Original Article:

Study of common allergens for United Airway Disease by skin prick test: A single center study

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Abstract

Background: United Airway Disease (UAD) encompasses allergic rhinitis and bronchial asthma, sharing common immunopathological mechanisms and environmental triggers. Identifying region-specific aeroallergens is essential for effective diagnosis and management. This study aimed to identify the most prevalent inhalant allergens in UAD patients using skin prick testing at a tertiary care center in Dhaka, Bangladesh. **Methods:** A cross-sectional observational study was conducted at the Department of Respiratory Medicine, Medicine, Dermatology and Venereology, Bangabandhu Sheikh Mujib Medical University (BSMMU) from March 2017 to February 2018. A total of 100 patients diagnosed with allergic rhinitis and/or bronchial asthma underwent skin prick testing with 62 allergen extracts, including pollens, fungi, insects, dust, animal dander, fabric, and miscellaneous allergens. Positive reactions were assessed 15 minutes post-application, with a wheal size of +2 or greater considered significant. **Results:** Among 100 participants, 43% had allergic rhinitis, 22% had bronchial asthma, and 35% had both conditions. The majority of patients were aged 21-30 years (44%) and were predominantly male (58%). Pollens were the dominant allergens occurring in over one third of patients (32%). This was followed by dust mites (Dermatophagoides farina) showing a 23% positivity rate. Insect allergens, particularly female cockroach (16%) and male cockroach (12%), also showed high reactivity. House dust (19%) and paper dust (19%) were prevalent dust allergens. Fungal allergens like Aspergillus fumigatus (10%) and textile allergens such as Kapok cotton (10%) were also notable. These findings reveal a significant overlap between allergic rhinitis and bronchial asthma, with varied sensitivities to different allergens. **Conclusion:** The findings demonstrate a significant overlap in allergen sensitivity between the upper and lower airways, supporting the UAD concept. Early identification of common allergens through skin prick testing can guide targeted interventions and personalized immunotherapy, improving outcomes for patients with allergic airway diseases in Bangladesh.

Keywords: Asthma, United Airway Disease, Skin Prick Test, Aeroallergens, Bangladesh

Introduction

Allergic diseases, including allergic rhinitis and asthma, have become a significant public health concern worldwide, with an increasing prevalence in both developed and developing countries. Allergic rhinitis affects between 10% and 30% of the population globally, and sensitization to environmental allergens, particularly foreign proteins, is present in up to 40% of individuals [1]. The rise in allergic diseases has been particularly notable in industrialized countries over the past 50 years, with studies indicating that the prevalence of asthma in children has grown substantially [2]. This rise has led to a stronger understanding of the relationship between allergic rhinitis and bronchial asthma, with up to 80% of asthmatic patients also suffering from allergic rhinitis and about 40% of individuals with allergic rhinitis developing bronchial asthma. This overlapping of diseases has led to

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the concept of United Airway Disease (UAD), where both the upper and lower airways are affected by similar allergic processes [3-5].

Aeroallergens, which include pollen, fungal spores, dust mites, animal dander, and other bioparticulates, are known to play a critical role in the pathogenesis of allergic rhinitis and asthma. These allergens trigger IgE-mediated immune responses in susceptible individuals, leading to symptoms such as nasal congestion, sneezing, and asthma-related symptoms like wheezing and coughing. The role of airborne bioparticles in causing allergic reactions has long been studied within the field of aerobiology, which focuses on the study of pollen, spores, and other airborne microorganisms as agents of infection or allergy [6]. Bioparticulates, particularly pollen and fungal spores, are significant contributors to allergic diseases, and their presence varies across different environmental regions. Understanding the specific aeroallergens responsible for these conditions is crucial for effective diagnosis and treatment [7,8].

In Bangladesh, allergic rhinitis and asthma are increasingly prevalent, with environmental and genetic factors contributing to the growing number of cases. Local studies have identified a range of airborne allergens, including pollen, fungi, dust mites, and animal dander, that are responsible for allergic reactions in the population. Exposure to these allergens has been linked to an increased incidence of allergic rhinitis and asthma, especially in urban settings where environmental factors such as pollution exacerbate the condition [9]. This growing burden of allergic diseases, particularly in individuals diagnosed with United Airway Disease, underscores the need for further research into the specific allergens contributing to these conditions.

In line with these findings, studies on the quality of life of patients with allergic rhinitis have highlighted the impact of these conditions on daily activities and overall well-being, further emphasizing the importance of accurate diagnosis and targeted treatment [10]. Understanding the local prevalence of allergens responsible for allergic diseases is crucial for developing effective diagnostic and therapeutic strategies. Furthermore, aeroallergens exhibit variability across regions, and their identification is essential for improving immunotherapy outcomes for allergic patients [11] The skin prick test remains one of the most effective diagnostic tools for identifying specific allergens responsible for allergic reactions. This study aims to evaluate and identify the common allergens responsible for allergic rhinitis and asthma in patients diagnosed with United Airway Disease at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. The findings of this study wil valuable data on the prevalence of allergens such as pollen, fungi, dust, and animal dander in this population, which is essential for developing targeted prevention and treatment strategies.

Methodology

This cross-sectional observational study aimed to assess the prevalence of positive reactions to various allergen extracts in patients with respiratory complaints was conducted over one year, from 01 March 2017 to 28 February 2018 at the Department of Respiratory Medicine, Medicine, Dermatology and Venereology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh.

A total of 100 patients with allergic rhinitis and/or bronchial asthma aged between 18 and 60 years were included in the study.Patients with other respiratory illnesses, uncontrolled asthma or taking any anti-allergic medications or systemic corticosteroids were excluded from the study. Pregnant or breastfeeding women were not included.

Skin prick testing was conducted to assess allergic sensitivity to various allergens. A total of 62 allergen extracts were used, which included:

- Pollen allergens: 36 types
- Fungi allergens: 5 types
- Insect allergens: 4 types
- Dust allergens: 8 types
- Animal dander: 4 types
- Fabric allergens: 3 types
- Miscellaneous allergens: 2 types

In addition, positive control (glycerol: histamine acid phosphate [1:100]) and negative control (glycerol buffer) were included to validate the results.

For each patient, a drop of allergen extract (concentration 1:10) was placed on the ventral aspect of the forearm. A 26-gauge hypodermic needle was used to introduce the allergen 0.5 mm beneath the skin. This procedure was done with 64 pricks, including the 62 allergens, positive, and negative controls. A 2 cm distance was maintained between each allergen to prevent cross-contamination.

Skin reactions were observed 15 minutes after the application of allergens. The wheal size was measured, and reactions were classified as follows:

- 2+ and above: Strongly positive reactions
- 1+: Mildly positive reactions
- Negative: No visible reaction

Data Analysis

Data were analyzed using descriptive statistics. Frequencies and percentages were calculated to summarize the prevalence of positive reactions (+2 to +4) for each allergen extract. Results were presented in tables to provide a clear overview of the allergic response to the various allergen extracts. All statistical analyses were conducted using SPSS version 23, and the results were expressed as percentages.

Result

Table 1 illustrates the distribution of 100 patients based on their diagnoses of allergic rhinitis, bronchial asthma, or a combination of both. Of the total participants, 43% (43 patients) were diagnosed with allergic rhinitis, making it the most common condition in the study. A smaller group, 22% (22 patients), were diagnosed with bronchial asthma exclusively. Interestingly, 35% (35 patients) of the participants had both allergic rhinitis and bronchial asthma, indicating a significant overlap between the two conditions. (Table 1)

Table 1: Distribution of Study Participants Based on Diagnosis of Allergic Rhinitis and Bronchial Asthma (n=100)

Indices	Number of patients (n=100)	Percentage
Allergic rhinitis	43	43%
Bronchial asthma	22	22%
Allergic rhinitis & Bronchial asthma	35	35%

Table 2 shows the demographic distribution of the study participants (n=100). Most patients were in the 21-30 years age group (44%), followed by those ≤ 20 years (32%). Fewer participants were in the older age groups, with 31-40 years (14%), 41-50 years (6%), and 51-60 years (4%). In terms of gender, 58% of participants were male, while 42% were female. (Table 2)

Table 2: Demographic Distribution of Patients Based on Age and Gender

Variables	Number of patients (n=100)	Percentage
Age (years)		
≤20	32	32%
21-30	44	44%
31-40	14	14%
41-50	6	6%
51-60	4	4%
Gender		
Male	42	42%
Female	58	58%

Table 3 presents the prevalence of positive reactions to various pollen allergen extracts in skin prick testing, with the results showing the percentage of patients who exhibited marked positive reactions (+2 to +4). The most common allergens were Cynodondactylon and Ricinuscommunis, with 26% and 29% of patients showing positive reactions, respectively. Other significant allergens included Amaranthusspinosus and Partheniumhysterophorus, both of which had positive reactions in 29% and 27% of patients, respectively. Allergens such as Sorghum vulgare (16%), Brassica campestris (21%), and Argemonemexicana (24%) also showed notable prevalence rates. In contrast, some allergens like Ipomoea fistulosa, Kocosnucifera, and Kigeliapinnata exhibited very low positive reaction rates, at only 4%. (Table 3)

Table 3: Prevalence of Positive Reactions to Pollen Allergen Extracts in Skin Prick Testing

Allergen extract	Total number of patients receive allergen	Marked positive reaction +2+4	Percentage
Cynodondactylon	100	26	26%
Sorghum vulgare	100	16	16%
Pennisetum, typhoides	100	12	12%
Zea Mays	100	7	7%
Gynandropsisgynandra	100	11	11%
Brassica campestris	100	21	21%
Ranunculus sceleratus	100	16	16%
RumexDenatus	100	9	9%
Ricinuscommunis	100	29	29%
Artemisiascoparia	100	16	16%
Argemonemexicana	100	24	24%
Cannabis sativa	100	9	9%
Chenodopodium album	100	14	14%
Lawsoniainermis	100	7	7%
CyperusRotundus	100	16	16%
Adhatodavasica	100	21	21%
Ageratum Conyzoides	100	14	14%
Xanthium Strumarium	100	16	16%
DododnaeaViscosa	100	7	7%
Amaranthusspinosus	100	29	29%
Partheniumhysterophorus	100	27	27%
Ipomoea fistulosa	100	4	4%
Maeruaarenaria	100	16	16%
Suaedafruticos	100	14	14%
Chenopoiummurale	100	14	14%
Putranjivaroxburghii	100	21	21%
Albizialebbeck	100	19	19%
Ailanthusexcelsa	100	22	22%
Eucalyptus tereticornis	100	27	27%
Broussentiapapyrifera	100	6	6%
Holopteleaintegriforia	100	19	19%
Morus alba	100	7	7%
Prospisjulifloria	100	14	14%
Azadirchtaindica	100	9	9%
Kocosnucifera	100	4	4%
Kigeliapinnata	100	4	4%

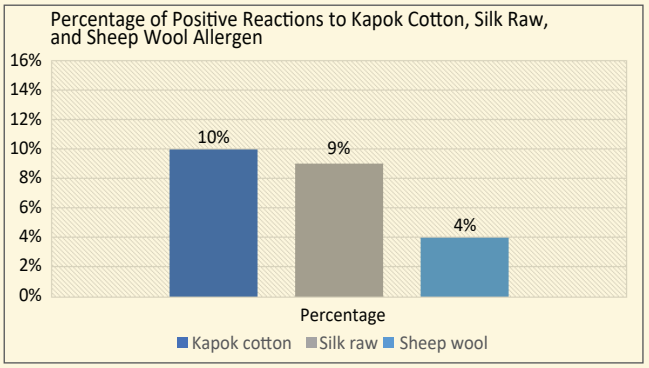

Fig 1. Percentage of Positive Reactions (+2 to +4) to Kapok Cotton, Silk Raw, and Sheep Wool Allergen

Figure 1 displays the percentage of positive reactions (+2 to +4) to three allergen extracts: Kapok cotton, Silk raw, and Sheep wool. The highest percentage of positive reactions was observed with Kapok cotton, showing 10% of patients with a positive response. Silk raw had a slightly lower rate, with 9% of patients testing positive, while Sheep wool exhibited the lowest percentage, with only 4% of patients showing positive reactions. These findings suggest a higher prevalence of allergic reactions to Kapok cotton compared to Silk raw and Sheep wool allergens. (Figure 1)

Table 4 shows the prevalence of positive reactions (+2 to +4) in skin prick tests with fungi and insect allergen extracts in patients with United Airway Disease. Aspergillus fumigatus had the highest positive reaction rate among fungi, at 10%, while other fungi like Aspergillus niger, Aspergillus versicolor, and Candida albicans showed lower rates (4-7%). Insect allergens exhibited higher reaction rates, with female cockroach leading at 16%, followed by male cockroach at 12%, and moth at 11%. Rice weevil showed the lowest insect allergen reaction at 7%. (Table 4)

Table 4: Prevalence of Positive Reactions (+2 to +4) in Skin Prick Tests with Fungi and Insect Allergen Extracts in Patients with United Airway Disease

Allergen extract	Total number of patients receive allergen	Marked positive reaction +2+4	Percentage
Skin prick test with fungi extract			
Aspergillus fumigatus	100	10	10%
Aspergillus nigus	100	7	7%
Aspergillus Versicolor	100	4	4%
Aspergillus flavus	100	4	4%
Candida albicans	100	6	6%
Skin prick test with insect allergens extract			
Cockroach (female)	100	16	16%
Cockroach (male)	100	12	12%
Moth	100	11	11%
Rice wevil	100	7	7%

Table 5 presents the prevalence of positive reactions (+2 to +4) in skin prick tests with dust and animal dander allergen extracts in patients with United Airway Disease. Among the dust allergens, house dust and paper dust had the highest positive reaction rate at 19%, other dust allergens, such as cotton mill dust (10%), grain dust wheat (9%), and hay dust (9%). Grain dust bajra and grain dust rice had the lowest rates of 2% and 4%, respectively. In terms of animal dander, cat dander was the most reactive allergen, with 9% of patients showing positive reactions, followed by dog dander at 7%. Cow dander and human dander exhibited lower reaction rates of 4% and 2%, respectively. (Table 5)

Table 5: Prevalence of Positive Reactions (+2 to +4) in Skin Prick Tests with Dust and Animal Dander Allergen Extracts in Patients with United Airway Disease

Allergen extract	Total number of patients receive allergen	Marked positive reaction +2+4	Percentage
Skin prick test with dust allergens extract			
House dust	100	19	19%
Paper dust	100	19	19%
Cotton mill dust	100	10	10%
Grain dust wheat	100	9	9%
Grain dust bajra	100	2	2%
Grain dust rice	100	4	4%
Hay dust	100	9	9%
Straw dust	100	4	4%
Skin prick test with animal dander extract			
Cat dander	100	9	9%
Dog dander	100	7	7%
Cow dander	100	4	4%
Human dander	100	2	2%

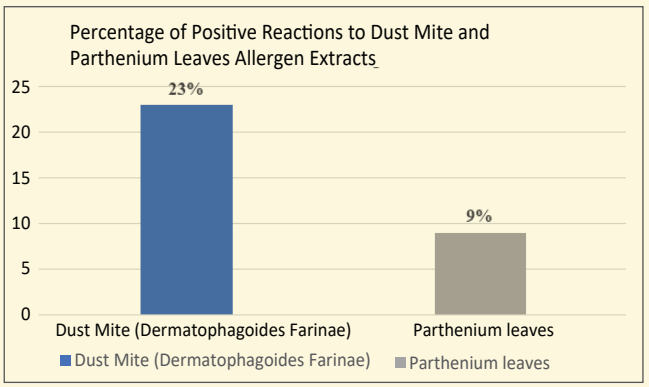

Fig 2. Percentage of Positive Reactions to Dust Mite and Parthenium Leaves Allergen Extracts

Figure 2 illustrates the percentage of positive reactions (+2 to +4) to Dust Mite (Dermatophagoidesfarinae) and Parthenium leaves allergen extracts. Dust mite sensitivity was observed in 23% while parthenium leaf sensitivity was seen in 9%

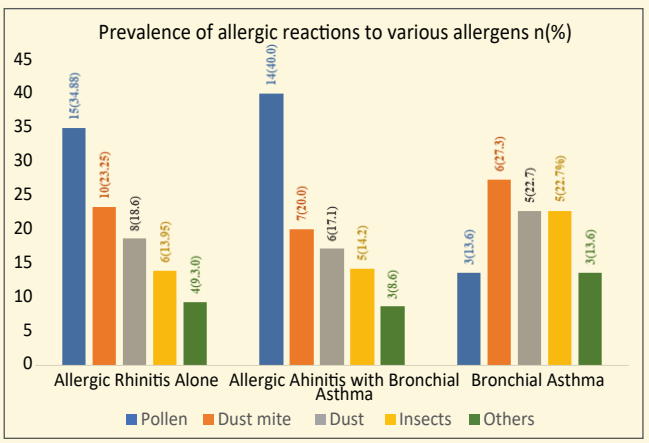

Fig 3. Prevalence of allergic reactions to various allergens in patients with allergic rhinitis (AR), bronchial asthma (BA), and both conditions (BA + AR).

Figure 3 shows the prevalence of allergic reactions to various allergens in patients with allergic rhinitis (AR), bronchial asthma (BA), and both (BA + AR). Pollen is the most common allergen overall particularly in patients with AR alone (34.9%) and in those with AR and BA (40%), followed by dust mites and dust.Sensitivity to insects and other allergens is also notable.

Discussion

This study identifies the prevalence of common inhalant allergens among patients with United Airway Disease (UAD) and highlights the overlapping sensitization patterns that affect both the upper and lower airways. The findings underscore the principle of UAD, which conceptualizes allergic rhinitis and asthma as manifestations of a single chronic inflammatory airway condition [5,12].

The highest prevalence of sensitization was seen in young adults aged 21–30 years, consistent with earlier findings that allergic diseases often manifest during adolescence and early adulthood [13]. Male predominance in our cohort is also supported by regional epidemiological data, suggesting a gender predisposition in allergic diseases due to hormonal, genetic, or environmental factors [4,11].

Among pollen allergens, Amaranthusspinosus, Ricinuscommunis, Partheniumhysterophorus, and Cynodondactylon were identified as the most common sensitizers. These allergens have also been found to be major contributors to allergic rhinitis and seasonal asthma in other parts of India [7,14]. Specifically, Parthenium is known for its aggressive growth and extensive pollination, which exacerbates respiratory allergic diseases [8].

Dust mite (Dermatophagoidesfarinae) was an important allergen in all three groups, with a 23% positivity rate, reflecting similar results seen in both allergic rhinitis and bronchial asthma patients in previous Indian and international studies [12,9]. The significance of dust mite sensitization in asthma has been particularly emphasized in urban settings, where indoor environmental pollution plays a substantial role.

Sensitization to insect allergens, particularly cockroaches (female) at 16% and cockroaches (male) at 12%, is consistent with previous findings in nasobronchial allergy patients [15,16]. Cockroach allergens have been strongly linked not only to allergic rhinitis but also to bronchial hyperresponsiveness and chronic asthma, especially in overcrowded and poorly ventilated-urban dwellings. Their proteolytic enzymes act as potent airway sensitizers and are considered significant triggers for persistent asthma.

Similarly, moderate reactivity to fungal allergens such as Aspergillus fumigatus (10%) supports earlier evidence that fungal spores are common in both allergic rhinitis and lower airway diseases like allergic bronchopulmonary aspergillosis [6]. The role of Aspergillus species has also been linked to increased asthma severity in sensitized individuals [17].

A noteworthy finding in our study is the sensitization to textile allergens like Kapok cotton (10%) and Silk raw (9%), which, although less frequently studied, have been implicated in occupational asthma and rhinitis among textile workers [7]. This suggests the importance of evaluating occupational exposure history during clinical assessments.

The overlap of allergens in patients with both upper and lower airway symptoms support the theory of a shared immunopathogenesis in allergic rhinitis and asthma. Both conditions involve Th2-type immune responses, elevated IgE levels, eosinophilic inflammation, and similar inflammatory mediators. These shared pathways explain the frequent co-occurrence of allergic rhinitis in up to 80% of asthma patients and vice versa [5,12].

Comparative analysis with diseases such as atopic dermatitis and conjunctivitis further extends the atopic spectrum. For instance, allergens like dust mite and cockroach are commonly associated with flare-ups in atopic dermatitis, suggesting systemic sensitization in predisposed individuals [10]. Likewise, ocular allergies often coexist with seasonal rhinitis and are triggered by the same pollen or fungal allergens [14,18].

Conclusion

This study highlights the most prevalent allergens responsible for sensitization in patients with United Airway Disease (UAD). The significant overlap of allergen sensitivity affecting both the nasal and bronchial airways supports the unified concept of UAD, wherein allergic rhinitis and asthma are part of a continuous inflammatory process rather than isolated conditions. Recognizing these shared allergenic triggers is essential for comprehensive disease management. Our study shows that overall, the most common allergen is pollen, followed by dust mites, particularly in those with allergic rhinitis with or without bronchial asthma. For those with bronchial asthma alone, dust mites are the most common. Early detection through skin prick testing, combined with targeted allergen avoidance strategies and potential immunotherapy, can play a vital role in reducing symptom burden, preventing disease progression, and enhancing overall patient quality of life.

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Informed Consent Statement

All patients provided written informed consent.

Ethical Considerations

Ethical approval was obtained from the BSMMU IRB. Participants were provided with clear explanations of the study, and written informed consent was obtained. Their confidentiality was maintained, and the risks and benefits were clearly outlined.

Conflict of interest

There are no conflicts of interest among authors.

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