ORIGINAL ARTICLE
Iran J Allergy Asthma Immunol
August 2017; 16(4):298-306.

Determination of the Most Common Indoor and Outdoor Allergens in 602 Patients with Allergic Symptoms Using Specific IgE Local Panel

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Received: 12 November 2016; Received in revised form: 2 March 2017; Accepted: 13 March 2017

ABSTRACT

Aeroallergens play an important role in developing allergic diseases. The aim of this study was to determine the outdoor and indoor sensitization using a specific regional panel of aeroallergens in allergic patients.

All patients with allergic symptoms referred to Immunology, Asthma and Allergy Research Institute (IAARI) in Tehran, Iran from December 2010 to July 2013 entered this cross sectional study. We evaluated serum samples for specific IgE against 20 selected aeroallergens provided by a specific panel (RIDA Allergy Screen test, IAARI panel). A p value less than 0.05 was considered as significant.

The patients (n=602) were 49.8 % male and 50.2% female. The median age was 9 years. Positive specific IgE at least to one allergen was 53.2%. The percentages of patients with only outdoor or indoor sensitization were 37.5 and 19.7%, respectively. Moreover, 42.8% showed sensitization to both indoor and outdoor aeroallergens. The most common outdoor aeroallergens in decreasing order were plane tree (32.8%), Bermuda grass (32.2%), timothy grass (30.6%), saltwort (28.4%). The percentage of specific IgE to indoor allergens including mold and mite were 23.8 % and 22.2%, respectively. There was a statistically significant relationship between specific IgE to timothy grass and mold allergens between two genders (p=0.04 and p=0.02, respectively).

The results of this study shows that outdoor aeroallergens can be considered as the most common causes of allergic symptoms in our allergic patients.

Keywords: Aeroallergens; Epidemiology; IgE-mediated hypersensitivities; Specific IgE; Sensitization

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Published by Tehran University of Medical Sciences (http://ijaai.tums.ac.ir)

INTRODUCTION

The increasing prevalence of allergic diseases including allergic rhinitis and asthma has been reported over the last fifty years.[1,2] More than 30% of the population in modern countries suffer from different types of allergies leading to noticeable cost burden and socioeconomic outcomes.[3,4] Aeroallergens categorized as outdoor and indoor allergens[5] play an important role in arising asthma and allergic rhinitis.[6] Also, recent studies have demonstrated the involvement of aeroallergens in developing or worsening other allergic diseases such as atopic dermatitis and urticaria.[7-9] According to previous studies the most common indoor and outdoor aeroallergens globally are as follows: indoors (house dust mites, animal's dander, some molds, cockroaches)[6,10] and outdoors (pollens and mold spores).[11,12] There are various factors that affect the feature and the numbers of aeroallergens like geographic location, climate conditions, air pollution, and botanical species.[12]

Sensitization to a range of allergens can be evaluated using in vivo or in vitro assessments. Obviously in vitro assays have some benefits compared to skin prick test (in vivo) including high specificity, no need for stopping medications, safety, non-invasiveness possibility for long-time maintenance of samples, and performing the test without limitation such as age, dermographism.[13,14]

According to the importance of accurate diagnosis of sensitization, it would be necessary to design a specific regional panel to identify the specific IgE antibodies against local allergens. In fact, it can be feasible by choosing the most relevant allergens based on the patients' history as well as specialists' comments. The specific feature of RIDA Allergy screen test as a multiplex in vitro assay to detect specific IgE against about 20 allergens simultaneously[15] can be used as a useful and practical tool for diagnosing the triggers of allergic diseases.

Up to now, there has not been any specific regional panel to identify common inhalant aeroallergens by in vitro specific IgE test in Iran. Determination of common aeroallergens in Iran and introducing a specific panel of aeroallergens entitled IAARI as an in vitro assay can help the screening of common aeroallergens in patients. Moreover, it could be useful for future researches in this field. The aim of this study was to determine outdoor and indoor sensitization in Iranian allergic patients using a specific regional panel of inhalant allergens.

MATERIALS AND METHODS

The participants of this cross sectional study included all of the patients with allergic symptoms who referred to Immunology, Asthma and allergy Research Institute, Tehran University of Medical Sciences, Tehran, Iran from December 2010 to July 2013. Demographics and clinical data consisting of respiratory symptoms (wheezing, dyspnea, cough, rhinitis, recurrent sneezing), skin symptoms (eczema, urticaria) were also recorded. The subjects without a clear history of allergic symptoms and those with more than 60 years of age were excluded from the study. This study was approved by Ethics committee of IAARI (No. 92/234). Informed consent was obtained from all patients. Serum samples of cases with positive history of allergy were stored at -20 C until assessment using RIDA Allergy Screen test (R-Biopharm, Darmstadt, Germany). In this test, serum specific IgE can be determined semi-quantitatively on nitrocellulose membrane with an enzymatic reaction of detecting antibody. Aeroallergens were selected based on previous studies [16-18] and comments of expert committee. Selected outdoor aeroallergens included trees (Acacia, Ash, Elder, Elm, Plane, Cypress, Scots pine, Poplar), grasses (Rye grass, Timothy grass, Bermuda grass), weeds (Goosefoot, Saltwort, Mugwort) and indoor allergens consisted of House dust mites, Feather, Cockroach, Dog and Cat allergens. Additionally, in this study, molds mix (*Aspergillus fumigatus, Alternaria alternate, Cladosporium herbarium, Penicillium notatum*) was considered as both indoor and outdoor aeroallergen.

The final results were evaluated using a RIDA quadro Screen (R-Biopharm, Darmstadt, Germany). The values were reported as IU/ml. A specific IgE more than 0.35 IU/ml was considered as a positive result.

Data analysis was done using SPSS version 18 (SPSS Inc., Chicago, USA). A *p* value less than 0.05 was considered as significant value. The frequency of sensitizations to inhalant allergens was reported in count and percentage in patients with at least one positive specific IgE result. The relationship between the qualitative variables was assessed using Pearson's chi-square.

RESULTS

The subjects were 602 allergic patients including 300 (49.8%) male and 302 (50.2%) female. The median age of patients was 9 years (Q1, Q3= 5, 25). 320 subjects (53.2%) had positive specific IgE for at least one allergen. Also, the median age of patients with at least one positive specific IgE was 12 years (Q1, Q3= 6, 28). The frequency of patients with one or more than one positive specific IgE in each age group (<10, 10-19, 20-29, 30-39, 40-49, 50-60 years) was as following; n=143/322(44%), 43/65(66%), 59/82(71%), 28/56(50%), 17/28(60%), 17/20(85%), respectively.

Among the patients with at least one positive specific IgE against allergens, 127(39.7 %) had mono sensitization and 193(60.3%) poly-sensitization (2 and >2 positive specific IgE to allergens).

The frequency of patients with outdoor or indoor sensitization and those who were sensitized to both indoor and outdoor allergens were 120(37.5%), 63(19.7%) and 137(42.8%), respectively.

The most common aeroallergens using this specific inhalant panel (IAARI) were plane tree (n=105, 32.8%), Bermuda grass (n=103, 32.2%), timothy grass (n=98, 30.6%), saltwort (Russian thistle) (n=91, 28.4%), acacia (n=81, 25.3%) and mugwort (n=78, 24.4%). The percentage of specific IgE to mold and mite were 23.8% (n=76) and 22.2% (n=71), respectively (Figure1). There was a statistically significant relationship between specific IgE to timothy grass and mold between two genders (p= 0.04 and 0.02, respectively). There was no significant relationship between sensitization to indoor or outdoor with gender (p=0.2).

Among patients with at least one positive specific IgE, sensitization to trees, weeds and grasses were 50.6% (n=162), 38.4% (n=123), 38.4% (n=123), respectively. In addition, 69 patients (21.6%) were sensitized to three above-mentioned types of aeroallergens.

The percentage of most common aeroallergens in six different age groups is shown in Figure 2. Also, the percentage of positive specific IgE tests to six common inhalant allergens in different age groups is shown in Figure 3.

The frequencies of referred patients in each season were; spring (n=127), summer (n=98), autumn (n=79) and winter (n=225). The positivity to at least one allergen in each season were; spring 58.3% (n=74), summer 59.2% (n=58), autumn 43% (n=34) and winter 47.6% (n=107). There was a statistically significant relationship between seasons and positivity to at least one allergen (p=0.04). The sensitization to weeds, trees, grasses, molds and mites in different seasons is shown in Figure 4.

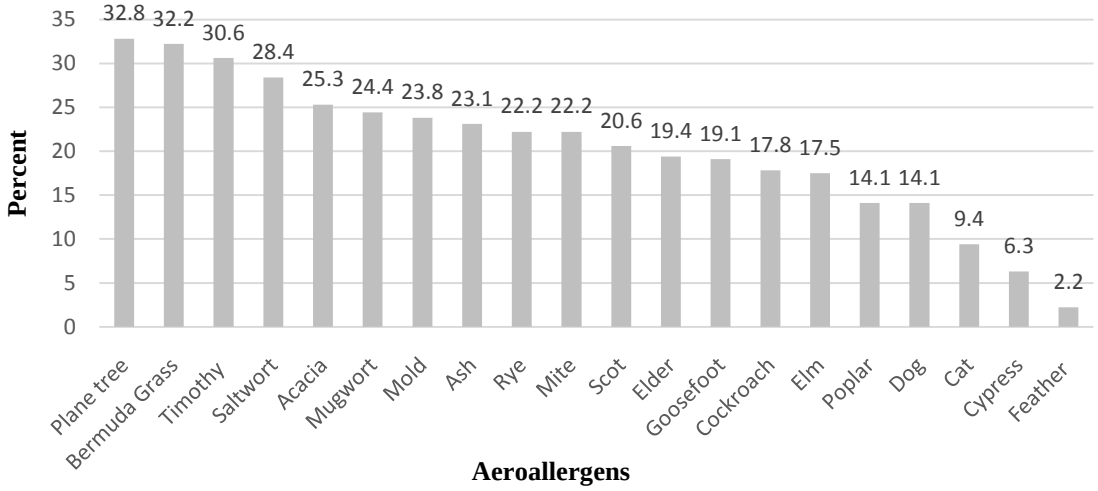

Figure 1. The percentage of sensitization to common aeroallergens in Iranian allergic patients with at least one positive specific IgE, evaluated during 2010-2013 in Tehran, Iran

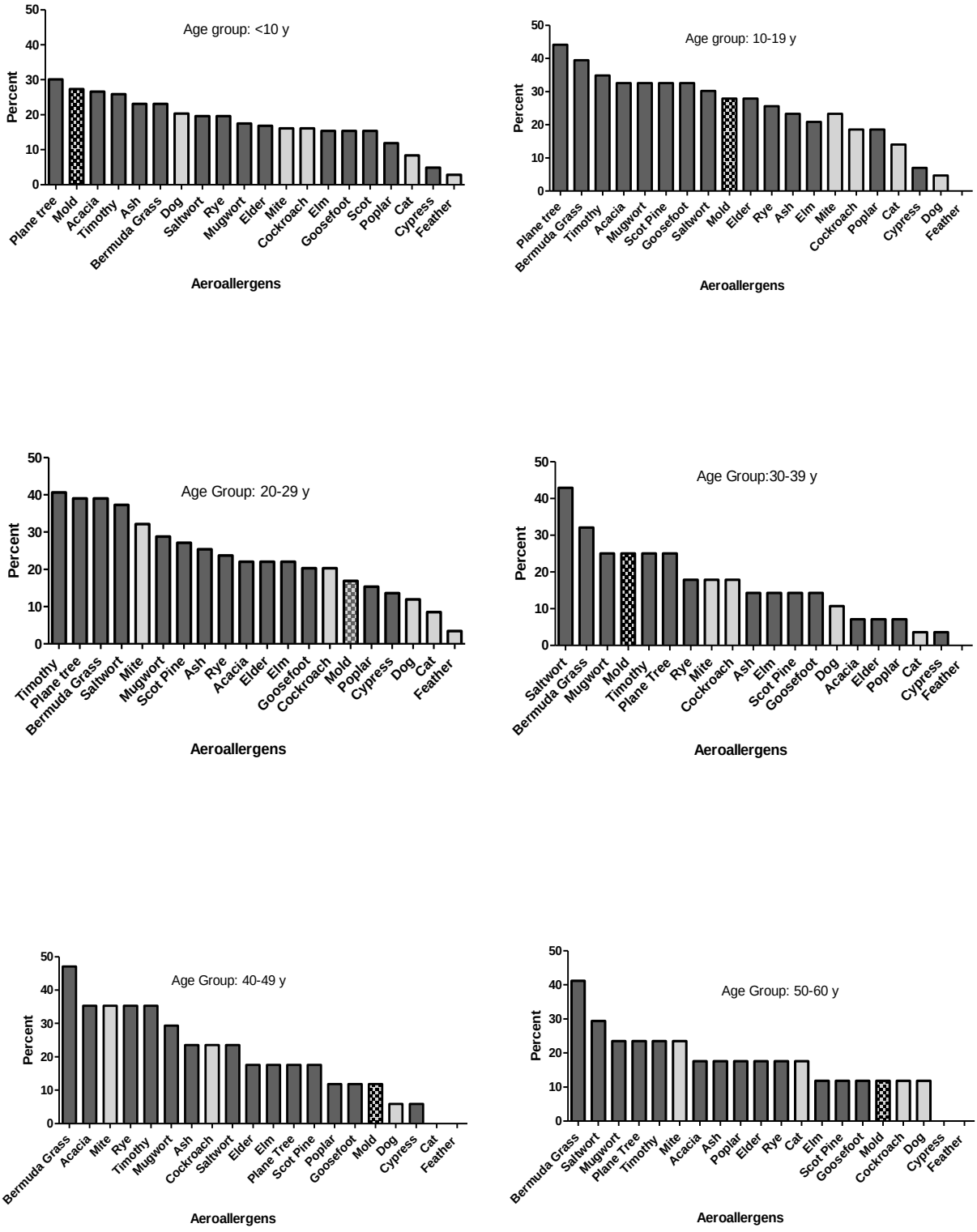

Figure 2. The percent of the most common aeroallergens in six different age groups of Iranian allergic patients with at least one positive specific IgE, evaluated in during 2010-2013 in Tehran, Iran

Outdoor allergens, indoor allergens, and mold are shown as dark gray, light gray and dotted columns, respectively.

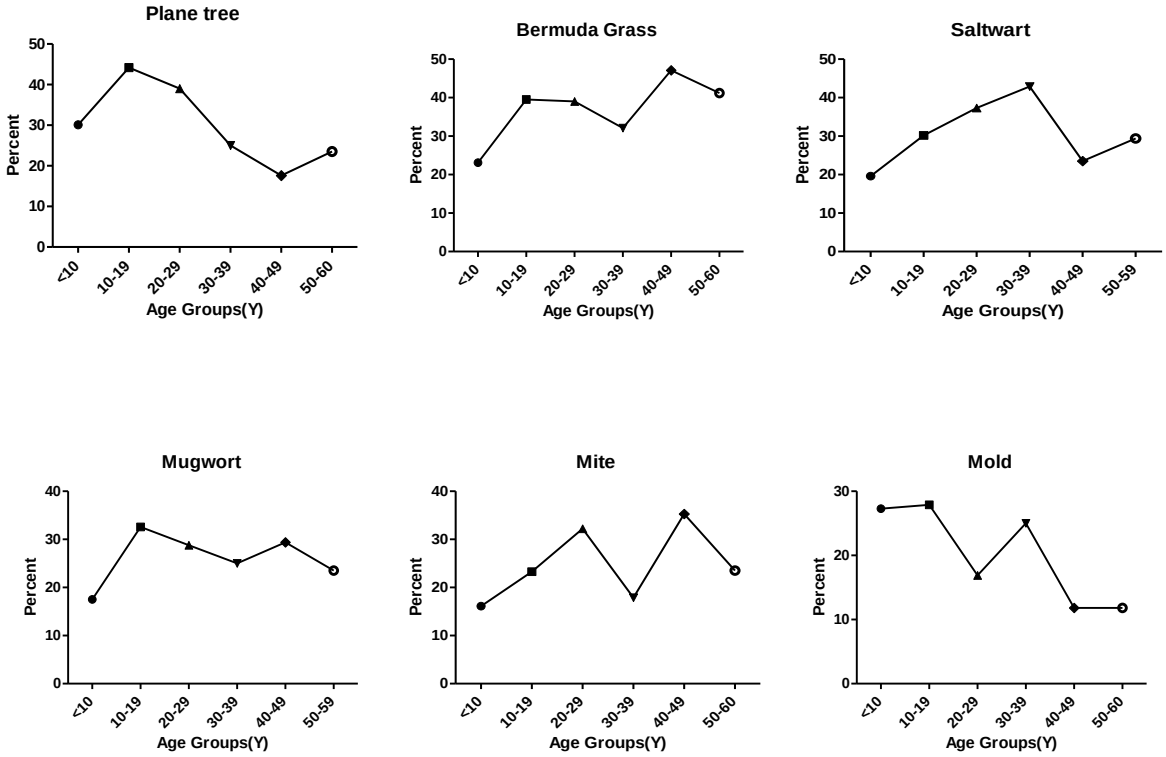

Figure 3. The prevalence of positive specific IgE to 6 common aeroallergens in different age groups in allergic patients with at least one positive specific IgE, evaluated in during 2010-2013 in Tehran, Iran

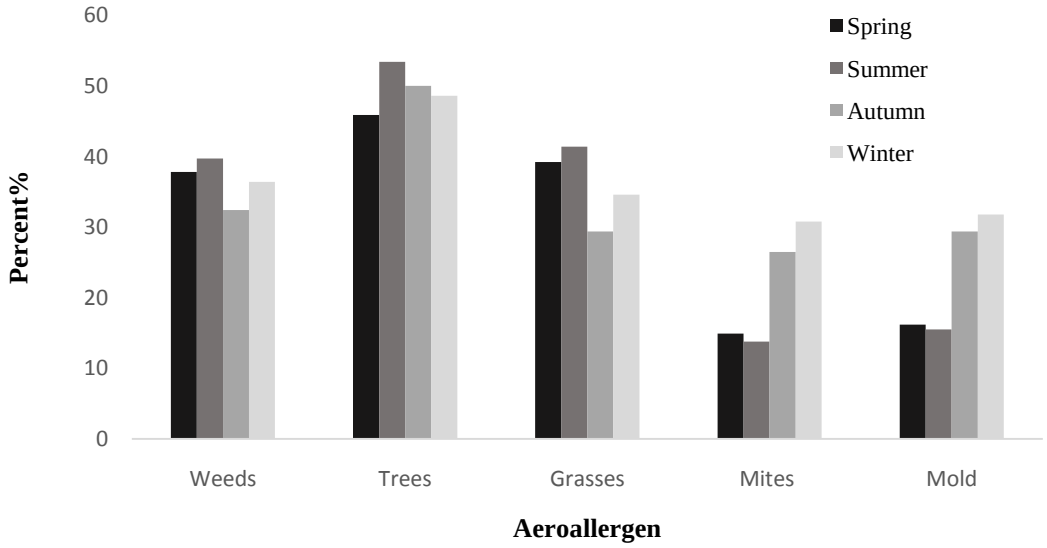

Figure 4. The percentage of common aeroallergen sensitization in different seasons, evaluated in during 2010-2013 in Tehran, Iran

DISCUSSION

In this study, the prevalence of the most common aeroallergens (indoors and outdoors) was determined by designing an in vitro specific regional panel. According to our findings, 53.2% of our patients showed positive specific IgE to at least one allergen. According to the findings of this study the most common outdoor allergen was Plane tree, while the most common indoor allergens were mold and mites.

We found no significant relationship between male and female with respect to sensitization to indoor and outdoor allergens, but there was a significant relationship between sensitization to timothy grass and mold with gender. The sensitization to these allergens was higher in men than women. This finding is compatible with Haftenberger et al study and might be due to different rate and period of exposure to aeroallergens and variability in triggering the immune response between two genders.[19]

In the present study, we investigated the aeroallergens sensitization in different age groups. According to Arbes et al study, age is considered as an important factor for sensitization to at least one allergen.[20]Sensitization to most aeroallergens was higher in second and third decade of life compared with other groups. Our study is consistent with Arbes et al study that reported the peak of specific IgE to aeroallergens in adulthood especially in the third decades of life. Cohort effect could be mentioned as the reason of this peak.[20] Also, we found a reducing trend in the prevalence of aeroallergens sensitivity among older patients which is in accordance with the recent reports on immune aging.[21] The patients ages with more than 18 years old showed more sensitization to weeds and grasses compared to participants less than 18 years old (p= 0.003, p=0.02, respectively). Also, in a study in Ahvaz, Iran, a similar relationship between grass and age groups was reported.[22]According to the present and also Sheehan et al study, the sensitization to weeds and grasses is developed later than trees. [23] However; this should be confirmed by further investigation.

The order of sensitization prevalence to trees, weeds and grasses was similar to the study by Hoseini et al[17] while inconsistent with Assarzadegan et al study in the city of Ahvaz, Iran.[22] In Ahvaz study, weeds, trees and grasses were the most common aeroallergens, respectively.[22] It could be because of climate difference due to geographical reasons, botanical species[12,22] and different type of used methods.[20]

No significant relationship was obtained between mono and poly sensitization to one or more than one allergens with age and gender. A similar study in USA has indicated the predominance of poly sensitization rather than mono-sensitization.[20] Moreover, a parallel study in Europe revealed a range of 16.2 to 19.6% in mono sensitization and 12.8 to 25.3% in poly sensitization among allergic patients.[24] It has been shown that multi sensitization to aeroallergens particularly perennial allergens increases the risk of asthma development.[25] Multi-sensitization could be caused by cross reaction between common allergenic molecules of different allergens.[26]

Outdoor allergens originate from different sources such as trees, grasses, weeds pollen, some animals and fungi spores.[27] The growing productions of CO_2 and greenhouse gasses worldwide as well as climate change have led to change in plants' pollen releasing pattern including the increase in production of pollens, their stability in air and their extended distribution. All these factors have resulted in a high incidence of respiratory disorders and allergic reactions.[6,28] Duration of exposure to aeroallergens, as well as some other environmental elements including air pollution[12,29] and also geographical variations[21] ought to be considered as well.

In the present study, outdoor allergens (plane tree, timothy grass, Bermuda grass, saltwort) were dominant in our patients. In Europe, outdoor allergens including the grasses are the most important aeroallergens.[12,29] Also, in our study grasses were the second (Bermuda grass) and third (Timothy grass) most common aeroallergens.

Plane tree (sycamore, *Platanus orientalis*) has been considered as the most common aeroallergen in our study. Because of tolerance to air pollution and adaptation to different ecological conditions, cultivating this plant is performed in urban regions[30] such as many cities in Iran.

Saltwort (Russian thistle) has been reported as fourth common aeroallergen in this study while in some other studies such as those performed in Mashhad, Iran and Ahvaz, Iran, this allergen has been identified as the most common aeroallergens.[16,22,31]

The indoor allergens usually exist throughout the year, develop perennial allergic rhinitis.[24] In some studies, there are a significant relationship between

positive specific IgE against one to more indoor allergens and asthma.[10,32]

The pollination season differs according to type of aeroallergens (including trees, weeds and grasses). The pollination time of trees, grasses and weeds are usually winter-spring, spring- summer and spring to autumn, respectively.[33] On the other hand, the start time of pollination and its length could be affected by several factors such as temperature, precipitation, and air pollution.[34] In this study, there was a significant association between positivity to at least one allergen and different seasons (p=0.04) but no significant relationship was found between specific IgE to weeds, trees and grasses with different seasons (p>0.05). Also, as it is shown in Figure 4, percentage of weeds, grasses and trees sensitization was somewhat higher in summer compared to other seasons.

In line with Choi study,[35] the sensitization to molds and mites were higher in autumn and winter compared to other seasons. This could be attributed to high temperature and humidity of indoor environment in cold seasons, which provide, suitable condition for growth of molds and mites.[36]

Sensitivity to mold was higher than mite but was lower compared with plane tree, Bermuda grass, timothy grass, and mugwort. Different studies reported fungal sensitization worldwide and in Iran. Their findings are different because it depends on ethnic and geographical area.[21] In the present study, the sensitization to mold mix was similar to the study done in Ahvaz, Iran[22] and inconsistent with those performed in Mashhad, Iran[16] and Shiraz, Iran.[18]

In spite of predominance of house dust mite sensitization in some countries such as Uganda and Puerto Rico,[37,38] outdoor allergens were the most prevalent aeroallergens in our study. However, in some cities of Iran such as Bushehr, house dust mite is the most common aeroallergens.[6] This high prevalence of mites sensitization could be because of growing of mites in hot and humid weather of Bushehr as a seaport.[38] In Europe, the sensitization to house dust mite is among the most common indoor allergens involving upper airway tracts.[39]

Allergy to cockroach is considered to play a role in causing and aggrevatingasthma.[40,41] In our study, among patients with at least one positive specific IgE, 17.8 % were cockroach sensitized. In the study of Assarzadegan et al done in southwest of Iran (Ahvaz), the frequency of cockroach sensitization (30.8%) in allergic patients were much more than our study.[22] In the another study carried out in northeast of Iran (Mashhad), 7.5% of allergic patients showed sensitization to cockroach, which was less than our study.[31] This difference could be due to variations in climate and age.[42]

In this study, the frequency of specific IgE to dog allergens was somewhat similar to Shirai et al study (Japan).[32] On the other hand, Langley et al showed 49% and 40% sensitization rate for cat and dog respectively in asthmatic patients.[43] In the study of Majkowaska B. et al in Poland, the most common aeroallergen was cat.[44] This discrepancy maybe due to the lower number of pets kept in Iranian houses.

One of the limitations our study was that the data analysis was performed regardless of patients' region of residency, job, and educational level. The other limitation of the present study pertained to the RIDA allergy screen, which cannot determine cross reactive molecules particularly in multi-sensitized patients. This study is merely a pilot study for determination of common allergens in Iran. Future supplementary investigations are under process for determining the prevalence of common allergens in different regions of Tehran as the capital of Iran considering the job and educational level of the participants as well.

Our findings showed that outdoor aeroallergens (such as plane tree, Bermuda grass and timothy grass) are the predominant aeroallergens detected using this specific regional panel. Determination of common outdoor aeroallergens, particularly pollens, in each city could be helpful for paying more attention to not cultivate the plants with allergenic pollens in public places to prevent asthmatic allergies. Determining the cross reactive molecules by new specific IgE techniques would be the next step in future studies.

ACKNOWLEDGEMENTS

This study has been supported by Immunology, Asthma and Allergy Research Institute, Tehran University of Medical Sciences, Tehran, Iran. The authors wish to extend special thanks to Dr. Laleh Nikfarjam and Dr. Maryam Nourizadeh for their outstanding collaboration.

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