

# Association between Vitamin D Deficiency and Asthma in childhood

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## Abstract

**Background:** This study was designed to determine the relationship between vitamin D deficiency and asthma in paediatric age group as compared to controls. Asthma is among one the major causes of morbidity in children and it is suggested that vitamin D deficiency plays a role in asthma severity since it has immunomodulatory effects.

**Methods:** This case-control study was performed at Benazir Bhutto Hospital Rawalpindi in paediatric department from January 2015 to May 2015. Cases and controls were recruited from the same hospital through consecutive sampling. Cases were patients with asthma and controls were patients with a minor illness other than asthma presenting in the outpatient department. The patients who had rickets, known vitamin D deficiency, renal disease, liver disease and other respiratory problems (tuberculosis, pneumonia cystic fibrosis) as assessed on medical records or history and examination were excluded both for cases and controls. Vitamin D levels were checked in all patients. The data was recorded and analysis was done through SPSS 14.

**Results:** The two groups were comparable for age and gender. The mean age of patients in cases was 7.66±2.92 while among controls it was 7.23±2.65 years. Among 30 patients with asthma, vitamin D deficiency was found in 19 (63.33%) while in controls it was found in 8 patients (26.67%). P-value was 0.004 which was statistically significant. The odds ratio was 4.75, 95 % confidence interval for odds ration showing a significant difference between the two groups.

**Conclusion:** Vitamin D deficiency was remarkably higher in asthmatics in comparison to non-asthmatic children.

**Keywords:** Children, Asthma, Vitamin D deficiency, Association.

## Introduction

Asthma is a chronic disorder of airways in which there is airway inflammation and hyper-responsiveness which results in recurrent episodes of wheezing, breathlessness and coughing.<sup>1</sup> Asthma is among one of the leading cause of morbidity in children.<sup>2</sup> The prevalence of asthma in children has increased from 8.7% in 2001 to 9.6% in 2009.<sup>3</sup> At 6-7 years of age prevalence ranges from 4-32%, the same is for ages 13 to 14 years.<sup>4</sup> It is anticipated that by the year 2025, 400 million people worldwide will be suffering from asthma.<sup>3,5</sup> According to WHO, it is expected that by the year 2020, asthma along with other chronic obstructive pulmonary diseases will be the third leading cause of death.<sup>5</sup>

Vitamin D which is a regulator of calcium and phosphate metabolism also has immunomodulatory effects.<sup>6</sup> It plays a major role in innate and acquired immunity because more than 900 different genes are regulated by vitamin D.<sup>7</sup> Vitamin D deficiency is considered to be a risk factor for several chronic disorders including asthma.<sup>8,9</sup> Seering et al suggested that vitamin D enhances the action of glucocorticoids to induce MPKI and IL-10, which have important immunosuppressive and anti-inflammatory effects.<sup>10</sup> There are certain studies suggesting that a higher intake of vitamin D by females during pregnancy reduces the risk of wheezing in young children suggesting that low vitamin D levels may play a contributing role in the development of asthma.<sup>9</sup> It is also studied that vitamin D plays a role in lung development and maturation as well as maintaining the structure and function of lungs.<sup>11</sup> Vitamin D deficiency also contributes to asthma severity and there are more chances of hospitalization of such patients due to asthma complications.<sup>12</sup>

This study is planned to determine the association between serum vitamin D levels and asthma since it is one of the leading causes of morbidity in children causing a burden on community and health resources. And by administering vitamin D, the burden of disease in the community can be reduced.

## Patients and Methods

This unmatched case-control study was performed at Benazir Bhutto Hospital in the paediatric department from January 2015 to May 2015. Permission from the hospital ethical committee was sought before the

commencement of the study. Parents signed a written consent before enrolment of their children in this study. All children of either gender with age ranging between 2 to 13 years presenting in the Emergency Department with asthma were enrolled as cases while patients of the same age range presenting with other minor illnesses in the outpatient department were enrolled as controls.

Asthmatic patients were assessed clinically by a resident by examining the general look of the patient, respiratory rate, and auscultation of the chest. Findings were confirmed by a consultant pediatrician. Other respiratory conditions if suspected was excluded by relevant investigations. The patients who had rickets, known vitamin D deficiency, renal disease, liver disease as assessed on medical records or history and examination were excluded both for cases and controls. Keeping a level of significance ( $\alpha$ ) =5% and the power of the test ( $1-\beta$ ) =80%, the WHO calculator was used to calculate the sample size for the study. According to a previous study<sup>13</sup>percentage of subjects having vitamin D deficiency among cases was 54%, it was 19% among controls. The total sample size was 60 patients, 30 for cases and controls. Patients were managed according to standard protocols. Necessary investigations were done where needed. 3ml blood was drawn from each patient by a venous puncture for 25 hydroxy-vitamin D levels. All the investigations were done from the same laboratory. All reports were verified by the same consultant pathologist. To avoid observer bias, single blinding was done and pathologists were not informed about patients and controls.

All data were collected on specially designed Performa and analysis was done using SPSS version 14. Both qualitative, as well as quantitative variables were accessed by employing descriptive statistics. For variables like age, mean and standard deviation were collected.

Frequency and percentages were calculated for gender and vitamin D deficiency. A chi-square test was used for comparison of vitamin D deficiency between the two groups. P-value of  $\leq 0.05$  was considered to be significant. The odds ratio was calculated and the chi-square test was applied taking p-value  $\leq 0.05$  on a significant level.

## Results

The mean age was  $7.66 \pm 2.92$  years among cases, while it was  $7.23 \pm 2.65$  years among controls. The age

distribution of participants in categories is illustrated in table1.

**Table 1: Age distribution (n=60)**

Age (years)	Cases (n=30)		Controls(n=30)		P value
	n	%	n	%	
2-8	16	53.33	18	60	0.602
9-13	14	46.67	12	40	
<b>Total</b>	30	100	30	100	
<b>Mean±SD</b>	7.66±2.92		7.23±2.65		0.552

**Table 2: Gender distribution (n=60)**

Gender	Cases(n=30)		Controls(n=30)		P value
	n	%	n	%	
<b>Male</b>	14	46.67	17	56.67	0.438
<b>Female</b>	16	53.33	13	43.33	
<b>Total</b>	30	100	30	100	

The prevalence of Vitamin D deficiency among cases was 19 /30, 63.33%. 95 % confidence interval for vitamin d deficiency among cases was 46.05% to 80.55 %.

The vitamin D deficiency among controls was 8/30, 26.67 %. 95 % confidence interval for vitamin D deficiency among controls was 10.85 % to 42.49%. chi square p-value was 0.0043 which shows asthmatic patients have increased prevalence of vitamin D deficiency than non- asthmatic patients.

The odds ratio was 4.75, 95% confidence interval for odds ratio 1.5838 to 14.2454, p-value 0.0054 which means compared to normal vitamin d level groups, odds of having asthma in vitamin D deficient groups were 4.75 times higher than the control group.

**Table 3: Vitamin d deficiency in cases versus controls (n=60)**

Vitamin D Deficiency	Cases (n=30)		Controls (n=30)		P value
	n	%	n	%	
<b>Yes</b>	19	63.33	8	26.67	0.004
<b>No</b>	11	36.67	22	73.33	
<b>Total</b>	30	100	30	100	

Odds ratio=4.75, 95% confidence interval for odds ratio 1.5838 to 14.2454, p value 0.0054

## Discussion

The innate and adaptive immune system is affected by vitamin D. Vitamin D may lead to asthma since it has

extensive effects on epithelial cells of airways, immune cells, and bronchial smooth muscles.<sup>14</sup> Several epidemiological types of research have studied the correlation between low vitamin D levels and asthma and their results are not consistent. For this reason, this study was planned to find out this correlation since asthma is among one of the major causes of ill health in children causing a burden on community and health resources and by administering vitamin D, the burden of disease in a community can be reduced. The results of our study correspond to a study conducted by Freishtat RJ showing that vitamin D deficiency was present in 54% of asthmatic population under study when compared to normal non-asthmatic population in which only 19% had inadequate levels of vitamin D.<sup>13</sup> A meta-analysis conducted by Lixin Man et al also concluded that the risk of asthma in childhood might increase if they have vitamin D insufficiency and deficiency.<sup>15</sup>

A study performed in Iran also showed a connection between vitamin D deficiency and asthma; however, it revealed that control status and severity of asthma may not be predicted by confirming vitamin D deficiency.<sup>16</sup> Contrasting to this Awasthi and his coworkers concluded that there is a strong link between vitamin D levels and control of asthma.<sup>17</sup> Many other studies showed findings supporting our results. These include a study by Metin Uysalo and coworkers<sup>18</sup> and Mahmood T Abd El Menem and coworkers.<sup>19</sup>

A randomized clinical trial performed by Majak et al found that children receiving 500 IU supplemental vitamin D per day had decreased risk of asthma exacerbations when triggered through acute respiratory tract infections.<sup>20</sup> It has also been suggested that asthmatic children with inadequate vitamin D levels are prone to have more severe attacks of asthma exacerbation. This observation is supported by Brehm et al.<sup>21</sup> and Manbirand Thomas<sup>22</sup> in their study.

Clinical trials performed by prenatal vitamin D supplementation have proved the protective role of vitamin D in asthma. A meta-analysis done by Wolsk HM and coworkers concluded a significantly reduced risk of recurrent wheezing/asthma in offsprings whose mothers received vitamin D supplementation antenatal period.<sup>23</sup> Studies conducted in Japan and Finland on greater than 750 child-mother pair found that there is an inverse correlation between vitamin D intake during pregnancy and incidence of wheezing in childhood.<sup>24, 25</sup>

From the current study, we should emphasize the importance of supplemental intake of vitamin D by

pregnant females to decrease the risk of asthma in children as well as regular vitamin D supplementation of asthmatic children to reduce the morbidity of the disease.

## Conclusion

Vitamin D deficiency is remarkably higher in asthmatic children when compared to normal non-asthmatic children

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