Original Article

Vitamin D deficiency in healthy children and associated factors

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ABSTRACT

Introduction: *This study aimed to investigate factors associated with vitamin D deficiency in healthy children in Bangladesh. This cross-sectional survey was conducted at the primary healthcare center from February 2021 to February 2022. The study included 200 healthy Bangladeshi nationals 5-16 years of age out of a random sample of 250 subjects approached, resulting in a response rate of 80%.* ***Methods and Materials****: Face-to-face interviews with a questionnaire were used to collect sociodemographic information, non-dietary covariates, dietary intake, vitamin D intake, type of feeding and laboratory investigations. These assessments cover various aspects of health status, including medical conditions, family history, body mass index, clinical manifestations, and biochemical parametes.* ***Results:*** *The study revealed a high prevalence of vitamin D deficiency in Bangladeshi adolescents (62% among 11-16 years old), followed by 5-10 year-olds (38%). The likelihood of vitamin D deficiency increased with age, with a significant difference between the vitamin D-deficient and normal children. Additionally, vitamin D-deficient children had a lower average body mass index (17.9) than normal children (19.6). A family history of vitamin D deficiency was more common among children with vitamin D deficiency (68.9%) than among normal children (19.2%). Most children with vitamin D deficiency exhibit limited physical activity. The differences between the two*

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groups were significant in terms of family history and physical activity. Low vitamin D levels are associated with reduced dietary and supplemental vitamin D intake. Vitamin D supplementation was lacking in both groups, with over half of the vitamin D-deficient (66.9%) and normal (51.9%) children not receiving any vitamin D supplements. Vitamin D-deficient children had poor dietary vitamin D intake, particularly from sources like vitamin D-fortified milk (64.9%) and fortified foods (26.4%). ***Conclusion:*** *The study findings emphasize the high risk of vitamin D deficiency among Bangladeshi children. Key factors include limited outdoor activity, physical activity, and dietary vitamin D intake. Extended vitamin D supplementation is crucial to ensure the health and development of breastfeeding infants.*

Keywords: *Vitamin D deficiency, health children, vitamin D supplements*

INTRODUCTION

Vitamin D deficiency is a significant public health problem in Asia, Middle East and immigrant populations in other countries [1, 2, 3]. The occurrence of vitamin D deficiency varies from country to country and is often attributed to diverse dietary habits and lifestyle factors within each population. Numerous studies have highlighted the global nature of this public health issue [4, 5, 6, 7]. Various eating habits and lifestyle factors contribute to differences in prevalence. It is estimated that at least one billion people worldwide are vitamin D-deficient due to inadequate fortification of the food for vitamin D levels [8]. Milk is an important source of vitamin D, but many young people do not consume sufficient fortified dairy products. Severe deficiencies can lead to rickets in children, osteomalacia in adults, and loss of muscle. It also increases the risks of osteopenia and osteoporosis. Furthermore, vitamin D deficiency and insufficiency have been linked to loss of muscle mass in recent research [9]. It also results in secondary hyperparathyroidism and contributes to skeletal problems such as osteopenia and osteoporosis [10]. Surprisingly, more infants, young children, and adolescents were identified as vitamin D-deficient, even when they displayed no apparent symptoms. deficiency. [11]. This study aimed to determine factors associated with vitamin D deficiency in healthy children in Bangladesh.

METHODS & MATERIALS

This study was conducted to determine the prevalence of vitamin D deficiency in Bangladeshi individuals aged 5-17 years old. This cross-sectional study was conducted at a tertiary healthcare center in Dhaka. The survey was conducted between February 2022 to February 2023.. All children included in the study provided parental consent. A random sample of 250 healthy Bangladeshi children participated in the study at tertiary health care centers. The children were selected based on age and sex to represent the population. Of the 250, 200 children were included in the study and blood samples were collected. The remaining 50 children were excluded because of parental refusal or difficulty drawing blood. The positive response rate for participation was 80%. We used blood tests to measure vitamin D levels in two groups: those with vitamin D deficiency (25 (OH) D level < 20 ng/ml). Blood samples were collected from the participants, and serum was collected at -

70°C for analysis. A radioimmunoassay kit was used to estimate 25 (OH) D levels following standard laboratory procedures. We created a survey for our study through interviews with trained health professionals and nurses. We asked the parents of the participants about their demographic information, such as age, gender, nationality, education, occupation, residence, housing type, income, and family relationships. We also collected data on non-dietary factors such as height, weight, skin color, family history, physical activity, vitamin D intake, and early feeding patterns. Height and weight were measured using standardized methods, and the participants were lightly dressed without shoes. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. We also gathered information on any current or past medical issues in the children, including weakness, digestive problems, fractures, developmental delays, rickets, and parathyroid disease.

To assess differences, we used the following statistical tests: Student's t-test for continuous variables, Mann-Whitney test, if appropriate, and chi-square analysis for categorical variables among different groups. We used Fisher's exact test when the assumptions for chi-square were not met (small sample size or expected frequency of less than five). Pearson's correlation coefficient was used to measure the associations between variables, with the significance level set at $p < 0.05$.

RESULTS

Table I summarizes the key characteristics of the children in terms of their vitamin D status. Children with vitamin D deficiency were older, with an average age of 11.4 years, than normal children with an average age of 9.8 years. This age difference was statistically significant. Vitamin D deficiency was most common among Bangladeshi adolescents (62%), followed by 5-10 year-olds (38%) and those under five years (7.0%). There was also a significant age group difference between vitamin D-deficient and normal children. Additionally, Bangladeshi girls had a higher prevalence of vitamin D deficiency (54.7%) than did boys (45.3%).

Table I. Socio-demographic characteristics and assessment of the non-dietary covariates in studied children according to vitamin D status.

Variable	Vitamin D deficiency (*n* = 148)	Normal (*n* = 52)	P-value
Age	11.4±4.78	9.8±4.38	0.0001

Gender			
Male	67 (45.3)	27 (51.9)	0.248
Female	81(54.7)	25 (48.1)	
Education of father			
Illiterate	19 (12.8)	3 (5.8)	0.159
Primary	23 (15.5)	5 (9.6)	
Intermediate	32 (21.6)	12(23.1)	
Secondary	56(37.8)	13 (25)	
University	18 (12.2)	19 (37)	
Household income			
<15,000	32 (22.5)	7(13.5)	0.467
15000 - 25,000	65(45.8)	24(46.2)	
>25,000	45(31.7)	21 (40.4)	
Consanguinity			
Yes	68 (45.9)	25 (48.1)	0.295
No	80 (54.1)	27 (51.9)	
Body mass index	17.9±2.9	19.6±3.1	0.017
Vitamin D serum concentration	12.8±7.7	25.8±7.2	0.018
Physical activity			
Yes	58 (40.8)	24 (46.2)	0.001
No	84 (59.2)	28 (53.8)	
Duration of breast feeding (months)	9.2±3.7	9.3±3.8	0.411
Family history			
Vitamin D Deficiency			
Yes	102 (68.9)	10 (19.2)	0.001
No	46 (31.1)	42 (80.8)	

Data presented as *n*(%) or as mean±standard deviation.

The table outlines various factors unrelated to diet in the studied children, based on their vitamin D status. Vitamin D-deficient children had a lower average body mass index (17.9) compared to normal children (19.6), with a significant difference. The vitamin D serum level was substantially lower in vitamin D-deficient children (12.8 ng/ml) than in normal children (26.3 ng/ml), with a significant difference. The study indicated that a higher percentage of children with vitamin D deficiency had a family history of vitamin D deficiency (68.9%) than normal children (19.2%). Vitamin D-deficient children engaged less in physical activity (59.2%) compared to normal children (53.8%). Significant differences were observed between the two groups in terms of family history of vitamin D deficiency and physical activity. Both groups had similar breastfeeding durations (approximately 10-11 months) and vitamin D supplement intake through the breast milk.

Table II shows the dietary and vitamin D intake patterns in children based on their vitamin D status. Both groups had an inadequate intake of vitamin D supplements. However, children with

vitamin D deficiency had poorer diets in terms of vitamin D sources, such as vitamin D-fortified milk (64.9%) and fortified foods (26.4%), than normal children.

Table II. Assessment of dietary habits and vitamin D supplement consumption in the participants with and without vitamin D deficiency.

	Vitamin D-deficient children (n = 148)		**Optimal vitamin D (normal) children (n = 52)**		
	Never	**Once monthly/weekly/daily**	**Never**	**Once monthly/weekly/daily**	**P-value**
Food consumption					
Fortified food	39 (26.4)	109 (73.6)	21 (40.4)	31 (59.6)	0.759
Fatty/oily fish	12 (8.1)	136 (91.9)	16 (30.8)	36 (69.2)	0.813
Eggs	9 (6.1)	139 (93.9)	6 (11.5)	46 (88.5)	0.871
Milk fortified with vitamin D	96 (64.9)	52 (35.1)	38 (73.1)	14 (26.9)	0.916
Supplement consumption					
Multivitamin	89 (60.1)	59 (39.9)	23 (44.2)	29 (55.8)	0.795
Vitamin D supplement	99 (66.9)	49 (33.1)	27 (51.9)	25 (48.1)	0.399

DISCUSSION

Previousstudies found significant differences in vitamin D levels across Asia, Europe, and the Middle East [12]. However, the association of vitamin D deficiency with dietary and lifestyle factors remains unclear in many studies. Therefore, our study aimed to investigate the factors associated with low vitamin D levels in Bangladeshi children aged 5-17 years.

Research showed that vitamin D deficiency was most common among Bangladeshi adolescents (ages 11-16) at 59.8%, followed by children aged 5-10 at 30.3%, and those under 5 years old at 9.9%. This means that vitamin D deficiency increased with age, particularly among 11-16 year-olds, with a significant difference between vitamin D-deficient and normal children.

In our study, a lack of physical activity was more common in children with

vitamin D deficiency (59.2%) than in normal children (53.8%). This indicates that physical activity is a primary factor contributing to vitamin D deficiency in young Bangladeshi populations, leading to a higher prevalence of vitamin D deficiency in Bangladeshi girls (54.7%) than in boys (45.3%).

Breastfed babies are often at risk of low vitamin D because breast milk is a poor source of this nutrient [13,14]. Among infants younger than 1 year, vitamin D-deficient and normal infants had similar durations of breastfeeding (around 10-12 months) and vitamin D supplement intake. However, the high prevalence of vitamin D deficiency in children suggests that vitamin D supplementation is inadequate. The American Academy of Pediatrics recommends vitamin D supplementation for all breastfed infants until weaning [15].

Low vitamin D status was associated with lower dietary and supplemental vitamin D intakes. Our study found that a small proportion of children took vitamin D supplements, with more than half of both vitamin D-deficient (66.9%) and normal (51.9%) children not taking any vitamin D supplements. While vitamin D supplementation was poor in both groups, vitamin D-deficient children had a particularly low dietary intake of vitamin D (e.g., milk fortified with vitamin D and fortified food) compared to normal children. Many young people do not consume enough vitamin D-fortified dairy products.

CONCLUSION

This study highlights that Bangladeshi children are at a significant risk of vitamin D deficiency. This is often due to the scarcity of vitamin D-fortified milk and foods, insufficient physical activity, and low vitamin D intake among the younger population in Bangladesh. It is crucial for breastfed infants to receive vitamin D supplements for extended durations.

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