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A study of common aeroallergens in children with wheeze-at a tertiary care centre

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Abstract

Background: Wheezing is a highly frequent symptom in paediatric populations. An etiologic diagnostic is complex and becomes more difficult with younger children. For asthma, allergen exposure plays a fundamental role in sensitization, and subsequent acute and chronic symptoms. Skin prick test (SPT) allows detection of sensitization safely and efficiently in all age-groups.

Aim and objectives: To assess the prevalence of sensitization to aeroallergens in a pediatric population with recurrent wheezing episodes using SPT.

Methodology: Cross-sectional observation study to study the type of allergic sensitivity in a pediatric population in Hyderabad.

Results: Children with recurrent (4 or more episodes of wheezing in the past year) ages between 2yrs to 10 yrs. The total number of the patients included in the study was 100 patients, 50 (50%) male and 50 (50%) with Mean Age = 6.15 years. Out of the 50 male cases, 35 (70%) had positive SPT to at least one of the aeroallergens and 15 (30%) were negative for all aeroallergens tested. Out of the 50 female cases, 32(64%) had a positive SPT to at least one of the aeroallergens and 18(36%) were negative for all aeroallergens. Out of 100 children, 67 (67%) had positive SPT to at least one of the aeroallergens. 26 (70.2%) of patients with positive tests were in the age group 5-7 years and 26 (78.78%) were in the age group of 8-10 Yrs. Only 15 (48.3%) were found in the age group 2-4 years. The highest prevalence of positive skin reaction was recorded for mite allergens among them Dermatophytosis pteronyssinus (80.5%), D. Farinae (80.5%), Bloomia (56.4%), among Fungi group, Aspergillus fumigates (11.9%) Alternaria alternata (10.4%), Cladosporium herbarum (2.9%) Cat, cockroach and pigeon showed positive in (19.4%) (14.9%) and (4.4%) of cases respectively. Allergy to indoor allergens was significantly higher than outdoor allergens (P-value <0.0001).

Conclusion: SPT is an effective way to determine aeroallergen with minimal expense & greater selection of antigen. Specific allergen identification helps in implementing specific allergen preventive measures. Dust mites are the most common aeroallergen in all age groups. Among Dust Mites Dermatophagoides Farinae, Dermatophagoides pteronyssiuns & Blomia are most common. Incidence of aero allergy in children with recurrent wheeze increases with age. Indoor allergens are more common than outdoor allergens.

Keywords: Wheezing, allergens, paediatric population, SPT, dust mites

Introduction

Wheezing is a frequent symptom in infants and children. Its major causes are respiratory infections and allergies. An allergy refers to a hypersensitivity reaction that occurs on re-exposure to sensitizing allergen, usually a protein molecule, causing a release of inflammatory mediators.

Wheezing is a common problem worldwide and the most frequent causes of wheezing in preschool children are bronchiolitis and asthma [1-3]. Parents of infants with recurrent wheezing often ask the Pediatrician: "Will my children develop asthma?" This is a crucial question that involved also a clinician in the diagnostic and therapeutic attempts. Proper identification of children at risk of developing asthma at school age may predict long-term outcomes and improve treatment and preventive approach, but the possibility to identify these children at preschool age remains limited. The proportion of Indian school children suffering from bronchial asthma has increased to more than double in the last 10 years and has reached its highest level ever. The prevalence of childhood asthma in Hyderabad was 8.5%. [4] There was a low prevalence of bronchial asthma (2.3-3.3%) in the children surveyed in Lucknow [5], North India, but in urban Delhi, the prevalence of bronchial asthma was 11.6% [6]. The prevalence of bronchial asthma in children from rural areas of Ludhiana and Punjab was 2.6% and 1%, respectively.

The rise in prevalence over time in Bangalore has been associated with environmental pollution, urbanization, and the change in the demography of the city. These factors might be responsible for inter-city variation in the prevalence of childhood bronchial asthma.

Among the children whoever reported wheeze, one-fourth of them confirmed to be suffering from bronchial asthma later in life. [7] A study done on children from urban and rural areas in Tamil Nadu in the age group of 6-12 years showed the prevalence of wheeze to be 18%. [8].

A major role is played by aero-allergens in the pathogenesis of respiratory allergic diseases, particularly asthma. Previous studies from different cities of India have identified airborne pollens, spores, mites and other particles responsible for allergy [9], and observed incidence of allergic manifestations and positivity rates for various allergens on skin prick testing (SPT) [10]. The prevalence of allergic diseases may be different both inside and between countries. This difference is attributed to the level or a total load of aeroallergens. The prevalence of different aeroallergens has been determined in the studies conducted in other parts of the world. Different allergens play different roles depending on environmental conditions of each region, such as climate, population, and level of exposure [11] Identifying the aeroallergens of each region help prevent allergic diseases in an advisable time, while it is effective in selecting the type of allergy vaccine for appropriate treatment when prevention and medical treatment are not effective and allergy vaccines are required.

The present study was planned to identify these common allergens, probably responsible for inducing recurrent wheezing in subjects, as no study has been done in the recent past, in this central geographical part of the country, at Hyderabad and surrounding area.

Materials and Methods

Design

Cross-sectional observation study to study the type of allergic sensitivity in a paediatric population in Hyderabad

Sample

Children with recurrent (4 or more episodes of wheezing in past one year) ages between 2yrs to 10yrs

Sample Size: n=100

Inclusion criteria

Frequent wheezers (>4 episodes in past one year) in the age group of 2 to 10yrs

Exclusion criteria

Dermatographism or any skin lesions was excluded during the physical examination before SPT.

Patients having SPT positive to one or more aeroallergens but negative to histamine control. Refusal of parents to give consent

Methodology

After a thorough medical history and physical examination, a written questionnaire was completed for each patient. Children with recurrent wheeze, who fall in inclusion criteria are subjected to skin prick tests for different aeroallergens listed below, the study was approved by the Ethics Committee of our hospital and all patients provided informed consent to participate in the study. In total 100

patients were included in the study if they met inclusion criteria and agreed to participate, data collected from SPT results are analyzed and most common aeroallergens causing allergic symptoms in patients visiting our OPD is studied

Method

Skin testing is done by the widely practiced skin prick test (SPT) According to European Guidelines [12].

Allergen extracts to be used

- Mites (Dermatophagoides pteronyssinus, Dermatophagoides farina, Blomia tropicalis)
- Anemophilous fungi (Alternaria alternate, Cladosporium herbarum, Aspergillus fumigates)
- Epithelia of a dog (Canis familiaris)
- Epithelia of a cat (Felis domesticus)
- Epithelia of pigeon (Columba livia)
- Cockroach (Periplaneta americana)
- Parthenium grass (Parthenium hysterophorus)
- Bermuda grass (Cynodon dactylon)

Statistical methods

The data is entered and analyzed in Microsoft Excel 2010. For analysis, descriptive statistics used were percentage, mean and standard deviation (SD). Data presented in descriptive tables and analysis was done at a 95% confidence interval (CI) using a Chi-Square test. A P value less than 0.05 was considered statistically significant. All the analysis was carried out using SPSS 16.0 and EPI Info 3.5.1.

Results

The total number of the patients included in the study was 100 patients, of the 50 [50%] male and 50 [50%] female. (Table-3) with Mean Age = 6.15 years and SD = 2.4.

Table 1: Sex Wise Distribution

	Frequency	Percent
Male	50	50
Female	50	50
Total	100	100.0

The study group is divided into three age groups, 2-4yrs., 5-7yrs and 8-10 yrs. The frequency of each group is shown in table 2.

Table 2: Age Distribution

Age Groups	Frequency	Percent
2-4Yrs	31	31
5-7Yrs	36	36
8-10Yrs	33	33
Total	100	100.0

Out of 100 children in the study, 67 children were found sensitive to at least one aeroallergen and 33 were negative for all aeroallergens association between positive skin prick test and wheezing is shown in Graph 1.

Out of the 50 male cases, 35(70%) had positive SPT to at least one of the aeroallergens and 15(30%) were negative for all aeroallergens tested. Out of the 50 female cases, 32(64%) had a positive SPT to at least one of the aeroallergens and 18(36%) were negative for all aeroallergens.

Table 3: Association of sex and allergen sensitization

SPT	Male	Female
Positive	35	32
Negative	15	18
P-Value	0.6709	

Out of 100 children, 67 (67%) had positive SPT to at least

Table 4: Association of Skin Prick test with age group

Age	Sensitivity Present	No Sensitivity	Total
2-4Yrs	15(48.3%)	16(51.7%)	31(31%)
5-7Yrs	26(70.2%)	10(29.8%)	36(36%)
8-10Yrs	26(78.78%)	7(21.22%)	33(33%)
Total	67(67%)	33(33%)	100(100%)

The highest prevalence of positive skin reaction was recorded for mite allergens among them Dermatophytosis pteronyssinus (80.5%), *D. farinae* (80.5%), *Bloomia* (56.4%), among Fungi group, *Aspergillus fumigates* (11.9%) *Alternaria alternate* (10.4%), *Cladosporium herbarum* (2.9%) Cat, cockroach and pigeon showed positive in (19.4%) (14.9%) and (4.4%) of cases respectively. Among Pollen group *Cynodon dactyl* (8.9) &

one of the aeroallergens. 26 (70.2%) of patients with positive tests were in the age group 5-7 years and 26 (78.78%) were in the age group of 8-10 Yrs. Only 15 (48.3%) were found in the age group 2-4 years (Table 4). A statistically significant correlation is seen between age groups and sensitivity (p-value 0.025).

Parthenium hysterophorus (7.4)

The frequency of positive tests to an individual allergen is depicted in the table (8). In the studied population, the highest a prevalence of positive skin reactions was documented for the *D. pteronyssinus* and *D. farinae* with a frequency of (80.5%) of cases, and the lowest for Dog (*Canis familiaris*) (0%) of cases respectively.

Table 5: Skin sensitivity to allergens

No	Allergen Group	Allergens	No of Patients	Percent	Percent of Cases
1	Mites	<i>D. Farinae</i>	54	54	80.5%
2		<i>D. Pteronyssinus</i>	54	54	80.5%
3		<i>D. Bloomia</i>	46	46	68.6%
4	Fungi	<i>Aspergillus Fumigatus</i>	8	8	11.9%
5		<i>Alternaria Alternate</i>	7	7	10.4%
6		<i>Cladosporium Herbarum</i>	2	2	2.9%
7	Pollens	<i>Cayanodon Dactylon</i>	6	6	8.9%
8		<i>Parthenium Hysterophorus</i>	5	5	7.4%
9	Epithelia	Cat Epithelia	13	13	19.4%
10		Dog Epithelia	0	0	0%
11		Pigeon	3	3	4.4%
12	Insects	Cockroach	10	10	14.9%

Out of the 67 children with a positive skin prick test, 66 showed sensitivity to indoor allergens (dust mites, fungi, cockroach, cat) & 10 showed sensitivity to the outdoor allergen (pollen, pigeon). The association between indoor allergens and wheezing is statistically significant (P-value <0.0001).

Table 6: Association between indoor and outdoor allergens

Allergen	Positive	Negative
Indoor	66	1
Outdoor	10	57

Chi square value= 95.3 p value <0.0001

Discussion

Aeroallergens are the prominent causes of allergic symptoms in patients with recurrent wheeze. In this study, 67% of patients were sensitive to aeroallergen but 33% had negative skin prick tests. This negative reaction may be probably that the patients were sensitized to particular allergens that have not been tested in our study; or not identified yet; the local generation of IgE explains this group. [13] This high percent of sensitization also was shown by the two studies in Iran which report (81%) [14], (63.2%) [15] of their patients had positive skin reactivity to aeroallergens, which were also comparable to 68% in

Farhoudi A *et al.*, [16] study. 89.2% in Shakurnia A *et al.* [17]. Mites were the most common aeroallergen in patients with allergic diseases in the current study. Which is similar to other Indian studies of Moitra *et al.* [18]. When compared to our study pollens are the most common cause of sensitization in Tehran [19], Tikrit [20], Qazvin [21]. This difference also was expected since mites tend to require high humidity and moderate temperature to thrive, whereas pollens require a dry climate and a high temperature. In many humid countries, dust mites were the most important cause of sensitization in allergic children, because mites tend to require high humidity to thrive [22, 23]. Surprisingly, mite allergens were also reported in hot and dry regions, like Kuwait [24] and Sistine and Baluchistan Province of Iran [25]. It might be related as reported that the wide use of air conditioners which make good conditions for mites to grow and increase susceptibility to indoor allergens [14]. Among mites, D.P had the highest rate of sensitization and D.F and bloomia were next in importance. In a similar study, house dust mites were reported to have the highest rate of sensitization among Malaysian asthmatic patients [26] and patients with allergic rhinitis in Thailand, [27] Singapore [28] and Beijing [29]. *Bloomia* also showed a significant reaction in our study which is comparable to other studies Chew FT *et al.* [28]. Our study showed there is a rising trend

in the sensitization pattern of bloomia which was not seen in other studies.

Among the fungi, in our study *Aspergillus fumigatus* (10.6%) being the most common sensitizer followed by *Alternaria Alternata* and (7.4%), *penicillium* species (5.4%). Similarly, *Aspergillus fumigatus* had been identified as a major fungal allergen in the study of Prasad *et al.* [30].

Results from the current study showed that 8.5% of patients had positive skin reactions to cockroach allergen. Farhoodi studied the sensitivity of asthmatics to cockroach allergens in children from 6 months to 12 years old and reported a 29% rate of positive skin tests in these children [31]. Results of a study in northern Iran have also reported the prevalence of sensitivity to cockroach allergen in patients with asthma, 12.7 percent [32].

This study result had shown that there is less sensitivity to animal dander, in contrast, Western and European countries [19] show a higher percent of sensitization because of the incidence of domestic pets in their homes more than our country.

In this study, according to the highest prevalence of allergies to mites, proper training of the patients about avoiding contact with these agents as the most important way to prevent and treat as well as informing about allergy symptoms, all are effective in prevention and reduction of the severity of symptoms in patients. Furthermore, using immunotherapy for desensitization to common allergens will have a significant effect on the symptoms to be completely disappeared.

The study showed a prevalence of positive skin prick tests of 70% in males and 64% in females. Thus it shows Boys had a slightly greater prevalence of any positive skin-test (70% vs 64%), responses to house dust mite (91.4% vs 100%). Gender difference is not statistically significant in an association of positive skin prick test and wheezing. Dust mites were the most common allergens in both genders.

Table 7: Association between sex and sensitivity

SPT	Male	Female
Positive	35	32
Negative	15	18
P-Value	0.6709	

Sensitivity to aeroallergens increased significantly with age. The frequency of sensitization was 48.3% among children aged 2 years to 4 years 70.2% in the age group of 5-7 years and 78.78% in the age group of 8-10 years. This is similar to the results of Pendino P, *et al.* Rosario [33]

The most common group of aeroallergens in each age group was found to be Dust Mites accounting for 100% of positive skin prick tests in the age group of 2-4 years, 88.88% of positive skin prick tests in the age group of 5-7 years and 92.3% of positive skin prick test in the age group of 8-10 years.

Overall, only 13 patients (13%) have positive pricks test to any pollen extract. *Ligustrum lucidum* accounts for 61.5% of total positivities (8 of 13). Grass mix and *Platanus americana* appear with 2 positivities each, and 1 for *Ambrosia elatior*. These results contrast with other studies in areas such as Virginia and the United States, where authors found high levels of sensitivity to pollen in young children. It shows a positive prick test in 29% of children aged 1 to 2 years, and it increases to 50% in those in the range of 3 to 4 years. [34] A greater number of pollinic

seasons are likely required to sensitize to young children.

The study showed an increased sensitivity to indoor allergens in the cases as out of the 67 children with a positive skin prick test, 66 showed sensitivity to indoor allergens (dust mites, fungi, cockroach, cat) & 10 showed sensitivity to the outdoor allergen (pollen, pigeon). The association between indoor allergens and wheezing is statistically significant (P-value <0.0001). The indoor allergens accounted for 98.5% of the positive skin prick test whereas the outdoor allergens accounted for 14.9% of the positive skin prick tests.

The major indoor allergenic proteins that have been characterized are house dust mite allergens, cat antigens, dog dander antigens, mouse antigens, cockroach antigens, and certain fungal allergens.

Conclusion

Our result confirmed that mites are the main sensitizing aero-allergens among patients with recurrent wheeze in and around Hyderabad. Among mites *Dermatophagoides Farinae*, *Dermatophagoides pteronyssinus* and *Bloomia* are the most common aeroallergens. The SPT is an important test to know the sensitization of aeroallergen, which has a high sensitivity, low specificity, less expensive with minimal equipment and a greater selection of antigen. The sensitivity to aeroallergens increases with age. In children, the sensitivity to indoor allergens is more prevalent than sensitivity to outdoor allergens. Sensitivity to pollen was found in older children more than 5 years of age. Furthermore, this study may also help control or avoid allergens causing allergic disease.

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