome, severe hepatocellular disease, and renal disease were excluded.

Operational definition

Vitamin D status was classified depending upon the measured serum 25(OH) D (ng /ml) as follows. Based on Misra et al.[5]

Table 1: Vitamin D status and serum 25 D level.

Vitamin D status	Serum 25 (OH) D levels (ng/ml)
Severe deficiency	≤5
Deficiency	<15
Insufficiency	<20
Sufficiency	20-100
Excess	>100
Intoxication	>150

Severe deficiency, deficiency, and insufficiency status are all included in hypovitaminosis D and a 25 (OH) D level of 20 ng/ml or more was regarded as adequate vitamin D.

Data collection

A cross-sectional observational study was conducted in children aged 0-18 years presenting to a private chamber at Chittagong, Bangladesh from July 2012 to December 2017. An informed consent was obtained before enrollment. Blood samples (5 ml) were taken from venous blood with sterile techniques, and serum 25(OH) D levels were determinated using the Cobas Elecsys 2010 analyzer with the electro-chemiluminescence method. Structured questionnaires were used to collect relevant sociodemographic, schooling and weight-for-age data. Participants without conditions that affect vitamin D metabolism, such as nephrotic syndrome, hepatocellular disease, or disease associated with anticonvulsant use were included.

Laboratory tests

Maximum 5 ml venous blood sample was taken for each case by disposable syringe, and was collected in a red capped tube (no anticoagulant) which was sent to centrifuge machine (Rotofix 32 A, 3000 RPM) after 1 hr. of collection in a standard lab in the Metropolitan city under supervision of Medical Biochemistry consultant.

With 10 minutes centrifugation the separated serum of sample cup (300 micro liter) was put in the Auto machine (Cobas: Elecsys 2010) for measuring 25(OH)D by Eletro-Chemiluminescence's in ADVIA centaur XP/Elecsys 2010/Immulite 2000 xPi and, the result was provided 24 minutes later.

Ethical consideration

Caregivers were provided with an informed consent or assent in written form. The ethical committee of Department of statistics, Faculty of Science of Chittagong University approved the study.

Statistical analysis of data

SPSS software was used to analyze data. Demographic and clinical variables were summarized by descriptive statistics. Associations between categorical variables were assessed using chi square and t tests and logistic regression was used to identify predictors of hypovitaminosis D, which had a significance level of $p<0.05$. Frequencies, percentages, mean and odds ratios with 95% confidence intervals were presented.

RESULTS

In this study, more than half (269, 51.3%) of the study subjects were in 1–5-year pre-school age group, followed by 5–10-year aged school children (171, 32.6%). The average age was 51.87 months (SD 39.91 months) (Table 2).

Table 2: Distribution of age among the study subjects (n=524).

Age groups	Frequency (N)	Percentage (%)
Infancy	72	13.7
1-5 years	269	51.3
5-10 years	171	32.6
≥10 years	12	2.3
Mean±SD	51.87±39.91	

Among the study subjects, hypovitaminosis D (<20ngm/dl) was noticed in more than half of the cases (265, 50.57%), Only 259 (49.42%) cases were found to be sufficient (20-100ng/ml). It was observed that there is a highly significant association between the age groups and vitamin-D status (p value <0.01) (Table 3).

Table 3: Association between age group and vitamin D status (n=524).

Age groups	Vitamin-D status			P value
	Hypovitaminosis (n=265)	Sufficiency (n=259)	Total (n=524)	
Infancy	39 (14.7)	33 (12.7)	72 (13.7)	<0.01
1-5 Years	113 (42.6)	156 (60.2)	269 (51.3)	
≥5 Years	113 (42.6)	70 (27)	183 (34.9)	

Among 265 subjects with hypovitaminosis D, 142 (53.6%) were in the grading of no education, 40(15.1%) in kindergarten level, 72 (27.5%) in primary level and 10 (3.8%) cases were in high school level. The association had shown statistically significant (p value <0.05) (Table 4).

Table 4: Distribution of vitamin D status with grading of school (n=524).

Grading	Vitamin-D status			P value
	Hypovitaminosis (n=265)	Sufficiency (n=259)	Total (n=524)	
No education	142 (53.6)	175 (67.6)	317 (60.5)	<0.01
Kindergarten	40 (15.1)	37 (14.3)	77 (14.7)	
Primary	73 (27.5)	41 (15.8)	114 (21.8)	
High	10 (3.8)	6 (2.3)	16 (3.1)	

The mean level of vitamin D according to school grading was as follows: No Education 23.63±12.059, Kindergarten 20.60±9.76, primary 18.18±9.20, high school 16.30±8.76. The mean of vitamin D level is significantly different in school grading category observed by F test (p value <0.001) (Figure 1).

Among 207 subjects, 54 (26%) were from government school and 153 (74%) from private school. Hypovitaminoses D were found in similar proportion in both types of school (57 % vs. 58%). The association was not statistically significant (p value >0.05) (Table 5).

Among 265 hypovitaminosis D subjects 38(14.3%) were in English medium, 80(30.2%) were in Bengali medium, 5 (1.9%) were in Madrasha medium. The association was not statistically significant (p>0.05) (Table 6).

The mean vitamin D level of English medium was 18.81±8.36, in Bengali medium was 18.50±9.63, and in

Madrasha medium was 23.32±11.20. This association was statistically significant (p<0.05).

Normal weight for age was found in 160 (60.4%) cases out of 265 hypovitaminosis D subjects. Low weight for age was in 89 (33.6%) cases and high weight for age was found in 16(6%) cases, which was statistically significant (p value <0.01) (Table 7).

The mean level of vitamin D among normal weight for age was (20.94±11.25). Among low weight for age it was (23.67±11.46), and among the subjects of high weight for age it was (15.80±7.14), there is significant mean difference of vitamin D levels among the weights of normal, low and high (p value <0.01) (Figure 2).

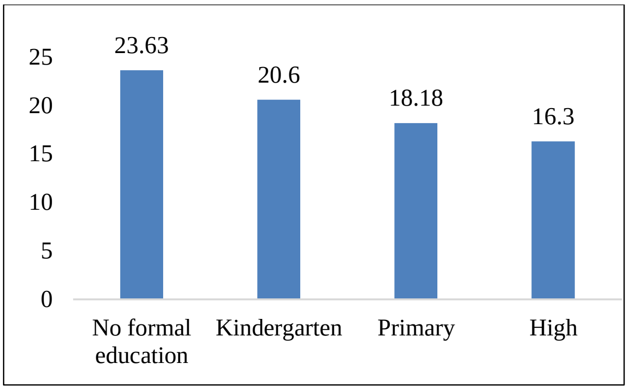

Figure 1: Mean vitamin D levels according to school grading.

Table 5: Vitamin D status according to school category among the study subjects.

Category	Vitamin-D status			P value
	Hypo-vitaminosis	Suffici-ency	Total (n=207)	
Government	31 (57)	23 (43)	54 (26)	>0.05
Private	88 (58)	65 (42)	153 (74)	
Total	119	88	207	

Table 6: Vitamin D status according to schooling medium (n=524).

Medium	Vitamin-D status			P value
	Hypovitaminosis (n=265)	Sufficiency (n=259)	Total	
No education	142 (53.6)	175 (67.6)	317 (60.5)	>0.05
English	38 (14.3)	27 (10.4)	65 (12.4)	
Bengali	80 (30.2)	50 (19.3)	130 (24.8)	
Madrasha	5 (1.9)	7 (2.7)	12 (2.3)	

Table 7: Distribution of weight for age and vitamin-D status (n=524).

Weight for age	Vitamin-D status			P value
	Hypovitaminosis (n=265)	Sufficiency (n=259)	Total	
Normal	160 (60.4)	146 (56.4)	306 (58.4)	<0.01
Low	89 (33.6)	109 (42.1)	198 (37.8)	
High	16 (6.0)	4 (1.5)	20 (3.8)	

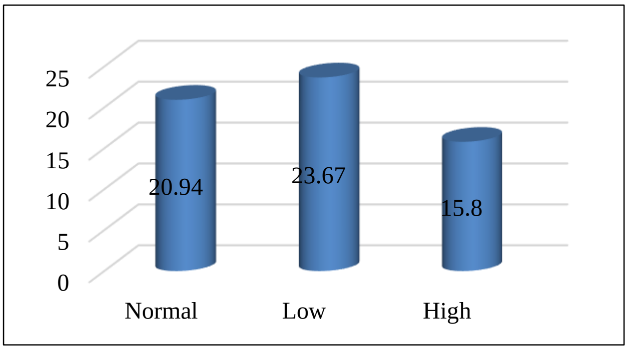

Figure 2: Mean vitamin D levels according to weight for age.

Logistic regression had shown more the educational level more is the likelihood of hypovitaminosis D. Kindergarten school children have 1.29 times, primary school children have 2.03 times and high school children have 2.01 times increased chance of hypovitaminosis D in relation to the children with no education.

It also shows that subjects with low weight for age were at less risk and subjects with high weight for age were at increased risk of suffering from hypovitaminosis D (OR=0.73 and 2.78 respectively) (Table 8).

Table 8: Multiple Logistic Regression analysis in differences of covariates on vitamin D levels.

Variables Category		B	S.E.	Wald	P value	Odds Ratio (OR)
School grade	**No education**	**Ref**				
	Kindergarten	0.255	0.527	2.769	0.014	1.29
	Primary	0.708	0.491	5.564	0.001	2.03
	High	0.698	0.669	2.784	0.005	2.01
Weight of child	Normal	Ref				
	Low	-0.315	0.186	2.988	0.004	0.73
	High	1.022	0.583	2.997	0.003	2.78
	Constant	-0.082	0.134	3.397	0	0.921

DISCUSSION

Vitamin D is vital for good bone health as well as immune function, and deficiency in this vitamin is a serious health issue worldwide. The prevalence of hypovitaminosis D in children (0-18 years) was high (50.57%) in Chittagong, Bangladesh, observed in this study. Vitamin D status was found to be influenced by several factors including schooling patterns, weight for age, and sociodemographic characteristics. These findings are consistent with global trends and add weight to the hypothesis that vitamin D deficiency is a multifactorial problem.

This study found that, adjusted for other confounders, children with higher grades of schooling (kindergarten, primary and high school) had significantly higher hypovitaminosis D than no schooling. A reduced outdoor exposure and increased sedentary activities in children as schooling proceeds might have been responsible for this trend. Voortman et al also reported similar findings; those children aged 6-12 years in the Netherlands with limited outdoor activity had an increased prevalence of vitamin D deficiency.[11] In addition, Marasinghe et al also noted that lifestyle factors including reduced sun exposure and urbanization affect vitamin D levels in preschool children in Sri Lanka.[12]

In our study, we found that children with both underweight and with overweight were more risk of hypovitaminosis D as compared to normal weight for age. This observation is consistent with the report from Wagner et al., who showed an association between suboptimal vitamin D status and both under- and over nutrition in children.[9] Rajakumar et al also showed that obesity might sequester vitamin D in adipose tissue leading to reduced bioavailability of the vitamin.[14]

Our study showed no significant difference in hypovitaminosis D prevalence between children from government and private schools. Although this finding is contradictory to a recent report of Fraser indicating that socioeconomic issues significantly impact dietary intake and outdoor activity patterns, creating inequality in vitamin D status.[15] While the common vitamin D status across school types in our study might reflect the shared environmental and dietary challenges of the region, our study did not detect significant differences in the vitamin D levels among school types.

Our results also identified a strong association between educational medium (English, Bengali, Madrassa) and vitamin D status, with Bengali medium students showing higher mean vitamin D levels than English medium students. Similar study done by Pettifor observed similar associations contrasting vitamin D intake in demographic groups with cultural and dietary practices pertinent to those groups.[7] Holick and Chen also emphasized how urbanization and the academic pressures in the English medium schools may prevent sun exposure.[4]

Vitamin D sufficiency was most prevalent in infants and preschoolers, possibly because of increased parental oversight over outdoor activity. Similarly, younger children who play more with caregivers outdoors were less likely to develop vitamin D deficiency; Misra et al also reported.[3] However, with increasing immobility and more structured schooling, sun exposure decreases concurrently with increasing risk of hypovitaminosis D.[1]

Our results are in agreement with Agarwal et al, who found that urban areas like Chittagong can reduce UVB penetration leading to cutaneous vitamin D synthesis impairment.[16] Additionally, non-Caucasian children were noted as having hypovitaminosis D incidence due to air pollution and urbanization.[8] These environmental factors, combined with lifestyle changes, highlight the importance of targeted interventions.

Even in sunny regions, hypovitaminosis D remains a prevalent issue globally as reported by Fuleihan et al with high deficiency rates in Middle Eastern countries.[17] Our findings are corroborative of the finding that sunlight exposure alone is insufficient to combat vitamin D deficiency, necessitating dietary and behavioral interventions.

This study has few limitations. The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community. Purposive sampling was used since many parents were unable to complete the lab tests for financial reasons, even after providing their consent.

CONCLUSION

In this study, hypovitaminosis D (<20 ng/ml) was observed in more than half (265, 50.57%) of the subjects. Children in kindergarten, primary, and high school are more likely to have hypovitaminosis D compared to those not yet in school. The mean vitamin D level is significantly higher in government school students than in private school students, and in Bengali medium students compared to English medium students. Additionally, subjects with low or high weight for age are at increased risk of hypovitaminosis D compared to those with normal weight for age.

Recommendations

Further multicentre study with large sample size should be done and earlier recognition and appropriately taken awareness programme and intervention addressing the contributing factors may promote positive health status of our future citizens.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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