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Original Research Article

Estimation of serum vitamin D level in childhood asthma at a tertiary care hospital in Bangladesh

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ABSTRACT

Background: Asthma is a prevalent chronic disease that significantly affects children globally, with implications for both health and quality of life. Recently, vitamin D deficiency has been associated with various respiratory disorders, including asthma. However, the relationship between vitamin D levels and asthma severity remains unclear, particularly in Bangladeshi children. This study aims to evaluate and compare serum 25-hydroxyvitamin D levels between children with asthma and healthy controls, examining whether vitamin D insufficiency is associated with different asthma subtypes.
Methods: A cross-sectional study was conducted at the paediatrics department of Bangladesh medical university (BMU), Dhaka, Bangladesh, from October 2020 to October 2021. A total of 90 children aged 8-18 years were enrolled: 60 children with asthma and 30 healthy controls. Serum 25-hydroxyvitamin D levels were measured and compared between the two groups. Additionally, the relationship between vitamin D levels and asthma subtypes was analysed.
Results: The mean serum vitamin D level in asthmatic children was significantly lower (24.7±7.1 ng/ml) compared to non-asthmatic children (35.9±7.6 ng/ml, $p<0.001$). Vitamin D deficiency was present in 23.3% of asthmatic children compared to 13.3% in the control group. However, no significant correlation was found between vitamin D levels and asthma severity.
Conclusions: Children with asthma exhibited significantly lower serum vitamin D levels than their healthy counterparts. While this study highlights the association of vitamin D deficiency with asthma, further research is needed to clarify its role in asthma severity.

Keywords: Asthma, Children, 25 hydroxy vitamin D

INTRODUCTION

Asthma is a chronic inflammatory disorder of the airways, characterised by recurrent episodes of wheezing, breathlessness, chest tightness, and coughing.[1] These symptoms vary in severity and frequency among individuals and are often triggered by a combination of genetic predispositions and environmental factors, which activate both innate and adaptive immune responses.[1] Globally, asthma represents a significant public health burden, with approximately 339 million people affected, a number projected to rise by an additional 100 million by 2025.[2] In Southeast Asia, the prevalence of asthma among school-aged children varies widely, from 1-2.4% in China to 13.8% in Malaysia.[3] In Bangladesh, approximately 7.4% of children under 15 years and 5.2% of the overall population are affected by asthma, defined by the occurrence of at least three attacks within the previous year.[4] Alarmingly, over 90% of asthma cases in Bangladesh lack proper management, as reported by the first national asthma prevalence study.[5]

Despite advances in asthma management guidelines, a significant proportion of patients continue to experience suboptimal control, leading to frequent exacerbations that can be life-threatening or result in permanent airway changes.[6] Asthma is responsible for 250,000-345,000 deaths annually worldwide, placing a substantial strain on healthcare systems and economies, particularly in resource-limited settings.[7,8] This underscores the urgent need for innovative and context-specific strategies to improve asthma care and outcomes.[9] One promising approach involves exploring the role of vitamin D in asthma management.

Vitamin D, a fat-soluble nutrient, is widely known for its role in bone health, but it has also been implicated in various chronic conditions, including asthma. Deficiency of vitamin D may influence the onset, severity, and phenotypes of asthma.[10-13] Low vitamin D levels have been shown to impair efficacy of steroids by disrupting important immune pathways, such as those involving p38 mitogen-activated protein kinase.[14] Supplementation with vitamin D has been suggested to reduce exacerbations, particularly in individuals requiring steroid treatment.[15] Beyond this, vitamin D may help modulate inflammation and improve immune responses.[1,13,16-18]

Several studies have established a link between vitamin D deficiency and poorer lung function, increased asthma symptoms, and frequent exacerbations.[18-20] In fact, even low prenatal intake of vitamin D has been associated with an increased risk of wheezing in offspring.[20,21] A study in Costa Rica found that 28% of asthmatic children had insufficient levels of vitamin D, which was inversely related to the severity of asthma.[22] Recent meta-analyses confirm that vitamin D supplementation can reduce exacerbations in children with asthma, particularly at standard doses.[49-51] Vitamin D is primarily obtained through skin exposure to UVB rays and dietary sources and is metabolised into 25-hydroxyvitamin D (25(OH)D), the key marker for assessing vitamin D status.[10,13,24] Genetic variations in vitamin D receptor (VDR) genes and vitamin D-binding proteins (VDBPs) have been shown to heighten susceptibility to asthma.[25] Vitamin D activation in immune cells can modulate responses, preventing airway hyper-responsiveness, and it also plays a role in reducing the risk of respiratory infections, which are common triggers for asthma exacerbations.[1,16,17,26-30]

In Bangladesh, asthma ranks high among paediatric respiratory diseases, with a significant number of cases managed at tertiary centres such as BMU. However, local data on vitamin D levels in asthmatic children is scarce. This study aimed to assess serum vitamin D levels in Bangladeshi children with asthma and examine any potential correlations with clinical asthma subtypes.

METHODS

This cross-sectional study was conducted at the Department of Paediatrics, BMU, Dhaka, from October 2020 to October 2021. The study included children aged 8-18 years, divided into two groups: a case group of 60 children diagnosed with asthma and a control group of 30 age- and gender-matched children without asthma. The case group consisted of children presenting with asthma-like symptoms, including intermittent cough, wheezing, chest tightness, and shortness of breath, all of which were alleviated by bronchodilators, in accordance with the GINA guidelines. Spirometry, typically used to confirm the asthma diagnosis, was not performed due to COVID-19 restrictions that posed a high risk of transmission. The control group was selected from the same paediatrics department's indoor and outdoor clinics and consisted of children who did not have asthma. Exclusion criteria for both groups included children who had received vitamin D supplements within the last three months or who had used medications known to affect vitamin D metabolism (such as systemic steroids, phenytoin, carbamazepine, cyclophosphamide, clotrimazole, rifampicin, nifedipine, spironolactone) within the past year. Additionally, children with musculoskeletal, endocrine, or any liver, bowel, or kidney disorders were excluded to avoid confounding factors. Informed consent was obtained from the parents or guardians of all participants.

Data collection encompassed demographics, asthma symptoms, atopy, supplementation history, medications, and signs of vitamin D deficiency. Clinical evaluations were conducted, focusing on asthma symptoms and potential signs of vitamin D deficiency, including physical indicators like enlarged wrists, frontal bossing, bow legs, or rachitic rosary. All asthmatic children underwent the bronchodilator reversibility test using a peak flow meter: baseline PEF, 200-400 mcg salbutamol via spacer, re-measure after 15 minutes; ≥20% increase confirmed reversibility.

Blood samples (2 ml) were drawn aseptically from the antecubital vein using a disposable syringe, without a tourniquet, and immediately placed into a clean test tube. Serum was separated by centrifugation (5 min, 3000 rpm) within 30-120 minutes of collection. Serum vitamin D levels (25-hydroxyvitamin D) were measured using the chemiluminescence microparticle immunoassay (CMIA) method on an Abbott Architect Ci 4100 analyser (USA, 2012) at BMU's biochemistry and molecular biology department. Vitamin D categories: deficiency (<20 ng/ml), insufficiency (20-<30 ng/ml), sufficiency (30-100 ng/ml).

Statistical analysis was performed using SPSS 26.0. Chi-square tests were used for qualitative data, and the unpaired Student's t test was applied for quantitative data. A p value of less than 0.05 was considered statistically significant.

RESULTS

The demographic characteristics of the asthmatic and non-asthmatic children are shown in Table 1. The mean

age was similar in both groups (p=0.579), and the sex distribution did not differ significantly (p=0.421). The majority of children in asthma group had mild persistent asthma (30.0%), followed by moderate persistent asthma (28.3%) and intermittent asthma (26.7%) (Table 2).

Anthropometry showed weight 31.88±6.54 kg (asthmatic children) vs. 31.72±6.65 kg (non asthmatic children) (p=0.910); height 134.9±14.5 cm vs. 136±14.8 cm (p=0.618); BMI 17.4±1.7 kg/m² vs. 17.1±1.6 kg/m² (p=0.360). There was no statistically significant difference (p>0.05) between the two groups (Table 3).

The mean serum 25(OH)D levels in the asthma group (24.7±7.1 ng/ml) were significantly lower than those in the control group (35.9±7.6 ng/ml) (p<0.05) (Table 4).

Vitamin D deficiency (<20 ng/ml) was found in 23.3% of asthmatic children compared to 13.3% in the control group. Furthermore, 53.3% of asthmatic children had insufficient vitamin D levels (20-30 ng/ml), compared to 40% of controls.

The mean serum vitamin D levels did not vary significantly across the different asthma subtypes, as shown in Figure 1. The minimum value of serum vitamin D level was 13 ng/ml and the maximum value was 43 ng/ml among asthmatic children. The median value of serum vitamin D lies between 20-30 ng/ml in each clinical type of asthma (Figure 2).

No significant correlation was observed between serum 25(OH)D levels and asthma severity (p=0.671) (Table 5).

Table 1: Demographic characteristics of the asthmatic and non-asthmatic children, (n=90).

Demographic characteristics	Asthmatic children, (n=60)		Non-asthmatic children, (n=30)		P value
	N	%	N	%	
Age (Mean±SD) (in years)	11.32±2.007		11.07±1.938		[a]0.579[ns]
Range (min-max)	8.0-18.0		8.0-17.0		
Sex					
Male	43	71.7	19	63.3	[b]0.421[ns]
Female	17	28.3	11	36.7	
Residence					
Rural	39	65.0	18	60.0	[b]0.643[ns]
Urban	21	35.0	12	40.0	

*ns=not significant, [a]P value reached from unpaired t-test, [b]P value reached from chi-square test

Table 2: Types of asthma in asthmatic children, (n=60).

Types of asthma	N	Percentage
Intermittent	16	26.7%
Mild persistent	18	30.0%
Moderate persistent	17	28.3%
Severe persistent	9	15.0%

Table 3: Comparison of weight, height, and BMI among asthmatic and non-asthmatic children.

Variables	Asthmatic children, (n=60) (Mean ±SD)	Non-asthmatic child, (n=30) (Mean ±SD)	P value
Weight (kg)	31.88±6.54	31.72±6.65	0.910[ns]
Height (cm)	134.9±14.5	136±14.8	0.618[ns]
BMI (kg/m^2)	17.4±1.7	17.1±1.6	0.360[ns]

*ns=not significant, p value reached from unpaired t-test

Table 4: Comparison of serum vitamin D level between asthmatic and non-asthmatic children, (n=90).

Vitamin D level (ng/ml)	Asthmatic children, (n=60)		Non-asthmatic child, (n=30)		P value
	N	%	N	%	
Deficiency (<20 ng/ml)	14	23.3	4	13.3	0.000[s]
Insufficient (20-<30 ng/ml)	32	53.3	12	40.0	
Sufficient (30-100 ng/ml)	14	23.3	14	46.7	
Mean±SD	24.7±7.1		35.9±7.6		
Range (min-max)	13.3-43.2		23.0-54.1		

*s=significant, p value obtained using chi-square test for categorical variables and unpaired t-test for mean values

Table 5: Comparison of serum vitamin D in different clinical types of asthma among asthmatic children, (n=60).

Types of asthma	Category of vitamin D						P value
	Deficiency, (n=15)		Insufficient, (n=35)		Sufficient, (n=10)		
	N	%	N	%	N	%	
Intermittent	4	26.7	8	22.9	4	40.0	0.671
Mild persistent	4	26.7	12	34.3	2	20.0	
Moderate persistent	3	20.0	11	31.4	3	30.0	
Severe persistent	4	26.7	4	11.4	1	10.0	

*s=significant and p value reached from chi-square test

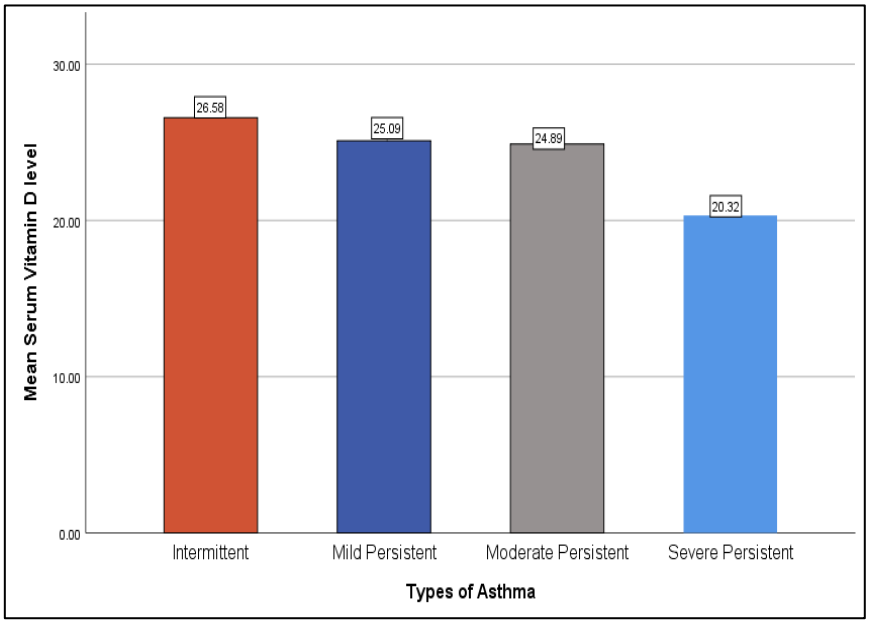

Figure 1: Mean serum vitamin D level in different clinical by types of asthma.

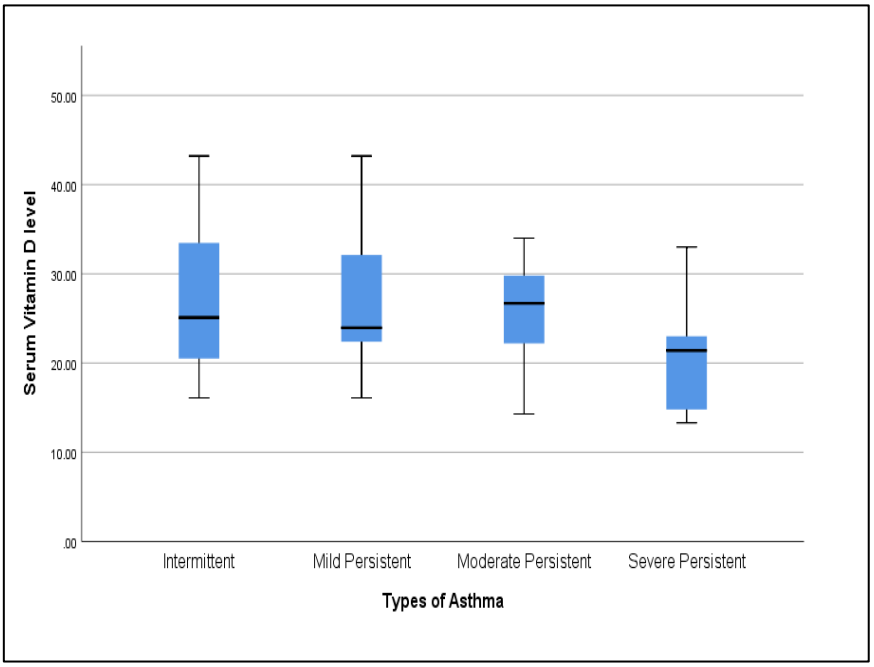

Figure 2: Simple box plot of serum vitamin D by type of asthma.

DISCUSSION

Bronchial asthma is a frequent respiratory issue in children, and vitamin D-beyond its role in bone health-has emerged as a factor in conditions like inflammation, infections, and allergies.[31,32] Epidemiological evidence often ties low 25(OH)D (<20 ng/ml) to worsened symptoms, exacerbations, lung function decline, and severity.[33] We aimed to assess levels in Bangladeshi asthmatic children and links to clinical types.

Demographics aligned across groups, matching prior research.[34-36] Anthropometrics showed no differences, consistent with studies finding similar BMI in asthmatic and non-asthmatic kids.[34,35,37]

Vitamin D deficiency/insufficiency affected 73.3% of asthmatic children (23.3% deficient, 53.3% insufficient), akin to general population trends.[38] Controls had 13.3% deficiency and 40.0% insufficiency, echoing Turkish data. High rates in Southeast Asia are attributed to lifestyle shifts, reduced sun exposure, and unhealthy dietary habits.[39-44] Our asthmatic group had 23.3% deficiency, asthma aligns with multiple studies, possibly due to indoor lifestyles, allergen avoidance, or heightened immune use.[34-36,40,45] Longitudinal studies are needed to clarify causality.

Recent studies reinforce the association between vitamin D deficiency and asthma in children. A 2025 study from Saudi Arabia reported significantly lower vitamin D levels in asthmatic children (21.5±8.8 ng/ml) compared to controls (33.3±13.2 ng/ml), with 85.8% of the asthmatic group exhibiting deficiency or insufficiency.[51]

A systematic review and meta-analysis found that vitamin D supplementation reduced asthma exacerbations in children, with a relative risk of 0.62, indicating a 38% reduction in exacerbation rates.[49] However, some studies have reported no significant association between vitamin D levels and asthma control.[55]

Regarding prenatal supplementation, a 2023 study demonstrated that high-dose vitamin D supplementation (4400 IU/day) during pregnancy was associated with a statistically significant reduction in asthma among offspring aged 3 and 6 years compared to standard prenatal multivitamins.[52]

No link to asthma types emerged, supporting research showing no ties to severity or control.[34,39,45-48] Yet, some contradict, associating deficiency with worse outcomes.[40] One possible explanation for this discrepancy is that the majority of the children in this research only had mild illnesses. Vitamin D undoubtedly plays a role in the case of its insufficiency or deficit, as there was no relationship between vitamin D and distinct clinical types of asthma in this study. This suggests that children with asthma who already have normal blood vitamin D concentrations may not benefit from vitamin D treatment.

This study had several drawbacks that should be taken into account. Firstly, the study was conducted in a single tertiary care hospital with a limited sample size. Additionally, the COVID epidemic prevented Spirometry from being performed. Furthermore, neither dietary vitamin D consumption nor exact sun exposure was evaluated in the study, even though both might have a significant impact on vitamin D levels.

CONCLUSION

This study highlights the high prevalence of vitamin D deficiency in children with asthma in Bangladesh. While vitamin D levels were significantly lower in asthmatic children compared to healthy controls, no significant correlation was found between vitamin D levels and asthma severity. Further research, including randomised controlled trials of vitamin D supplementation, is needed to determine the role of vitamin D in asthma management.

Recommendations

Future studies should involve larger, multi-centre cohorts and explore the impact of vitamin D supplementation on asthma control and exacerbations. Additionally, it would be beneficial to assess dietary vitamin D intake and sun exposure to gain a more comprehensive understanding of the relationship between vitamin D and asthma.

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