Original Article

Study on Association Between Severity of Childhood Asthma and Serum Vitamin D Levels in Children 1 to 12 Years of Age

Childhood Asthma and Serum Vitamin D Levels in Children

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ABSTRACT

Objective: To assess serum Vitamin D levels in 100 Asthmatic children 1-12 years of age and to study the relation between Vitamin D levels and the severity of asthma.

Study Design: Cross-sectional study.

Place and Duration of Study: This study was conducted at the Department of Pediatrics, Liaquat University of Medical and Health Sciences Jamshoro for one year 1st December 2019 to 30th November 2020.

Materials and Methods: This study was done in 100 asthmatic children diagnosed and Vitamin D levels were assessed. Vitamin D levels <20ng/dl were taken as deficient levels, 21-29 as insufficient levels, and more than 30 as sufficient levels.

Result: Fifty-four (54%)of asthmatic children had vitamin D deficiencies and 17% had inadequate levels. Deficient Vitamin D levels were found in 41% of children with intermittent asthma, 58% of children with mild persistent asthma, and 56 % of children with moderate persistent asthma whereas insufficient levels of Vitamin D were found in 18% of the children with intermittent asthma, 16% with mild persistentasthma and 19% with moderate persistent asthma. It was also found that nasal eosinophilia was associated with increased severity of asthma and children with nasal eosinophilia had a higher risk for persistent asthma.

Conclusions: A high prevalence of Vitamin D deficiency and insufficiency was found in asthmatic children studied. No association between the deficit in vitamin D and the severity of asthma was discovered.

Key Words: Asthma; Vitamin D; Children, Severity

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INTRODUCTION

As with many other chronic conditions, pediatric asthma has a likely effect on the social and emotional components in children's and their families' living conditions. Asthma is the most frequent chronic disease in children. The asthma prevalence reported in Pakistan varies widely from 4.3% to 31.58% in various fields.[1]In our country, the frequency of bronchial asthma in children is over 5% and the burden is increasing regularly.[2] Bronchial asthma not only affects breathability, but also physical, social and emotional life components.

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There have been more studies on children with asthma which have identified higher adaptation problems due to unfavourable developmental effects, psycho-social stress on the family and numerous meetings with medical staff.[2]

Inhaled corticosteroids are preventive drugs that reduce asthma and frequent hospitalization. Inhaled corticosteroids. Inhaled steroids minimize the requirement for bronchodilator rescue and inpatient therapy, increase pneumonia, diminish bronchial hyper responsiveness, and decrease collagen and tenascine deposition in the airways of the mucosa.[3]The actual cause of asthma is uncertain and probably originated from complicated interactions between several genetic and environmental elements. There is evolving evidence that there is an increased severity of the disease and poorer response to medication in Vitamin D deficient asthmatics.[4]The anticipated link between increased asthma prevalence and low vitamin D levels has resulted from common risk factors for asthma and vitamin D deficiency, such as urbanization, Westernized lifestyles, race and obesity, and increasing evidence of immunomodulsive impact of vitamin D.[5]

Vitamin D insufficiency is related to various disorders that are immune-mediated, infectious and cancer-sensitive.[6] First direct evidence for asthma and the

development of allergies involving vitamin D was derived from investigations on human genetic associations. Increased data implies that Vitamin D has a complex role in immune response modulation. Vitamin D receptor, including activated T cells, B cells, macrophages, and dendritic cells, expresses multiple types of immune cells. More recent reports have shown that vitamin D inhibits the generation of interleukin -17 involving asthma. Vitamin D inhibits T-helper 2 cells which limit synthesis by B cells, mast cells and eosinophils of cytokines like IL-4, IL-5 IL-13, and Immunoglobulin E.[7] Several studies have demonstrated that the disease has increased and that there are a deficient asthmatic drug response, and hypothesized linkages have evolved between rising asthma prevalence and low levels of vitamin D are increasingly apparent in vitamin D immunity to the TH2 (T helper 2) phenotype. As there are no studies available in our population linking Vitamin D levels and asthma, this study is being conducted to find out the association between Vitamin D levels and the severity of asthma.

MATERIALS AND METHODS

This cross-sectional study was undertaken in children with asthma attending the Out-patient and In-patient Department of Pediatrics of LUMHS for one year from 1st December 2019 to 30th November 2020. Children with asthma aged 1 year to 12 years diagnosed according to the National Asthma Education and Prevention Program were included in this study while those children with other comorbidities like heart disease, tuberculosis, epilepsy, liver disease, chronic lung disease, and renal disease were not included.

This study included 100 children having asthma diagnosed based on the National Heart, Lung, and Blood Institute, Guidelines for the Diagnosis and Management of Asthma, between the ages of 1 and 12 years, admitted to the wards or attending the outpatient of Department of Pediatrics at LUMHS. Consent was taken from the Parents, detailed history taken using a structured questionnaire, clinical examination done and the parents were advised to maintain an asthma diary that was evaluated during regular follow-ups. Following investigations were done: complete blood count (CBC), and nasal smear cytology, chest x-ray, Peak Expiratory Flow Rate, and spirometry were done wherever possible.

Statistical Analysis: Statistical analysis was done using the SPSS version 22.0 and Pearson's Chi-square test was applied wherever necessary. Frequencies and percentages were calculated for categorical variables. P-value < 0.05 was considered as significant levels.

RESULTS

In the study done, out of 100 asthmatics, 29 % were in the age group of 1-5 years, 71% were in the age group of 6-12 years. The mean age group of the study population is 7.57 with a standard deviation of 3.5. Out of 100 asthmatic children, 62% were males and 38% were females, 44% of the children had a positive family history of asthma, whereas in 56% of the children there was no family history of asthma or atopy.

In the study, it was found that 22% of children had intermittent asthma, 62% had mild persistent asthma and 16% had moderate persistent asthma and none in the study group had severe persistent asthma.

In the study, among the children in the 1-5 years' group, 21% had intermittent asthma, 76% had mild persistent asthma and 3% had moderate persistent asthma.

22% of children in age group 6-12 years had intermittent asthma, 56%ihadimild persistent asthma and 21% had moderate persistent asthma. There was a statistically significant correlation between the severity of asthma and increasing age.

Out of 100 children in the study group, nasal smear cytology was done in 62 patients. 28 (45%) had nasal smear-positive for eosinophilia as compared to 34 (55%) whose smears were normal.

In our study, 75% of children with nasal smear eosinophilia belonged to mild persistent asthma and 25% to moderate persistent with none in the intermittent group. There was a strong positive correlation between the severity of asthma and nasal eosinophilia. It was also found that nasal eosinophilia was associated with an increased risk of persistent asthma as compared to intermittent asthma.

Table No.1: Baseline characteristics of the children (n = 100)

	Number	Percentage
Age Groups:		
1 to 5 years	29	29%
6 to 12 years	71	71%
Gender		
Male	62	62%
Female	38	38%
Family History		
Yes	44	44%
No	56	56%
Severity of Asthma		
Intermittent	22	22%
Mild Persistent	62	62%
Moderate Persistent	16	16%
Severe Persistent	0	0
Nasal Eosinophilia:		
Smear Positive	28	28%
Smear Negative	34	34%
Vitamin D Levels		
Deficiency	54	54%
Insufficiency	17	17%
Sufficient	29	29%

Among 100 study subjects, it was found that 54% had deficient, 17% had insufficient and 29% had sufficient levels of Vitamin D. The mean of Vitamin D levels of

the study population was 25.26 with a standard deviation of 24.8.

Table No.2: Severity of asthma in relation to Age, Nasal Eosinophilia and Vitamin D Levels (n = 100)

	Intermittent n = 22	Mild Persistent n = 62	Moderate Persistent n = 16	Total	P – value
Age Groups:					
1 to 5 years	6 (21%)	22 (76%)	1 (3%)	29	0.03
6 to 12 years	16 (23%)	40 (56%)	15 (21%)	71	
Nasal Eosino-philia		21 (75%)			0.02
Yes	0	21	7 (25%)	28	1
No	9 (26%)	(62%)	4 (12%)	37	
Vitamin D Levels		36 (58%)	9 (56%)		
Deficiency	9 (41%)	10 (16%)	3 (19%)	54	0.76
Insufficiency	4 (18%)	16 (26%)	4 (25%)	17	0
Sufficient	9 (41%)			29	

Table No.3: Vitamin D Status in Relation to Age, Gender and Nasal Eosinophilia (n = 100)

	Deficient n = 54	Insufficient n = 17	Sufficient n = 29	Total	P – value
Age Groups:					
1 to 5 years	15 (52%)	4 (14%)	10 (34%)	29	0.832
6 to 12 years	39 (55%)	13 (18%)	19 (27%)	71	
Gender					
Male	32 (52%)	11 (18%)	19 (30%)	62	
Female	22 (58%)	6 (16%)	10 (26%)	38	0.282
Nasal Eosinophilia					
Yes	0	21 (75%)	7 (25%)	28	0.021
No	9 (26%)	21 (62%)	4 (12%)	37	

In the 1-5-year age group, 52% of youngsters had deficient Vitamin D, 13% had insufficient Vitamin D and 34% had appropriate Vitamin D levels. Of the 6-12-year age group 55% had poor Vitamin D levels, 18% had low Vitamin D levels. There is no statistical relation between Vitamin D deficiency and age.52% males and 58% females had Vitamin D deficiency, 18% males and 16% females had insufficient levels. There was no statistically significant difference between gender and Vitamin D deficiency. In the study, it was found that children with Vitamin D deficiency and insufficiency had a longer duration of illness as compared to those with sufficient levels. There was a significant negative correlation between Vitamin D levels and duration of illness in asthmatics. 41% of children with intermittent asthma, 58% with mild persistent asthma, and 56% of children with moderate persistent asthma had Vitamin D deficient levels. 18% of children with intermittent asthma, 16% with mild persistent asthma, and 19% of children with moderate persistent asthma had Vitamin D insufficient levels. Pearson‘s Chi-square Test has shown no significant correlation between the severity of Asthma and Vitamin D levels.

DISCUSSION

In this study, the majority (71%) were in the age group of6-12 years. The mean age in our study was 7.8 which was similar to the study done by Brehm et al[8] and CAMP study.[9]

In our study, it was found that the majority 62% had mild persistent asthma, 22% of children had intermittent asthma, 16% had moderate persistent asthma and none had severe persistent asthma.

There was a strong positive correlation between the age of the patients and the severity of asthma, as the age increased the severity increased. It was also found that as age increased the incidence of persistent asthma increased, which can be explained by the natural course of asthma itself.

The severity of asthma was also strongly associated with the number of exacerbations, which might be probably because severe asthma might have multiple triggers along with genetic factors that cause an increase in the severity and thereby making it difficult to control. There was no significant correlation between gender and severity of asthma in our study.

The various triggers in the asthmatics were dust (90% of children), upper respiratory tract infections (URI) (80% of children), winter/rainy season (54% of children), ice creams, and bakery products (43% of children), smoke (32% of children), oily food (27% of children), exercise (22% of children). In the study conducted by Kalyan G et al, URI accounted for 37%, dust for 7%, winter/rainy season for 8%, ice creams 11%,and other food items 9% of triggers.[10]

Nasal eosinophilia was found to be positive in 28 out of 62 (45%) of children and nasal eosinophilia had a strong positive correlation with the severity of asthma. It was also found in the study that nasal eosinophilia was associated with an increased risk to have persistent asthma as compared to intermittent asthma. This was by the study done by Price et al[11] who showed that incidence of severe asthma was more in patients with allergicirhinitis, and allergic rhinitis was associated with increased incidence of exacerbations.

Fifty-four (54%) of the asthmatics had Vitamin D deficiency and 17% had insufficient levels of Vitamin D. Among the children in the age group of 1-5 years, 52% had deficient Vitamin D levels and 13% had insufficient levels. Among the children aged 6-12 years,

55% had deficient Vitamin D levels and 18% had insufficient levels. The mean Vitamin D level of the study population was 25.26. The distribution of Vitamin D levels in our study was comparable to the study done by Bener et al[12]though other studies done by Brehm et al[8], Krobtrakulchai et al[13], and CAMP study[14] had a lower number of children in the deficient group but the higher number in the insufficient group.

There was no significant correlation between the age or gender of the study population with Vitamin D levels.

No significant association between serum vitamin D levels and asthma severity was found in our study. It was similar to the findings of the study done by Krobtrakulchai et al.[13]that was done in Thailand which is also located in a similar tropical zone as that ours. The Costa Rican study[9] did not find a temporal link between asthma severity and vitamin D. But it showed that low Vitamin D levels were associated with increased frequency of hospitalization/ exacerbations. Our study also found out a significant positive correlation between increased risks of exacerbations and Vitamin D deficiency.

The induction of AMPs in the airway epithelium has been demonstrated. Vitamin D may also regulate the inflammatory response of viral infections in addition to the generation of AMPs.[9]

In the study, it was found that Vitamin D deficiency had a significant correlation with the duration of illness in asthmatics. There were no comparable similar studies, but a study done by Sutherlands et al.[15] showed that lower Vitamin D levels were associated with decreased response to inhaled corticosteroids thereby increasing the disease severity and control.

In the study, a significant positive correlation was found between Vitamin D levels and absolute eosinophil counts. It was by the Costa Rican study that had shown that Vitamin D deficiency was associated with markers of allergy and asthma-like high AEC and serum IgE levels.[15] This was in contrast to the CAMP study which did not prove any relation between the same.[9]

There was no significant correlation between allergic rhinitis and low Vitamin D levels in our study. It was in contrast to the findings of Jung J[16] who found a strong positive correlation between Vitamin D deficiency and allergic rhinitis.

CONCLUSION

Our study has shown a high prevalence of vitamin D deficiency and insufficiency in asthmatics. There was no significant correlation between the severity of asthma and Vitamin D levels but low Vitamin D levels are found to be associated with prolonged duration of the illness and more number exacerbations suggesting the role of Vitamin D in asthma exacerbations.

Author's Contribution:

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