AEROALLERGEN SENSITIZATION PATTERNS IN PATIENTS WITH ALLERGIC RESPIRATORY DISEASES AT A SINGLE CENTER IN PESHAWAR, PAKISTAN: RETROSPECTIVE ANALYSIS INCLUDING PATIENTS FROM NEIGHBORING AFGHANISTAN

Saima Alam[1], Wajeeha Qayyum[2], Nabeel Khan[3], Suleman Ali Khan[4]

How to cite this article

Alam S, Qayyum W, Khan N, Khan SA. Aeroallergen Sensitization Patterns in Patients with Allergic Respiratory Diseases at A Single Center in Peshawar, Pakistan: Retrospective Analysis Including Patients from Neighboring Afghanistan. J Gandhara Med Dent Sci. 2026;13(2):50-54
https://doi.org/10.37762/jgmds.13-2.796

Date of Submission: 02-10-2025
Date Revised: 10-03-2026
Date Acceptance: 15-03-2026

[2]Assistant Professor, Department of Medicine, Rehman Medical Institute, Peshawar
[3]Medical Officer, Department of Pulmonology, Rehman Medical Institute, Peshawar
[4]Trainee Medical Officer, Department of Pulmonology, Rehman Medical Institute, Peshawar

Correspondence

[1]Saima Alam, Associate Professor, Department of Pulmonology, Rehman Medical Institute, Peshawar
: +92-336-9616105
: saima.alam@rmi.edu.pk

ABSTRACT

OBJECTIVES

To investigate the prevalence and patterns of aero-allergen sensitization in patients assessed for allergic respiratory diseases, referred to a tertiary care center in Peshawar, Pakistan, including patients from neighbouring Afghanistan.

METHODOLOGY

This retrospective observational study reviewed the results of 452 skin prick tests (SPTs) performed as part of routine assessment between January 2017 and December 2022 at the Rehman Medical Institute. The sensitization response to 13 types of inhalant allergens (both seasonal and perennial) was documented. Using a multivariate logistic regression model, associations with age, gender, and region of origin were investigated, reporting the adjusted odds ratio(OR) and 95% confidence interval (CI).

RESULTS

Four hundred and fifty-two (452) patients were studied; 362 (80.1%) had at least one positive skin prick test result and were therefore included in the analysis. HDM was the most common allergen identified (62.7%), followed by mouse (40.9%) and cockroach (40.3%). Mulberry (17.1%), silver birch (16.0%), and grass mix (13.5%) were the leading seasonal allergens. Polysensitisation was demonstrated in 66.6% of the patients studied. Multivariate logistic regression analyses showed that age was inversely related to sensitization to weeds (OR=0.97, CI 0.94-0.99, p=0.03), mixed feather (OR=0.97, CI 0.95-1.00, p=0.04), and cockroach allergens (OR=0.98, CI 0.97-0.99, p=0.038). No other associations with demographic or regional factors reached statistical significance.

CONCLUSION

HDM is the major allergen causing sensitization among patients with allergic respiratory disease in this clinical group, and has a high level of Polysensitisation. The observed differences in association with gender and age highlight the need for region-specific diagnostic panels and caution when interpreting statistically borderline associations.

KEYWORDS: *Allergic Respiratory Diseases, Aeroallergen Sensitization, House Dust Mite, Skin Prick Test, Peshawar, Pakistan, Afghanistan, Polysensitization*

INTRODUCTION

The increasing prevalence of allergic respiratory diseases, especially allergic rhinitis and asthma, represents a growing public health issue in South and Southeast Asia. Rise in urbanization, environmental pollution, climate change, and lifestyle changes are the major contributors to the increase in these disorders.[1,2,3,4,5,6] HDM is the most common allergen responsible for sensitization, with rates reported at 50-85% among allergic individuals in Pakistan, Bangladesh, and Iran.[7,8,9,10] Cockroach allergens are also highly prevalent in urban environments, due to high exposure levels resulting from overcrowding and poor living conditions.[2,4,8] In addition to HDM and cockroach allergens, other aeroallergens of significance in Pakistan include pollen from grasses and weeds (including Parthenium hysterophorus, Chenopodium album, and Prosopis juliflora), animal dander and mould spores (Alternaria, Aspergillus).[6,9,10,11,12,13] Geographic variations in allergen sensitivity exist, primarily due to differences in climate, plant species, and occupational exposure.[6,9,10] Early and progressive Polysensitisation to HDM and cockroach allergens is

common in pediatric populations and is associated with more severe allergic phenotypes.[14,15] Regardless of the considerable burden of allergic respiratory diseases across South and South East Asia, cross-border epidemiological studies of allergens remain poorly characterized, particularly for Afghanistan. Therefore, the primary aim of this study was to identify patterns of aeroallergen sensitization among patients assessed for allergic respiratory diseases at a tertiary care center in Peshawar, Pakistan, including those from neighbouring Afghanistan, using standardized skin prick testing and following ARIA guidelines for allergic rhinitis diagnosis and GINA guidelines for asthma diagnosis. Additionally, the study investigated demographic associations, the proportion of patients demonstrating monosensitization vs polysensitization, and seasonal vs perennial allergen patterns to provide a regional benchmark for clinical allergy practice.

METHODOLOGY

This is a retrospective observational study examining skin prick test (SPT) results from 452 patients who underwent SPTs to determine their allergen sensitivities to environmental allergens for allergic respiratory diseases between January 2017 and December 2022. Data was collected from records at Rehman Medical Institute (RMI) in Peshawar, Pakistan, where the skin prick tests were conducted. Approval was granted by the Institutional Review Board of Rehman Medical Institute, Peshawar (Approval No. RCD-005-25-216). Because this study involved a review of anonymized clinical data, the need for individual informed consent was waived. Patient demographics and clinical information were obtained retrospectively from the hospital's electronic medical record system and allergy clinic registers using a standard data collection form. Variables recorded included age, gender, location, clinical diagnosis, and SPT results for each aeroallergen tested. Before statistical analysis, all data were anonymized to protect patient privacy. Patients were included if they had a physician-confirmed diagnosis of allergic rhinitis, asthma, or both. Allergic rhinitis was diagnosed in accordance with the Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines, based on characteristic symptoms such as nasal congestion, rhinorrhea, sneezing, and nasal itching, with identifiable environmental triggers. Asthma was diagnosed in accordance with the Global Initiative for Asthma (GINA) guidelines, which include a history of variable respiratory symptoms such as wheeze, shortness of breath, chest tightness, and cough that vary over time and intensity. The availability of objective evidence of expiratory airflow limitation, including spirometry demonstrating reversible airflow obstruction or documented lung function variability, was used to support the diagnosis. Patients with atopic dermatitis without concurrent respiratory allergic disease were excluded. All patients were advised to discontinue systemic antihistamines for at least seven days before testing to reduce the likelihood of false-negative results. Skin prick testing was done using standardized allergen extracts from Stallergenes Greer (USA). These extracts are produced under controlled manufacturing conditions with standardized allergenic protein concentrations (typically 1:20 w/v or the highest available commercial concentration), ensuring consistency and reproducibility. The SPTs were done on the volar aspect of the forearm with a sterile single-use lancet (30 gauge, Golden+, Batla Impex). Each SPT included both a positive (histamine) and a negative (saline) control to confirm skin responsiveness to the testing extract and to rule out non-specific reactions. The diameter of the wheal was determined 15-20 minutes later. A wheal diameter of $\geq$ 3mm, greater than that of the negative control, indicated a positive reaction. To ensure uniformity of procedure, all SPTs were performed by trained personnel using a standard protocol, and the reliability of the SPTs was confirmed by repeating the testing in a random sample of patients. The allergen panel included 13 inhalant aeroallergens, categorized as seasonal and perennial. Seasonal allergens included: a mixture of grass pollen, a mixture of weed pollen, alder pollen, hazel pollen, white birch pollen, and mulberry pollen. Perennial allergens included: house dust mites, cockroaches, rodent epithelium, cat dander, dog epithelial cells, Aspergillus fumigatus, and Alternaria. This panel of allergens was chosen based on previously published studies of allergen distribution in the region and the ready availability of commercial extracts of these allergens. Some common allergens found in Pakistan (Parthenium hysterophorus, Chenopodium album, Prosopis juliflora) were not included in this panel because commercial extracts of these allergens were unavailable during the study. The study sample included all patients who underwent SPT during the study period following an outpatient department consultation. All patients who met the inclusion criteria were enrolled using a nonprobability, consecutive sampling technique. The sample size of 452 patients provided adequate numbers to estimate the prevalence of sensitization to specific allergens with reasonable accuracy and to evaluate associations with demographic characteristics. Data were analyzed using IBM SPSS Statistics version 25.0 (Armonk, NY, USA).

RESULTS

Of the 452 patients who underwent SPT, 362 (80.1%)

were found to be sensitive to at least one allergen. Ninety patients were excluded from the study because their SPTs failed to detect any sensitivity to the tested allergens. The patients were divided into four age categories: 0-20, 21-40, 41-60, and >60 years, and into five geographically distinct regional areas: Region 1- Peshawar, Jamrud, Khyber Agency; Region 2- Kohat, Bannu, Hangu, Lakki Marwat, Karak, Dera Ismail Khan, Darra Adam Khel, Orakzai Agency; Region 3- Charsadda, Mardan, Nowshehra; Region 4 - Swabi, Attock, Swat, Dir, Malakand, Abbottabad; and Region 5 - Afghanistan. Among the 362 patients with positive SPT results, 206 were male (57%), and 156 were female (43%). The average age of the patients studied was 29.8±13.1 years. When divided into age categories, the largest number of patients were in the 21-40 year category (n=193, 53.3%), followed by those 0-20 years old (n=102, 28.2%), 41-60 years old (n=59, 16.3%), and those >60 years old (n=8, 2.2%).

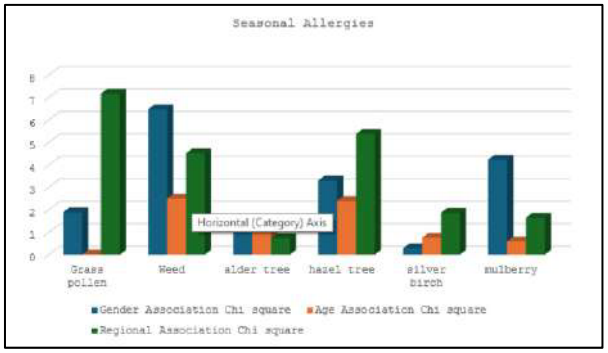

Figure 1: Chi-Square Associations of Aeroallergen Sensitization (n = 362 Patients with Positive Allergen Test Results) with Demographic Factors.

Note: Blue bars represent associations with gender, orange bars represent associations with age groups, and green bars represent associations with region.

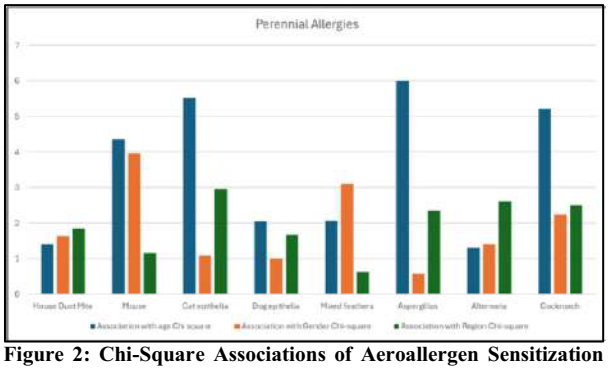

Figure 2: Chi-Square Associations of Aeroallergen Sensitization with Demographic Factors Among 362 Patients with Positive Allergen Test Results.

Note: Blue bars indicate associations with gender, orange bars indicate associations with age groups, and green bars indicate associations with region.

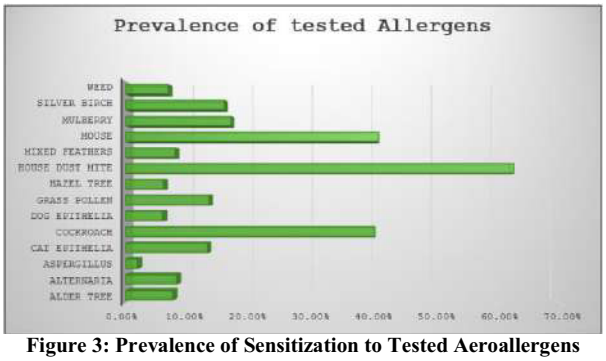

Figure 3: Prevalence of Sensitization to Tested Aeroallergens Among 362 Patients with Positive Allergen Test Results.

Note: Horizontal bars represent the percentage of patients sensitized to each allergen, including both seasonal and perennial allergens.

Table 1: Prevalence of Selected Perennial Allergens and Their Associations with Demographic Factors Among Patients Testing Positive for at least one Allergen (n = 362).

Aller-gens	Aller-gen	Association with age		Association with Gender		Association with Region	
	Frequency	Chi square	P-Value	Chi square	P-Value	Chi square	P-Value
House Dustmite	62.70%	1.403	0.705	1.633	0.201	1.838	0.765
Mouse epithelia	40.90%	4.357	0.225	3.963	0.047	1.158	0.885
Cat epithelia	13.30%	5.507	0.138	1.076	0.3	2.966	0.563
Dog epithelia	6.60%	2.041	0.564	0.999	0.318	1.672	0.796
Mixed feathers	8.00%	2.05	0.562	3.092	0.079	0.612	0.962
Aspergillus	1.90%	6.005	0.111	0.575	0.448	2.342	0.673
Alternaria	8.30%	1.307	0.727	1.399	0.237	2.603	0.626
Cockroach	40.30%	5.202	0.158	2.24	0.135	2.49	0.646

Table 2: Prevalence of Selected Seasonal Allergens and their Associations with Demographic Factors among Patients Testing Positive for at least One Allergen (n = 362)

Aller-gens	Aller-gen	Association with Gender		Association with age		Association with the region	
Type	Frequency	Chi square	P-Value	Chi square	P-Value	Chi square	P-Value
Grass pollen mix	13.80%	1.886	0.596	0.001	0.971	7.167	0.127
Weed mix	6.90%	6.473	0.91	2.495	0.114	4.51	0.341
Alder tree pollen	7.70%	1.518	0.678	1.484	0.223	0.736	0.947
Hazel tree Pollen	6.10%	3.297	0.348	2.391	0.122	5.37	0.251
Silver birch Pollen	16.00%	0.287	0.962	0.751	0.386	1.863	0.761
Mulberry Pollen	17.10%	4.23	0.24	0.586	0.444	1.647	0.8

Table 3: Logistic Regression Analysis of Demographic Factors Associated with Allergen Sensitization among Patients Testing Positive for at least One Allergen (n = 362)

Allergen	Age OR (95% CI)	P-Value (<0.05)	Gender OR (95% CI)	P-Value (<0.05)
Grass Pollen mix	0.995 (0.973-1.018)	0.677	0.998 (0.542-1.837)	0.995
Weed mix	0.970 (0.943-0.998)	0.033	0.516 (0.209-1.277)	0.153
Alder tree pollen	1.004 (0.974-1.034)	0.807	0.598 (0.263-1.364)	0.222
Hazel tree pollen	0.986 (0.955-1.017)	0.366	0.488 (0.186-1.280)	0.145
Silver birch Pollen	0.995 (0.974-1.017)	0.663	0.782 (0.439-1.394)	0.405
Mulberry Pollen	0.992 (0.972-1.013)	0.454	0.816 (0.465-1.430)	0.477
House Dust Mite	0.992 (0.976-1.009)	0.352	0.767 (0.498-1.179)	0.226
Mouse epithelia	1.013 (0.996-1.029)	0.140	1.505 (0.984-2.304)	0.060
Cat epithelia	0.989 (0.967-1.011)	0.319	1.411 (0.766-2.600)	0.270
Dog epithelia	0.994 (0.964-1.025)	0.694	0.649 (0.270-1.562)	0.335
Mixed feather	0.974 (0.948-1.000)	0.049	0.498 (0.213-1.163)	0.107
Aspergillus	0.966 (0.922-1.013)	0.157	1.904 (0.417-8.697)	0.406
Alternaria	0.989 (0.962-1.016)	0.422	1.603 (0.755-3.403)	0.219
Cockroach	0.983 (0.967-0.999)	0.038	0.743 (0.483-1.143)	0.177

Note: Odds ratios (ORs) and 95% confidence intervals (CIs) are presented by age group and gender to indicate the strength and significance of the associations.

DISCUSSION

This retrospective evaluation is one of the largest assessments of aeroallergen sensitization among patients with Allergic Respiratory Diseases within a single center in Peshawar, Pakistan, including patients from surrounding Afghanistan. The current evaluation confirms the dominance of perennial indoor allergens (i.e., HDM, Cockroach, and mouse) and identifies seasonal allergens (i.e., Grass, Mulberry, and silver birch pollen). The prevalence of HDM sensitisation (62.7%) is consistent with previous studies from Pakistan (50-70%), India (55 - 75%), Bangladesh (67 - 74%), and Iran (up to 85%).[7,8,9,10,16,17,18] In addition, cockroach and mouse allergens were identified as significant sensitizers, reflecting indoor exposures common in densely populated urban and peri-urban environments. The most common seasonal allergens in our cohort, i.e., mulberry (17.1%), silver Birch (16.0%), and grass mix (13.5%), were consistent with studies from northern Pakistan.[18] In our cohort, polysensitization was observed in 66.6% of patients. The frequency of polysensitization increased with age, reflecting cumulative exposure to allergens. Logistic regression analysis identified that increasing age was inversely associated with sensitization to weeds, mixed feathers, and cockroach allergens, indicating age-related variations in immune responsiveness or exposure. No other significant demographic or regional associations were seen. The allergen panel included 13 inhalant allergens, chosen based on their availability as commercially standardized extracts and clinical relevance. Regionally important allergens (e.g., Parthenium, Chenopodium, Prosopis Pollen) were not included due to a lack of commercially available standardized extracts at the time of testing. Although this may have underestimated the prevalence of sensitization to these weeds, the allergen panel provides a reliable representation of the most commonly used diagnostic allergens in clinical practice during the study period.

LIMITATIONS

As a single-center retrospective evaluation, selection and referral bias may influence generalizability. Molecular data and longitudinal follow-up were not available. Therefore, our understanding of the mechanisms behind some of the results observed in the current cohort of patients is limited. Cross-sectional design and a limited allergen panel also limit the assessment of all regionally relevant exposures. However, the inclusion of patients from multiple geographic clusters (including Afghanistan) enhances the representativeness of the study. Future multicenter studies using component-resolved diagnostics, environmental allergen monitoring, and longitudinal follow-up are needed to clarify regional sensitization patterns and support personalized management strategies.

CONCLUSIONS

HDM remains the dominant allergen causing sensitivity among patients with allergic respiratory diseases within this cohort. High rates of poly-sensitization and demographic trends highlight the need for region-specific diagnostic panels and careful interpretation of results. The increased sensitivity to weed pollen, mixed feathers, and cockroach in older patients may be explained by age-related immunosenescence and immune imbalance, making older individuals more prone to allergic inflammation. These findings provide a foundation for improved allergy diagnostics, avoidance strategies, and future multicenter research in Pakistan and neighboring regions.

CONFLICT OF INTEREST: None

FUNDING SOURCES: None

REFERENCES

1. Sangsupawanich P, Surapon J, Teerayuth R. Aeroallergen sensitization among adults with allergic rhinitis in Chiang Mai, Thailand. Asian Pac J Allergy Immunol. 2021;39(3):151-157. PMID: 34262297.
2. Rujanapun N, Wongsa C, Thongngarm T, et al. Epidemiology and patterns of aeroallergen sensitization in adult Thai patients with allergic rhinitis. Asian Pac J Allergy Immunol. 2022;40(4):267-274. https://doi.org/10.12932/AP-130921-1277.
3. Ong C, Leong K, Lee BW. Aeroallergen sensitization and associated comorbidities in urban adult populations in Southeast Asia. Asia Pac Allergy. 2018;8(3):161-168. https://doi.org/10.5415/apallergy.2018.8.3.161 PMID: 30116654 PMCID: PMC6080034.
4. Nguyen TH, Nguyen LT, Pham LD, et al. Prevalence of sensitization to common aeroallergens among Vietnamese adults. Asia Pac Allergy. 2018;8(4):e36. https://doi.org/10.5415/apallergy.2018.8.4.e36 PMID: 30349872 PMCID: PMC6193395.
5. Janwitayanujit S, Wongsa C, Thongngarm T, et al. Prevalence and predictors of aeroallergen sensitization among children with allergic diseases in southern Thailand. Asian Pac J Allergy Immunol. 2024;42(1). PMID: 39220568.
6. Ngamphaiboon J, Manuyakorn W, Kamchaisatian W, et al. Polysensitization patterns in Southeast Asia: implications for diagnosis and therapy. World Allergy Organ J. 2021;14(2):100569. https://doi.org/10.1016/j.waojou.2021.100569 PMID: 33614964 PMCID: PMC7889871.
7. Parmar D, Gupta N, Sharma A, et al. Aeroallergen sensitization patterns in patients with allergic rhinitis and asthma in North India. Indian J Allergy Asthma Immunol. 2022;36(1):18-24.
8. Rahman A, Saeed A, Ahmad A, et al. Aeroallergen sensitivity patterns in allergic rhinitis patients in urban Pakistan. Pak J Med Sci. 2019;35(3):657-662. https://doi.org/10.12669/pjms.35.3.151 PMID: 31258539 PMCID: PMC6595284.
9. Kabir A, Rahman MA, Rahman MM, et al. Allergen sensitization among patients with respiratory allergies in Dhaka, Bangladesh. J Asthma Allergy. 2020;13:399-407. https://doi.org/10.2147/JAA.S260073 PMID: 32982319 PMCID: PMC7501026.
10. Keshavarzian A, Nabavi M, Amini M, et al. Pattern of aeroallergen sensitization among Iranian patients with asthma and allergic rhinitis. Iran J Allergy Asthma Immunol. 2021;20(4):401-410.
11. Bousquet J, Khaltaev N, Cruz AA, et al. Allergic rhinitis and its impact on asthma (ARIA) 2008 update. Allergy. 2008;63(Suppl 86):8-160. https://doi.org/10.1111/j.1398-9995.2007.01620.x PMID: 18331513.
12. Global Initiative for Asthma (GINA). Global strategy for asthma management and prevention. 2023 update. Available from: https://ginasthma.org.
13. Iqbal S, Mahmood K, Qureshi S. Pollen allergies and plant sources in Lahore: a growing urban health concern. J Pak Med Assoc. 2021;71(3):882-886. PMID: 33904452.
14. Liang H, Wei J, Xiao Z, et al. Component-resolved diagnostics in allergy: recent advances and applications. Clin Rev Allergy Immunol. 2023;65(1):50-64. https://doi.org/10.1007/s12016-022-08935-2 PMID: 35951333.
15. Martínez-Aranguren R, Gómez F, Garcia BE, et al. Emerging frontiers in allergen immunotherapy: molecular diagnosis and novel vaccines. Allergol Immunopathol (Madr). 2016;44(3):235-246. https://doi.org/10.1016/j.aller.2015.07.004 PMID: 26315677.
16. Shafique RH, Akhter S, Abbas S, Ismail M. Sensitivity to house dust mite allergens and prevalence of allergy-causing house dust mite species in Pothwar, Pakistan. Exp Appl Acarol. 2018;74(4):415-426. https://doi.org/10.1007/s10493-018-0246-8 PMID: 29546546.
17. Raza SN, Saleem M, Qamar N, et al. Frequency of aeroallergen sensitization in patients with allergic asthma in Pakistan. J Pak Med Assoc. 2018;68(8):1217-1221.
18. Khan MA, Khan MA, Ullah I, et al. Aeroallergen sensitization patterns among patients with allergic rhinitis in northern Pakistan. Pak J Med Sci. 2016;32(5):1211-1215. https://doi.org/10.12669/pjms.325.10541 PMID: 27882035 PMCID: PMC5116223.

AUTHORS CONTRIBUTION

Saima Alam **-** *Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Supervision; Final Approval*

Wajeeha Qayyum **-** *Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Final Approval*

Nabeel Khan **-** *Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Final Approval*

Suleman Ali Khan **-** *Concept & Design; Data Acquisition; Drafting Manuscript; Final Approval*

The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.