

Sensitivity to common aeroallergens in asthma patients in Delhi-National Capital Region

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Abstract

BACKGROUND: Skin prick test (SPT) is the “gold standard” in the assessment of sensitivity to inhalant allergens. SPT is performed with antigen extracts from India and evaluated according to the Standard Indian Guidelines.

OBJECTIVE: The aim of this study was to determine sensitivity by skin prick test in asthma patients in metropolitan city of Delhi-National Capital Region (NCR).

MATERIALS AND METHODS: This is a prospective study of skin prick test with aeroallergens in asthma patients and their combination with clinical diagnosis. Two hundred asthma patients consisting of 81 (40.5%) males and 119 (59.5%) females with a mean age of 30.51 ± 9.85 years aged between 12 and 60 years were selected for study from Viswanathan Chest Hospital, Vallabhbhai Patel Chest Institute, Delhi, between 2017 and 2018. Fifty-eight different common aeroallergen tests were tested through skin prick test (SPT) in patients of bronchial asthma. The sensitivity of all common aeroallergens was analyzed by MS Excel 2010.

RESULTS: A significant (2+ and above) skin-positive reaction against aeroallergens was found in 114 (57%) asthma patients. The younger adults aged 21-30 years were the foremost commonly affected group with 84 (43.5%). Among individual allergens, the most common aeroallergens showed a significant positive skin reaction, which were cockroaches 68 (34%) and moth 63 (32.5%), followed by mosquito 61 (30.5%), housefly 55 (27.5%), rice weevil 41 (20.5%), and house dust mite (HDM) 22 (11.0%).

CONCLUSION: In the present study, we found that insects (cockroaches, housefly, mosquito, and rice weevil) and HDM are the most common skin sensitive aeroallergens in Delhi-NCR. The sensitization was the most common in the younger age group patients.

Keywords: Allergy, asthma, common aeroallergens, SPT

Introduction

Aeroallergens play an important role in the assessment of respiratory allergic diseases. Pollens, house dust mites (HDMs), molds, insects, and pets are the most common allergens.^{[1],[2]} The types of aeroallergens, however, differ widely depending on localities and even vary both within and between countries.^[3]

Asthma is a major cause of chronic morbidity and mortality throughout the world and is characterized by paroxysmal spasmodic narrowing of the bronchial airway due to inflammation of the bronchial tree and contraction of the bronchial smooth muscles.^[4] It is well known that asthma and rhinitis coexist in many patients. Allergic rhinitis (AR) is a recognized risk factor for asthma, with 20%–30% of such patients having asthma; conversely, 60%–78% of patients with asthma have coexisting AR.^{[5],[6]} Common risk factors include indoor and outdoor exposures to allergens including HDMs, cockroaches, mosquitos, housefly, pollens, molds, animal dander, and birds' feather and droppings.

Skin prick testing (SPT) has been considered to be the “gold standard” in the assessment of inhalant allergen sensitivity, and results are interpreted in the context of clinical history and epidemiological profile. SPT reactivity prevalence in any community depends on age, sex, and geographical factors. This study was designed for the detection of the prevalence of skin reactivity to common aeroallergens in asthma patients in the metropolitan city of Delhi-National Capital Region (NCR).

Materials and Methods

It was a prospective observational study conducted at the Outpatient Department of Viswanathan Chest Hospital, Vallabhbai Patel Chest Institute, Delhi, in the years 2017–2018. We enrolled 200 asthmatic patients comprising 81 (43.5%) males and 119 (59.5%) females, with a mean age of 30.51 (12–60 years). The diagnosis of asthma was done as per the Global Initiative for Asthma guidelines 2017.^[7] We selected asthma patients who had symptoms for a minimum of 1 or more years to establish the diagnosis and exclude other identifiable causes by virtue of their clinical history and physical examination. All patients were nonsmokers. There was no associated history of tuberculosis, diabetes mellitus, hypertension, endocrine disease, or coronary artery disease. Pregnant females were excluded from the study. Hemogram, sputum, and chest radiography were done to rule out other diagnoses. The study was approved by the Institutional Ethical Committee, and written consent of each patient was obtained for participation in the study. All the enrolled patients underwent SPT for 57 common aeroallergens.

Skin prick test

SPT was done with 57 different types of common aeroallergens, which included 5 types of grass pollens, 16 types of weed pollens, 11 types of tree pollens, 4 types of dust, 12 types of fungi, and 5 types of insects, HDM, kapok cotton, wool, and silk antigens. The allergen extracts (1:10 w/v, 50% glycerinated) were obtained from All Cure Pharma Pvt. Ltd., New Delhi, India. Glycerinated buffered saline and histamine diphosphate in glycerinated buffer were used as negative and positive controls, respectively. In brief, the volar aspect of the forearm cleaned with cotton ball soaked in 70% alcohol was allowed to dry. A small drop of antigen was placed on the forearm, and each drop was numbered. Then, skin was pricked using 26.5G sterile needles. The skin test reactions were graded by calculating the mean diameter as $(D + d)/2$; D = largest diameter and d = orthogonal or perpendicular diameter at the largest width of D after 15–20 min in comparisons to the wheal size of positive control, i.e., histamine diphosphate (10 mg/ml). To ensure uniformity, the same lots of cockroach extracts were used in all patients, and only one researcher performed all SPT. A positive result (2+ and above) to a specific allergen is indicated by a mean wheal diameter measuring 3 mm or more, greater than the negative control (buffered saline) as per Standard Indian Guidelines.^[8]

Results

Out of the 200 enrolled patients, 81 (40.5%) were males and 119 (59.5%) females, with 80.5% of the study population from an urban area of the metropolitan city, i.e., Delhi-NCR. The age of patients ranged from 12 to 60 years, with a mean of 30.51 ± 9.85 years. The average body mass index of the patients was 25.74 ± 5.27 kg/m², and overall skin prick sensitivity to aeroallergens (2+ and above) in asthma patients with at least one positive to aeroallergens was 114 (57%). The epidemiological data of asthma patients are shown in [Table 1].

Variables	Asthmatics (n=200), n (%)		Total
	Male	Female	
n	81 (40.5)	119 (59.5)	200
Age (mean in years)	29.72±9.75	31.31±9.96	30.51±9.85
BMI (mean in kg/m ²)	24.96±4.38	26.52±6.16	25.74±5.27
Population			
Urban area	59 (29.5)	102 (51.0)	161 (80.5)
Rural area	22 (11.0)	17 (8.5)	39 (19.5)
SPT			
Sensitivity to CAA	57 (28.5)	57 (28.5)	114 (57.0)
Positive (2+ and above)	24 (12.0)	62 (31.0)	86 (43.0)

CAA=Common aeroallergens, SPT=Skin prick testing, BMI=Body mass index

Table 1: Epidemiological data of asthma patients

The SPT positivity to common aeroallergens was highest in the 21–30 years' age group and least in >50 years [Figure 1].

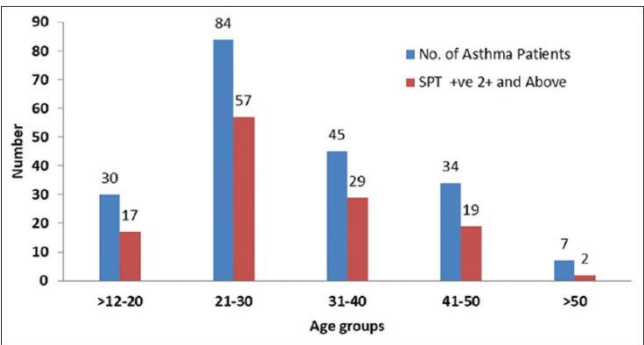


Figure 1: Patients' age-wise distribution and skin prick testing sensitivity in aeroallergens

Patients' clinical characteristics

The majority of enrolled patients, i.e., 129 (65.5%), were in the age group of ≥25 years, while the remaining 71 (35.5%) were ≤25 years. The duration of asthma patients <5 years was present in 136 (68%) and more than ≥5 years was in 64 (32%) cases. The family history of asthmatic was positive in 121 (60.5%) patients. Wheezing was the most common symptom (92.5%), followed by cough (91.5%), nasal congestion (88%), and skin complaints (22%) [Table 2].

Clinical characteristics	Number of patients (n=200), n (%)	Table: 2 Clinical characteristics of asthma patients
Age (years)		
≤25	71 (35.5)	
≥25	129 (64.5)	
Duration of disease (years)		
≤5	136 (68.0)	
≥5	64 (32.0)	
Family history of asthma		
Positive	121 (60.5)	
Negative	79 (39.5)	
Symptoms		
Wheezing	185 (92.5)	
Cough	183 (91.5)	
Nasal	176 (88.0)	
Skin complaints	44 (22.0)	

Offending aeroallergens

In our study, insects (97; 49%) were found the most common aeroallergens, followed by weed pollens (14%), HDM (11%), fungi (10.5%), tree pollen (9.5%), dust (6%), kapok cotton (5.5%), grass pollen (3.5%), silk (1.5%), and wool (1%). Among insects, cockroach allergen (68; 34%) was found highest in SPT-positive patients [Table 3].

Offending allergens	n (%)
Insects	97 (48.5)
Weed pollen	28 (14.0)
HDM	22 (11.0)
Fungi	21 (10.5)
Tree pollen	19 (9.5)
Dust	12 (6.0)
Kapok cotton	9 (4.5)
Grass pollen	7 (3.5)
Silk	3 (1.5)
Wool	2 (1.0)
HDM=House dust mite	

Table 3: Offending allergens in asthma patients

Detailed sensitivity of all antigens tested

Among individual allergens, the most common insect was cockroach (34%) and least common was rice weevil (20.5%). Among grass pollens, overall, 7 (3.5%) were positive, in which *Cenchrus*, *Cynodon*, and *Pennisetum* (2%) were the most common allergens, followed by *Sorghum* (0.5%). However, *Imperata* was negative in all enrolled patients [Table 4].

Table	4:	Detailed	sensitivity	of	all	antigens	tested	on	asthma	patients
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Allergens	2+and above (%)	1+ (%)	2+ (%)	3+ (%)	4+ and above (%)
Grass pollens	7 (3.5)	11 (8.5)	6 (3.0)	1 (0.5)	0
Cenchrus	2 (1.0)	6 (3.0)	2 (1.0)	0	0
Cynodon	2 (1.0)	5 (2.5)	1 (0.5)	1 (0.5)	0
Imperata	0	2 (1.0)	0	0	0
Pennisetum	2 (1.0)	5 (2.0)	2 (1.0)	0	0
Sorghum	1 (0.5)	5 (1.5)	1 (0.5)	0	0
Weeds pollens	28 (14.0)	27 (13.5)	19 (9.5)	8 (4.0)	1 (0.5)
Asphodelus	0	1 (0.5)	0	0	0
Parthenium	0	2 (1.0)	0	0	0
Cannabis	1 (0.5)	2 (1.0)	1 (0.5)	0	0
Chenopodium Murale	1 (0.5)	2 (1.0)	1 (0.5)	0	0
Brassica	2 (1.0)	3 (1.5)	2 (1.0)	0	0
Chenopodium album	2 (1.0)	4 (2.0)	1 (0.5)	1 (0.5)	0
Dodonaea	2 (1.0)	2 (1.0)	2 (1.0)	0	0
Amaranthus spinosus	3 (1.5)	9 (4.5)	2 (1.0)	1 (0.5)	0
Xanthium	3 (1.5)	1 (0.5)	2 (1.0)	0	1 (0.5)
Adhatoda	4 (2.0)	5 (2.5)	4 (1.5)	0	0
Argemone	4 (2.0)	6 (3.0)	3 (1.5)	1 (0.5)	0
Artemisia	4 (2.0)	3 (1.5)	2 (1.0)	2 (1.0)	0
Suaeda	4 (2.0)	4 (2.0)	4 (2.0)	0	0
Gynandropsis	5 (2.5)	6 (3.0)	3 (1.5)	2 (1.0)	0
Ageratum	6 (3.0)	9 (4.5)	5 (2.5)	1 (0.5)	0
Cassia occidentalis	8 (4.0)	6 (3.0)	5 (2.5)	3 (1.5)	0
Trees pollens	19 (9.5)	20 (10.0)	12 (6.0)	7 (2.0)	0
Cassia siamea	5 (2.5)	5 (2.5)	3 (1.5)	2 (1.0)	0
Ehretia	0	1 (0.5)	0	0	0
Eucalyptus	0	2 (1.0)	0	0	0
Kigelia	2 (1.0)	2 (1.0)	2 (1.0)	0	0
Melia	2 (1.0)	5 (2.5)	2 (1.0)	0	0
Morus	2 (1.0)	3 (1.5)	2 (1.0)	0	0
Prosopis	5 (2.5)	2 (1.0)	3 (1.5)	2 (1.0)	0
Putranjiva	2 (1.0)	4 (2.0)	2 (1.0)	0	0
Ricinus	8 (4.0)	4 (2.0)	5 (2.5)	3 (1.5)	0
Salvadora	3 (1.5)	6 (3.0)	3 (1.5)	0	0
Holoptelea	4 (2.0)	7 (3.5)	2 (1.0)	2 (1.0)	0
Dusts	12 (6.0)	5 (2.5)	11 (5.5)	1 (0.5)	0
House dust	17 (8.5)	6 (3.0)	13 (6.5)	3 (1.5)	1 (0.5)
Wheat dust	12 (6.0)	13 (6.5)	9 (4.5)	1 (0.5)	2 (1.0)
Paper dust	3 (1.5)	2 (1.0)	1 (0.5)	1 (0.5)	1 (0.5)
Cotton dust	5 (2.5)	3 (1.5)	3 (1.5)	2 (1.0)	0
House dust mite	22 (11.0)	14 (7.0)	11 (5.5)	5 (2.5)	6 (3.0)
Fungi	21 (10.5)	17 (8.5)	12 (6.0)	4 (2.0)	5 (2.5)
Alternaria	3 (1.5)	3 (1.5)	0	1 (0.5)	2 (2.0)
Aspergillus fumigatus	9 (4.5)	10 (5.0)	5 (2.5)	2 (1.0)	2 (1.0)
Aspergillus tamarit	6 (3.0)	2 (1.0)	5 (2.5)	0	1 (0.5)
Candida	2 (2.0)	2 (0.5)	1 (1.0)	1 (0.5)	0
Cladosporium	1 (0.5)	1 (0.5)	0	1 (0.5)	0
Curvularia	1 (0.5)	1 (0.5)	1 (0.5)	0	0
Helminthosporium	2 (1.0)	1 (0.5)	3 (1.5)	0	0
Mucor	1 (0.5)	2 (1.0)	0	1 (0.5)	0
Phoma	1 (0.5)	1 (0.5)	1 (0.5)	0	0
Trichoderma	4 (2.0)	1 (0.5)	3 (1.5)	1 (0.5)	0
Rhizopus	2 (1.0)	2 (1.0)	2 (1.0)	0	0
Epicoccum	4 (2.0)	3 (1.5)	2 (1.5)	0	1 (0.5)
Insects	97 (48.5)	61 (30.5)	43 (21.5)	26 (13)	28 (14)
Cockroach	68 (34.0)	19 (8.5)	33 (16.5)	16 (8.0)	19 (10.5)
Housefly	55 (27.5)	24 (12.0)	32 (16.0)	12 (6.0)	11 (5.5)
Rice weevil	41 (20.5)	22 (11)	20 (10.0)	18 (9.0)	3 (1.5)
Mosquito	61 (30.5)	19 (9.5)	24 (12)	18 (9)	19 (9.5)
Moth	63 (32.5)	21 (10.5)	29 (14.5)	27 (13.5)	7 (3.5)
Others	9 (4.5)	5 (2.5)	8 (4.0)	1 (0.5)	0
Kapok cotton	2 (1.0)	1 (0.5)	1 (0.5)	1 (0.5)	0
Wool	3 (1.5)	5 (2.0)	3 (0.5)	0	0

Among weed pollens, overall, 28 (14%) were positive, in which *Cassia occidentalis* (4%) was the most common allergen, followed by *Ageratum* (3%), *Gynandropsis* (2.5%), *Adhatoda* (2%), *Artemisia* (2%), *Argemone* (2%), *Suaeda* (2%), *Amaranthus spinosus* (1.5%), *Xanthium* (1.5%), *Chenopodium album* (1%), *Brassica* (1%), *Dodonaea* (1%), *Cannabis* (0.5%), *Chenopodium Murale* (0.5%). However, *Parthenium* and *Asphodelus* had shown no SPT reactivity in any patient [Table 4].

Among tree pollens, overall, 19 (9.5%) were positive, in which *Ricinus* (4%) was most common, followed by *Cassia siamea* (2.5%), *Prosopis* (2.5%), *Holoptelea* (2%), *Salvadora* (1.5%), *Melia* (1%), *Putranjiva* (1%), *Kigelia* (1%), and *Morus* (1%). However, *Eucalyptus* and *Ehretia* were found the least common allergen in the group [Table 4].

Among dusts, overall, 12 (6%) were positive, in which house dust (8.5%) was most common, followed by wheat dust (6%), cotton dust (2.5%), and paper dust (1.5%). HDM was significantly positive in 22 (11%), with the overall third offending allergen in the study population [Table 4].

Among the fungal spores, overall, 21 (10.5%) were positive, in which *Aspergillus fumigatus* (4.5%) was the most common, followed by *Aspergillus tamarit* (3%), *Candida* (2%), *Epicoccum* (2%), *Trichoderma* (2%), *Rhizopus* (2%), *Alternaria* (1.5%), and *Helminthosporium* (1%). *Curvularia*, *Cladosporium*, *Phoma*, and *Mucor* (0.5%) were found the least common aeroallergens [Table 4].

Among insects, overall, 97 (48.5%) were positive, in which cockroach (34%) was the most common allergen, followed by moth (32.5%), mosquito (30.5%), and housefly (27.5%). The least common allergen was rice weevil (20.5%). In other group, kapok cotton was significantly positive in 4.5%, followed by silk (1.5%) and wool (1%) [Table 4].

Skin prick testing has been considered to be the “gold standard” in the assessment of inhalant allergen sensitivity. Results are interpreted as per the Indian Standard Guidelines [9] in the context of clinical history and epidemiological profile [Table 1] and [Table 2]. Our study showed that the sensitizing common aeroallergens in asthma patients were pollens (grasses, weeds, and trees), HDM, dusts, fungi, insects, kapok cotton, silk, and wool. It was observed that the most common aeroallergens, mainly insects including cockroach (34%) and moth (32.5%) allergens, showed a significant positive skin reaction, followed by mosquito (30.5%), housefly (27.5%), and rice weevil (20.5%).

In the present study, the highest number of asthmatic patients (84; 42%) were in the younger aged 21–30 years, and they were the most commonly affected group with 114 (57%) patients who found significant skin positive [Figure 1]. Similar studies by Kumar *et al.* reported that younger adults were the most commonly affected group with significant skin positive patients. [9],[10],[11] Similar to our study, Ghaffari *et al.* showed that allergen SPT reactivity is low in the younger age group, increases in the middle age group, and then tends to decrease with advancing age. [12] Wang *et al.* showed the prevalence of sensitization to aeroallergens decreased with increasing age. [13]

In our study, all the 114 (100%) patients were multi-allergen sensitive on SPT. The insect group was the most common offending aeroallergen seen in 48.5% of patients, followed by weed pollen (14%), HDM (11%), fungi (10.5%), tree pollen (9.5%), dust (6%), kapok cotton (4.5%), grass pollen (3.5%), silk (1.5%), and wool (1%). Among the patients sensitive to insect, the commonly offending antigen was cockroach seen (34%), followed by moth (32.5%), mosquito (30.5%), housefly (27.5%), and rice weevil (20.5%). Ghaffari *et al.* in 2010 revealed that the most common SPT reaction was with HDM, i.e., *Dermatophagoides pteronyssinus* (25.3%) and *Dermatophagoides farina* (24.8%), followed by cockroach (15.7%) and feather (7.5%). [12] Similar results were obtained by Knight-Madden *et al.* who showed that the most common significant SPT was due to *D. pteronyssinus* (33%) and *D. farina* (32%), followed by cockroach (23%). [14] Almogren observed that the most frequently reacting indoor allergen was HDM (77.8%), followed by cat (33.6%) and cockroach (19.2%) allergens. [15] Lopes *et al.* [16] from Recife, Brazil, in a case-control study found that 27.6% were SPT positive for cockroach (*Periplaneta americana*) allergen. Wang *et al.* from China demonstrated that HDMs (84.4%) comprised the most common aeroallergen, then followed by pet allergens (23.4%), cockroaches (21.1%), molds, and pollen. [13] Sattar *et al.* from Qatar found that cockroaches and dust mites were more common aeroallergens in asthmatic patients. [17] Sam *et al.* from Malaysia also demonstrated that cockroach was the most common allergen in 200 asthmatics. [18] The different studies from different parts of the world show different SPT patterns. Most of the studies showed that HDM and cockroach are the two main allergens. Our study also found cockroach as the most common allergen and HDM as the third most common allergen. This difference over the globe may be due to different genetic susceptibilities, geographic locations, cultures, and lifestyles of people.

An early study by Singhal *et al.* (2003) from the same institute showed that the most common allergen positive on SPT among all allergic disease was insects (17.29%), followed by various types of dust (4.39%), grass pollen (2.28%), weed pollens (2.18%), tree pollens (1.22%), fungal spores (1.22%), and kapok cotton (1.75%). [9] Among insects, the most common offending allergen was housefly, followed by mosquito and moth. [9] Again, the same author in (2012) from Vallabh Patel Chest Institute, Delhi, showed that most common positive in SPT were insect (43.90%), weed (21.79%), tree (15.14%) pollens, dust (14.49%), HDM (12.42%), fungi (11.98%), grass pollens (7.73%), kapok cotton (2.18%), silk (1.30%), and wool (0.76%). [10] Among the insects, the most common allergens were moth and mosquito. The present study from the same institute found that insect was the most common allergen. Among the insects, the most common allergen was cockroach. The above finding showed a different pattern of allergen sensitivity in the same institute in the last two decades. These differences may be due to change in patient profile, as in the present study, we enrolled only asthmatic patients. While in early studies includes all respiratory allergic disease i.e. asthma, allergic rhinitis and both. These differences may be due to change in climatic condition, fauna, and flora of Delhi-NCR in the last two decades.

In our study among insects, cockroach (34%) was the most common aeroallergen showing a significant positive skin reaction, followed by moth (32.5%), mosquito (30.5%), housefly (27.5%), and rice weevil (20.5%). Patel *et al.* from Gujarat have shown that moth was the most common insect allergen. [19] Agrawal *et al.* from Uttar Pradesh demonstrated cockroach as the most common offending insect. [20] Similarly, Giridhar *et al.* from Lucknow city also reported that cockroach was the most common allergen [21] and Rasool *et al.* studied on Kashmiri population, observed that pollens was the most common allergens, followed by HDM. [22] Furthermore, Singhal *et al.* in 2003 revealed that cockroach, housefly, mosquito, moth, and rice weevil were also the most important insect allergens showing a significant positive skin reaction. [9] It is seen that different studies from different regions/states of our country report different SPT patterns. This difference in allergen among respiratory allergic patients from different parts of the country may be due to different cultures, geographic, climatic conditions, fauna, and flora of particular area/region.

Our study will be useful in providing information on the pattern of allergen sensitization in Delhi-NCR of the country. The variability in skin prick test results for various aeroallergens in different regions of the country can be helpful for diagnosis and management of respiratory disease patients.

The SPT sensitivity among allergic patients was different even in the same institute over the last two decades, with cockroach as the most common insect allergen in the present study. These changes in SPT pattern may be due to change in climatic conditions and fauna and flora with patients' characteristics over the last two decades.

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Conflicts of interest

There are no conflicts of interest.

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