Original Research Paper

Volume - 15 | Issue - 08 | August - 2025 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Respiratory Medicine

"A PROSPECTIVE STUDY OF AEROALLERGEN SENSITIZATION PATTERNS USING MONTHLY SKIN PRICK TESTING IN OPD PATIENTS AND HEALTHY VOLUNTEERS IN SOUTH INDIA"

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ABSTRACT Allergy-The voice of the people. Skin prick test accurate test for determining offending allergens in allergic conditions. House dust mites were the most common offending aeroallergen among patients with allergic rhinitis and/or bronchial asthma Allergic airway diseases like allergic rhinitis and asthma are on the rise in South Asia, with aeroallergen sensitization being a key contributing factor. 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. Skin prick testing (SPT) is used to identify allergen sensitization, like asthma or allergic rhinitis. It involves introducing small amounts of various aeroallergens onto the skin, usually the forearm, and observing for a localized skin reaction, which indicates sensitization. **Objective:** To assess sensitization trends to common aeroallergens in outpatient department (OPD) patients and healthy volunteers over a 5-month period using SPT, and to evaluate clinical correlation via detailed second-history confirmation. **Methods:** This prospective study was conducted from September 2023 to January 2024 at Apollo Medical College, Hyderabad. A total of 35 individuals (30 symptomatic patients and 5 asymptomatic volunteers) underwent monthly SPT using a standardized panel of 13 aeroallergens. Demographic data, clinical symptoms, spirometry results, and sensitization profiles were recorded. Sensitizations were cross-validated using "second-history" - a detailed retrospective review of clinical symptoms and allergen exposure. **Results:** The most common sensitization was to house dust mite mix (Dp/Df) (68%), followed by cockroach (43.3%) and Cyanodon dactylon (36.7%). Sensitizations were ruled out in 4 patients through second-history, and 2 SPTs were invalid. Among sensitized patients, 85.7% had allergic rhinitis, and 80% had asthma, with 71.4% showing good reversibility. A strong association (92.3%) between moderate persistent allergic rhinitis and asthma was found in patients ≤30 years. **Conclusion:** House dust mite and cockroach remain the most dominant aeroallergens in urban South India. Second-history correlation is essential to avoid overdiagnosis. Early sensitization, especially in younger individuals, highlights the need for proactive allergen identification and targeted management.

KEYWORDS : Aeroallergens, skin prick testing, house dust mite, asthma, allergic rhinitis

INTRODUCTION

The prevalence of asthma and other allergic diseases (e.g., rhinitis and eczema) has increased worldwide over the last twenty years (1).

The origins of these diseases are complex, but understanding genetic and environmental risk factors can shed light on possible measures which can be taken to prevent the development of the disease (2).

Atopy is an individual predisposition to the development of allergic diseases. IgE-mediated sensitization to food or at least one environmental allergen can be detected with SPT, which is an easy-to-use, fast, and highly sensitive method for diagnosing IgE-mediated allergies (3).

Studies have suggested that the type of allergen sensitization may influence the development, duration, and severity of allergic diseases (4,5).

Aeroallergens are an important causal factor in the pathogenesis of these disorders, and sensitivity to allergens varies by country and region. This can be explained by differences in climate and variations in the presence of allergens in different geographical areas (6).

Identifying sensitization patterns in specific geographic areas allows specific interventions such as allergen reduction and/or avoidance and encourages the use of specific immunotherapy (7).

In two previous studies conducted in our region to determine childhood aeroallergens sensitivity, house dust mites (HDMs), Molds and pollens were found to be the most common allergens (8,9).

Numerous substances of diverse origins continuously circulate in the atmosphere, forming atmospheric aerosols. (10)

When these allergens enter the human body through inhalation, they can stimulate the immune response in genetically predisposed individuals, leading to the development or exacerbation of allergic diseases, such as allergic rhinitis and asthma. (11)

The allergenic content of the atmosphere varies significantly based on climate, geography, and vegetation.(12)

The composition of biological particles in the atmosphere exhibits both spatial and temporal variability, meaning that allergen levels can differ widely between locations and change over time. (13)

Given the health implications of airborne allergens, monitoring their presence in the atmosphere has become essential. Pollen monitoring, in particular, has become a standard practice in many countries enabling the collection of data that helps predict allergen levels and inform public health strategies.(14)

Allergic diseases, including conditions such as allergic rhinitis, asthma, and atopic dermatitis, significantly impact the quality of life of affected individuals (15)

Avoiding specific allergens can be an effective strategy for preventing allergies and managing symptoms. Reports indicate that avoiding significant allergens can lead to clinical remission and, in many instances, decrease bronchial hyper-reactivity. (16)

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. (17,18)

The types of aeroallergens, however, differ widely depending on localities and even vary both within and between countries.(19)

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.(20)

MATERIALS AND METHODS

Study Design and Setting

This was a prospective observational study conducted at the Department of Pulmonology, Apollo Medical College, Hyderabad, India. The study duration was 5 months, from September 2023 to January 2024.

Participants

A total of 35 individuals were recruited. This included 30 patients presenting with symptoms suggestive of allergic airway disease (allergic rhinitis and/or asthma), and 5 asymptomatic healthy volunteers, one of whom had a positive family history of allergy.

Participants were aged between 4 and 76 years. Written informed consent was obtained from all participants or their guardians (in case of minors).

Inclusion Criteria

Patients with clinical suspicion of allergic rhinitis or asthma
Age ≥4 years

Exclusion Criteria

Use of medications that interferes SPT
Active skin diseases interfering with SPT
Uncontrolled comorbid illness

Skin prick testing (SPT) was performed monthly using a standardized panel of 13 aeroallergens including:

Saline (S) Negative Control

Histamine (H) Positive Control
1.House Dust Mite mix Dp Df mix
2.Alternaria
3.aspergillus fumigatus
4.Cat Dander
5.Dog dander
6.Cockroach
7.Cyanodon
8.Parthenium
9.Artemesia
10.Amaranthus
11.Chenopdium
12.Ricinus
13.Acacia

Positive (histamine) and negative (saline) controls were used. Tests were considered valid if the histamine wheal was ≥3 mm and the saline control was <3 mm.

SPTs were conducted on the volar forearm, and results were recorded 15 minutes post-application. A wheal ≥3 mm larger than the negative control was considered positive. Presence of pseudopods or flare reactions was also noted.

Clinical History And Second-history Correlation

Detailed clinical history was obtained at baseline and correlated monthly. A second focused retrospective clinical review ("second-history") was done after positive SPTs to determine if the sensitization had clinical relevance (e.g., exposure, symptoms, seasonality).

Spirometry

Pulmonary function tests were performed on all patients using standard spirometry protocols. Reversibility was assessed following inhaled bronchodilator administration. Obstruction and response were categorized based on ATS/ERS criteria.

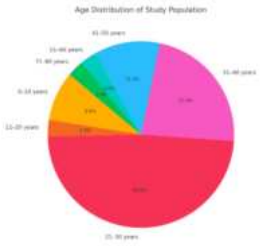
Data Analysis

Descriptive statistics were used to analyse sensitization frequencies, demographic distribution, and clinical patterns. Age-wise distribution, sensitization combinations, asthma-reversibility patterns, and associations between allergic rhinitis and asthma were evaluated using simple percentage-based breakdowns.

RESULTS

Study Population

A total of 35 participants were included in the study, of which 30 were symptomatic outpatient department (OPD) patients, and 5 were asymptomatic healthy volunteers. The mean age was 28.6 years (range 4–76 years), with 17 females and 18 males. Among the volunteers, 4 were females and 1 was male.



Age Group	Number of Participants	Percentage (%)
0–10 years	3	8.6%
11–20 years	1	2.9%
21–30 years	17	48.6%
31–40 years	8	22.9%
41–50 years	4	11.4%
51–60 years	1	2.9%
71–80 years	1	2.9%

Skin Prick Test Validity

SPT was valid in 33 participants. Two subjects were excluded due to recent antihistamine use, which invalidated their tests.

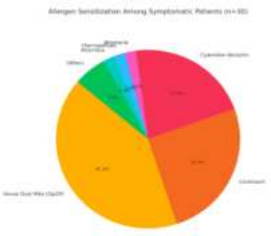
Sensitization Overview

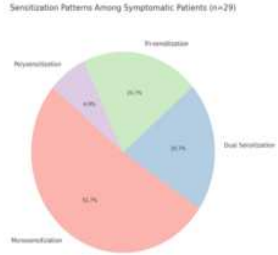
Out of the 33 valid tests: 27 participants (81.8%) showed at least one sensitization

6 participants showed no sensitization (including 3 of the 5 volunteers)

Most Common Allergens:

Allergen	Positive (n=30)	Percentage (%)
House Dust Mite (Dp/Df)	21	68.0%
Cockroach	13	43.3%
Cyanodon dactylon	11	36.7%
Alternaria	1	3.3%
Chenopodium album	1	3.3%
Artemisia scoparia	1	3.3%
Others (*Ricinus*, Cat/Dog dander, Acacia)	Rare (1 each)	<5%





Sensitization Patterns

Monosensitizations: 15 patients had monosensitization (e.g., HDM or cockroach alone).

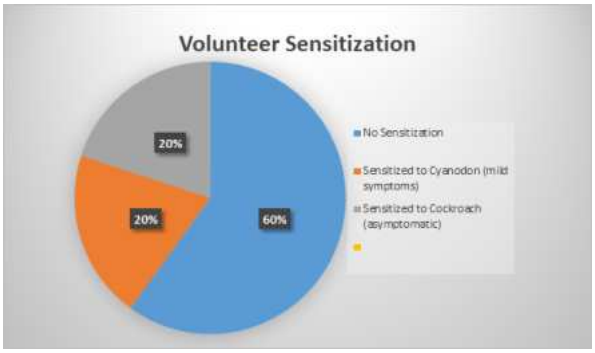
Dual sensitizations: 6 patients had combinations (e.g., HDM + Cyanodon or Cockroach + Cyanodon).

Tri-sensitizations: 6 patients had three allergens positive.

Polysensitization (>3 allergens): 2 patients had ≥4 allergen sensitizations, including food cross-reactivity (shrimp) and pet dander.

Volunteers

1 of 5 volunteers with family history of allergy showed sensitization to Cyanodon, with mild symptoms (itching after grass exposure).
1 volunteer showed asymptomatic cockroach sensitization.
3 volunteers had no sensitization.

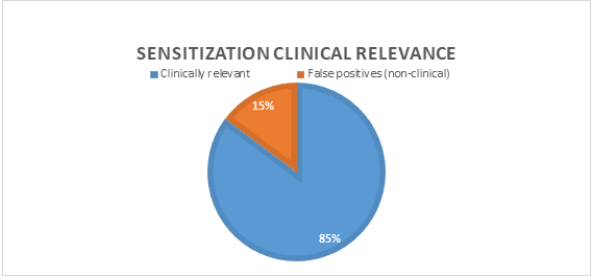


Clinical History Correlation

Second-history correlation- confirmed that 23 of 27 sensitizations were clinically relevant.

4 sensitizations (3 cockroach, 1 Ricinus) were ruled out as non-clinical (false positives).

Pseudopods were observed in 10 subjects, mostly with HDM, cockroach, and Cyanodon.



Association with Asthma and Allergic Rhinitis

Allergic rhinitis: 30/35 (85.7%)
Asthma: 28/35 (80%)
Spirometry obstruction: 27/35 (77.1%)
Reversibility with bronchodilator: Observed in \~71.4%

Age-wise Clinical Patterns

Young adults (21–30 years)-showed highest sensitization rates, with 92.3% of those with moderate persistent allergic rhinitis also having asthma.

Children (≤10 years) had early-onset allergic airway disease.

Older adults (>50 years) were more likely to have fixed obstruction (50%).

Age Group	Key Findings
Children (≤10 yrs)	- Early-onset allergic airway disease - Often nasal symptoms predominate early
Young Adults (21–30 yrs)	- Highest **sensitization rates** overall - **92.3%** of those with moderate persistent **allergic rhinitis** also had **asthma**
Older Adults (>50 yrs)	- More likely to have **fixed obstruction** - Seen in **50%** of this age group - Suggestive of chronic airway remodeling

Cases Needing Further Workup

3 patients with strong clinical history for HDM but negative SPT were advised for Component Resolved Diagnostics (CRD) or Nasal Provocation

DISCUSSION

This prospective observational study highlights aeroallergen sensitization patterns in symptomatic patients and healthy volunteers in an outpatient setting in South India, using monthly skin prick testing (SPT) over five months. Our findings emphasize the prominence of house dust mite (HDM) and cockroach allergens in urban Indian populations, consistent with previous regional and international studies.House dust mite mix (Dp/Df) was the most prevalent allergen, sensitizing 68% of tested individuals. This aligns with known patterns in tropical climates where HDM thrives due to high humidity and indoor allergen accumulation. Cockroach sensitization was the second most common (43.3%), highlighting the impact of poor ventilation and urban overcrowding - a finding similarly observed in studies from Southeast Asia and Latin America.

Interestingly, Cyanodon dactylon (Bermuda grass) emerged as the third most common sensitizer (36.7%), indicating significant pollen exposure even among city dwellers. This suggests that pollen allergen relevance may be under-recognized in urban Indian settings.

The novel aspect of this study was the use of "second-history" correlation, where positive SPTs were retrospectively matched with clinical symptom patterns. This approach helped rule out four sensitizations that were not clinically significant, underscoring the critical role of context in interpreting SPT results. Overdiagnosis and unnecessary treatment can be minimized through this method.

Another key observation was the strong association (92.3%) between moderate persistent allergic rhinitis and asthma in young adults (≤30 years). This supports the unified airway theory, which proposes that allergic inflammation affects both upper and lower respiratory tracts simultaneously.

Three patients with strong clinical suspicion of HDM allergy but negative SPT results were advised for further testing using component resolved diagnostics (CRD) or nasal provocation testing. This highlights the limitations of extract-based SPT in certain phenotypes or endotypes of allergy, and supports the move toward molecular-level diagnostics when possible.

Among volunteers, one sensitization (to Cyanodon) was correlated with mild cutaneous symptoms without respiratory involvement. This reinforces the need to interpret test results within a clinical allergy framework, rather than treating sensitization as disease.

CONCLUSION

This study confirms that house dust mite, cockroach, and Cyanodon dactylon are the leading aeroallergens in urban Indian populations. Skin prick testing remains a useful tool for allergen identification but should be combined with clinical history — including second-history assessment — to avoid misdiagnosis. The high prevalence of allergic rhinitis and asthma in younger adults, and the strong association between the two, calls for early detection and targeted management strategies. Future studies with larger samples and extended seasonal follow-ups are needed to explore longitudinal patterns and the impact of interventions.

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