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MAIN ARTICLE

A study on allergen sensitivity in patients with allergic rhinitis in Bangalore, India

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Abstract

Background: Allergic rhinitis is the most common form of non-infectious rhinitis, affecting 500 million people worldwide, with one-fifth of those affected living in the Indian subcontinent. The skin prick test is the most valuable test for detecting offending allergens, and can be helpful for patient education, allergen avoidance and immunotherapy planning.

Method: The skin prick test was performed with 49 allergens in 486 patients who presented with symptoms of allergic rhinitis, and the allergen profile was studied.

Results: Of the 486 allergic rhinitis patients, 335 (68.93 per cent) showed allergen positivity to the skin prick test. Dust mite was the most common allergen, with positive results in 44.65 per cent of cases.

Conclusion: The most common offending allergen in our study was the dust mite. Identification of specific allergens for a particular geographical area aids patient education and enables allergen-specific immunotherapy.

Key words: Allergic Rhinitis; Allergens; Skin Test; India; Prevalence; Diagnosis

Introduction

Allergic rhinitis is a symptomatic disorder of the nose that is induced after allergen exposure and caused by immunoglobulin E (IgE) mediated inflammation of the membrane lining the nose. It is characterised by nasal congestion, rhinorrhoea, sneezing, itching of the nose and/or postnasal drainage.[1] Allergic rhinitis is the most common form of non-infectious rhinitis, affecting between 10 and 30 per cent of all adults, and as many as 40 per cent of children. The prevalence of allergic rhinitis continues to increase worldwide. Allergic rhinitis affects 500 million people around the world, with 100 million of the affected people living in the Indian subcontinent.[2]

Treatment of allergic rhinitis involves allergen avoidance, pharmacotherapy, immunotherapy and patient education. Identifying the profile of allergens aids allergen avoidance, immunotherapy planning and patient education. There are very few studies on allergic rhinitis in India. Therefore, our aim was to study the profile of offending allergens in patients with allergic rhinitis in Bangalore. The skin prick test was used to identify allergen sensitivity in our study.

Materials and methods

This was a descriptive study conducted at our allergy clinic from January 2011 to December 2012. The skin prick test was used on 486 patients suffering from allergic rhinitis, who were diagnosed based on the Allergic Rhinitis and its Impact on Asthma ('ARIA') guidelines.[2] Pregnant and lactating women were excluded from the study.

A detailed history was taken from all patients. Patients were subjected to clinical examination and investigations, such as total leucocyte count, differential count and absolute eosinophil count. Informed consent was obtained, which was approved by the institutional ethics committee.

Skin prick test

The allergens were obtained from Creative Diagnostic Medicare Private (Navi Mumbai, India). The test was performed with 49 allergen extracts, which included 19 types of pollen, 10 kinds of fungi, 5 types of dust, 2 species of dust mites, 10 kinds of insects and 3 types of epithelia.

Patients stopped taking long-acting antihistamines for 2 weeks, and short-acting antihistamines and sympathomimetic drugs for 5 days prior to the test. The

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skin prick test was performed on the flexor aspect of the arm and forearm. In children, the skin prick test was performed on the back.

The interpretation of results was carried out in accordance with the Indian College of Allergy, Asthma and Applied Immunology guidelines.[3] Those results classified as grade 2+ and above were considered positive.

Results

The skin prick test was performed on 486 patients with allergic rhinitis; 231 patients (47.5 per cent) were males and 255 (52.5 per cent) were females. The majority of patients (63.58 per cent) were in the 21–40-year age group (as indicated by the 21–30 and 31–40 age group bars in Figure 1). A total of 175 patients (36.01 per cent) had a family history of allergic rhinitis or atopy. Of the 486 allergic rhinitis patients, 212 (43.6 per cent) had asthma, 144 (29.6 per cent) had chronic urticaria and 122 (25.1 per cent) had allergic conjunctivitis.

Of the 486 patients tested, 335 (68.93 per cent) were sensitive to one or more allergens (Table I). The most common offending allergen was the dust mite, with positive results in 44.65 per cent of cases. This was followed by pollen (6.15 per cent), dust (5.06 per cent), insects (2.11 per cent), fungi (1.72 per cent) and epithelia (1.23 per cent).

Among dust mites, the most common mite was *Dermatophagoides pteronyssinus* (46.30 per cent), followed by *Dermatophagoides farinae* (43.00 per cent).

The most common pollen allergen was *Parthenium hysterophorus* (16.26 per cent), followed by *Peltophorum pterocarpum* (13.99 per cent), *Chenopodium album* (11.93 per cent), *Prosopis juliflora* (11.52 per cent), *Ricinus communis* (8.23 per cent), *Xanthium strumarium* (7.61 per cent), *Cocos nucifera* (6.79 per cent), *Ageratum conyzoides* (5.56 per cent), *Amaranthus spinosus* (4.73 per cent) and *Azadirachta indica* (4.53 per cent).

The most common insect allergen was the cockroach (6.38 per cent), followed by the grasshopper (2.88 per cent), mosquito (2.88 per cent), housefly (2.06 per cent) and cricket (1.65 per cent).

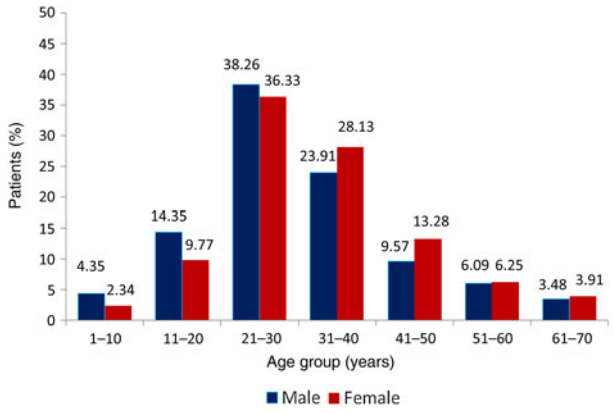

FIG. 1
Age and sex distribution of study population (n=486).

TABLE I
SKIN PRICK TEST REACTIONS TO VARIOUS ALLERGENS*

Serial number	Allergen	Positive reactions† (n (%))
	Pollen	
1	– *Acacia arabica*	9 (1.85)
2	– *Ageratum conyzoides*	27 (5.56)
3	– *Ailanthus excelsa*	18 (3.70)
4	– *Amaranthus spinosus*	23 (4.73)
5	– *Azadirachta indica*	22 (4.53)
6	– *Cassia siamea*	12 (2.47)
7	– *Casuarina equisetifolia*	23 (4.73)
8	– *Chenopodium album*	58 (11.93)
9	– *Cocos nucifera*	33 (6.79)
10	– *Cynodon dactylon*	21 (4.32)
11	– *Dodonea viscosa*	8 (1.65)
12	– *Holoptelea integrifolia*	16 (3.29)
13	– *Parthenium hysterophorus*	79 (16.26)
14	– *Peltophorum pterocarpum*	68 (13.99)
15	– *Prosopis juliflora*	56 (11.52)
16	– *Ricinus communis*	40 (8.23)
17	– *Sorghum vulgare*	12 (2.47)
18	– *Typha angustata*	6 (1.23)
19	– *Xanthium strumarium*	37 (7.61)
	– Total pollen	568 (6.15)
	Fungi	
20	– *Alternaria alternata*	13 (2.67)
21	– *Aspergillus flavus*	17 (3.50)
22	– *Aspergillus fumigatus*	11 (2.26)
23	– *Aspergillus niger*	8 (1.65)
24	– *Candida albicans*	14 (2.88)
25	– *Cladosporium herbarum*	9 (1.85)
26	– *Curvularia lunata*	3 (0.62)
27	– Helminthosporium	3 (0.62)
28	– Penicillium species	2 (0.41)
29	– Trichoderma	4 (0.82)
	– Total fungi	84 (1.72)
	Dust	
30	– Cotton dust	28 (5.76)
31	– Hay dust	6 (1.23)
32	– House dust	31 (6.38)
33	– Paper dust	46 (9.47)
34	– Wheat dust	12 (2.47)
	– Total dust	123 (5.06)
	Dust mites	
35	– *Dermatophagoides farinae*	209 (43.00)
36	– *Dermatophagoides pteronyssinus*	225 (46.30)
	– Total dust mites	434 (44.65)
	Insects	
37	– Ant (black)	2 (0.41)
38	– Cockroach	31 (6.38)
39	– Cricket	8 (1.65)
40	– Grasshopper	14 (2.88)
41	– Honey bee	6 (1.23)
42	– Housefly	10 (2.06)
43	– Mosquito	14 (2.88)
44	– Moth	4 (0.82)
45	– Rice weevil	6 (1.23)
46	– Wasp	8 (1.65)
	– Total insects	103 (2.11)
	Epithelia	
47	– Buffalo dander	6 (1.23)
48	– Dog epithelia	8 (1.65)
49	– Sheep's wool	4 (0.82)
	– Total epithelia	18 (1.23)

*Number of patients = 486. †Reaction of grade 2+ and above.

The most common dust allergen was paper dust (9.47 per cent), followed by house dust (6.38 per cent), cotton dust (5.76 per cent) and wheat dust (2.47 per cent).

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TABLE II
COMPARISON OF ALLERGIC RHINITIS PATIENTS WITH POSITIVE VERSUS NEGATIVE SKIN PRICK TEST RESULTS

Factor	Positive skin test result (n)*	Negative skin test result (n)†	Chi-square	p	Odds ratio	95% CI
Aggravating factor						
– Age of onset <20 y	175	60	6.516	0.005	1.659	1.123–2.450
– Family history of allergic rhinitis	133	42	6.383	0.005	1.709	1.125–2.595
– Exposure to dust	229	77	13.46	0.00012	2.076	1.401–3.077
Association with other allergic diseases						
– Asthma	157	55	4.615	0.015	1.54	1.037–2.285
– Allergic conjunctivitis	98	24	9.88	0.0008	2.18	1.333–3.592
– Chronic urticaria	99	45	0.003	0.477	0.988	0.649–1.504

*Total n = 335; †total n = 151. CI = confidence interval; y = years

The common fungi detected were *Aspergillus flavus* (3.50 per cent), *Candida albicans* (2.88 per cent), *Alternaria alternata* (2.67 per cent), *Aspergillus fumigatus* (2.26 per cent), *Cladosporium herbarum* (1.85 per cent) and *Aspergillus niger* (1.65 per cent).

The common epithelial allergens were dog (1.65 per cent), buffalo (1.23 per cent) and sheep (0.82 per cent) epithelia.

The data of patients with positive and negative skin prick test results were compared. This revealed stronger associations between skin prick test positive cases and bronchial asthma and allergic conjunctivitis compared with negative cases; these findings were statistically significant ($p < 0.05$). The probability of having a positive skin prick test result was higher when the age of disease onset was less than 20 years and in those with a family history of atopy ($p < 0.05$). Dust-induced aggravation of symptoms was greater in patients with positive skin prick test results as compared with those who had negative skin prick test results, and the difference was found to be statistically significant ($p < 0.05$) (Table II).

Discussion

Allergic rhinitis is a global health problem that is also responsible for several co-morbid conditions. The diagnosis of an allergy to a specific allergen enables patients to avoid the allergen and makes them candidates for allergen-specific immunotherapy.[4]

Allergen sensitivity can be diagnosed by a skin prick test, an intradermal test, specific IgE estimation and an allergen provocation test. Skin prick testing is currently considered the most valuable test in the diagnosis of IgE-mediated allergic disorders. Skin prick testing is more sensitive than specific IgE estimation and has the best positive predictive value in diagnosing respiratory atopic diseases.[5] It is also simple, inexpensive and provides immediate educational information to both the patient and the doctor.[6]

In the present study, the commonest allergen was the dust mite (44.65 per cent), followed by pollens (6.15 per cent), dust (5.06 per cent), insects (2.11 per cent), fungi (1.72 per cent) and epithelia (1.23 per cent). Table III compares the allergen sensitivity findings in this study with those of other studies.[7–9] The variation in the allergen-positive results across the different studies may be due to the use of different allergen extracts and/or grading criteria. Skin allergy testing performed in Indian adults by Shah and Pawankar indicated that the house dust mite (*D farinae*) was the most common allergen.[10] In the present study, the commonest dust mite was *D pteronyssinus* (46.30 per cent).

The most commonly detected pollen allergens in the current study were *P hysterophorus* (16.26 per cent), *P pterocarpum* (13.99 per cent), *C album* (11.93 per cent), *P juliflora* (11.52 per cent), *R communis* (8.23 per cent), *X strumarium* (7.61 per cent), *C nucifera* (6.79 per cent), *A conyzoides* (5.56 per cent), *A spinosus* (4.73 per cent) and *A indica* (4.53 per cent). Studies carried out in Southern India found that casuarina, parthenium, spathodea, cheno-amaranth, cocos, eucalyptus, poaceae, peltophorum and cyperaceae were the dominant pollen allergens.[11,12] Subbarao *et al.* found allergenicity to *P hysterophorus* pollen extracts in 12 per cent of allergic rhinitis patients from Bangalore.[13] In a similar study by Prasad *et al.*, conducted in Lucknow, the most common pollen was *A spinosus* (35.4 per cent), followed by *Argemone*

TABLE III
COMPARISON OF ALLERGEN SENSITIVITY IN VARIOUS STUDIES

Study	Patients (total n)	Dust mite (%)	Pollen (%)	Insects (%)	Animal dander (%)	Fungi (%)
Prasad *et al.*[7]	48	12	7.8	21.2	3.1	1.3
Agrawal *et al.*[8]	50	78	29.09	66	20	42
Kumar *et al.*[9]	918	12.42	14.88	43.9	Not done	11.98
Present study	486	44.65	6.15	2.11	1.23	1.72

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mexicana (22.9 per cent), *Adhatoda vasica* (18.5 per cent), ailanthus (12.5 per cent) and cannabis (8.3 per cent).[7] In a study by Agrawal *et al*., conducted in Allahabad, Uttar Pradesh, the most common pollen was *Cynodon dactylon* (56 per cent), followed by *Gynandropsis gynandra* (54 per cent), *Brassica campestris* (52 per cent), *Putranjiva roxburghii* (52 per cent), *Sorghum vulgare* (46 per cent), *C album* (32 per cent), *X strumarium* (28 per cent) and *P hysterophorus* (26 per cent).[8] The variation in pollen sensitivity shown in the above studies may be because of geographical variation.

- **Allergic rhinitis is a growing problem worldwide**
- **The skin prick test is an efficient diagnostic tool**
- **Skin prick test positivity increased in allergic rhinitis patients with early onset of disease, family history of atopy and other co-morbid atopic conditions (e.g. asthma and allergic conjunctivitis)**
- **This study is one of the largest conducted on a South Indian urban population**
- **It aimed to identify the allergen profile in allergic rhinitis patients**
- **The results can enhance patient education, immunotherapy planning and allergen test selection, and enable allergen avoidance**

In the present study, 1.72 per cent of patients tested positive to fungi. The most common fungus was *A flavus* (3.50 per cent), followed by *C albicans* (2.88 per cent), *A alternata* (2.67 per cent), *A fumigatus* (2.26 per cent), *C herbarum* (1.85 per cent) and *A niger* (1.65 per cent). The study conducted by Agrawal *et al*. showed marked skin positivity to *A fumigatus* (16 per cent), followed by *C albicans* (10 per cent) and *A niger* (10 per cent).[8] In a study by Prasad *et al*., the most common fungal antigen was *A fumigatus*, followed by *A flavus*, *Alternaria tenuis* and *Fusarium solani*.[7] Aspergillus species were common allergens in both studies, consistent with our study findings.

In the present study, 2.11 per cent of patients were allergic to insects. The common insect allergens were cockroach (6.38 per cent), grasshopper (2.88 per cent), mosquito (2.88 per cent), housefly (2.06 per cent) and cricket (1.65 per cent). In a study by Prasad *et al*., the common insect allergens were female locust (33.3 per cent), male locust (25 per cent), grasshopper (20.8 per cent), cricket (16.7 per cent), female cockroach (16.7 per cent) and male cockroach (14.6 per cent).[7] Gaur *et al*. found that allergies to moths, mosquitoes, locusts, cockroaches and grasshoppers were common in patients with nasobronchial allergy.[14] Similarly, Acharya found that moth, mosquito and ant allergens were commonly responsible for nasobronchial allergy.[15]

Different geo-climatic conditions have resulted in variations in the prevalence of aeroallergen reactivities in different regions. Adaptation of specific microbiological flora and fauna in specific climatic conditions also adds to the variation of allergens. The percentage of allergen positivity varies from one study to another. This may be because different studies adopt different types of allergens. There is no uniformity in the selection of allergens used for testing. The strengths of allergen extracts used and the criteria for skin reactivity grading also vary from one study to another. There is a need for guidelines on the selection of allergens utilised for testing and for a standardised grading system, for use in allergic rhinitis and respiratory allergy cases.

Conclusion

The most common allergen for allergic rhinitis in our study was the dust mite. Allergens responsible for allergic rhinitis have geographical, seasonal and subject variation. A positive reaction with the skin prick test was found to correlate with early onset of allergic rhinitis (age of less than 20 years) and family history of atopy. In addition, there was an association with other atopic conditions, such as asthma and allergic conjunctivitis. The study findings could aid the selection of allergens for the skin prick test in this part of the world, avoiding unnecessary testing for other allergens.

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