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Original Research Article

Sensitization pattern to various common allergens, using allergy skin prick test in children suffering from asthma and allergic rhinitis attending asthma outpatient department, at a tertiary care hospital in Central India

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ABSTRACT

Background: Bronchial asthma is one of the most common chronic conditions of children. Allergy skin test, specific IgE levels can help to identify the triggers and better management. This observational study was carried to analyze the pattern of sensitization to various common allergens in children suffering from asthma and/ or allergic rhinitis at AIIMS, Raipur and to correlate sensitization with the various demographic parameters.
Methods: Children between the age of one to 14 year diagnosed with asthma and/or allergic rhinitis were enrolled. They were subjected to skin prick test (SPT) using 18 common antigens. Induration more than 3mm than the negative control was considered as positive test.
Results: 70 patients with an average age of 9.1 year were enrolled. 46 were males. Almost 80% (56) patients had sensitization to at-least one antigen tested. Highest sensitization was observed for cockroach mix 33 (58.92%) followed by Dermatophagoides farinae 18 (32.14%) and grain dust rice 16 (28.57%%). Sensitization was more in children with history of asthma in family (OR=2.37), residing near main road (OR=2.4), and in nuclear family (OR=1.54). There was no relation of SPT positivity with absolute eosinophil count (p=0.45, OR=0.41), family h/o allergic rhinitis (p=1.0, OR=0.86) and atopic dermatitis (p=1.0, OR=0.81). Statistically significant difference observed in the positivity of SPT in relation to severity of illness. (p=0.01, OR=0.162).
Conclusions: Sensitization rate was high (80%) with cockroach mix being the commonest antigen. Family history of asthma, residence near main road and severity of illness were associated with higher sensitization.

Keywords: Asthma, Allergic rhinitis, Allergens, Skin prick test, Sensitization

INTRODUCTION

Bronchial asthma is an important health issue, especially in developing countries like India.[1] It is one of the most important chronic conditions causing school absenteeism. It also leads to increased number of preventable hospital emergency visits and hospitalization in children.[2] The prevalence of asthma is increasing since 1970 and now affects an estimated 4-7% of world population.[3] Many clinical phenotypes of asthma have been recognized. Allergic asthma affects a large proportion of patients with asthma.[4] In 50 -80% of patients of asthma, atopy and allergic mechanism have been implicated and these mechanisms also account to 50% of patients with severe asthma.[5] Diagnosis of allergic asthma is based on history, allergy skin test and also serological tests like IgE levels. Detection of IgE antibody of a defined allergen specificity in the skin and blood simply provide

confirmation of sensitization.[6] Studies comparing the skin test with sIgE (specific IgE) assay have found skin tests to be more sensitive and serum sIgE tests to be more specific.[7,8] Studies have demonstrated a strong connection between allergies and asthma-related health service use, symptom days and suboptimal lung functioning.[9-11] By understanding patterns of allergen sensitization, clinicians and public health officials may be more able to direct resources to those most likely to benefit.[12]

It is known that asthma exacerbations are precipitated by variety of triggers like exposure to an aeroallergen. Similarly poor control of asthma symptoms or allergic rhinitis, despite adequate therapy may be due to continued exposure to an allergen. Routine allergy testing, medication changes or addition of allergen-specific immunotherapy, and public health interventions to assess in-home allergen exposure and reduce or remediate exposures that are found; all have the potential to reduce asthma morbidity among high-risk patients.[13] There is paucity of data regarding allergen sensitivity from Central India. Hence this study was planned with a primary objective to analyze the pattern of sensitization to various common allergens in children suffering from asthma and/ or allergic rhinitis (AR), attending the asthma outpatient department (OPD), at AIIMS, Raipur. The secondary objective of the study was to correlate sensitization with the various demographic parameters.

METHODS

This was a cross sectional study of 18 months duration conducted from January 2019 to June 2020. The sample size was calculating using the formula $4pq/d^2$ for cross sectional studies; with population proportion (p) was considered 86.4 % based on the previous study.[14] The confidence interval was 95% and absolute precision of 8% on either side of the proportion. Therefore, the minimum sample size estimated was 73.44 which was rounded to 75.

The study population was children in the age group of one to 14 years attending asthma OPD. Convenience sampling technique was used. Patients in the age group of one to 14 years with a clinical diagnosis of Asthma based on Global Initiative for Asthma GINA 2017 guidelines, and/ or allergic rhinitis were included in the study.[15] Allergic rhinitis was strongly suspected when two or more symptoms out of watery rhinorrhea, sneezing, nasal obstruction and nasal pruritis persist for ≥ one hour on most days.[16] Patients who were on beta blockers or on antihistaminic, which affect the allergy skin test and in whom the drug could not be withheld for any reason (ex. Cetrizine, Loratidine, ketotifen, tricyclic antidepressants), were excluded.[17] Similarly patients who were having severe eczema were also excluded.

The study was started after obtaining approval from the Institute ethics committee (Institute Ethics Committee, AIIMS, Raipur. Letter number 544/IEC-AIIMSRPR/2018). All patients fulfilling the inclusion criteria and consenting to participate in the study were recruited. Their demographic parameters and other details were recorded in a standardized proforma.

A detail physical examination and relevant blood investigations were done. Imaging studies if indicated were also done. These patients were tested for sensitization to common allergens using skin prick test. Standardized antigens were used for skin prick test. Before the skin prick test the patient were told to withhold antihistaminic medication for at least three days prior. Any other medication which can affect the results like antidepressants, beta blockers were with-hold if the clinical condition permitted. After obtaining consent, skin prick test (SPT) was done on the forearm. Normal saline was used as negative control and histamine was used as positive control for the test. Histamine was read at 10 minutes and test antigens at 15 minutes using a transparent scale (cm scale) in vertical and horizontal direction. The test was considered valid if negative saline control was between zero to three millimeter (any one direction) and the positive histamine control was three millimeters larger than the negative saline control. The patient was considered to be sensitized to a particular antigen if he / she developed wheal of three millimeters more than the negative saline control.[17]

The data was arranged in Microsoft Excel sheet. Skin prick positivity rate was calculated as percentage of the study population. Chi-square or Fisher Exact test was used to find association between various categorical variables with the SPT positivity. P value less than 0.05 was considered as statistically significant. All calculations were done using the Microsoft Excel and GraphPad InStat 3 demo version.

RESULTS

Total 70 participants were recruited in the study as due to COVID -19 pandemic the desired sample size of 75 could not be achieved. Out of these males were 46. The average age of the participants was 9.1 years. Out of the total 70 subjects 45 had asthma, 20 had asthma with allergic rhinitis and only five patients had allergic rhinitis (Table 1).

The subjects were tested for common 18 antigens using normal saline and histamine as negative and positive control. 80% (56) patient had sensitization to at-least one of the antigen tested, whereas polysensitization i.e more than one antigen sensitization was found in 38 (48.71%) subjects. Overall SPT positivity rate in children with only asthma was 81.3%, asthma with AR was 80% and with allergic rhinitis alone was 60% (Table 2).

The highest sensitization rate was seen for cockroach mix antigen followed by Dermatophagoids farinae and grain dust rice. Out of the various factors studied for association of SPT positivity rate only family history of

asthma and distance from the main road were found to statistically influence the positivity rate. No association could be found with other factors like family history of allergic rhinitis, absolute eosinophil count (AEC), type of family or gender (Table 3).

Table 1: Demographic parameters of study population (n =70).

Age group	No. of patients		Asthma=45	Asthma +Allergic Rhinitis=20	Allergic Rhinitis=5	Skin prick positive
	Male= 46	Female =24				56
<5 year =7	6	1	5	2	0	4
5-10 year =37	22	15	24	10	3	31
>10 year =26	18	8	16	8	2	21

Table 2: Sensitization to various common allergen as per skin prick test (SPT) positivity.

Name	SPT - Positive	Percentage
Cockroach mix	33	58.92
Dermatophagoides farinae	18	32.14
Grain dust rice	16	28.57
Dermatophagoides pteronyssinus	12	21.42
Dog hair	9	16.07
Parthenium	8	14.28
Grass mix	6	10.71
Mold mix/Peanut*	5	8.92
Common weed mix/ Aspergillus*	4	7.14
Alternaria/ Cat dander/ Milk/Fish *	3	5.35
Wheat	2	3.57
Chicken/ Egg	1	1.78

*The antigens are mentioned in the same row only because the SPT positivity rate was same.

Table 3: Association of various demographic factors with skin prick test (SPT) positivity.

Associated factors	Category	SPT-positive	SPT – negative	P value	Odd`s Ratio
Gender	Male	36	10	0.75	0.9
	Female	20	4		
Family history of asthma	Present	22	3	0.35	2.37
	Absent	34	11		
Family history of allergic rhinitis	Present	26	7	1	0.86
	Absent	30	7		
Type of family	Nuclear	34	7	0.54	1.54
	Joint	22	7		
Distance from the main road	< 500 mt	32	5	0.23	2.4
	>500 mt	24	9		
Severity of the disease	Mild	13	8	0.02	0.22
	Moderate	40	4		

DISCUSSION

In the present study 80% (56) of the children showed sensitization to at least one of the antigens tested and polysensitization was seen in 38 children (54.28%). In a retrospective study done by Nagaranjan et al where 35 children presenting with allergy symptoms were evaluated by skin prick test, aeroallergen sensitization was seen in 85.7% of children.[18] Similar high sensitization rate of 85.71% was seen in study by Tikkas et al among 128 children with nasobronchial allergy diagnosed clinically.[19] Other studies did not show such high sensitization rate. In a hospital- based study done by Dey et al in Kolkata where skin prick test was used to study common environmental allergens in children with asthma and allergic rhinitis, they found a sensitization rate of 57.5% only.[20] Similarly the study by Hosseini et al which recruited 313 children referred to Asthma and Allergy Clinic of Children`s Medical Center in Tehran, positive skin prick test to at-least one allergen tested was seen in 58.1% patients.[21] These studies indicates that there is difference in the positivity rates of skin prick test based on different Geographical region and also the allergens tested.

In the present study the highest sensitization was seen for Cockroach mix (76.3%), followed by farniae (39.4%), Grain dust rice (34.2%) and D. pteronyssinus (23.6%). Similar results were seen in the study by Tikkas et al where Cockroach was the commonest antigen with positive skin prick test (61.71%) followed by House dust (58.59%), Holoptelea (52.34%), Prosopis and Parthenium (47.65%) though the percentage positivity was less as compared to our study.[19] Nagarjuna et al reported a very high sensitization rate to D. pteronyssinus (80%).[18] Though in this study also D. farinae positivity was the 2nd most common the percentage is more than our study (68.5% as against 39.4%). Sensitization to Cockroach antigen (17.6%) was very less as compared to our results. Dey et al also reported high positivity rate to House dust mite (50.9%) and Cockroach (39.6%). They also found high sensitization to Egg (31.13%) and milk (30.1%) which was not seen in the current study (Egg- 1.78% and milk 5.35%).[20] The reason for this low sensitization could be different food habits in the study populations as many patients of Chhattisgarh Raipur region are vegetarian.

We did not find any gender differences in the sensitization rates in our study, though few studies have found a higher prevalence of sensitization in boys.[22] Though we did not find any statistically significant increase in the skin prick test positivity in patients with family history of allergic rhinitis (p=1.00, OR =0.86), but family history of asthma did have significant effect on skin prick test positivity with an odd ration of =2.37 (p=0.35). In a study done by Gowda et al in patients with allergic rhinitis, they concluded that, with younger age of onset of disease and in those with family history of atopy the probability of having a positive skin prick test is higher.[23] Another significant factor associated with increased sensitization was distance of the house from main road. (OR=2.4, p=0.23). Beck et al have also reported high sensitization which is attributable to carbon exposure from traffic.[24] There was a statistically significant difference in SPT positivity in children with mild disease and moderate disease with a p value of 0.02 and odd`s ratio of 0.22 indicating that mild disease was likely to have less sensitization rate. Though relation of eosinophil count and allergic disease is well known very few studies have tried to evaluate relation of skin prick positivity with eosinophil count. Mahmoud H et al in their study found a significant association between eosinophilia and positive allergen tests. Which was not seen in our study. They also found that the severity of asthma was associated with increasing number of positive allergens in SPT.[25] This result is similar to our study. In the present study we did not find any association of SPT positivity with type of family or socioeconomic status. Though we speculated that children living in nuclear family might have more sensitization as they are less likely to be exposed to repeated infections due to less exposure to other family members. Jarvis D et al conducted a study in young adults to explore the association of family size with development of atopic disease or atopy based on the background studies suggesting negative association of family size with atopy and atopic disease. Their findings were suggestive of a negative association between size of the family and symptoms suggestive of atopic diseases like nasal allergies, hay fever, asthma and also sensitization to grass in the studied population. But no consistent significant association between family size total IgE, eczema or sensitization to various allergens. These findings are similar to our observations.[26] In relation to the socio-economic status Hamid F et al reported that, in school children of urban area of Indonesia allergic symptoms and IgE were higher in low socio-economic status children, but skin prick test positivity was higher in children with high socio-economic status. Positive SPT being a risk factor for allergy symptoms in children with higher socioeconomic status and not in low socioeconomic status, it might affect the diagnosis of allergies in children from developing country.[27] These findings were in contrast to our study.

Sensitization pattern in different geographical area vary considerably. This study tried to identify sensitization to local allergens based on the local socio-demography. This was the strength of this study. But the limitation was that since most of the patients were from urban and semi-urban area of Raipur the results may not be generalizable.

CONCLUSION

In patients with asthma and allergic rhinitis sensitization rate by SPT is high and almost 80% of the children show sensitization to common allergen. In this study sensitization to Cockroach mix was high. We conclude that sensitization is positively affected by history of asthma in the family, exposure to traffic related air pollution and severity of illness. But there is no relation with gender of the child and absolute eosinophilc count or other factors examined in this study.

Recommendations

Based on the results of this study we recommend that skin prick testing should (SPT) routinely be used in patients with asthma and allergic rhinitis. Identification of sensitization pattern will help in proper avoidance measures and improve symptom control. It will also be useful in choosing immunotherapy in properly selected patients.

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