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Pattern of Allergen Sensitization in Patients with Allergic Rhinitis: A Hospital-Based Observational Study

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ABSTRACT

Background: Allergic rhinitis is a common immunoglobulin E (IgE)-mediated inflammatory disorder characterized by nasal symptoms triggered by exposure to environmental allergens. The pattern of allergen sensitization varies according to geographical and environmental factors, and identification of predominant allergens is essential for effective allergen avoidance strategies and individualized management.

Objective: To evaluate the pattern of allergen sensitization among patients with allergic rhinitis attending a tertiary care teaching hospital in Northern India.

Methods: This hospital-based observational study was conducted in the Department of Otorhinolaryngology over a two-year period (October 2022–June 2024) following institutional ethics committee approval. Sixty-four patients aged 18–55 years with allergic rhinitis diagnosed according to Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines were included. Allergen sensitization was assessed using skin prick testing and/or serum allergen-specific IgE testing. A standardized allergen panel comprising house dust mites, pollens, fungi, dusts, and cockroach allergens was evaluated. Data were analyzed using descriptive statistics and expressed as frequencies and percentages.

Results: The study included 38 (59.4%) males and 26 (40.6%) females, with a mean age of 31.8 years. *Dermatophagoides farinae* was the most frequently identified allergen, with sensitization observed in 23 (35.9%) patients. Other commonly identified allergens included *Chenopodium album*, *Aspergillus fumigatus*, hay dust, house dust, *Cassia fistula*, cement dust, and *Candida albicans*. Sensitization to multiple allergens was common, with 36 (56.3%) patients demonstrating polysensitization to four or more allergens, while only 12 (18.8%) exhibited mono- or paucisensitization.

Conclusions: House dust mites, particularly *Dermatophagoides farinae*, were the predominant sensitizing allergens among patients with allergic rhinitis in this population. The high prevalence of polysensitization highlights the importance

of comprehensive allergen evaluation to facilitate targeted environmental control measures and support individualized management, including consideration of allergen-specific immunotherapy where appropriate.

Keywords: Allergic Rhinitis; Hypersensitivity, Immediate; Skin Tests; Mites; Immunoglobulin E; Allergens.

INTRODUCTION

Allergic rhinitis is a chronic inflammatory disorder of the nasal mucosa mediated by immunoglobulin E (IgE) following exposure to environmental allergens. It represents a type I hypersensitivity reaction in which allergens trigger the release of inflammatory mediators such as histamine, leading to the classic symptoms of sneezing, rhinorrhoea, nasal obstruction, and itching. On re-exposure, cross-linking of allergen-specific IgE antibodies on mast cells results in the release of histamine, leukotrienes, and prostaglandins, causing characteristic nasal symptoms.

Allergen sensitization refers to the development of specific IgE antibodies after exposure to environmental allergens and plays a central role in the pathophysiology and severity of allergic rhinitis. Common sensitizing allergens include house dust mites (HDMs), pollens, molds, and animal dander. Their prevalence varies according to geographic and climatic conditions.

Identification of sensitizing allergens aids in planning allergen avoidance, pharmacotherapy, and allergen-specific immunotherapy, thereby improving disease control and quality of life. **[1,2,5]**

Allergic rhinitis is one of the most common chronic respiratory disorders worldwide, with a prevalence ranging from 10–30% in adults and up to 40% in children. The prevalence has increased over recent decades due to urbanization, pollution, and lifestyle changes. It is frequently associated with asthma, sinusitis, and otitis media, supporting the concept of a unified airway. The pattern of allergen sensitization varies significantly by geographic region, climate, and environmental exposure. **[3,4,5]**

This hospital-based observational study was conducted to evaluate the pattern of allergen sensitization among patients with allergic rhinitis attending a tertiary care teaching hospital in Northern India. The findings aim to inform local allergen profiles and guide targeted management strategies.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based observational study conducted in the Department of Otorhinolaryngology at a tertiary care teaching hospital after obtaining approval from the Institutional Ethics Committee (HIMSR/IEC 0066/2022). Patients suffering from allergic rhinitis over a two-year period (October 2022 to June 2024) were included.

Study Population

Patients attending the outpatient department with symptoms suggestive of allergic rhinitis were screened. A total of 64 patients with complaints of anterior or posterior watery rhinorrhea, sneezing episodes, and nasal blockage were included. Severity was assessed as per ARIA guidelines.

Inclusion Criteria:

1. Patients aged 18–55 years.
2. Diagnosis of allergic rhinitis as per ARIA guidelines.
3. Willingness to undergo allergen testing (skin prick test and/or serum-specific IgE).

Exclusion Criteria:

1. Non-allergic rhinitis
2. Acute upper respiratory tract infection
3. Chronic rhinosinusitis
4. Gross structural abnormalities of the nasal cavity
5. Immunodeficiency disorders
6. Pregnancy or lactation

Allergen Testing

Allergen sensitization was evaluated using skin prick testing (SPT), the reference

standard for the diagnosis of IgE-mediated allergic sensitization, and/or serum allergen-specific immunoglobulin E (IgE) testing. For SPT, standardized allergen extracts were applied epicutaneously using a sterile lancet to a penetration depth of approximately 1 mm. Negative (diluent) and positive (histamine/codeine) controls were included to ensure test validity. Skin reactions were assessed 15 minutes after allergen application, and a positive result was defined as a wheal diameter exceeding the negative control by >3 mm.

Allergen panel included:

- House dust mites (Dermatophagoides farinae, Dermatophagoides pteronyssinus)
- Pollens (e.g., Amaranthus, Chenopodium, Cassia)
- Fungi (e.g., Aspergillus species, Candida albicans)
- Dusts (house dust, hay dust, flour mill dust, cement dust)
- Cockroach allergens (Blattella germanica)

Statistical Analysis

Data were entered into Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) and analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 20.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation (SD), whereas categorical variables were expressed as frequencies and percentages. The distribution of demographic characteristics and allergen sensitization profiles was described using descriptive statistics. The prevalence of sensitization to individual allergens and the pattern of mono-/paucisensitization and polysensitization were calculated and presented in graphical format.

RESULTS

A total of 64 patients with a confirmed diagnosis of allergic rhinitis were enrolled in the study. The study population comprised 38 males (59.4%) and 26 females (40.6%), with a mean age of 31.8 years. The majority of participants belonged to the 18–30 years age group (n = 27), followed by 31–40 years (n = 21), >40 years (n = 11), and <18 years (n = 3).

Overall Pattern of Allergen Sensitization

The most common allergen identified was Dermatophagoides farinae (house dust mite), observed in 23 patients (35.9%), making it the predominant sensitizing allergen (Figure 1). Other frequent allergens included Chenopodium album (n=8, 12.5%), Aspergillus fumigatus (n=7), hay dust (n=6), house dust (n=6), cement dust (n=5), Cassia fistula (n=6), and fungal allergens such as Aspergillus niger and Candida albicans (combined n=12). Sensitization to Dermatophagoides pteronyssinus was observed in 4 patients.

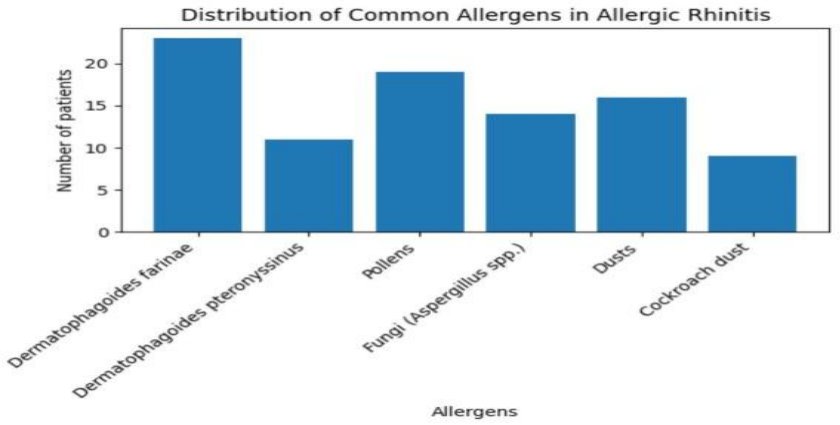

Figure 1: Distribution of common allergens in allergic rhinitis.

Pattern of Allergen Sensitization (Polysensitization)

A high prevalence of sensitization to multiple allergens was observed among the study participants. Overall, 36 patients (56.3%) demonstrated sensitization to four or more allergens, indicative of polysensitization, whereas 16 patients (25.0%) were sensitized to three allergens. In contrast, only 12 patients (18.8%) exhibited sensitization to one or two allergens, representing mono- or paucisensitization (Figure 2).

These findings indicate that polysensitization was the predominant sensitization pattern in the study population, with more than half of the patients exhibiting reactivity to multiple allergen groups. The relatively low proportion of mono- or paucisensitized individuals suggests a complex pattern of allergen exposure and sensitization among patients with allergic rhinitis in the present cohort.

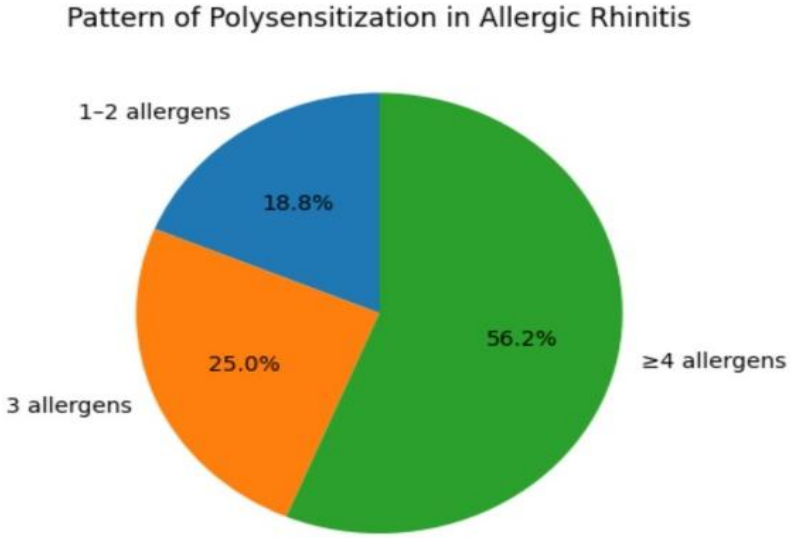

Figure 2: Pattern of polysensitization in allergic rhinitis.

DISCUSSION

This hospital-based observational study evaluated the pattern of allergen sensitization among patients with allergic rhinitis. The findings demonstrate a clear predominance of indoor allergens, particularly house dust mites, along with a substantial burden of polysensitization in the study population.

Predominance of House Dust Mite Sensitization

The most significant observation in the present study was the high prevalence of sensitization to Dermatophagoides farinae, which emerged as the leading allergen. This finding aligns with numerous Indian and Asian studies that consistently report house dust mites (HDMs) as the principal perennial aeroallergens in allergic rhinitis. The climatic conditions prevalent in many parts of India—characterized by warmth and humidity—create an ideal environment for mite proliferation. Continuous indoor exposure to mite allergens, particularly in bedding, carpets, and upholstered furniture, likely explains their dominant role. The identification of HDM as the most frequent allergen reinforces the importance of environmental control measures in the management of allergic rhinitis. Variations in sensitization to specific mite species may be influenced by microenvironmental differences, housing conditions, or allergen panel composition **[6-10]**.

Role of Pollens and Outdoor Allergens

Pollens represented the second important group of allergens in the present study, with sensitization noted to allergens such as Chenopodium album and Cassia fistula. Pollen sensitization suggests that seasonal factors may contribute to symptom exacerbations in a subset of patients. Although house dust mites are typically associated with perennial allergic rhinitis, pollen sensitization may explain intermittent or seasonal worsening of symptoms. This dual pattern of sensitization highlights the mixed perennial and seasonal nature of allergic rhinitis in the studied population **[1]**.

Fungal Sensitization

Fungal allergens, including Aspergillus fumigatus, Aspergillus niger, and Candida albicans, were identified in a notable proportion of patients. Airborne fungal spores are recognized aeroallergens and may contribute to persistent nasal inflammation. The presence of fungal sensitization in this cohort underscores the need to consider damp indoor environments and poor ventilation as contributing factors. In regions with high humidity, fungal growth may further augment the allergen burden **[11]**.

Environmental and Occupational Exposures

Sensitization to environmental allergens such as hay dust, cement dust, and house dust indicates the influence of occupational and environmental exposure patterns. Such findings emphasize that allergic rhinitis in developing countries may reflect not only indoor domestic exposure but also occupational risk factors.

These observations highlight the importance of taking a detailed environmental and occupational history while evaluating patients with allergic rhinitis **[12]**.

Pattern of Polysensitization

A major finding of this study was the high prevalence of sensitization to multiple allergens. Most patients were reactive to more than one allergen, indicating a pattern of polysensitization.

Polysensitization may arise from prolonged exposure to diverse environmental allergens or from cross-reactivity between allergen families. Clinically, polysensitized patients may experience more persistent or severe symptoms and may present management challenges. This suggests that multi-allergen sensitization is a common phenomenon in allergic rhinitis **[13]**.

Limitations of this study include its observational design, single-center setting, and reliance on descriptive analysis without inferential statistics or control group comparison. Future studies with larger samples and longitudinal follow-up could further elucidate clinical correlations.

CONCLUSION

This hospital-based observational study demonstrated that house dust mites, particularly *Dermatophagoides farinae*, were the predominant sensitizing allergens among patients with allergic rhinitis attending a tertiary care center in Northern India. A high prevalence of polysensitization was observed, indicating that exposure to multiple environmental allergens is common in this population. In addition to house dust mites, pollens, fungal allergens, and environmental dusts contributed substantially to the overall sensitization profile, highlighting the heterogeneous nature of allergen exposure.

The findings emphasize the importance of comprehensive allergen evaluation for identifying clinically relevant sensitization patterns and facilitating individualized management strategies. Knowledge of regional allergen profiles may aid clinicians in implementing targeted allergen avoidance measures, optimizing pharmacological therapy, and selecting appropriate candidates for allergen-specific immunotherapy. Furthermore, these data contribute to the growing evidence on geographical variations in allergen

sensitization and may assist in developing region-specific diagnostic and preventive approaches.

Given the descriptive nature of this single-center study and its relatively small sample size, larger multicenter studies incorporating inferential statistical analyses and longitudinal follow-up are warranted to validate these findings and explore the relationship between allergen sensitization patterns, disease severity, and long-term clinical outcomes.

Declaration

Ethical Approval: Approved by Institutional Ethics Committee (HIMSR/IEC/0066/2022)

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Conflict of Interest: The authors declare no conflict of interest.

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