**Research Article**

# Aeroallergen Sensitization in Asthmatics children and its association with Asthma severity

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## Abstract

**Introduction:** Chronic low level exposure and sensitization to indoor allergens plays a major role in asthma pathogenesis and subsequent provocation of symptoms. Asthma severity is proportional to degree of aeroallergen exposure and sensitization. This study was conducted to determine the prevalence of sensitization to common aeroallergens and its association with asthma severity. **Material and methods:** Cross sectional observational study that evaluated 70 asthmatic patients from 5 – 18 years of age attending pediatric allergy asthma clinic at a tertiary care teaching hospital from January to December 2014. Skin prick test was performed on all these patients. Pattern of aeroallergen sensitization and its impact on asthma severity was studied. **Results:** Skin prick testing (SPT) was performed on 70 children above 5 years of age, with a mean (SD) age of 8.8 (2.99) years. 52 children (74%) were sensitized to at least one aeroallergen, suggesting atopy; 27(38.5%) were sensitized to more than one allergen. 65.3% children were sensitized to house dust mite; 46.1% to alternaria, 38.4% to cynodon and 19.2% to cockroach antigens. Frequency of aeroallergen sensitization correlated with increasing age. Asthma severity was associated with sensitization to house dust mite and cockroach. **Conclusion:** Approximately three fourth of asthmatic children in our study were sensitized to at least one aeroallergen showing that these children had atopic/ aeroallergen induced asthma. Sensitization was most commonly seen to dust mite, alternaria and cynodon. Children sensitized to dust mite and cockroach had more severe asthma.

**Keywords:** Aeroallergens, Asthma, Atopy, Sensitization, Skin Prick Test.

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## Introduction

IgE mediated aeroallergen sensitization can be evaluated using either skin prick testing or measuring specific IgE to these aeroallergens. Allergy skin prick test is a bioassay that detects the presence of allergen specific IgE on patients mast cells. It is most rapid, sensitive and cost effective way of detecting IgE mediated diseases [1]. The SPT is the standard for the diagnosis of IgE-mediated allergic diseases. The SPT is done either to identify the allergen responsible for an IgE-mediated allergic disease in clinical practice or to determine the sensitization patterns of different populations in epidemiological studies [1,2,3].

Atopy is defined as genetic tendency to develop allergic diseases such as allergic rhinitis, asthma and atopic dermatitis. Atopy is associated with heightened immune responses to common aeroallergens. Allergic asthma/atopic asthma are the basic term for asthma with immunological mechanisms. When there is role of IgE mediated mechanisms the term IgE mediated asthma is recommended [4, 5].

Aeroallergen induced asthma/ Atopic asthma is more common during latter childhood and adolescence and peaks in the second decade of life. Chronic low level exposure to indoor allergens and dust mite and cockroach in particular may play a major role in both asthma pathogenesis and subsequent provocation of symptoms [6, 7].

Sensitization to house dust mite, cockroach, alternaria and cat are important in asthma pathogenesis. Alternaria exposure may produce acute asthma exacerbation and sensitivity to alternaria has been implicated as a risk factor for sudden respiratory arrest in adolescents and young adults with asthma [8].

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Documentation of aeroallergen sensitization is important because of its role in asthma pathogenesis and acute asthma exacerbation. This will enable effective implementation of measures to prevent asthma exacerbations. Allergen Immunotherapy can also be instituted based on the allergy skin prick test results.

This study was conducted in view of the crucial importance of aeroallergens in childhood asthma. The purpose of this study was to determine the prevalence of sensitization to common aeroallergens in children with asthma residing in our region and to elucidate the association of aeroallergen sensitization with asthma severity

## Materials and Methods

**Design**

Cross-sectional observational study to assess the type of allergic sensitivity and its association with asthma severity in pediatric asthma patient's attending pediatric allergy asthma clinic at Chhattisgarh Institute of Medical Sciences Bilaspur (C.G.). This is the first study evaluating aeroallergen sensitization pattern in asthmatic children in Chhattisgarh region.

**Sample**

We recruited 70 asthmatic patients aged 5 to 18 years. The study period was between January 2014 to December 2014. Eligibility criteria were children with asthma who stayed in Bilaspur and nearby areas and willing to follow up 3 monthly regularly for at least 1 year. The diagnosis and treatment of asthma was based on the Global Initiative for Asthma (GINA) guidelines [9].

At enrolment, baseline data was collected, PEFR and FEV1 was recorded wherever feasible using Koko peak flow meter depending on patient level of cooperation. Asthma was classified as per the NAEPP guidelines [10]. The patients were followed up every 3 months. Asthma control and inhaler technique was checked at each visit as per GINA guidelines [9]. Written asthma action plan was given to each patient.

**Assessment Tools**

SPT was done using 10 aeroallergens. Histamine 1mg/ml was taken as positive control. Patient must have a positive response to histamine control to proceed with skin testing. Saline was taken as negative control to detect any problems with technique, possible skin irritation, or dermatographism.Antihistamines, both H1 and H2 blockers that may interfere with skin testing were discontinued for > 48 hours prior to skin prick test. The ten allergens used for allergy skin prick test were house dust mite (D. farinae, D. pteronyssinus), alternaria alternata, cockroach, cynodon dactylon, cat dander, dog dander, parthenium, cyperus rotundus, amaranthus spinosus and prosopis juliflora. Allergens were obtained from Creative diagnostics Pvt Ltd Mumbai. Test was performed by placing a small drop of allergen on the cleansed skin surface and passing a 25- or 26- gauge needle through the antigen at a 45º angle. Test antigens were placed > 2 cm from one another on the ventral surface of forearm. The test was read by measuring the diameter of the wheal in mm at the peak of reaction. Histamine control was read at 10 min and allergens at 15 minutes. Positive test was any wheal that measures > 3mm in diameter than the saline control. Children with positive SPT to at least one allergen were considered atopic whereas children with negative SPT to all the tested antigens were considered non atopic.

## Results

In our study 70 Asthmatic children above 5 years of age were evaluated with mean age of 8.8 ± 2.99 years. There were 48.5% boys and 51.5% girls. The age of onset of symptoms was 5.02 ± 3.24 years (Table 1)

**Table 1: Sample demographic profile (n=70)**

| S.No. | Variable | Value |
|---|---|---|
| 1. | **Age (yr)** | |
| | Mean | 8.8 |
| | SD | 2.99 |
| 2. | **Sex, n (%)** | |
| | Male | 34 (48.5) |
| | Female | 36 (51.5) |
| 3. | **Age of onset of symptoms (yr)** | |
| | Mean | 5.02 |
| | SD | 3.24 |

52 children (74.28%) were sensitized to at least one aeroallergen suggesting atopy. Skin prick test was negative in 18 (25.7%) children suggestive of non atopic asthma.22/70 (31.4%), 23/70 (32.8%) and 25/70 (35.7%) children had intermittent asthma, mild persistent asthma and moderate persistent asthma respectively. Baseline characteristics of cohort are given in Table 2.

**Table 2: Baseline characteristics of patient**

| S. No. | Characteristics | n (%) |
|---|---|---|
| 1 | **Baseline Asthma severity** | |
| | Intermittent Asthma, n (%) | 22 (31.4) |
| | Mild persistent Asthma, n (%) | 23(32.8) |
| | Moderate persistent Asthma, n (%) | 25 (35.7) |
| | Severe Persistent Asthma, n (%) | 0 |
| 2 | **Exposure to Tobacco smoke at home, n (%)** | 23 (32.8) |
| 3 | **Atopy (Skin Prick Testing)** | |
| | Negative | 18 (25.7) |
| | Positive to at least one allergen | 52 (74.28) |
| | Positive to more than one allergen | 27 (38.5) |
| 4 | **Residence** | |
| | Rural, n (%) | 39(55.7) |
| | Urban, n (%) | 20(28.5) |
| | Urban slum, n (%) | 11(15.7) |
| 5 | **Family history of asthma, n (%)** | 29 (41.4) |
| 6 | **Family history of any allergic disease** | 53 (75.7) |

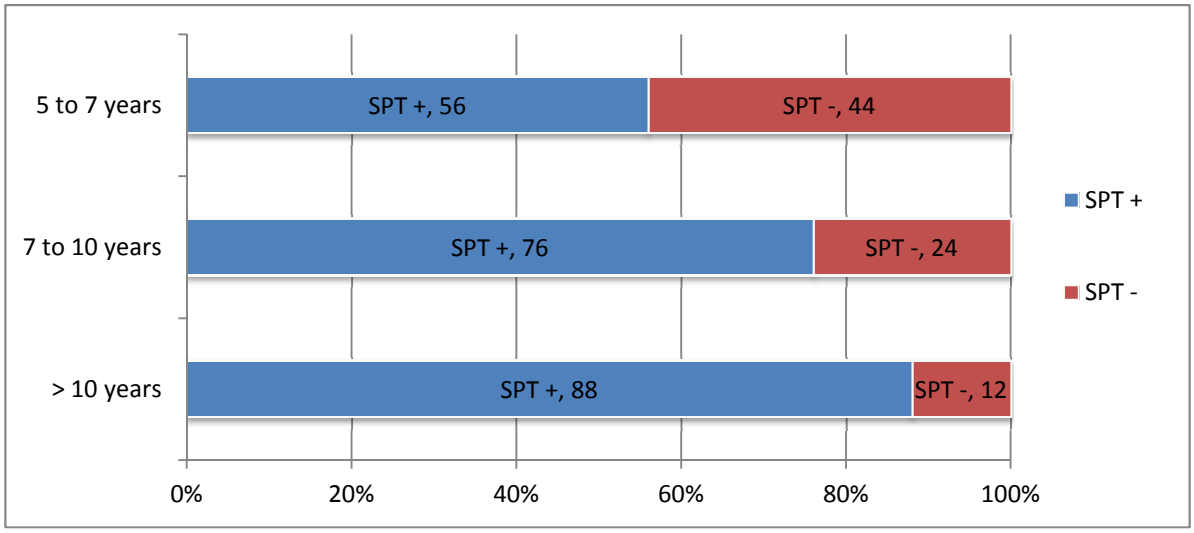
The most common prevalence of aeroallergen sensitization was to house dust mite (65.3%) followed by alternaria (46.1%), cynodon (38.4%) and cockroach (19.2%).Aeroallergen sensitization pattern in our study is given in Table 3.

**Table 3: Aeroallergens causing sensitization**

| Aeroallergen | n (%) |
|---|---|
| Dust Mite (D. farinae, D. pteronyssinus ) | 34 (65.3%) |
| Alternaria | 24 (46.1%) |
| Cat dander | 2 (3.8%) |
| Dog dander | 4 (7.69%) |
| Cockroach | 10 (19.2%) |
| Parthenium | 6 (11.5%) |
| Cynodon | 20 (38.4%) |
| Cyperus rotundus | 2 (3.8%) |
| Amaranthus spinosus | 3 (5.7%) |
| Prosopis juliflora | 1 (1.92%) |

In 5 to 7 year age group 13/23 (56 %) children had a positive skin prick test and 10/23 (44%) had negative skin prick test. In 7 to 10 year age group 16/21 (76%) and 5/21 (24%) children had positive and negative skin prick test respectively. The prevalence of positive and negative skin prick test in > 10 year age group was 23/26 (88%) and 3/26 (12%) respectively. Frequency of aeroallergen sensitization correlated with increasing age (Bar chart 1).

**Bar Chart 1: Age group and sensitization to any allergen**




Sensitization to dust mite was documented in 72% children with moderate persistent asthma, 43% children with mild persistent asthma and 27% children with intermittent asthma. Cockroach sensitization was seen with 24% children with moderate persistent asthma, 13% children with mild persistent asthma and 4% children with intermittent asthma. This suggests that sensitization with dust mite and cockroach is associated with increasing asthma severity. The pattern of aeroallergen sensitization and its association with asthma severity is shown in Table 4.

**Table 4: Aeroallergen sensitization and association with Asthma severity**

| Allergen | Moderate persistent Asthma (n=25) | Mild persistent Asthma (n=23) | Intermittent Asthma (n=22) |
|---|---|---|---|
| Dust Mite (D. farinae, D. pteronyssinus ) | 18(72%) | 10 (43%) | 6 (27%) |
| Alternaria | 9(36%) | 8 (34%) | 7 (31%) |
| Cat dander | 2 (8%) | 0 | 0 |
| Dog dander | 2 (8%) | 2 (8%) | 0 |
| Cockroach | 6 (24%) | 3 (13%) | 1 (4%) |
| Parthenium | 2 (8%) | 2 (8%) | 2 (9%) |
| Cynodon | 8 (32%) | 6 (26%) | 6 (27%) |
| Cyperus rotundus | 0 | 1 (4%) | 1 (4%) |
| Amaranthus spinosus | 1 (4%) | 1 (4%) | 1 (4%) |
| Prosopis juliflora | 0 | 0 | 1 (4%) |

50% children with atopic asthma had moderate persistent asthma as compared to 67% children with non atopic asthma. Similarly 40% children with atopic asthma had intermittent asthma as compared to 33% children with non atopic asthma. This suggests that baseline asthma severity is not related to atopic asthma (Table 5)

**Table 5: Comparison between atopic and non atopic Asthmatics**

| Asthma severity | Atopic Asthma (n=52) | Non Atopic Asthma (n=18) |
|---|---|---|
| Intermittent Asthma | 21 (40%) | 6 (33%) |
| Mild Persistent Asthma | 5 (10%) | 0 |
| Moderate Persistent Asthma | 26 (50%) | 12 (67%) |

## Discussion

There are numerous studies that show a strong relationship between early exposure and sensitization to indoor allergens and the development of asthma and persistent wheezing in children [11-13]. Allergens involved are house dust mite, cockroach, cat and dog [12]. Sensitization to outdoor pollens, with the exception of the mold alternaria, is of much less importance to the risk of developing asthma [14].

The prevalence of aeroallergen and food sensitization, eosinophilia and elevated total serum IgE (>100 IU/ml) are atopic characteristics that may predict children to be at high risk of developing asthma [15].

In our study 74.28% asthmatic children were sensitized to one or more aeroallergens suggesting atopy. Atopy and allergen exposure are known to exacerbate asthma and atopy is a risk factor for relapse of asthma after remission [16]. Prevalence of atopy (defined as at least one positive SPT) in childhood asthmatics varies from 45 to 79% which is consistent to our study result, and percentage of asthma cases attributable to atopy in population based studies varies from 25 to 63% [17].

We used a panel of 10 aeroallergens for skin testing. In our study, sensitization to house dust mite, alternaria, cynodon and cockroach was the commonest. The pattern of skin test sensitivity in our patients was comparable to several studies which showed sensitivity to dust mite, alternaria and cockroach being the most frequent aeroallergen causing sensitization in childhood asthmatics [11-14].

Sensitization to house dust mite was observed in 65.3% patients in our study. Similarly a study from Mysore in children and adults with allergic rhinitis and/or asthma found dust mite allergy in 65-70% [7]. Sensitization to house dust mite has been incriminated in the development of asthma, and has been observed in over 50% children and adolescents [14]. Sensitization to allergens (mite, dog or cat) in the first 3 years of life is associated with loss of lung function at school age [15]. A whole population birth cohort study identified house dust mite as the most common allergen [16]. Dust mite allergy has also been associated with increased asthma morbidity and severity [17].

Prevalence of cockroach allergy ranges from 17% to 41% in various studies involving both children and adults [11, 12]. This is consistent to our study result where cockroach sensitization was documented in 19.2% patients.

It was observed in our study that there was a significant and gradual increase in the frequency of sensitization in older age-groups. Roberts G et al [15] reported that aeroallergen sensitization gradually increases from childhood to adolescence, and presence of aeroallergen sensitization at 4 years is related to later sensitization to additional allergens.

In our study sensitization to house dust mite and cockroach was associated with increasing severity of asthma. The results of our study demonstrate that sensitization to indoor aeroallergens affects asthma severity. Our findings are consistent with many other studies in children and adults [16-18**].** Platts-Mills et al [17] reported that exposure to house dust mites is associated with development of bronchial asthma. There is a threshold of HDM exposure to induce symptoms of asthma. Exposure to low levels of mite allergens (0.02-2.0 µg/g dust) was found to be a significant risk factor for sensitization. Rosenstreich et al [18] documented that cockroach allergy is directly linked to poorer asthma outcome and increased asthma related health care use in inner city children with asthma.

Evidence on the relation between asthma severity and sensitization or atopy is conflicting [19-22]. In our study, there was no difference in asthma severity between atopics and non-atopics. This could be because of the fact that uncontrolled/ partly controlled asthma is not solely due to aeroallergen exposure. Other factors like viral respiratory tract infections, exercise, non steroidal anti inflammatory drugs, GERD and psychosocial factors may trigger asthma exacerbation.

Recently FeNO have been demonstrated as an important biomarker of asthma and a promising index of asthma control. Allergen sensitization has been known to cause increased FeNO, not only in children but also adults [23-25]. FeNO has been found to be elevated in asthmatics and other atopic conditions like allergic rhinitis and atopic eczema. FeNO is a marker of inflammation in asthma, with the magnitude of FeNO increasing proportionately to airway hyper-responsiveness and induced sputum eosinophilia [26]. FeNO increases with deterioration in asthma control and reduces in a dose dependent manner with anti-inflammatory treatment [27]. A number of studies show normal FeNO levels to be 5-20 ppb, and FeNO values of > 15ppb may serve as a cut off for asthma [28].

In our study a panel of 10 aeroallergens was used for allergy skin prick test to facilitate ease of testing and better patient cooperation. Those patients who had a negative SPT, additional testing with a broader panel of antigens or intradermal skin test could have been done to conclusively detect atopic sensitization.

The pattern of aeroallergen sensitization may vary from place to place. Allergy skin testing should be performed on all patients of asthma to detect sensitization pattern and improve asthma management.

## Conclusion

Aeroallergen sensitization to indoor and outdoor allergens is common in asthmatic children. Sensitization to indoor aeroallergens especially house dust mite and cockroach is associated with asthma severity. Aeroallergen sensitization pattern varies with geographical region, season and annual fluctuations. Knowledge of aeroallergen sensitization pattern in allergic children in different geographical areas is important to institute appropriate specific allergen avoidance measures and achieve asthma control. Allergen immunotherapy can also prescribed to modify the natural course of the disease.

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