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Original Article

Prevalence study of common environmental allergens in children with asthma and allergic rhinitis in Kolkata: A hospital-based study

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ABSTRACT

Background: Studies evaluating the role of skin prick testing (SPT) as the sole testing technique in children below 12 years of age involving a broader and more relevant group of aero- and food-allergens in this part of India are still lacking. **Objectives:** To identify the commonly prevalent environmental allergens by SPT in children with asthma as per British Thoracic Society and Scottish Intercollegiate Guidelines Network Criteria and allergic rhinitis (AR) as per British Society for Allergy and Clinical Immunology Criteria attending the OPD of a tertiary care pediatric unit in the eastern part of India**. Methods:** Testing of inhalant and food allergens by SPT in children from 4 to 12 years age group with asthma and AR satisfying the inclusion criteria. **Results:** Total 106 children (70 males and 36 females) were included in the study. Study of inhalant allergens in asthmatic patients revealed the highest positivity for house dust mite followed by male cockroach and among food allergens, highest positivity for egg/egg products, followed by milk/milk products. Study of inhalant allergens in asthmatic patients with coexistent AR revealed the highest positivity for house dust mite, cockroach male and female and among food allergens, highest for milk/milk products, egg/egg products, banana, and mustard. **Conclusions**: In Kolkata, in the eastern part of the country, among the asthmatic children of 4-12 years age group, the most common inhalant allergens were house dust mite and cockroach, whereas the common food allergens identified were milk and milk products, egg and egg products, and mustard.

Key words: *Allergen, Allergic rhinitis, Atopy, Asthma, Skin prick test*

The burden of allergic diseases in India has been on a rising trend in terms of both prevalences as well as severity. These comprise of asthma, allergic rhinitis (AR), anaphylaxis, drug, food and insect allergy, eczema, urticaria, and angioedema. Approximately 20-30% of total population in India suffers from at least one or more of the allergic diseases [1]. Prevalence of atopy (defined as at least one positive skin prick test [SPT]) worldwide is about 45-79% and that of atopic asthma varies from 25% to 63% [2]. In India, the prevalence of asthma is estimated to range from 3% to 38% in children and from 2% to 12% in adults [3,4]. AR is considered to be a trivial disease in India; although, the symptoms of rhinitis were present in 75% and 80% of asthmatic children and adults, respectively [5].

According to the new concept of "One Airway, One Disease" proposed by Global Initiative for Asthma (GINA), AR and asthma are considered as comorbid conditions [6]. The term "Allergic March" has been introduced to describe the progression of allergic disease from the nose and sinuses, down to the lower airways [7]. Allergic testing can be done by skin testing (by SPT, intradermal testing, and patch tests) or by blood investigations for allergy (by detecting free antigen-specific IgE), e.g. enzyme-linked immunosorbent assay (ELISA/enzyme immunoassay), radioallergosorbent testing, and immunocapture assay (ImmunoCAP) [8,9].

Results of blood and skin allergy are usually concordant except in cases of high total IgE when false-positive results are obtained [10,11]. Although blood allergy tests are easier to perform in children, it is limited by the fact that the tests are very expensive and the panel of allergens commonly used in various parts of India, and it consists of mainly of imported varieties of allergens, which are more relevant for the western temperate countries. The SPT is more sensitive, tests a broader panel of allergens suited for our country and immediate results can be obtained. Intradermal testing, although more sensitive than SPT, cannot be used for food allergens because of the high risk of anaphylaxis [8-12].

Multiple studies [8,9,11-15] conducted in India and abroad have identified multiple aero- and food-allergens prevalent in asthma or AR, in children as well as adults using the SPTs and other blood allergy tests. None of these studies [8,9,11-15] were conducted exclusively in children below 12 years, probably because children were not considered to be cooperative enough to perform an SPT using multiple allergens on them. Hence, this study was undertaken to identify the common environmental allergens prevalent in children with atopic asthma and AR using SPT in Kolkata, in eastern part of India.

MATERIALS AND METHODS

This prospective, cross-sectional study was conducted in the Pediatric OPD of Peerless Hospitex Hospital and Research Centre, Kolkata, West Bengal, India, between June 2012 and June 2013. Approval from the institutional ethics committee was obtained before starting the study. Sample size was determined by complete enumeration technique and a sample of around 100 for a period of 1-year was considered adequate for study. All children from 4 to 12 years attending the OPD during the study period and satisfying inclusion criteria were recruited for the study.

Children diagnosed with asthma and AR, which were cooperative enough to perform the SPTs, and had a positive personal or family history of atopy were included in our study. Children were diagnosed as asthma according to British Thoracic Society and Scottish Intercollegiate Guidelines Network guidelines and/or AR as per British Society for Allergy and Clinical Immunology guidelines. Children, who were uncooperative or whose symptoms were considered to be of infective origin and not atopic and who were immunosuppressed or suffered from any extensive skin disease, were excluded from the study. The cost of the SPT was waived by the hospital for those recruited for the study. There were no other costs incurred by the patient apart from the usual mandatory OPD registration.

A questionnaire, required to be filled up by the parents, helped in diagnosing the cases as well as selecting the range of allergens to be tested. Informed consent of parents was taken before the test, and they were asked to withhold the antihistaminic medications (if any) for 72 h, and then, the test was conducted. Inhalers/intranasal medications were not withheld. Abstinence required for children, who were on short-term steroids (<10 days), was 3 days for dosage <50 mg/day and 1-week for dosage >50 mg/day. Children, who were on long-term steroids (>10 days), abstinence required was 1-week for dosage <10 mg/day and 3 weeks for dosage >10 mg/day.

SPT

After taking consent from the parents and explaining the procedure, SPT was performed in all the recruited children using allergen test kit (CREDISOL®, manufactured by Creative Diagnostic Medicare Private Limited) and skin test reaction scale (All Cure Pharma Private Limited). The allergens were available as "standardized allergen extract for SPT." The concentrations used were as follows: Mite (D. farina) - 1500 PNU/mL, Mite (D. pteronyssinus) - 1000 PNU/mL, Pollen - 5000 PNU/mL, Dust - 5000 PNU/mL, Insect - 1000 PNU/mL, Food - 1% w/v.

We tested 56 allergens (28 inhalant allergens and 28 food allergens) by SPT. The panel of food allergens tested was modified according to the dietary habits of the subject. In children, who were vegetarian, non-vegetarian allergens, e.g., fish, prawn, and egg were not tested. The test involved placing drops of allergen extracts on the forearm and then pricking with a lancet through the drops taking care blood should not be oozing from the site. The required distance of 2 cm between two allergen extracts was maintained. 28 allergens were tested in each arm. Results were read after 20 min and were compared with that of positive (histamine) and negative (normal saline) control. The wheals, which were equal to or larger than the positive control in the subject being tested, were taken as positive [10]. The study was done in the OPD, and there was adequate provision for dealing with any adverse reactions including anaphylactic shock with the additional facility of a fully equipped intensive care unit.

Statistical Analysis

Estimates of population proportions were obtained using minimum variance unbiased estimator sample proportions. Large sample Z-test for testing equality of population proportions (two sample tests), and Chi-square test and Fisher exact test (three sample tests for equality of proportions) were used for computing p value. The 95% confidence interval for population proportion is obtained using standard normal approximation for large sample. All statistical analyses are done using MS Excel and statistical software R.

RESULTS

During the study period, 123 children were eligible for recruitment as per the inclusion criteria. Out of these, parents of 7 children did not give consent, and 10 children did not cooperate for SPTs. Hence, the total number of cases included in the study was 106 (70 males and 36 females). Out of these, 30 (28.3%) children were in the age group of 4-6 years, 23 (21.6%) in 6-8 years, 24 (22.6%) in 8-10 years, and 29 (27.3%) were in 10-12 years age group. 45 (42%) were from urban location, 24 (23%) from rural, and 37 (35%) were from the semi-urban location. Out of 106 cases of asthma, 61 cases (57.5%) had associated AR and 44 cases (42.5%) had asthma alone. Similarly, 32 cases (30.12%) had atopic dermatitis coexistent with asthma.

Distribution of asthma and AR according to positivity for allergens is presented in Table 1. Maximum number (50.95%) of asthmatic and AR patients was positive for 6-10 inhalant allergen factors followed by 23.58% positive for 11-15 allergens. Maximum number (57.55%) of asthmatic patients was positive for 1-5 food allergens followed by 27.36% positive for 6-10 food allergens. Maximum number (53.77%) of AR patients was positive for 1-5 food allergens followed by 27.36% cases positive for 6-10 food allergens. Distribution study of inhalant/food allergens according to residence and sex showed statistically insignificant differences.

As depicted in Fig. 1, in patients with allergic asthma, the highest positivity for inhalant allergens was seen for house dust mite (50.94%) followed by male cockroach (39.62%), whereas among food allergens, the highest positivity was seen for egg/egg products (31.13%) followed by milk/milk products (30.19%) (Fig. 2). Study of inhalant allergens in coexistent asthma and AR patients revealed the highest positivity for house dust mite

Table 1: Allergen distribution (number of allergens giving positive reaction in patients with asthma and allergic rhinitis)

Number of allergens	Number (%)	
	Asthma patients	Allergic rhinitis patients
Inhalant allergens		
0	0 (0)	0 (0)
1-5	17 (16.05)	17 (16.05)
6-10	54 (50.95)	54 (50.95)
11-15	25 (23.58)	25 (23.58)
16-20	8 (7.54)	8 (7.54)
>20	2 (1.88)	2 (1.88)
Food allergens		
0	9 (8.49)	10 (9.43)
1-5	61 (57.55)	57 (53.77)
6-10	29 (27.36)	29 (27.36)
11-15	6 (5.66)	8 (7.54)
16-20	1 (0.94)	2 (1.88)
>20	0 (0)	0 (0)

(58.73%) followed by cockroach male (42.86%) (Fig. 3), whereas study of food allergens in these patients showed the highest positivity for milk/milk products (34.92%) followed by egg/egg products (33.33%) (Fig. 4). Figs. 5 and 6 show the study of inhalant (house dust mite in 68.75% and house dust in 56.25% cases) and food allergens (milk/milk products in 37.50% followed by brinjal in 28.13% cases) in asthmatic patients with coexistent atopic dermatitis respectively.

DISCUSSION

Our study aimed to know the allergen prevalence in both AR and asthma. All the cases satisfying the definition of AR, on further questioning, revealed that the asthmatic symptoms had been preceded by the AR symptoms. Of the 106 subjects with asthma, 61 cases (57.5%) were associated with AR, and so, there was a marked overlap. Giridhar et al. had shown that in cases of asthma with AR, 70% had nasal symptoms preceding respiratory symptoms and only 5% had *vice versa* [12]. Pawankar et al. had shown that 80% of cases of asthma had coexistent AR [13]. This finding reinforces the concept of "one airway, one disease" given by GINA. Although our study did not aim to evaluate atopic dermatitis, it was incidentally found that 32 cases (30.12%) with asthma had coexistent atopic dermatitis.

None of the patients were completely vegetarian, but food preferences varied. Hence, for those patients who had never had a certain food, e.g. prawn, mutton, or beef that particular food was not tested. In our study, maximum number of children with asthma and AR had 6-10 inhalant allergens positive and 1-5 food allergens positive, probably suggesting a greater role of aero-allergens in allergic airway diseases. In our study, the aero-allergens most commonly associated with both asthma and AR were house dust mites and insects (male and female cockroaches and mosquitoes). Majorities (77%) of our subjects were residing

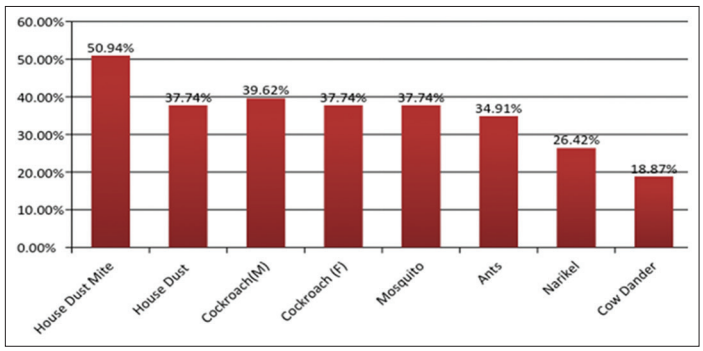

Figure 1: Distribution of inhalant allergens in patients with allergic asthma

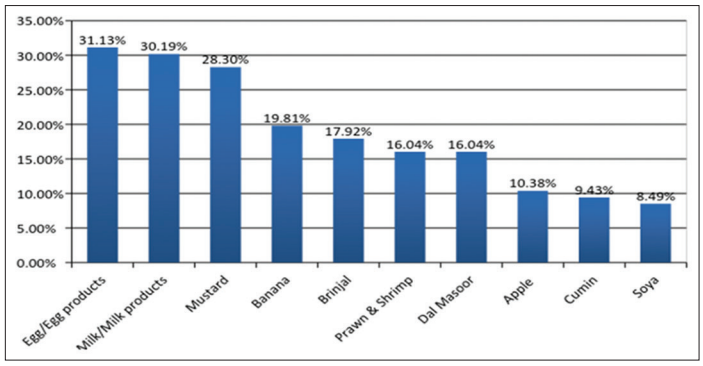

Figure 2: Distribution of food allergens in patients with allergic asthma

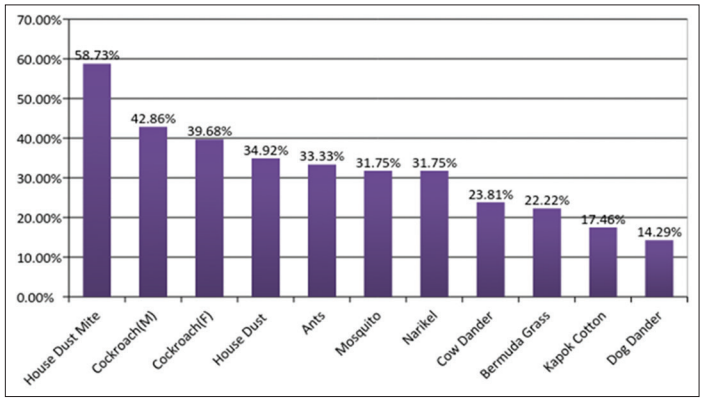

Figure 3: Distribution of inhalant allergens in patients with allergic rhinitis

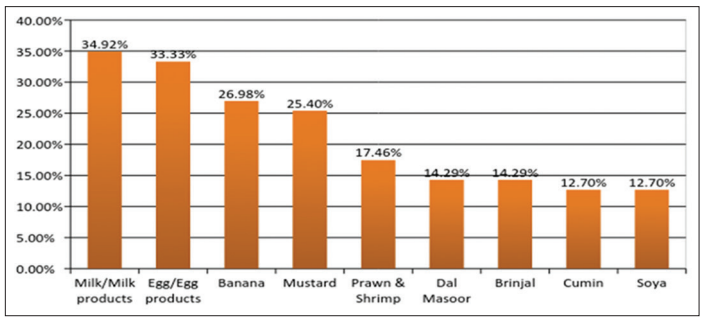

Figure 4: Distribution of food allergens in patients with allergic rhinitis

in urban and semi-urban location, and therefore, probably had negligible exposures to pollens and animal danders. Our

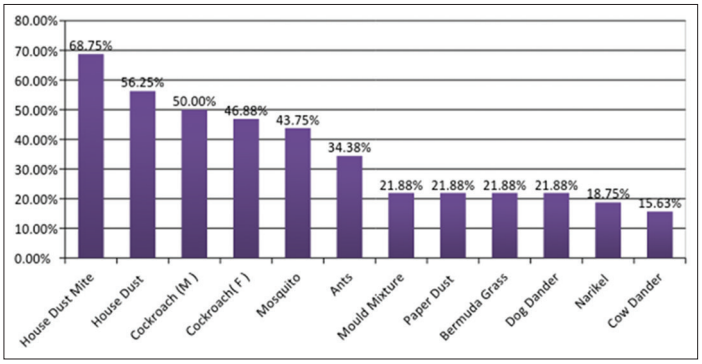

Figure 5: Distribution of inhalant allergens in atopic dermatitis

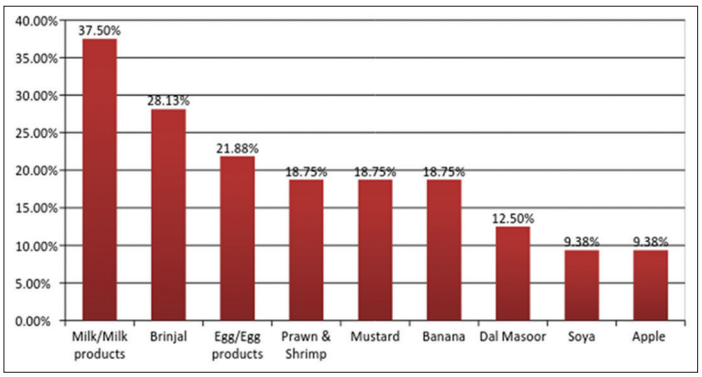

Figure 6: Distribution of food allergens I patients with atopic dermatitis

results were at par with the study by Giridhar et al. in Lucknow, who found that cockroach allergens to be the most common allergen [12]. However, Rasool et al. in Kashmir found pollens to be the most common allergen followed by house dust mite, probably because of the rich natural flora of the state [13]. Raj et al. in New Delhi found house fly and rice grain dust to be the most common allergen [14]. Insect sensitization in asthmatics has been found in few earlier studies as well and worldwide allergy to house dust mite is the most common allergen in asthma and AR [15,16].

Among the food allergens tested, milk and milk products and egg and egg products were found to be the most common allergens in both asthma and AR, which was an expected finding based on the earlier studies [13,17]. However, surprisingly, mustard was found to be a common food allergen in our study in both the categories probably because of the cooking practices and widespread use of mustard oil and mustard paste in this part of the country. This reveals that local cooking practices might have a bearing on the allergen prevalence of food allergens. Although it was not a part of the stated aims and objectives of our study, in the course of our study, we also evaluated the allergens in asthmatic subjects with coexistent atopic dermatitis and found that house dust mites and milk and milk products were the most common inhalant and food allergens, respectively. This finding helped us to advise feeding practices too.

The subjects in our study being mainly from the urban and semi-urban areas surrounding the hospital, and belonging to a similar socioeconomic background, there were no major changes in the climatic condition or flora and fauna; significant differences could not be elicited based on the residence of subjects. In a study conducted on adults, it was found that sensitization patterns did not vary a lot according to different areas of residence except in younger subjects. They found higher sensitization to fungi and cockroach in younger subjects from the rural and urban areas, respectively [18]. Our study has opened a new avenue in the field of allergen testing in children and has shown that SPT is very much feasible even in younger age groups when needed. None of the subjects suffered any severe reaction, the most common being mild local itching. However, medication tray with the provision of adrenaline was always available at our OPD for managing any severe anaphylactic reaction if needed. Large, cross-sectional studies in other settings are required to be conducted to establish the SPT as an easy, cost-effective, and sensitive method of allergen study. It has already been shown by multiple studies that allergen avoidance can lead to reduction in symptoms in AR and asthma [19-21].

This study also sets the direction toward allergen avoidance, as depending on the prototype of allergens present in our region, allergen avoidance measures can be suggested to those children in whom SPT could not be done due to age or other factors. However, the effect of the allergen avoidance can be only studied in a separate study conducted over a longer period. Recent trials suggest that exclusive breastfeeding for the first 6 months of life, timely introduction of complementary feeds beyond 4 months but not beyond 6 months, and the use of hypoallergenic formula feeds in children in whom breastfeeding is not feasible, instead of normal complementary feeds is associated with low risk of developing allergy in infants and delayed development of atopic dermatitis and allergic march in at-risk infants [22].

Based on the SPT results of our study, foods that need to be restricted in the subjects can be ascertained and unnecessary avoidance of multiple foods leading to nutritional deprivation in the years of growth can be avoided [22,23]. Our study did not evaluate the role of allergen avoidance in reducing the acute exacerbations of allergic airway diseases and also did not proceed for any interventions like immunotherapy because the duration of the study was limited for any follow-up to be done. Our study had been conducted only at the OPD of a tertiary care hospital, and therefore, inherent sampling bias might be present.

CONCLUSIONS

In the subjects with asthma and or AR studied, house dust mite, cockroach, and other insect allergens were the most common inhalant allergens and milk and milk products, egg and egg products, mustard, and brinjal were the found to be the most common food allergens. These findings will ensure better advise regarding avoidance measures in the subjects studied. Furthermore, our study may form the platform for advising the avoidance measures in children with allergic airway diseases in this region, especially from the inhalant allergens, even in those in whom SPT cannot be performed. Our study also showed that SPT is a simple, cheap, and feasible technique of allergen testing in

younger children and is associated with very low risk of adverse reaction when done under proper supervision.

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