



## **Determination of Specific Immunoglobulin E Levels in Serum against Aeroallergens among Suspected Allergic Patients at Dhaka City of Bangladesh**

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### **Abstract**

**Background:** Prevalence of allergic diseases is increasing worldwide. Most allergic responses are mediated by immunoglobulin E (IgE) antibodies specific for the trigger allergen, which can be detected by in vitro tests that are excellent for identifying a sensitized state in which allergen-specific IgE (sIgE) is present, and thus identify triggers to be eliminated and help guide immunotherapy treatment. **Objective:** The purpose of the present study was to determine the specific Immunoglobulin E levels in serum against 23 aeroallergens among suspected allergic people in Bangladesh. **Methodology:** This cross-sectional study was conducted at Biomed Diagnostics Laboratory, Panthapath, Dhaka, Bangladesh from March 2021 - September 2021. This study aims to quantitatively determine allergen- specific IgE antibodies (sIgE) to a selected battery of 23 aeroallergens in Bangladeshi population who were clinically suspected cases of allergic diseases. Blood samples were collected from clinically suspected cases of allergic diseases. Quantitative detection of sIgE antibodies in human serum was done by Immunoblot assay manufactured by Proteome Tech Inc. **Results:** A total of 402 blood samples were collected from clinically suspected cases of allergic diseases. In the present study, the most prevalent indoor allergen was cockroach against which 72.39% patients' sera exhibited raised specific IgE among Bangladeshi population. Dog dander (10.2%) showed highest prevalence among the aeroallergens of animal origin. Among the pollen allergens, Timothy grass (13.18%) was the most abundant one and *Aspergillus fumigatus* (2%) was most common fungal aero allergen. **Conclusion:** The most prevalent allergen was cockroach among indoor aeroallergens. Dog dander showed highest prevalence among the aeroallergens of animal origin.

**Keywords:** Allergy; aeroallergens; allergen- specific IgE antibodies

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### **Introduction**

Allergic diseases are now major contributors to the healthcare burden and morbidity in many countries. A number of aeroallergens associated with a spectrum of allergic disorders ranging from allergic rhinitis, asthma, atopic dermatitis, urticarial to even allergic

shock and death have been reported from all over the world. Although allergic diseases are usually not fatal, death can result as a consequence of allergic anaphylaxis or the adverse consequences may involve one or many organ systems of the body<sup>1</sup>. Allergen is any substance that can elicit an immunoglobulin E (IgE) antibody response in our body. It can be an indoor or outdoor allergen. The indoor environment includes not only home but also daycare, schools, work environment and these can be found in bedding, on the floor, and in dust from soft furnishings. Due to the chronic nature of the exposures, indoor allergies

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tend to be associated with the development of many allergic disorders<sup>2</sup>. An aeroallergen is an airborne substance that can cause allergic reactions.

The indoor aeroallergens constitute of dust mites, cockroaches, house dust, flour mite, mold mite and aeroallergens of animal origin such as dog dander, cat dander. Fungal spores can also be present in the indoor environment. On the other hand, the outdoor aeroallergens are predominantly comprised of plant pollens and fungal spores. Aeroallergens from pollen and fungi have seasonal emission patterns that correlate with plant pollination and fungal sporulation and are strongly associated with atmospheric weather conditions. External exposure to aeroallergens significantly impacts the prevalence and severity of allergies.

Global distribution of aeroallergens and their sensitization pattern in human are affected by geography, climate and urbanization<sup>3</sup>. In developing countries, the prevalence and impact of these aeroallergens are even higher than developed countries, in terms of total numbers of people affected<sup>4</sup>. Due to diverse climate and lifestyle Bangladesh is exposed to a wide range of aeroallergens. Since the prevalence of allergic diseases is increasing, in the process of appropriate avoidance and rescue measures, determining the specific allergens and subsequently avoiding them in the environment is imperative.

The complete identification of atopic subjects in any population requires determination of allergen-specific IgE against a large panel of allergens as allergic patients generate specific IgE antibodies when exposed to certain allergens<sup>5</sup>. To our knowledge, only one previous study from Bangladesh provided information regarding allergen skin test reactivity by skin prick test to three indoor allergens (house dust, dust mite and cockroach) in adult asthmatic subjects<sup>6</sup>. As the prevalence of allergic diseases mediated by aeroallergens varies among different race and ethnicities, it is imperative to know the prevalence in Bangladesh as well to identify allergic triggers to be eliminated and to guide clinicians on immunotherapy<sup>7</sup>. The present study was aimed to quantitatively determine allergen-specific IgE antibodies (sIgE) to a selected battery of 23 aeroallergens in Bangladeshi population who were clinically suspected cases of allergic diseases.

## Methodology

**Study Design and Population:** This cross-sectional

study was conducted at Biomed Diagnostics Laboratory, Panthapath, Dhaka, Bangladesh from March 2021 to September 2021 for a period of eight months. The study population includes patients referred to the Biomed Diagnostics Laboratory for diagnostic purpose to confirm an allergic trigger suspected on the basis of history and clinical evaluation irrespective of age and gender.

**Laboratory Procedure:** Purposive sampling method was selected to collect a total of 402 blood samples. This multiplex allergy diagnostic kit is based on the principle of an enzyme immunoassay manufactured by Proteome Tech Inc (PROTIATM Allergy –Q64S panel, South Korea) and for detection of allergen-specific IgE antibodies (sIgE) sera was subjected to a selected battery of 23 aeroallergens. Aero allergens included six common indoor aeroallergens (house dust, cockroach, *Dermatophagoides pteronyssinus* (*D. pteronyssinus*), *Dermatophagoides farina* (*D. farina*), *Acarus siro*, *Tyrophagus putrescentiae*), four moulds (*Alternaria alternata*, *Aspergillus fumigatus*, *Penicillium notatum*, *Candida albicans*), six pollens (timothy grass, cultivated rye, common ragweed, Acacia, white ash, olive pollen) and seven aeroallergens of animal origin (dog dander, cat dander, horse, mouse, rabbit, , bee venom, sheep wool). This multiplex allergy diagnostic kit includes nitrocellulose membranes having various allergens adsorbed at regular interval lines which make it possible to test several allergens in one test.

**Specimen Preparation:** Serum was separated by standard methods. Blood cells or any solid matters were removed by centrifugation. The serum samples were stored at 2 to 8°C when they were used for a short period (within 2 weeks) and at -15°C for a longer duration.

**Assay Procedure:** All reagents were brought to room temperature around 30 minutes before use and mixed well. The other procedures were fully automated. The Q-STATION ELITE was set and it automatically performed the entire procedure of dispensing patient samples and reagents, incubation, washing, drying and measurement. Quantitative detection of sIgE antibodies in human serum was done by Immunoblot assay manufactured by Proteome Tech Inc (PROTIA™ Allergy - Q64S panel, South Korea). Assay procedure was conducted by semi-automated method.

**Evaluation and Interpretation:** The allergen specific IgE antibodies were quantitatively analyzed as IU/ml via Q-STATION ELITE.

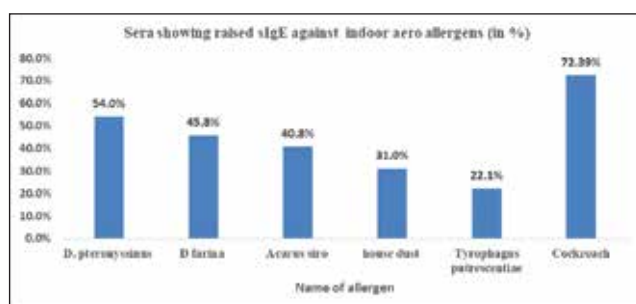
**Statistical analysis:** Statistical analysis was performed by Windows based software named as Statistical

Package for Social Science (SPSS), versions 22.0 (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). Continuous data were expressed as mean, standard deviation, minimum and maximum. Categorical data were summarized in terms of frequency counts and percentages. Every efforts were made to obtain missing data.

**Ethical Clearance:** All procedures of the present study were carried out in accordance with the principles for human investigations (i.e., Helsinki Declaration 2013) and also with the ethical guidelines of the Institutional research ethics. Formal ethics approval was granted by the local ethics committee. Participants in the study were informed about the procedure and purpose of the study and confidentiality of information provided. All participants consented willingly to be a part of the study during the data collection periods. All data were collected anonymously and were analyzed using the coding system.

## Results

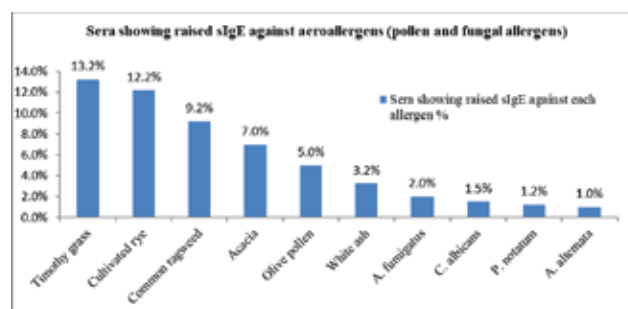
Among 402 patients specific IgE estimation was carried out for 23 types of aeroallergens. The most prevalent indoor allergen was cockroach against which 72.39% patients sera exhibited raised specific IgE. The order of frequency of indoor aero allergens against which sIgE levels significantly raised were *D. pteronyssinus* (53.98%), *D. farina* (45.77%), *Acarus siro* (40.79%), house dust (31%) and *Tyrophagus putrescentiae* (22.13%) (Figure I).



**Figure I:** Sera showing raised sIgE against indoor aero allergens

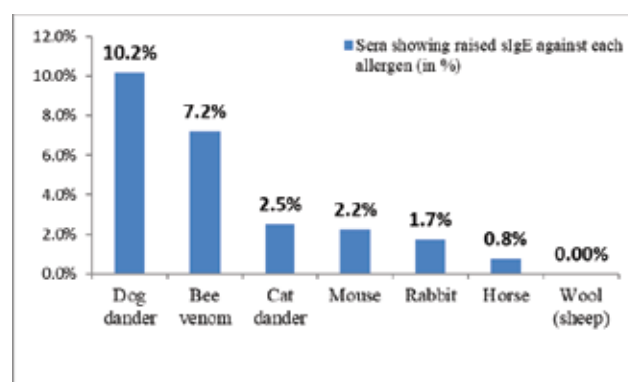
Raised sIgE against different pollen allergens was measured and Timothy grass (13.18%) was the most prevalent among those. Cultivated rye (12.2%), Common ragweed (9.2%), Acacia (6.96%), Olive pollen (4.97%) and white ash (3.2%) were the other allergenic pollens. *Aspergillus fumigatus* (2.0%) was most common fungus followed by *Candida albicans* (1.49%), *Penicillium notatum* (1.24%) and *Alternaria*

*alternata* (1.0%) among the study subjects (Figure II).



**Figure II:** Sera showing raised sIgE against aeroallergens (Pollen and Fungal Allergens)

Among the aeroallergens of animal origin dog dander (10.2%) showed highest prevalence followed by bee venom (7.2%), cat dander (2.5%), mouse (2.2%), rabbit (1.7%) and horse (0.8%). However, sIgE against sheep wool allergen was not raised to detectable range (Figure III).



**Figure III:** Sera showing raised sIgE against aeroallergens of animal origin

In group A, most were students which comprised of 43(29.7%) cases followed by laboures, housewife, service holder and business man which were 39(26.9%) cases, 28(19.3%) cases, 22(15.2%) cases and 7(4.8%) cases respectively. In group B, majority were student which was 45(31.0%) cases followed by labour, housewife, service holder and Business, which were 41(28.3%) cases, 20(13.8%) cases, 20(13.8%) cases and 13(9.0%) cases respectively. The difference was not statistically significant ( $p = 0.702$ ) (Table 5).

## Discussion

In the present study, the most prevalent indoor allergen was cockroach against which 72.39% patients' sera exhibited raised specific IgE among Bangladeshi population. A previous study among asthmatic Bangladeshi patients was conducted where skin prick

test was used and it was reported that cockroach was one of the significant aeroallergens<sup>6</sup>.

Evidence of high prevalence of cockroach sensitivity has been documented in many countries around the world. Two different studies from India reported that cockroach was one of the most prevalent aeroallergens<sup>8</sup>. Similarly, in Africa 30% prevalence was reported for cockroach allergen. Several studies among European population observed inhalant allergy to the cockroach ranging from 4% to 26%. In addition, Sun et al<sup>9</sup> conducted a study among 6,304 Chinese population and 45% of them showed positive SPT responses to cockroach allergen.

Chang and colleagues<sup>7</sup> assessed sIgE levels against common aeroallergens among 3,721 Chinese population. The order of frequency of allergens against which sIgE levels significantly raised were house-dust mite, cockroach, ragweed and mold. In Taiwan and Hong Kong, the prevalence of allergy to cockroach were revealed as 43.0% to 58.0% and 23.0% respectively<sup>10</sup>. In addition, in several other studies conducted, it was demonstrated that the prevalence of cockroach allergy varied from 17.0% to 59.0%<sup>11-14</sup>.

The fact that cockroach is the most prevalent indoor allergen in Bangladesh can be explained by three reasons: (1) the temperate environment of the country is conducive for cockroaches. (2) cockroach belongs to one of those insects which are ubiquitous in nature prevailing in both indoor and outdoor environments. (3) the major allergenic cockroach protein tropomyosin is present in cockroach feces, saliva, eggs, scales and shedding body parts and these are not only allergenic when derived from living cockroach but also from dead cockroaches<sup>15-17</sup>.

In the current study, prevalence of *Dermatophagoides pteronyssinus* (European dust mite) and *Dermatophagoides farinae* (American dust mite) was 53.98% and 45.77% respectively. Many studies corroborated the finding of higher prevalence of specific IgE to dust mite. In 2009, a study conducted among Bangladeshi asthmatic patients reported that maximum numbers of asthmatic patients had positive skin prick test for dust mite (*D. farina* or *D. pteronyssinus*)<sup>6</sup>. Among Indian population *D. farina* and *D. pteronyssinus* were the most significant ones among aeroallergen burden<sup>18-20</sup>. Furthermore, many other studies revealed that dust mite contributed as a significant aeroallergen<sup>21-22</sup>. Co-sensitization to cockroach and dust mites (*D. pteronyssinus*, *D. farina*) is common, as reported by previous studies. This could be explained by the fact that cockroach and

dust mites usually share some major allergens as well as same indoor environments<sup>23, 24</sup>.

The present study observed that house dust exhibited 31.0% prevalence. Previously, a great number of studies reported that house-dust mite was the most common allergenically implicated antigen against which sIgE was raised<sup>6, 20-21, 25-28</sup>. House-dust mite being one of the most predominant aeroallergens against which sIgE was produced, might be due to comparatively a more continuous exposure to house-dust mite than to the other allergens<sup>27</sup>. This hypothesis is in concordance with several studies as it was reported that some allergens remain persistent, leading to long-lasting allergic diseases through persistent allergen sensitization<sup>28-30</sup>.

In the present study, dog dander (10.2%) showed highest prevalence among the aeroallergens of animal origin and cat dander was also allergenically implicated showing 2.5% prevalence. Similarly, several studies reported that dog dander and cat dander were found to be significant aeroallergens<sup>9, 31-32</sup>. Furthermore, it was reported that cat dander and dog dander contribute to the aero allergen burden as cats and dogs are the most common co-habitants<sup>33</sup>.

The current study observed that bee venom was another significant aeroallergen of animal origin exhibiting 7.2% prevalence. Other aeroallergens of animal origin included in the present study were mouse, rabbit and horse showing 2.2%, 1.7% and 0.8% respectively. Several studies explained that occupational exposure to bee venom, rodents (rats, mice), horses, sheep wool, rabbit could be possible in farmers, veterinarians, and laboratory personnel resulting in sensitization and allergic manifestations<sup>34, 35</sup>. Our study observed that among the pollen allergens Timothy grass (13.18%) was the most abundant one followed by cultivated rye (12.18%) and common ragweed (9.2%). Previous studies around the world also reported Timothy grass and cultivated rye being the most common pollen allergen. Common ragweed has been described as a source of highly allergenic pollen as well<sup>9, 20, 21, 25, 36</sup>.

In the present study Acacia pollen, olive pollen and white ash exhibited 6.96%, 5.0% and 3.2% prevalence respectively. Several studies reported these pollens as a contributor of aeroallergen burden in India, USA, Italy, Spain, Australia, and several countries of Middle East<sup>37, 38</sup>. Considering the uneven geographical distribution of these trees in the world the prevalence to the pollen allergens shows wide variation in different studies<sup>38</sup>. The current study observed that



among the fungal allergens *A. fumigatus* was the most common allergenically implicated antigen showing 2.0% prevalence followed by *Candida albicans* (1.5%), *Penicillium notatum* (1.2%) and *Alternaria alternata* (1.0%). In India among fungal allergens, *Alternaria alternata*, *Candida albicans*, *Aspergillus versicolor*, *Aspergillus terreus*, and *Aspergillus japonicus* were the most significant ones<sup>19</sup>. Moreover, several other studies reported *Aspergillus* as a source of highly allergenic fungus<sup>39-40</sup>. Several studies<sup>41-42</sup> suggested a role for *C. albicans* in the exacerbations of Atopic Dermatitis.

Bernstein et al<sup>43</sup> reported an association of chronic vaginal candidiasis and local hypersensitivity response to *Candida albicans* that may improve with allergy immunotherapy with *Candida albicans* extract immunotherapy. *Aspergillus*, *Alternaria* and *Penicillium* have frequently been implicated in allergic asthma. *Penicillium notatum* (also known as *Penicillium chrysogenum*) widely exists in the environment and is the most frequent *Penicillium species* used for the clinical diagnosis of fungal allergy<sup>44</sup>.

## Conclusion

In the present study, the most prevalent allergen was cockroach among indoor aeroallergens. Dog dander showed highest prevalence among the aeroallergens of animal origin. Timothy grass was the most abundant pollen aeroallergen and *Aspergillus fumigatus* was most common fungal aero allergen. This study sheds some light on the prevalence of aeroallergens in Bangladeshi population which might identify allergic triggers to be eliminated and to guide clinicians on immunotherapy. Further researches with multivariable regression analysis in this topic are recommended.

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## Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this article.

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## Authors' contributions

Afrin S, Ahmed M, Faiyaz KM conceived and designed the study, analyzed the data, interpreted the results, and wrote up the draft manuscript. Anam MS, Mahboob N, Shameem MA contributed to the analysis of the data, interpretation of the results and critically reviewing the manuscript. Afrin S involved in the manuscript review and editing. All authors read and approved the final manuscript.

## Data Availability

Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the

corresponding author on reasonable request.

## Ethics Approval and Consent to Participate

Ethical approval for the study was obtained from the Institutional Review Board. As this was a prospective study the written informed consent was obtained from all study participants. All methods were performed in accordance with the relevant guidelines and regulations.

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