Pacific Journal of Medical Research
https://scienceget.org/index.php/pjmr
Vol. 2, No. 1, 2025
eISSN: 3067-2147
ARTICLE
DOI: https://doi.org/10.70818/pjmr.2025.v02i01.021

Evaluation of serum vitamin D level in children with Asthma

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ABSTRACT ***Background:*** Asthma is a chronic condition of the respiratory passages marked by reversible airway obstruction and inflammation. Pediatric asthma is a significant problem since it raises the frequency of hospital visits and the economic burden more than adult asthma. ***Objective:*** Objective of this study was evaluated serum vitamin D levels in children with asthma. Materials and ***Methods:*** This was a cross-sectional study was conducted in the Department of Pediatrics, Bangladesh Shishu Hospital & Institute (BSHI), Dhaka during October 2023 to September 2024. Patients (2-18 years) attending in the indoor and outdoor of the Department of Pediatrics, BSHI presenting with recurrent cough, breathlessness, wheeze, reversible with bronchodilator was recruited as Asthma cases. Gender and age-matched children with no history asthma who was attend at Pediatric outdoor and inpatient, Department of Pediatrics, BSHI, was purposively selected, after considering the exclusion criteria, as a control for comparison. ***Results:*** The majority (52.0%) patients were found vitamin D level 20-<30 ng/ml in case group and 18(36.0%) in control group. The mean vitamin D level was found 26.33±7.59 ng/ml in case group and 33.50±7.19 ng/ml in control group. The difference was statistically significant ($p<0.05$) between two groups. Four (50%) patients were found severe asthma in deficiency group, 4(15.38%) in insufficient group and not found in sufficient group. ***Conclusion:*** Children with asthma had lower serum vitamin-D levels than age and sex matched generally healthy controls. Severe asthma was more frequently seen in the Vitamin D deficient and inadequate groups.
Keywords: Vitamin D Status, Asthma, Vitamin-D Deficiency.

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Received: December 18, 2024 | **Accepted:** February 22, 2025 | **Published:** March 30, 2025

INTRODUCTION

Vitamin D exhibits anti-inflammatory properties through multiple mechanisms. Vitamin D deficiency is associated with increased inflammation, exacerbations, and overall worse outcomes in pediatric asthma and is observed in asthmatic children with obesity [1]. Asthma is a chronic disorder of the conducting airways characterized by reversible airway obstruction and airway inflammation [2]. Pediatric asthma is a significant concern because it increases the number of hospital visits and economic burden more than asthma in adulthood [2]. Asthma is a major public health problem, affecting an estimated 339 million individuals worldwide with a reported prevalence of 5% to 20% in children aged between 6 and 15 years.3 Of 7 million people suffering from asthma in Bangladesh, an estimated 4 million

remain 5- to 14-year-old children, yielding a prevalence of 7.3% in this age group [3]. The First National Asthma Prevalence Study (NAPS) in Bangladesh, also showed that more than 90% of asthma patients do not receive modern treatment [4]. Despite the continuous development and ready availability of effective asthma management strategies, a lack of proper implementation of treatment guidelines results in asthma control that is far below optimum in the majority of patients [5]. Globally, Vitamin D (S. 25(OH) cholecalciferol) have been stated to play a role in asthma due to its plausible effects on bronchial tree (airway epithelium, bronchial smooth muscle) and immune-modulatory effects on innate and adaptive immune systems that may carb severity of asthma [6].

Most reports suggest low Serum 25(OH) cholecalciferol (circulating levels of Serum 25(OH) cholecalciferol of <30 ng/mL) in children with asthma remains associated with poor control of symptoms, frequent exacerbations, reduced lung function, decreased responsiveness to corticosteroids, increased medication usage and disease severity [7,8]. Childhood asthma poses significant morbidity but similar studies remain scarce in South East Asian-region, like Bangladesh. Proper documentation on the association between S. Vitamin-D [25(OH)] and asthma in Bangladeshi children lack grossly, which prompted us to conduct this study. Once our findings yield any significant association, further multi-center studies involving larger sample and healthy controls may be planned to better understand the causal relationship between vitamin D and asthma, which will be a step forward in the management of childhood asthma in countries like Bangladesh. The aim of this study is to assess the independent serum vitamin D level in children with asthma and the relationship between vitamin D and severity of asthma.

MATERIALS AND METHODS

This was a cross-sectional study was conducted in the Department of Pediatrics, Bangladesh Shishu Hospital & Institute (BSHI), Dhaka during October 2023 to September 2024. Patients (2-18 years) attending in the indoor and outdoor of the Department of Pediatrics, BSHI presenting with recurrent cough, breathlessness, wheeze, reversible with bronchodilator was recruited as Asthma cases. Gender and age-matched children with no history asthma who was attend at Pediatric outdoor and inpatient, Department of Paediatrics, BSHI, was purposively selected, after considering the exclusion criteria, as a control for comparison. After selection of the subjects and control 2 ml of blood was collected and Vit-D level was assessed by using Siemens Dimension EXL With LM. The objectives, nature, purpose and potential risk of all procedures used for the study was explained to the parents in detail and informed written consent was taken from the parents.

A questionnaire collecting sociodemographic information with questions to determine asthma severity in the patients was prepared by the investigator and completed by patients' parents. History and examination was include demographic details such as age, gender, address and socioeconomic status of all the children, symptoms of asthma, past and family history of asthma, atopy, vitamin D supplementation history, drug h/o which affect vitamin D level and features of vitamin D deficiency disease and cases was categorized into types of asthma based on the National guideline for management of asthma using clinical criteria after assessing the symptoms status in the previous four weeks clinical criteria. A thorough clinical examination was done in all the cases particularly concerning to find out the clinical signs of asthma along with vitamin D deficiency such as widened wrists, frontal bossing, bow legs or rachitic rosary, etc. systemic examination was done in all the children. Statistical analyses were carried out by using the Statistical Package for Social Sciences version 23.0 for Windows (SPSS Inc., Chicago, Illinois, USA).

A descriptive analysis was performed for all data. The mean values were calculated for continuous variables. The quantitative observations were indicated by frequencies. Chi-Square test with Yates correction was used to analyze the categorical variables, shown with cross tabulation. Student t-test was used for continuous variables. A "p" value <0.05 was considered as significant.

RESULTS

Table 1: Demographic characteristics of the study patients (n=100)

Demographic characteristics	Case (n=60)		Control (n=30)		P value
	n	%	n	%	
Age (years)					
≤ 5 years	10	20.0	12	24.0	
6-12 years	35	70.0	35	70.0	0.71
>12 years	5	10.0	3	06.0	
Mean±SD	7.86	±2.94	7.58	±3.1	[a]0.64[ns]
Range (min-max)	8.0	-18.0	8.0	-17.0	
Sex					
Male	43	86.0	43	86.0	[b]1.0 [ns]
Female	07	14.0	07	14.0	
Residence					
Rural	33	66.0	29	58.0	[b]0.41[ns]
Urban	17	34.0	21	42.0	

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

Table 1 shows that majority (70.0%) patients were belonged to age 6-12 years in case group and control group both. The mean age was found 7.86±2.94 years in case group and 7.58±3.1 years in control group. Majority (86.%) patients were male in case group and control group. Almost two third (66.0%) patients come from rural in case group and 29(58.0%) in control group. The difference was not statistically significant (p>0.05) between two groups.

Table 2: Vitamin D status of the study patients (n=90)

Vitamin D level (ng/ml)	Case (n=50)		Control (n=50)		P value
	n	%	n	%	
Deficiency (<20 ng/ml)	8	16.0	0	0.0	
Insufficient (20-<30 ng/ml)	26	52.0	18	36.0	
Sufficient (30-100 ng/ml)	16	32.0	32	64.0	
Mean±SD	26.33	±7.59	33.50	±7.19	<0.001[s]
Range (min-max)	13.3	-43.2	23.0	-54.1	

s= significant
P value reached from unpaired t-test

Table 2 shows that majority (52.0%) patients were found vitamin D level 20-<30 ng/ml in case group and 18(36.0%) in control group. The mean vitamin D level was found 26.33±7.59 ng/ml in case group and 33.50±7.19 ng/ml in control group. The difference was statistically significant (p<0.05) between two groups.

Table 3: Association between different types of asthma and vitamin D status among cases group (n=60)

Types of asthma	Vitamin D (ng/ml)						P value
	Deficiency (n=8)		Insufficient (n=26)		Sufficient (n=16)		
	n	%	n	%	n	%	
Intermittent	0	0	2	7.69	6	37.5	0.01[s]
Mild persistent	2	25	10	38.46	4	25	
Moderate persistent	2	25	10	38.46	6	37.5	
Severe persistent	4	50	4	15.38	0	0	

s= significant

P value reached from chi square test

Table 3 shows that 4(50%) patients was found severe asthma in deficiency group, 4(15.38%) in insufficient group and not found in sufficient group. The difference was statistically significant (p<0.05) among three groups.

DISCUSSION

In this study observed that the majority (70.0%) patients were belonged to age 6-12 years in case group and control group both. The mean age was found 7.86±2.94 years in case group and 7.58±3.1 years in control group. Majority (86.0%) patients were male in case group and control group. Almost two third (66.0%) patients come from rural in case group and 29(58.0%) in control group. The difference was not statistically significant (p>0.05) between two groups. Similar observation was found Omole *et al* [9]. they showed there was no significant difference in the age, sex distribution, and socioeconomic classification of the two groups of study participants. Somashekar *et al* [10]. reported the mean age in year's ±SD in the controls was 7.17±2.17 and 7.50±2.33 in cases. Esfandiar *et al* [11]. observed similar in male gender distribution (56.6 versus 59.0%, p = 0.559) and mean age (5.63±3.24 years versus 5.56±3.90 years, p = 0.920, which 43.4% in the case group were women and 49.1% in the control group as well).

Present study showed majority (52.0%) patients was found vitamin D level 20-<30 ng/ml in case group and 18(36.0%) in control group. The mean vitamin D level was found 26.33±7.59 ng/ml in case group and 33.50±7.19 ng/ml in control group. The difference was statistically significant (p<0.05) between two groups. Omole *et al*. reported the mean (SD) serum vitamin D levels of the children with asthma was 49.2(±7.2) ng/mL while that of their controls was 51.2(±6.9) ng/mL [9]. The range of serum vitamin D levels in children with asthma was 28.8-62.3 ng/mL while that of children without asthma was 32.0-63.2 ng/mL. Sharif *et al* [12]. in Iran reported 59.7% of the children with asthma to be vitamin D deficient, Uysalol *et al.* in Turkey reported 67.0% of them to be insufficient and 29.4% deficient [13]. None of the apparently healthy children without asthma in this study had either vitamin D deficiency or insufficiency. Forty-six percent of the apparently healthy children studied by Sharif *et al* were vitamin D deficient, Uysalol *et al*. reported 23.5% deficiency and 35.3% insufficiency among the apparently healthy children [13,14]. Somashekar *et al*. observed the mean serum vitamin D level was found 16.49±1.13 ng/mL in without asthma group and 12.88±1.79 ng/mL in with asthma group [10]. The difference was statistically significant (p<0.05) between two groups.

These findings are consistent with a similar study done in Thailand, where 61.4% of the asthmatic children had vitamin-D deficiency (31.2% of uncontrolled asthmatics, 17.4% of partly controlled and 12.8% of controlled asthmatic children) [15]. Esfandiar *et al*. (2016) observed in the groups with and without asthma, the prevalence of vitamin D deficiency was 73.6 and 49.1%, and the prevalence of vitamin D insufficiency was 18.9 and 18.9%, while normal vitamin D level was revealed in 7.5 and 32.1%, respectively with a significant difference (p = 0.005) [11]. Assessing the serum level of vitamin D showed that the asthmatic children had significantly lower level of vitamin D compared to normal cases (14.53±8.10 ng.ml versus 22.45±13.46 ng/ml, p <0.001). Khan, *et al*. reported Vitamin D in controls was 17.91±0.48 ng/ml and in cases was 15.18±0.21ng/ml (p<0.001). Current study showed 4(50%) patients was found severe asthma in deficiency group, 4(15.38%) in insufficient group and not found in sufficient group [16]. The

difference was statistically significant ($p<0.05$) among three groups. Hakamifard, *et al* [17]. Regarding the relationship between Vitamin D levels and asthma severity, the mean Vitamin D level was 59.8±18 ng/ml in those with mild asthma and 42.8±18.5 ng/ml in those with moderate asthma, suggesting a statistically significant difference ($p = 0.02$) and indicated that Vitamin D levels are higher in children with mild asthma. Omole *et al* [9]. observed that the mean (SD) of the children with intermittent asthma was 48.9(±7.2) ng/mL, those with mild persistent asthma had a mean (SD) of 50.5(±7.2) ng/mL, and those with moderate persistent asthma had a mean (SD) of 50.4(±8.1) ng/mL. None of the children with asthma who participated in the study had severe persistent asthma. Esfandiar *et al* [11].

observed that the mean serum level of vitamin D in the patients with mild asthma was 12.85±7.06 ng/ml, in the group with moderate asthma was 16.98±8.63 ng/ml, in the patients with severe asthma was 12.42±7.52 ng/ml, and in those with persistent asthma was 12.01±5.00 ng/ml ($p=0.260$). Khan *et al* [16]. reported serum levels of mild and moderate asthmatics with insufficient vitamin D were 16.5±0.24 ng/ml and 14.31±0.41 ng/ml respectively and deficient vitamin D of both groups were 7.3±0.15 ng/ml and 6.8±0.44 ng/ml respectively. Vitamin D insufficient levels between mild and moderate asthmatics revealed significant result ($p<0.001$) as well as comparison of deficient level shows significant differences in these subgroups ($p<0.001$).

CONCLUSION

According to our research, children with asthma had lower serum vitamin-D levels than age- and sex-matched, generally healthy controls. Severe asthma was more frequently seen in the Vitamin D deficient and inadequate groups.

Funding: No funding sources

Conflict of interest: None declared

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