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Sensitization to common aeroallergens in the atopic population of Malatya Province, Turkey: A retrospective analysis using skin prick test

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Abstract

Aim: Asthma and allergic rhinitis (AR) are chronic disorders that occur frequently and affect the quality of life. It is important to identify aeroallergens in a certain region to diagnose and treat asthma and AR in susceptible persons. We aimed to determine the distribution of aeroallergen sensitization rates using the skin prick test (SPT) in adult patients with AR and/or asthma in Malatya Province, Turkey.

Materials and Methods: Between May 2018 and December 2021, we retrospectively reviewed the data of patients with AR and/or asthma and sensitivity to at least one aeroallergen on the SPT.

Results: Of the 419 patients enrolled in our study, 334 (79.7%) had only AR, 68 (16.2%) had both AR and asthma, and 17 (4.1%) had only asthma. A total of 259 (61.8%) patients were women, and the mean age was 30.52 ± 10.06 years. Sensitization to grass mix was most common (71.8%), and its rate was higher among patients with only AR and those with AR and asthma (75.1% vs. 64.7%, $p = 0.001$) than in patients with only asthma. However, the sensitization rate to *Dermatophagoides pteronyssinus* was higher in patients with only asthma (47.1%, $p < 0.001$) than in the other groups.

Conclusion: We found that grass mix was the most common sensitizing aeroallergen in accordance with the geographic and climatic characteristics of Malatya Province. This information may help with diagnosis, management, and prevention of AR and asthma.

Introduction

Asthma and allergic rhinitis (AR) are chronic disorders that affect the quality of life, and their prevalence is increasing among persons of all age groups worldwide [1,2]. Sensitization to aeroallergens is a major risk factor for the development of allergic disorders, and determining the susceptibility of patients to these disorders is important to ensure optimal treatment [3]. The allergen can be identified in patients having immunoglobulin (Ig) E-mediated disease and susceptible individuals recognized through epidemiological studies using the skin prick test (SPT), which has high sensitivity and specificity [4,5]. Dust mites, grass mix, tree mix, weed mix, cat/dog epithelium, and molds are the major allergens [6], and the first step in the prevention of allergies is to avoid allergens.

Aeroallergen distribution varies between countries and even within different regions of a country [7] depending on geographic characteristics, seasons, socioeconomic status, and cultural factors [8]. This variation has been observed in Turkey as well, and the most common aeroallergen differs between various regions of the country [9-12]. In this study, we aimed to determine the distribution of aeroallergens involved in the etiology of AR and asthma using the SPT in Malatya Province, Turkey.

Materials and Methods

Selection of participants

We retrospectively reviewed the medical files of patients aged ≥ 18 years who visited the adult allergy and immunology outpatient clinic at the Malatya Training and Research Hospital between May 2018 and December 2021. The diagnoses of AR and asthma were based on the Allergic Rhinitis and Its Impacts on Asthma and Global Initiative for Asthma guidelines, respectively [13,14]. Among the patients with AR and/or asthma, only those who demonstrated sensitivity to at least one aeroallergen on the SPT were included. Finally, 419 eligible patients were selected for this study. Data regarding demographic features, accompanying atopic diseases (urticaria, eczema), serum eosinophil counts, total IgE levels, and the allergens that the patients were sensitive to were recorded. Criterion sampling, a type of probability sampling technique, was performed.

SPT

The SPTs were performed using a prick test solution (ALK-Albello, Hamburg, Germany) and comprised a standard panel that included the following aeroallergens: grass mix *(Holcus lonatus, Dactylis glomerata, Lolium perenne, Phleum pratense, Poa pratensis, Festuca pratensis)*, weed mix *(Artemisia vulgaris, Plantago lanceolata, Parietaria judaica, Urtica dioica, Taraxacum vulgaris)*, tree mix *(Betula verrucosa, Fagus sylvatica, Quercus robus, Platanus orientalis, Robinia pseudoacacia)*, *Populus alba*, dust mites *(Dermatophagoides pteronyssinus, D. farinae)*, molds *(Alternaria alternata, Cladosporium herbarum)*, cat and dog epithelium, and cockroaches *(Blatella germanica)*. They were performed and evaluated by the same trained nurse and doctor to ensure standardization in accordance with previously established guidelines [15,16]. SPTs were not conducted in cases of pregnancy, dermographism, and usage of drugs that suppress the effects of immediate skin testing. Histamine dihydrochloride 10 mg/mL was used as a positive control and saline as a negative control. Tests were performed on the volar surface of the forearm of each patient, and the results were recorded after 15 minutes. The result was considered positive if the wheal size was 3 mm than that arising from the negative control.

This study was approved by the ethics committee of Malatya Turgut Özal University, Faculty of Medicine (approval number: 2022/33).

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics for Windows, version 21.0 (IBM Corp., Armonk, N.Y., USA). The normality of continuous variables was evaluated using the Kolmogorov–Smirnov test, normal distribution curve, Q-Q graphs, and skewness and kurtosis coefficients (± 3.29). Normality was evaluated among the categorical variables by examining cells with an expected count < 5. While age was presented as mean ± standard deviation, all other variables were presented as categorical variables, which were expressed as percentages. The Pearson's chi-square test was performed to compare the differences in associations between the aeroallergens and sex, age, atopic disease, and season. The Fisher's exact test was used in tables where the expected count of cells < 5 was high (>20%). A p-value < 0.05 was considered statistically significant.

Results

Among the 419 patients included in this study, 259 (61.8%) were women and 160 (38.2%) were men. The mean age was 30.52 ± 10.06 years, and a majority of the patients (n = 230, 54.9%) were aged 18–29 years. A total of 334 (79.7%) patients had only AR, 68 (16.2%) had both asthma and AR, and 17 (4.1%) had only asthma. Among the patients, 18 (4.3%) had eczema and 17 (4.1%) had urticaria. The serum eosinophil count was > 0.30/µL in 97 (27.1%) of 358 patients whose eosinophil count measurements were available, while the total IgE level was > 100 UI/mL in 100 (77.6%) of 129 patients whose total IgE level measurements were available. The clinical characteristics of the patients are shown in Table 1.

Table 1. Clinical characteristics of patients (n = 419).

Sex, n (%)	
Female	259 (61.8%)
Male	160 (38.2%)
Age (years)	
Mean ± SD	30.52 ± 10.06
Age groups, n (%)	
18–29 years	230 (54.9%)
30–49 years	171 (40.8%)
≥ 50 years	18 (4.3%)
Allergic diseases, n (%)	
AR	334 (79.7%)
AR + asthma	68 (16.2%)
Asthma	17 (4.1%)
Atopic diseases, n (%)	
Eczema	18 (4.3%)
Urticaria	17 (4.1%)
Serum eosinophils level (n = 358)	
≤ 0.3/µL	261 (72.9%)
> 0.3/µL	97 (27.1%)
Total IgE level (n = 129)	
0–100 UI/mL	29 (22.5%)
101–500 UI/mL	66 (51.2%)
> 500 UI/mL	34 (26.3%)

AR, allergic rhinitis; SD, standard deviation.

Prevalence of aeroallergen sensitization

Grass mix was identified as the most common aeroallergen (71.8%), followed by weed mix (18.6%), *D. pteronyssinus* (16%), cat epithelium (14.8%), *D. farinae* (13.1%), tree mix (4.5%), *Populus alba* and dog epithelium (3.8%), *Alternaria alternata* (1.9%), cockroach (1.2%), and *Cladosporium herbarum* (1%). Figure 1 shows the distribu-

Table 2. Distribution of aeroallergen sensitization rates according to sex.

	Women (n = 259) n (%)	Men (n = 160) n (%)	p value
Grass mix	175 (67.6)	126 (78.8)	0.013*
Weed mix	47 (18.1)	31 (19.4)	0.754*
Tree mix	10 (3.9)	9 (5.6)	0.399*
D. pteronyssinus	49 (18.9)	18 (11.3)	0.037*
D. farinae	36 (13.9)	19 (11.9)	0.551*
Molds	9 (3.5)	1 (0.6)	0.097**

* Pearson's chi-square test was performed ** Fisher's exact test was performed.

Table 3. Distribution of aeroallergen sensitization rates according to age.

	18–29 years (n = 230) n (%)	30–49 years (n = 171) n (%)	≥ 50 years (n = 18) n (%)	p value
Grass mix	178 (77.4)	114 (66.7)	9 (50)	0.007*
Weed mix	38 (16.5)	36 (21.1)	4 (22.2)	0.475*
Tree mix	12 (5.2)	6 (3.5)	1 (5.6)	0.702*
D. pteronyssinus	32 (13.9)	30 (17.5)	5 (27.8)	0.234*
D. farinae	25 (10.9)	26 (15.2)	4 (22.2)	0.225*
Molds	3 (1.3)	7 (4.1)	0 (0)	0.184**

* Pearson's chi-square test was performed ** Fisher's exact test was performed.

Table 4. Distribution of aeroallergen sensitization rates according to disease groups.

	Only AR (n = 334) n (%)	AR and asthma (n = 68) n (%)	Only asthma (n = 17) n (%)	p value
Grass mix	251 (75.1)	44 (64.7)	6 (35.3)	0.001*
Weed mix	60 (18)	16 (23.5)	2 (11.8)	0.427*
Tree mix	17 (5.1)	2 (2.9)	0 (0)	0.486*
D. pteronyssinus	41 (12.3)	18 (26.5)	8 (47.1)	< 0.001*
D. farinae	42 (12.6)	10 (14.7)	3 (17.6)	0.762*
Molds	4 (1.2)	3 (4.4)	3 (17.6)	0.002**

AR, allergic rhinitis * Pearson's chi-square test was performed ** Fisher's exact test was performed.

Table 5. Distribution of aeroallergen sensitization rates according to seasons.

	Spring (n = 58) n (%)	Summer (n = 220) n (%)	Fall (n = 98) n (%)	Winter (n = 43) n (%)	p value
Pollen	54 (93.1)	170 (77.3)	74 (75.5)	27 (62.8)	0.003*
Dust mites	4 (6.9)	47 (21.4)	31 (31.6)	14 (32.6)	0.002*
Cat/dog epithelium	11 (19)	44 (20)	11 (11.2)	5 (11.6)	0.189*
Molds	1 (1.7)	8 (3.6)	0 (0)	1 (2.3)	0.231**

* Pearson's chi-square test was performed ** Fisher's exact test was performed.

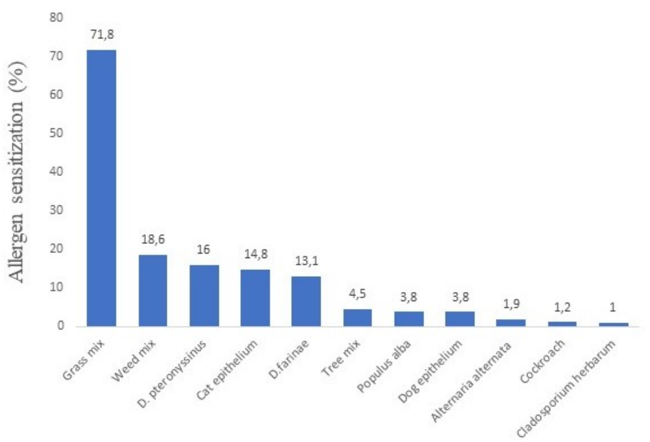

Figure 1. Distribution of aeroallergens sensitization rates in the study group.

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Aeroallergen sensitization and sex

The women showed a higher test positivity rate for *D. pteronyssinus* than the men did (18.9% vs. 11.3%, p = 0.037). Compared with the women, the men demonstrated a higher test positivity rate for grass mix (78.8% vs. 67.6%, p = 0.013). There were no significant differences in sensitization to the remaining aeroallergens between the sexes. The distribution of aeroallergen sensitization rates according to sex is shown in Table 2.

Aeroallergen sensitization and age groups

We classified patients into the following three age groups: 18–29 years, 30–49 years, and ≥ 50 years old. There was a significant difference in grass mix allergen sensitivity rates among these groups (77.4%, 66.7%, and 50% for participants aged 18–29 years, 30–49 years, and ≥ 50 years, respectively; p = 0.007). There were no significant differences in sensitization to the remaining aeroallergens between the age groups. The distribution of aeroallergen sensitization rates according to the age groups is shown in Table 3.

Aeroallergen sensitization and disease groups

There were significant differences in sensitization to grass mix, *D. pteronyssinus*, and molds among the disease groups. The rates of sensitization to grass mix were higher in the AR (75.1%) and AR with asthma (64.7%) groups than in the only asthma (35.1%) group ($p = 0.001$). The rates of sensitization to *D. pteronyssinus* were higher in the only asthma (47.1%) group than in the AR (12.3%) and AR with asthma (26.5%) groups ($p < 0.001$). The rates of sensitization to molds were higher in the only asthma (17.6%) group than in the AR (1.2%) and AR with asthma (4.4%) groups ($p = 0.002$). The distribution of aeroallergen sensitization rates according to the disease groups is shown in Table 4.

Among the patients with only AR, the most common aeroallergen was grass mix (75.1%), followed by weed mix (18%), cat epithelium (12.9%), *D. farinae* (12.6%), and *D. pteronyssinus* (12.3%). Sensitization to molds was rare (0.6%). Among the patients with asthma and AR, the most common aeroallergen was grass mix (64.7%), followed by *D. pteronyssinus* (26.5%), weed mix (23.5%), cat epithelium (22.1%), and *D. farinae* (14.7%). Sensitization to cockroaches was not observed (0%).

Among the patients with only asthma, the most common aeroallergen was *D. pteronyssinus* (47.1%), followed by grass mix (35.3%), and cat epithelium (23.5%). The rates of sensitization to *D. farinae*, *Alternaria alternata*, and dog epithelium were equal (17.6%). Sensitization to cockroaches and tree mix was absent (0%).

Aeroallergen sensitization and seasons

There were significant differences in sensitization to total pollen (grass mix, weed mix, tree mix, and Populus alba) and dust mites between the seasons. Sensitization to pollen was frequently observed among the patients tested in the spring and that to dust mites was detected most commonly in the winter and fall. The rates of sensitization to pollen were 93.3%, 77.3%, 75.5%, and 62.8% in the spring, summer, fall, and winter, respectively ($p = 0.003$). The rates of sensitization to dust mites were 32.6%, 31.6%, 21.4%, and 6.9% in the winter, fall, summer, and spring, respectively ($p = 0.002$). The distribution of aeroallergen sensitization rates according to the seasons is shown in Table 5.

Discussion

Allergic airway diseases, such as asthma and rhinitis, are increasingly becoming prevalent, and determining the allergen is the initial step in the treatment of these disorders [17,18]. The SPT is a quick and easy diagnostic tool for the identification of allergens whose distribution depends on genetics, regions, and environmental factors, such as climate, temperature, humidity, and precipitation [17,19]. Turkey consists of regions with markedly different geographic features and climate types that affect the distribution of allergen sensitization. To the best of our knowledge, this was the first and largest study conducted to investigate the aeroallergen distribution among adult patients with AR and/or asthma in Malatya Province, Turkey.

This province has a population of 800,000 people and is located between 35° 54' and 39° 03' N latitudes and 38° 45' and 39° 08' E longitudes. It has an altitude of 977 m and a semi-arid, temperate continental climate with moderate temperatures. Humidity is low in the summer because of severe aridity [20]. These climate characteristics may be likely to cause more differences in allergen distribution in Malatya Province compared with those in other regions of Turkey. We investigated the sensitizing potential of some common aeroallergens, such as pollen, mites, cat and dog epithelium, and molds, in this province. A positive reaction to the SPT was detected in 419 patients. The most prevalent sensitizing aeroallergen was grass mix (71.8%) followed by weed mix (18.6%).

Pollen has been identified as the most sensitizing aeroallergen in Europe [21]. Aeroallergen sensitization studies conducted in different regions of Turkey showed that sensitization to weed-cereal pollen is the most common in Elazığ, and sensitization to grass pollen is the most common in Diyarbakır and Mardin [22-24]. While one study comprising 94 adult and 32 pediatric patients showed that sensitization to grass mix is most prevalent (19.4%), another including pediatric patients showed that sensitization to grass/cereal mix occurs most frequently (48.9%) in Malatya Province [25,26]. These findings may be attributed to the flora characteristics of this area.

In our study, low sensitization to dust mites (*D. pteronyssinus*, 16%; *D. farinae*, 13.1%) was expected because of the region's altitude and low humidity. Kalpaklıoğlu et al. showed that the rates of sensitization to dust mites are lower in the central region than those in other regions of the country [27]. While the ideal humidity for the presence of dust mites is 65–80%, they die at humidity levels $< 50\%$ [28]. The rates of sensitization to dust mites have been reported to range between 44% and 78% [10-12].

Furthermore, we found that the sensitization rate to grass mix was higher among the male patients than that among the female ones. Studies from Kuwait and China showed that compared with women, men demonstrate a higher susceptibility to outdoor allergens [29,30]. Additionally, we observed that the sensitization rate to *D. pteronyssinus* was higher in women than in men. This finding may be attributed to the prolonged time spent by women at home owing to cultural reasons.

When allergen distribution was assessed according to age, sensitization to grass mix was found to be most common in the 18–29 years and 30–49 years age groups. No significant difference was detected in the distribution of the remaining allergens by age group. In a recent study by Ediger et al., sensitization to grass-rye, grass mix, and wheat pollen was observed more frequently in patients aged 30–49 years [12]. Additionally, a study from Turkey suggested that the sensitization to certain allergens (grass-rye mix, tree mix, weed mix, and cat epithelium) decreases with advancing age [23]. This is probably due to the increased exposure to aeroallergens in the outdoor/occupational areas encountered by younger adults than do the older ones. Furthermore, a high prevalence of sensitization to common allergens in young adult groups (13–59 years) with progressively decreasing prevalence among advanced age groups has been reported previously [31]. However, some studies from Turkey and other countries did not report a significant correlation between SPT positivity and age

[32-34].

Several researchers have reported that sensitization to dust mites is associated with an increased risk of asthma and rhinitis in children and adults [7,35]. Dust mites are the most important indoor allergens for asthma [36]. We found that sensitization to *D. pteronyssinus* (47.1%) was most common among patients with only asthma, which concurs with the observation of previous studies [6,7,12,37].

Additionally, our study included positive SPT results over a period of 3.5 years; therefore, we were able to assess the relationship between allergen sensitization and the seasons. Sensitization to pollen was detected most frequently in the spring, while that to dust mites was observed most commonly in the winter and fall. In an SPT study conducted in the Republic of Korea over a period of 4 years, positivity to several types of pollen and dust mites was reported to rise in the spring and fall [38]. Additionally, a study from Turkey showed that sensitization to tree mix in Turkey increases in May, although the timing of SPT is not critical among patients with pollen allergy [39].

Despite these significant findings, our study has a limitation, namely the study group was small. Further studies including a larger sample size may help establish previous findings regarding the distribution of aeroallergen sensitization rates in Malatya Province.

Conclusion

In conclusion, we retrospectively evaluated SPTs in patients with AR and/or asthma in Malatya Province and found that sensitization to grass mix was most common in the only AR and AR with asthma groups, while that to *D. pteronyssinus* was most prevalent in patients with only asthma. Our findings may provide valuable information required for the diagnosis and management of allergies in susceptible patients.

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Ethics approval

This study was approved by the ethics committee of Malatya Turgut Özal University, Faculty of Medicine (approval number: 2022/33).

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