

An investigation of the prevalence of indoor and outdoor inhalant allergens in children with allergic rhinitis

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Abstract

Objective: The aim of the present study was to determine the prevalence of the aeroallergens sensitivity among children with allergic rhinitis in the province of Istanbul in Turkey, based on skin prick test (SPT) reactivity.

Methods: This study, including 729 AR patients with positive SPT, was conducted in three age groups. SPT with extracts including pollens, house dust mites (HDMs), animal dander's (ADs) and molds was performed on these patients. All these patients have a positive reaction to at least one allergen with SPT.

Results: The allergen prevalence of 729 patients with positive SPT results was 33% for HDMs, 31% for pollen, 19% for molds and 17% for ADs. The sensitivity to aeroallergens significantly decreased as the age increased ($p<0.01$). Both outdoor and indoor allergen positivity in preschool children (Group 1) were 89 (43.4%) and in adolescent children (Group 3) were 32 (15.6%), and also sensitivity to allergens significantly decreased according to increase of age ($p<0.01$).

Conclusion: We provided regional allergens profile of children with AR in Istanbul. Avoiding exposure to allergens and finding the best formulation of allergen immunotherapy for AR are important steps in the clinical management of patients.

Keywords: Aeroallergen, allergic rhinitis, children, skin prick test.

Özet: Allerjik rinitli çocuklarda indoor ve outdoor inhalen alerjen prevalansının araştırılması

Amaç: Bu çalışmanın amacı, İstanbul'da allerjik rinitli (AR) çocuklarda deri prick testi (DPT) reaktivitesine dayanan aeroallerjen duyarlılığının prevalansının belirlenmesidir.

Yöntem: Pozitif DPT olan 729 AR'li hastanın dahil edildiği bu çalışma, üç yaş grubu halinde incelendi. Bu hastalar üzerinde polen, ev tozu akarları, hayvan epiteli ve mantarlar içeren ekstraktlarla birlikte DPT yapıldı. Araştırmaya dahil olan hastalar DPT'de en az bir alerjene karşı pozitif olan bir tepkiye sahiptir.

Bulgular: Pozitif DPT sonuçları olan 729 hastanın alerjen prevalansı, ev tozu akarları için %33, polen için %31, mantarlar için %19 ve hayvan epiteli için %17 idi. Aeroallerjenlere karşı duyarlılık, yaş arttıkça belirgin olarak azaldı ($p<0.01$). Okul öncesi çocuklarda (Grup 1) outdoor ve indoor alerjen pozitifliği 89 (%43.4), ergen çocuklarda (Grup 3) 32 idi (%15.6) ve alerjenlere duyarlılık da yaş artışına göre belirgin olarak azaldı ($p<0.01$).

Sonuç: Bu çalışma ile İstanbul'daki AR'li çocukların alerjen profili elde edildi. AR'li hastaların klinik yönetiminde sorumlu alerjenlere maruz kalmaktan kaçınma ve AR için en iyi alerjen immünoterapi formülasyonunu bulma önemli adımlardır.

Anahtar sözcükler: Aeroallerjen, allerjik rinit, çocuklar, deri prick testi.

Hypersensitivity and allergic disorders of the immune system which occur through allergic inflammation induced by an allergen-specific immunoglobulin E (IgE) mediated

response.^[1,2] Today, homes have been insulated for energy efficiency, carpeted, heated and cooled especially in developed countries and indoor allergens have increased in

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homes, where is an ideal habitat for the production of indoor allergens.^[3,4] Globally, the most abundant indoor allergens include those derived from house dust mites (HDMs), cats, and cockroaches.^[4,5] The principal HDM species are the pyroglyphid mites (*Dermatophagoides pteronyssinus*, *dermatophagoides farina*, and others), which usually account for 90% of mite species in house dust in temperate regions.^[6,7] Grass pollen are clinically important sources of outdoor aeroallergens and is recognized as an important trigger for allergic rhinitis.^[8,9] People are exposed to outdoor allergens that directly or through penetrate the interior throughout life. The most abundant source of outdoor aeroallergens and the most commonly known ones are pollen grains and fungus spores.^[10]

In fact, aeroallergens play an important role in the pathogenesis of respiratory allergic diseases. Pollen, mold, house dust mites (HDMs) and animal dander's (ADs) are the most common allergens.^[11,12] Allergic disorders are diagnosed by performing a physical examination and epidermal skin testing. Skin prick test (SPT) in the assessment of allergic response continues to be the most appropriate in vivo diagnostic test applied.^[1] Any bubble greater than 3 mm at 15 minutes is considered a positive response when there is no response to the negative control.^[13] It is also important to identify common allergens in the environment to avoid exposure to allergens and to find the best allergen immunotherapy formulation.^[12] So far, there has been no information regarding the common aeroallergens according to outdoor and indoor classification. The aim of this study was to investigate the prevalence of various aeroallergens in Istanbul and their involvement in sensitizing children with AR.

Materials and Methods

This retrospective study was performed on the patients who admitted to otolaryngology clinic between March 2008 and August 2015 and the data from 2–16 years old patients with symptoms of rhinitis were collected in this study.

The diagnosis of allergic rhinitis is in line with “Allergic rhinitis and its Impact On Asthma (ARIA)” guidelines.^[14] To avoid false-negative skin tests, patients using antihistamine medications, immune suppressive drugs, and antidepressants were not included in the study groups because antihistamines suppress the skin test results.^[15] The study was conducted with the data from ENT clinic. The age range of these patients was 2–16 years and they were divided into three groups, 2–6 years of age were preschool children (Group 1), 7–11 years of age were school children (Group 2) and 12–16 years of age ones were adolescent (Group 3). The results of SPT in these patients were evaluated from their

files in this study. SPT was also used for allergens (Allergopharma, Reinbeck, Germany; Stallergenes SA, Antony, France), which were investigated in terms of both individual responses and in groups. The groups were as follows: outdoor allergens; pollen allergens (tree pollen mix, olive tree, red oak, grass pollen, grain pollen, weed pollen), fungal allergens (*Alternaria alternata*, *Aspergillus fumigatus*) and indoor allergens; house dust allergens (*Dermatophagoides farinae*, *Dermatophagoides pteronyssinus*) and animal dander's (dog epithelium, cat epithelium).

Statistical analysis was performed using SPSS for Windows, Version 21.0 (SPSS Inc., Chicago, IL, USA). A difference in the mean number of siblings between the categories of each index of exposure was tested by Kruskal-Wallis test. A p value <0.05 was considered significant.

Results

Demographic data

In our study, the results of SPT in 1210 patients who had clinical findings for rhinitis were evaluated. Patient's medical history and physical examination findings (sneezing, nasal congestion, frequent and transparent watery runny nose, nasal itching, burning in the eyes, with symptoms such as itching) had been used to diagnose rhinitis. Of them, 729 (60.2%) had at least one or more allergen-positive SPT responses, and this group was accepted as AR patients and their results were evaluated in this study. Remaining 481 (39.8%) patients had no allergen sensitization with SPT and these rhinitis patients were excluded from the study.

The age of patients was between 2 and 16 years and the male/female ratio and the mean age of subjects were 1.03 and 8.25±3.61 years, respectively. The average age of the girls was 8.54±3.66 years, while that of boys was 7.99±3.54 years. These patients were grouped into 3 age groups in 5-year brackets and the Groups 1, 2 and 3 included 276, 307 and 146 patients, respectively.

The prevalence of allergens in SPT positive children with allergic rhinitis

In children with AR living in the Istanbul, the positive SPT allergens consist of 33% house dust allergens, 31% pollen allergens, 19% fungal allergens, and 17% ADs (**Fig. 1**).

SPT reactivity to outdoor and indoor aeroallergens in our patients' groups

The data of SPT positive patients (who had at least one of the house dusts, pollens, fungi, or ADs allergens) were cal-

culated and outdoor allergens were positive in 261 patients (35.80%) from all groups and 96 (36.8%) were in Group 1, 101 (38.7%) were in Group 2 and 64 were (24.5%) in Group 3 ($p>0.05$) (**Table 1**). Indoor allergens were positive in 263 patients (36.08%) from all groups and 91 were (34.6%) in Group 1, 122 were (46.4%) in Group 2 and 50 were (19.0%) in Group 3 ($p>0.05$) (**Table 1**).

Both indoor and outdoor allergens were positive in 205 patients (28.12%) from all groups and 89 were (43.4%) in Group 1, 84 were (41.0%) in Group 2 and 32 were (15.6%) in Group 3 ($p=0.001$) (**Table 1**). However, preschool children (Group 1) showed high sensitivity, while teenager group (Group 3) showed lower sensitivity to all allergens ($p<0.01$) (**Table 1**).

The distribution of allergens reactivity in our patients with AR

In children with AR living in the Istanbul region, the positive SPT allergens consist of 33% house dust allergens, 31% pollen allergens, 19% fungal allergens, and 17% ADs (**Table 2**). No significant differences between men and women in the distribution of allergen species were observed.

Sensitivity to indoor allergens such as house dust, fungus, and animal allergens decreased inversely with increasing age ($p<0.05$) (**Table 2**). Especially, the sensitivity to animal allergens decreased more significantly in the adolescence group (Group 3) ($p<0.01$) (**Table 2**). There was no statistically significant correlation between pollen allergens and age groups ($p>0.005$) (**Fig. 2**). When each outdoor allergens were examined one by one, poplar, red oak, and weed pollen sensitivity were seen more frequently in the Group 1 and the sensitivity decreased with age (Group 3) ($p<0.01$) (**Table 2** and **Fig. 2**).

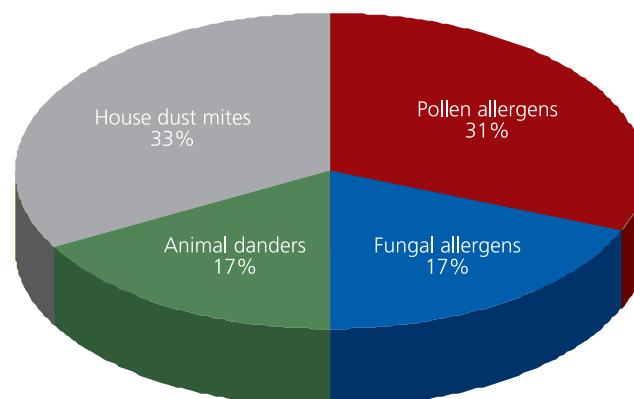


Fig. 1. The prevalence of allergens in SPT positive children with allergic rhinitis.

When the indoor allergens were examined one by one, dermatophagoides farinae, dog epithelium and cat epithelium sensitivity was more frequent in the preschool children (Group 1) and sensitivity decreased in the adolescence group (Group 3) ($p<0.01$). HDMs were highly positive in the Group 2 and sensitivity decreased in the adolescence group (Group 3) ($p<0.01$) (**Table 2**). The fungal allergen sensitivity was higher in preschool children (Group 1), whereas it was found lower in the adolescence group (Group 3) ($p<0.05$) (**Table 2** and **Fig. 2**).

There was male predominance in the percentage of preschool children with allergic rhinitis (male 21.40% and female 16.46%), there was also male predominance in the percentage of school children with allergic rhinitis (male 22.09% and female 20.03%) and there was female predominance in the percentage of adolescent children with allergic rhinitis (female 11.25% and male 8.78%) (**Fig. 3**).

Table 1. The prevalence of outdoor, indoor and both allergen-positive groups for patients with allergic rhinitis.

Allergens	All groups	Group 1	Group 2	Group 3	p-value
Type	100% N=729	n=276	n=307	n=146	
Outdoor	35.80% N=261 100%	96 (36.8%)	101 (38.7%)	64 (24.5%)	0.207
Indoor	36.08% N=263 100%	91 (34.6%)	122 (46.4%)	50 (19.0%)	0.069
Outdoor & Indoor	28.12% N=205 100%	89 (43.4%)	84 (41.0%)	32 (15.6%)	0.001

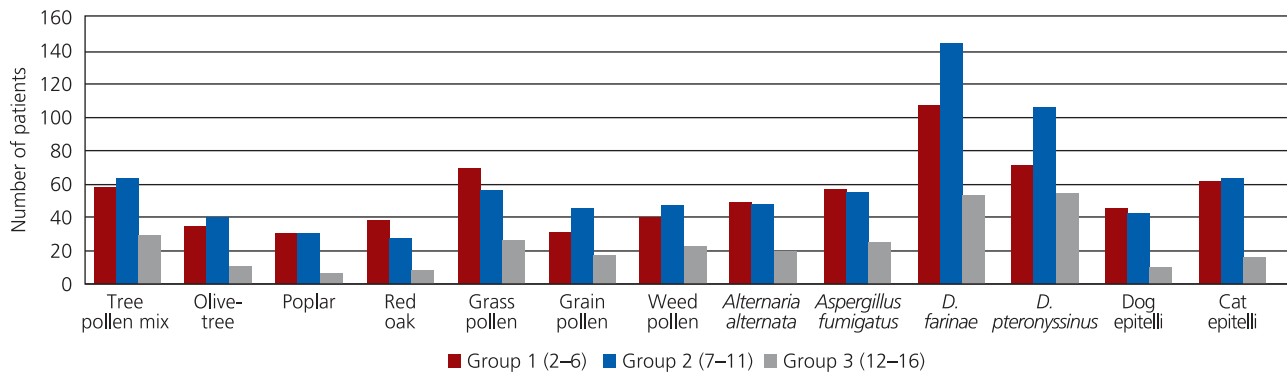


Fig. 2. Allergen distribution in three age groups of patients with allergic rhinitis.

Discussion

In this study, the characteristics of allergen causing AR and their prevalence in the children living in Istanbul were investigated. Characteristics of allergen types were important for the evaluation of allergic rhinitis. So the prevalence of indoor and outdoor allergens among children was investigated according to the age groups. The result showed that the sensitizing aeroallergens among our patients with AR were including 33% house dust allergens, 31% pollen allergens, 19% fungal allergens, and 17% ADs (Table 1) (Fig. 1). HDMs (33%) were the most common aeroallergens in our patient’s groups. Moreover, HDMs’ percentage is mostly dependent on ambient humidity and high temperature in environmental condition. Likewise, the incidence of HDMs sensitization in Singapore, Malaysia, and Thailand was as high as our study.^[16,17]

It was also observed that the percentage of indoor allergens (36.08%) including HDMs and ADs were similar with outdoor allergens (35.80%) like pollens and fun-

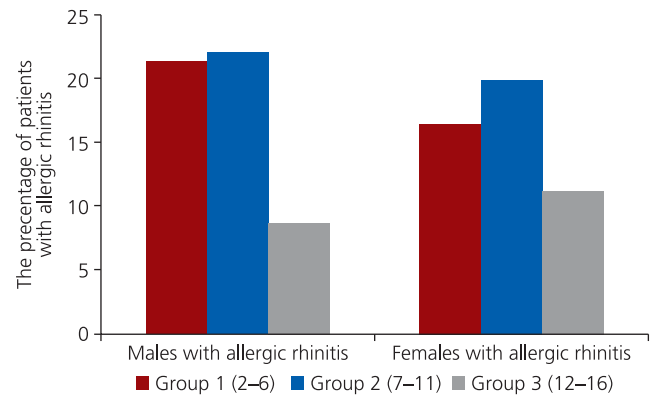


Fig. 3. Gender of patients and percentage of allergic rhinitis in preschool (Group 1), school (Group 2) and adolescent (Group 3) children.

gal allergens (Table 1). Additionally, both indoor and allergens were positive in 28% of the patients. It has been observed that outdoor allergens in AR patients are more prevalent in different cities where dry climate prevails,

Table 2. The percentage of allergens in age groups and statistical significance in patients with allergic rhinitis.

Allergens	Group 1	Group 2	Group 3	Total	p-value*
	Positive value				
	n (%)	n (%)	n (%)	N† (%)	
HDMs	131 (30.46%)	169 (34.28%)	74 (25.78%)	374 (30.90%)	0.045
Pollen allergens	135 (31.39%)	143 (29.01%)	70 (24.39%)	348 (28.76%)	0.126
Fungal allergens	91 (21.63%)	86 (17.44%)	40 (13.94%)	217 (17.93%)	0.044
Animal dander’s	89 (20.69%)	83 (16.84%)	22 (7.66%)	194 (16.03%)	0.000
Total	276 (37.86%)	307 (42.11%)	146 (20.03%)	729 (100%)	

unlike our study.^[18,19] Indoor allergens are seen more frequently in preschool children but less in adolescents ($p < 0.01$) (Table 1). We observe these results because children spend more time at home in their early ages. Additionally, outdoor allergens were more frequent in preschool children, but less in adolescents ($p < 0.01$) (Table 1). We associate this with our region which is very dense in terms of pollen levels.

A study conducted on 5080 children with asthma in Istanbul region has shown allergen sensitivities to house dust mite for 50%, cat feathers for 15% and dog feathers for 10%.^[20] A study from Ankara in preschool children with respiratory problems showed that the sensitivity to HDMs and *A. Alternaria* were 46.3% and 29.9%, respectively.^[21] Our study has similar results and the sensitivity to both outdoor and indoor allergens in preschool children was (43.4%) and it was significantly higher than adolescents 15.6% (Table 2). Therefore, the allergen sensitivity decreased depending on the age ($p < 0.01$) (Tables 1 and 2).

In our study, there was a male predominance for allergic rhinitis (21.3%, female 16.4%) in the preschool group and there was a female predominance for allergic rhinitis (11.2%, male 8.8%) in adolescents. The multicenter allergy study followed up 467 children until 13 years of age and showed a similar frequency of rhinitis.^[17,22] The reason for this difference may be the lifestyle, and cultural difference of sexes make it possible for a male to expose to antigens more than female children from the environmental conditions in the preschool periods. Thus, the delay of exposure to antigens in the female children could be postponed the allergic reaction and sensitization period in the later ages.

Avoiding exposure to allergens and looking for the best formulation of allergen immunotherapy for AR are important steps in clinical managements of these patients. The eradication of common indoor allergens in domestic living spaces is important in the prevention of symptoms of allergic disease in children groups. Therefore, the prevalence information obtained from our study can be used for the diagnosis and treatment strategies of allergic rhinitis in Istanbul region.

We provide regional allergen profile of AR patients in Istanbul, which is based on the identification of common aeroallergens with the pattern of SPT reactivity.

Conflict of Interest: No conflicts declared.

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