IgE Mediated Skin Test Reactivity to Indoor Allergens Correlates with Asthma Severity at Jeddah, Saudi Arabia

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Citation

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Abstract

Background: There is an increase attention on the role of indoor allergens in asthmatics.

Objective: To examine the spectrum of skin test reactivity (sensitization) to indoor allergens and its correlation with asthma severity.

Methodology: Asthmatics referred to allergy clinic at King Abdulaziz University Hospital and living in Jeddah were studied. Clinical severity was determined using international and national asthma guidelines. Degree of sensitization was assessed by the wheal size (positive ≥ 3 mm) of standard skin prick test to common indoor inhalant allergens: House dust mites (HDMs): Dermatophagoides pteronyssinus (Dp) and D. farinae (Df), Cat, and Cockroach.

Results: Out of 151 asthmatics, 113 asthmatics were skin test positive to one or more allergen (74.8%). Their ages ranged between 9 to 63 years (mean± = 30 ±13) and females constituted 65.5%. The predominant asthma severity level was moderate persistent 55.8%, followed by mild persistent 33.6%. Prevalence of sensitization to indoor allergens was as follow: DP 87% (3 – 25 (mean = 7) mm), DF 84% (3 – 20 (mean = 7) mm), Cat 44% (3 – 15 (mean = 6) mm), and Cockroach 33% (3 – 12 (mean = 4) mm). Higher asthma severity levels were significantly correlated with the number of allergens with positive sensitization (R=0.3, P< 0.001), and the degree of sensitization to HDM Dp (df= 16, p<0.001) and Df (df=17, p<0.01), but not to Cat (df=10, p<0.24) or Cockroach (df=8, p<0.36).

Conclusions: The IgE skin test reactivity to indoor allergens, particularly to HDMs, was common in asthmatics at Jeddah city. Its elevated degrees were clearly associated with higher asthma severity, which is compatible with the literature. This advocates the importance of identification of sensitization of clinically relevant allergens in asthmatics, and promotes tailored educational strategies of avoidance measures for enhanced asthma control.

INTRODUCTION

Asthmatic airways are characterized by an immunological chronic inflammation that has been documented to occur after exposure to allergen1. Several studies have suggested a correlation between allergen exposure and the prevalence of asthma2,3. Exposure to airborne allergens in sensitized individuals is a risk factor for asthma exacerbations, the persistence of asthma symptoms, and significant changes in the pulmonary functions4,5,6.

Worldwide, the documented increase in the prevalence of asthma has been almost entirely in perennial asthma, and a large proportion of them are allergic to allergens found all year round in houses (indoor)7,8. This has lead to an increase attention on the immunological role of allergenic substances that accumulate indoors. Indoor allergens today have increased in developed countries where homes have been insulated for energy efficiency, carpeted, heated, cooled, and humidified–changes that have also made homes ideal habitat for indoor allergens9,10.

Globally, the most abundant indoor allergens include those derived from house dust mites (HDMs), cat, and cockroach11,12. The principal HDM species are the pyroglyphid mites Dermatophagoides pteronyssinus (Dp), D. farinae (Dp), and others, which usually account for 90 percent of the mite species in house dust from temperate regions13,14. According to some local studies, similar allergens have been isolated
from the indoors of asthmatics living in different regions at Saudi Arabia. Recent progresses in allergy and immunology have promoted extensive studies on identification of sensitization to indoor allergens. In vivo and in-vitro allergy tests to allergen has been considered a valuable tool for exploring the presence of an IgE mediated immune response in atopic disorders, like bronchial asthma, and it is a reflection of sensitization to that allergen. A direct relationship between the positive allergy skin tests or sensitization to inhalant indoor allergens and the increase in severity of asthma has been demonstrated by pervious investigators. However, no study focused primarily on the clinical severity of asthma assessed by international and national asthma management guidelines in relation to common indoor allergens detected in Saudi Arabia. Hence, this study was initiated to explore the spectrum of IgE mediated skin test reactivity or sensitization to common indoor inhalant allergens in asthmatics seen at King Abdulaziz University Hospital (KAUH) at Jeddah, Saudi Arabia. This work focuses on the hypothesis that the skin test reactivity to indoor allergens may have a relationship with higher levels of clinical severity of asthma. METHODS One hundred and fifty one patients with a primary diagnosis of bronchial asthma examined at the allergy clinic of King Abdulaziz University hospital (KAUH) from January 1997 to December 1999 were sequentially selected. Only patients who were living in Jeddah city were included in the study. Jeddah is a coastal city located at the western region of the Kingdom of Saudi Arabia on the Red sea. It is characterized by high humidity particularly in the summer season. The diagnosis and the assessment of the levels of clinical severity of each asthmatic were conducted according to international and Saudi national guidelines for asthma management. Patient's charts were reviewed for demographic data, asthma severity level, results of skin prick test to common inhalant allergens. Patients who were smokers, pregnant, on antihistamines, oral steroids, and beta-blockers were excluded because of their negative effect on skin tests results. The results of skin test reactivity (sensitization) were obtained from reviewing the results of reactions to standard skin prick test (SPT) after 15 minutes. A verbal consent was obtained from candidates prior to SPT. The panel of indoor allergens appropriate for SPT was obtained from Greer Laboratories at United States of America at 1:10 dilutions, except for house dust mites (Dp&Df) and Cat hair extracts which exists in 10,000 AU/ml. The indoor allergens used include: the two common species of house dust mites (DP and DF), cat and cockroach. The cockroach extract contained a mixture of the two common species: German and American cockroaches (Blattella germanica and Periplaneta Americana). After sterilization of the forearm with propyl alcohol swap, a drop of each allergen extract was put on one-centimeter mark apart. Then inside the allergen drops on the skin was performed a prick with gauge 24 needle. Additionally, a drop of histamine phosphate at a concentration of 2.7 mg/ml and the diluents were used as a positive control and negative control respectively. A five millimeter (mm) wheal or more reaction to histamine is considered adequate for the competency of the test. A 3mm diameter wheal and more (more than the negative control) were considered as a positive test for sensitization to that peculiar allergen. The wheal size for each indoor allergen was recorded, and was used as a reflection of the degree of skin test reactivity (sensitization). The degree of skin test reactivity for each case was classified according to the wheal diameter size into: mild sensitization (3-5mm), moderate sensitization (6-10mm) severe sensitization (≥11mm). Furthermore the number of indoor allergens with positive reaction was recorded for each case. The data were entered into a personal computer. Frequency tables, correlation analysis by Pearson’s test and analysis of variance by ANOVA test were performed using SPSS statistical program (version 11).

RESULTS Out of 151 different asthmatics living in Jeddah, 113 asthmatics were skin test positive to one or more indoor allergen, which account to 74.8% of the studied group. The ages of the cases with positive skin test ranged between 9 to 63 years (mean= 30± 13SD). Female sex was in 74 cases and constituted 65.5% of them. The predominant levels of asthma severity were the moderate persistent in 63 cases (55.8%), followed by the mild persistent in 38 (33.6%), see table-1.
The prevalence of positive skin reactivity to the different indoor allergens in the asthmatics was highest to HDM Dp in 98 cases (87%) and to HDM Df in 95 cases (84%), the rest of the data is shown in table-2. The frequency of the number of allergens with positive skin test reaction is shown in tabl-3.

**DISCUSSION**

Increases in asthma must relate to some aspect of our predominantly sedentary indoor lifestyle; this could be either increased exposure to allergens or an increase in factors that enhance the response of the lungs to foreign proteins. Clearly, exposure to allergens can provoke acute asthma attacks as well as chronic allergic symptoms.

In this study, the prevalence of positive skin test reactivity in asthmatics to indoor allergens was common in up to three quarter of the participated asthmatics, which is compatible with some international figures. Sensitization to the two species of HDMs was the predominant indoor allergens in more than 80% of the asthmatics. This pattern of sensitization is expected in a humid coastal city like Jeddah. Conditions for mite growth are a temperature between 22 and 26°C and a relative humidity greater than 55%. Dp is the dominant mite in constantly damp climates and Df survives better in somewhat drier climates. Modern houses are featured by wall to wall carpet, mattresses with boxes, optimal temperature for the growth of HDM. Worldwide, there is evidence to suggest that HDMs are the most common indoor allergen associated with asthma.

The frequency of asthma cases in each sensitization category is shown in graph-1. There was a very mutual correlation between sensitization to the two species of HDMs (Df and Dp) (P< 0.001), which represent a known cross reactivity between them.

Statistically, the increasing levels of the clinical severity of asthmatics were significantly correlated to the number of indoor allergens with positive skin test reactivity (sensitization) (R=0.3, P< 0.001), and the degree of skin test reactivity (wheat size) to the two species of HDMs: Dp (df=16, p<0.001) and Df (df=17, p<0.01), but did not reached statistical significance to Cat (df=10, p<0.24) or Cockroach (df=8, p>0.36). The relationship between the severity of asthma and the degree of skin test reactivity to the different indoor allergens are demonstrated in graph-2. The linearity between the severity of asthma and the mean of the degree of skin test reactivity is demonstrated in graph-3.
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Figure 4
Figure 1: The degree of skin test reactivity (sensitization) to the indoor allergens

![Graphs showing the degree of skin test reactivity to different indoor allergens including D. Farinae and D. Pteronyssinus.]

Cat and Cockroach

<table>
<thead>
<tr>
<th>Degree of skin test reactivity</th>
<th>0 – 2</th>
<th>3 – 5</th>
<th>6 – 10</th>
<th>&gt; 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td></td>
<td></td>
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<tr>
<td>Mild</td>
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<tr>
<td>Moderate</td>
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<tr>
<td>Severe</td>
<td></td>
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</tr>
</tbody>
</table>

Figure 5
Figure 2: Boxplot of skin test reactivity to the different indoor allergens

![Boxplots showing the distribution of skin test reactivity for D. Farinae and D. Pteronyssinus among different asthma severity levels.]

Cat and Cockroach

Figure 6
Figure 3: Mean skin test reactivity (wheal size) in millimeter to indoor allergens

![Graphs showing the mean skin test reactivity (wheal size) in millimeter for D. Farinae and D. Pteronyssinus.]

Cat and Cockroach
Alferah et al conducted a study in order to analyzing HDMs contents in samples collected from asthmatics' indoor environment at four regions of Saudi Arabia\textsuperscript{15}. The humid western region showed a high concentration of HDM more of the Der f I. Variations in both qualitative and quantitative assessment of HDMs may be attributed to variation in geography and climate, particularly humidity. SPT results with HDMs allergens also revealed a considerable number of IgE-mediated reactions, consistent with the frequency of HDMs in the region\textsuperscript{15}. This indicates the possible influence of mites in the allergic manifestations of many patients, which is not only common, but increasing in parts of the country. Airborne allergens were identified to be risk factors for asthma and other allergic diseases in other Arabian Gulf Countries\textsuperscript{24}.

In this study, sensitization to cat allergen was evident in nearly half of the skin test positive cases and sensitization to cockroach allergen may be as common as sensitization to domestic mite allergens and can have a greater effect on asthma morbidity\textsuperscript{29,30}. Some of the indoor fungi (molds) are an established risk factor for asthma in various populations\textsuperscript{29}. Future studies on the impact of other indoor allergens, such as molds, on asthma severity in Saudi Arabia are recommended.

This study demonstrated clearly the parallel correlation between the degrees of an IgE mediated skin test reactivity to indoor allergens, particularly HDMs, and the higher levels of clinical severity of asthma. In other regions of the world, such correlation has been recognized by several investigators\textsuperscript{20-33,34}. The strength of the IgE antibody response to HDM in humid climates could contribute to the increased prevalence and severity of asthma\textsuperscript{20-33,34}.

Recent asthma guidelines established that although pharmacological intervention to treat asthma is highly effective in controlling symptoms and improving quality of life, every attention should be given to measures to prevent this chronic, lifelong, and incurable disease\textsuperscript{35}. Some measures for the prevention of asthma involve avoidance of allergens and non-specific triggers when asthma is established. Several studies have documented an improvement of asthma after exposure to allergens ceases\textsuperscript{36,37,38}. Thus, indoor environmental control measures to reduce exposure to allergens might be important, although it is difficult to achieve complete control, and there is conflicting evidence about whether such control measures are effective at reducing asthma symptoms\textsuperscript{39,40}. Effective control strategies should be tailored to individual allergens, flexible to suit individual needs, and cost effective\textsuperscript{35-41}.

HDMs are especially important in humid areas at Saudi Arabia like the cities of Jeddah and Dammam\textsuperscript{15}. According to recent international and national asthma guidelines, anti-mite measures that significantly reduce their exposure should be employed when asthma is poorly controlled or requires significant medication or whenever there is a suggestion that exposure to mites is playing a role\textsuperscript{35,42}. The most effective and probably most important avoidance measure is to use mattress, pillow, and duvet covers that are impermeable to mite allergens (Evidence level B)\textsuperscript{43-45}.

In conclusion, this work demonstrated that the prevalence of sensitization to common indoor inhalant allergens was in three quarter in asthmatics living in Jeddah. Additionally,
there was a clear association between the degree of skin test reactivity to common indoors inhalant allergens and higher levels of clinical severity of bronchial asthma. Based on this, asthmatics, particularly if symptoms are not controlled with appropriate pharmacological therapy, should be offered a fair amount of education about the importance of exploring their sensitization to relevant environmental allergens. Subsequently, for better symptoms control, health care workers have to be encouraged to apply individualized educational strategies for avoiding the clinically relevant allergens in that particular asthmatic. Eventually, this will be of significant help in the overall management of asthma symptoms.

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