

High sensitization to house-dust mites in patients with allergic rhinitis in the eastern Black Sea region of Turkey: A retrospective study

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ABSTRACT

Objectives: Identification of the most common aeroallergens to which patients are sensitized in a specific area is important in the diagnosis and treatment of allergic rhinitis (AR). We determined the distribution of aeroallergens, detected by skin-prick tests (SPT), in adult patients with AR in the Eastern Black Sea region of Turkey and compared the results with the other regions of Turkey and in the world.

Methods: The medical records of SPT performed on 1457 patients with symptoms of AR (with regard to the Allergic Rhinitis and its Impact on Asthma 2008 guidelines) between March 2010 and March 2013 were analyzed retrospectively. SPT were carried out with the same panel, which included grass; weeds; trees; mold; epidermal mixtures; and with two house-dust mite (HDM) extracts, *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*.

Results: In 1229 of 1457 patients (84.4%), there were positive reactions for at least one aeroallergen on the SPT. The most common aeroallergen was the HDM *D. pteronyssinus* (84% [$n = 1033$]) followed by *D. farinae* (78.2% [$n = 962$]). Grass pollen sensitivity (70.8% [$n = 871$]) was higher than tree or weed pollen sensitivity in this region.

Conclusions: The most common aeroallergens in AR are HDMs of *D. pteronyssinus* and *D. farinae* in the Eastern Black Sea region in Turkey. Our study may help in developing environmental control strategies for AR.

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Allergic rhinitis (AR) is the most common atopic disease and affects >500 million people around the world. There is also evidence that the prevalence of AR is increasing worldwide.^{1–4} Knowledge of the aeroallergen sensitivities will enhance both diagnostic and treatment strategies.⁵ Economic impact is often underestimated because it also affects social life, school, and work.

AR is defined as inflammation of the membranes that line the nose, and is induced by immunoglobulin E mediated immune response after allergen exposure. AR is characterized by nasal congestion, rhinorrhea, sneezing, itching of the nose, and/or postnasal drainage. It is not a life-threatening disease but can cause extranasal effects and results in decreased quality of life, decreased sleep quality, and impaired performance at work and school.^{6,7} Consequently, AR results in significant medical expenditures and indirect costs. It is often associated with asthma. There are other associated conditions, such as rhinosinusitis, nasal polyps, recurrent viral infections, adenoid hypertrophy, tubal dysfunction, and otitis media with effusion.^{5,8,9} Thus, in otorhinolaryngology practice, it is important to recognize the presence of sensitization to inhaled allergens in this patient group. Avoiding allergen exposure is the first step in the management of AR. Identification of the spectrum and the most common aeroallergen in an area has an important role in the diagnosis and treatment of AR and comorbid diseases. Skin-prick testing (SPT) is a practical, reliable, and well-tolerated method of establishing AR.¹⁰

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Turkey is a country that has lands both in Asia and Europe. It is surrounded in three directions by seas. There are many different climates and ethnic populations. It is not a surprise that there are varying aeroallergen spectra and prevalence rates in different regions in Turkey. There is no research to investigate the aeroallergen spectra of adult patients with AR in Rize or neighboring cities in the eastern Black Sea region. Rize is located at an altitude of 9 m (30 feet) above sea level. The climate in the Black Sea area is usually rainy and humid. The average temperature is 23°C in the summer and 7°C in the winter.¹¹

The prevalence of AR detected by physicians in a recent epidemiologic study conducted in Turkey varied between 16.6 and 23.4%.¹² This study showed that the prevalence of AR was as high as 20.9% in our area, but, despite this high prevalence, there are no data regarding the most important aeroallergens there. In the present study, we investigated the distribution of aeroallergens, detected by SPT, in adult patients with AR in the Eastern Black Sea region of Turkey and compared the results with the other regions of Turkey and in the world.

METHODS

This retrospective study was conducted in the otorhinolaryngology department of Recep Tayyip Erdogan University Medical Faculty. Ethical permission for the study was obtained before collection of data, with approval from the ethics committee of our institution (identification 2015/20).

Subjects

The medical records of SPTs of 1457 patients (352 male and 1105 female patients) who lived in the urban and rural areas of the city of Rize and two neighboring cities in the eastern Black Sea region are analyzed. They presented with symptoms of AR (according to the ARIA 2008 guidelines) to the otorhinolaryngology department from March 2010 to March 2013. The data were analyzed retrospectively. The mean age was 35.1 ± 14.4 years (range, 15–84 years).

Table 1 Contents of mixed aeroallergens in the multiprnick test kit

Mixed Aeroallergens	Contents of Mixed Aeroallergens
Grass mix	Standardized Bermuda grass, rye grass, timothy, orchard, June grass, sweet wernal, meader fescue, red top
Epidermal mix	Dog, cow, horse, goat, sheep epithelium, cat pelt, cotton linters, mixed feathers
Tree mix	Birch, olive tree, poplar, hazelnut, oak, elm, ash, alder, willow, beech, maple, linden, red mulberry, juniper, elderberry, pine
Weed mix	Mugwort, English plantain, lamb's quarter, yellow dock, ragweed, wall pellitory, dandelion, quack grass
Mold mix	<i>Alternaria alternata</i> , <i>Aspergillus funigatus</i> , mucor plumbeus, mixed penicillium, <i>Cladosporium</i> species, <i>Candida albicans</i> , <i>Rhizopus nigricans</i> , <i>Botrytis cinera</i>

Exclusion Criteria

The files of the patients who were <15 years old were excluded. Patients with dermatographism or dermatosis that may have affected SPT results were excluded.

SPT

SPTs were performed on all patients according to European guidelines¹³ by using a multiprnick test kit (Lincoln Diagnostics Inc., Decatur, IL), which comprise a total of 48 allergens, including grass mix, tree mix, weed mix, mold, epidermal mix (dog, cow, horse, goat, sheep epithelium, cat pelt, cotton linters, mixed feathers), and house-dust mites (HDM) (*Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*) (Table 1). Histamine hydrochloride (9%) and glycerol saline solution were used as positive and negative controls, respectively. SPT was performed on patients after they had stopped taking long-acting antihistamines for 2 weeks and short-acting antihistamines and sympathomimetic drugs for 5 days before the test. The SPT was performed on the flexor aspect of the forearm. The mean wheal size was recorded after 20 minutes. Allergens were determined as positive results according to erythema, induration, and the size of the wheal produced. A wheal diameter of >3 mm was considered positive with adequate positive and negative controls.¹⁰

Statistical Analysis

The SPSS software (version 18.0; IBM, Chicago, IL) was used to analyze the data. Percentages, χ^2 tests, and Fisher's exact test were used to compare the prevalence and tendencies between the study populations. The p values of <0.05 were considered to indicate statistical significance.

RESULTS

The age range of the 1457 patients diagnosed with AR and enrolled in the study was 15–84 years (mean age, 35.1 ± 14.4 years). Of the patients, 75.8% were female ($n = 1105$) and 24.2% were male ($n = 352$) patients (Table 2). We determined sensitization to at least one aeroallergen in the SPTs in 84.3% of these 1457 patients. The most common allergen was *D. pteronyssinus*, one of the HDMs (84% [$n = 1033$]), followed by *D. farinae* (78.2% [$n = 962$]). In the region, the rate of the sensitivity to grass pollens (70.8% [$n = 871$]) was higher than that to tree pollens (33% [$n = 406$]) or weed pollens (29.5% [$n = 363$]) (Fig. 1).

Evaluation of the female and male patients separately did not show any change in the frequency of sensitization to common allergens. In

Table 2 Distribution of all the patients, and patients with positive and negative SPT according to age, sex, and location (city center or rural area)

	Total Patients, no. (%)	Patients with Positive SPT Result, no. (%)	Patients with Negative SPT Result, no. (%)
Age group			
15–20 y	292 (20)	222 (18.0)	70 (30.7)
20–40 y	610 (1.8)	515 (41.9)	95 (41.7)
40–60 y	482 (33.1)	424 (34.5)	58 (25.4)
≥60 y	73 (5.0)	68 (5.5)	5 (2.1)
Sex			
Male	352 (24.2)	254 (20.7)	98 (43.0)
Female	1105 (75.8)	975 (79.3)	130 (57.0)
Location			
Urban	979 (67.2)	822 (66.9)	157 (68.9)
Rural	478 (32.8)	407 (33.1)	71 (31.1)

SPT = Skin-prick test.

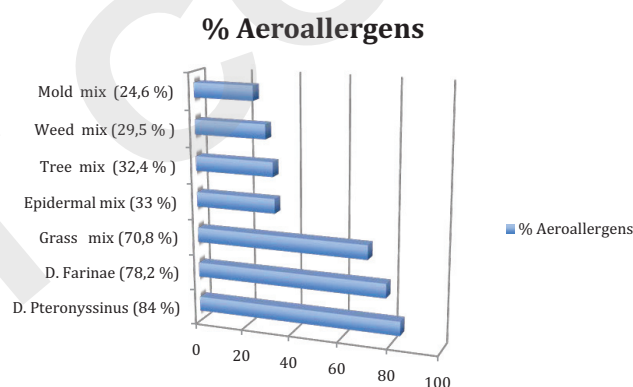


Figure 1. Distribution (%) of sensitization to aeroallergens in patients with allergic rhinitis (AR) and with positive skin-prick test results.

both, the most common sensitization was to *D. pteronyssinus*, followed by *D. farinae* and grass mix allergens (Fig. 2). There was no statistically significant difference between the sexes regarding the sensitization rates to *D. pteronyssinus*, *D. farinae*, grass mix, or weed mix allergens. However, sensitization rates to epidermal mix, tree mix, and mold mix allergens were significantly higher in female than in male patients ($p = 0.001$, $p = 0.003$, and $p = 0.0001$, respectively) (Fig. 2).

Grouping of the patients with SPT positive and SPT negative results according to age revealed that the highest sensitization rate was in the age group of 20–40 years (41.8%) (Table 2). The rate of the sensitization to weed mix and epidermal mix aeroallergens increased significantly with age ($p = 0.015$ and $p = 0.011$, respectively) (Table 3). There was no statistically significant difference between the patients who lived in the city center and those in the rural area with regard to the total positive SPT rates ($p = 0.636$) (Table 2). However, separate evaluation of the aeroallergens showed that *D. farinae* sensitivity in the rural area (83%) was significantly higher than in the city center (75.9%) ($p = 0.025$) (Table 4).

DISCUSSION

To our knowledge, this was the first reported study to investigate the aeroallergen distribution in adult subjects with AR in the eastern Black Sea region in Turkey. We showed that HDM sensitivity was frequently found in AR at this region. The presence of HDMs is related to the mean temperature, humidity, and altitude of a region.¹⁴

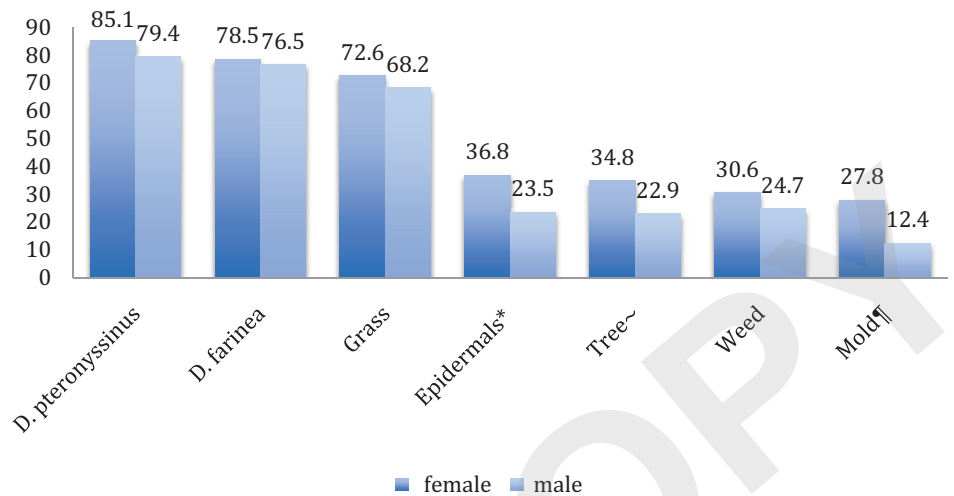


Figure 2. Distribution (%) of sensitization to aeroallergens in the female and male patients with positive skin-prick test results. * $p = 0.001$; ~ $p = 0.003$; † $p = 0.0001$.

Table 3 Distribution of the sensitization to aeroallergens according to age groups

Test Result	Age Groups, no. (%)				<i>p</i>
	15–20 y	20–40 y	40–60 y	≥60 y	
House-dust mite (+)*	186 (83.8)	425 (82.5)	357 (84.1)	63 (92.6)	0.330
House-dust mite (+)#	171 (77.0)	403 (78.2)	332 (78.3)	53 (77.9)	0.989
Grass (+)	159 (71.6)	352 (68.3)	319 (75.2)	51 (75)	0.256
Tree (+)	66 (29.7)	156 (30.2)	157 (37.1)	18 (26.4)	0.191
Epidermal (+)	58 (26.4)	162 (31.4)	174 (41.0)	25 (36.7)	0.011
Weed (+)	57 (25.7)	129 (25.0)	152 (35.7)	25 (36.7)	0.015
Mold (+)	40 (18.2)	128 (24.8)	117 (27.6)	28 (26.4)	0.198

(+) = Positive test results.

Bold denotes sensitization to weed mix and epidermal mix aeroallergens increased significantly with age ($p < 0.05$).

**Dermatophagoides pteronyssinus*.

#*Dermatophagoides farinae*.

Table 4 Distribution of the sensitization to aeroallergens in urban and rural areas

Test Result	Urban, no. (%)	Rural, no. (%)	<i>p</i>
House-dust mite (+)*	684 (83.2)	349 (85.7)	0.365
House-dust mite (+)#	624 (75.9)	338 (83)	0.025
Grass (+)	573 (69.7)	308 (75.6)	0.084
Tree (+)	267 (32.4)	130 (32.1)	0.937
Epider (+)	265 (32.2)	153 (37.5)	0.159
Weed (+)	241 (29.3)	121 (29.7)	0.871
Mold (+)	196 (23.8)	106 (26)	0.492

(+) = Positive test results.

**Dermatophagoides pteronyssinus*.

#*Dermatophagoides farinae*.

The most important allergy-causing mites found in homes worldwide are the HDMs *D. farinae*, *D. pteronyssinus*, and *Euroglyphus maynei*.¹⁵ Surveys in selected areas of the United States found *D. farinae* and *D. pteronyssinus* to be the two most prevalent mite species.¹⁶ In the present study, we determined sensitization to at least one aeroallergen in the SPT results in 84.3% of these 1457 patients. The high prevalence of allergy positivity in our study might be from a group of patients who presented having already met the symptom guidelines, whereas the overall prevalence in the population at large is likely to be much lower.

Indoor allergens are the most common causes of AR in some countries and regions. There is variability in the prevalence of AR and aeroallergen distribution among countries and among regions within the same country. Differences may be due to environmental, socio-economic, and genetic factors.^{2,17} Wang *et al.*¹⁸ found that a high level of HDM allergen was a risk factor for the development of AR.

Turkey consists of regions with markedly different geographic features and climates. Although studies that examined the prevalence of AR in the western and middle Black Sea regions exist, to our knowledge, no epidemiologic study regarding the aeroallergen distribution of patients with AR in the eastern Black Sea region of Turkey was reported previously. The eastern Black Sea region in the north-east has a rainy and humid climate, which provides a suitable environment for the proliferation of HDMs. These climatic conditions could result in different patterns of sensitization, which are likely to be different from most parts of Europe (especially the central parts of Europe) and the United States. For the most part, Europe lies in the northern temperate climate zone. Much of far western Europe is classified as a Temperate Oceanic climate.¹⁹ The climate of the United States varies due to differences in latitude and a range of geographic features, including mountains and deserts.²⁰

Turkey and some other countries, *e.g.*, Greece, in the Balkan Peninsula were not included in recent European epidemiologic studies that evaluated the prevalence of positive SPT results to environmental aeroallergens in Europe.^{21,22} In the study the European Community Respiratory Health Survey I,²¹ adults who lived in 35 centers in 15

developed countries underwent SPT for allergies to nine common aeroallergens. The prevalence of sensitization to *D. pteronyssinus* was significantly higher in centers in Australia, Belgium (Antwerp), France (Bordeaux), Ireland, New Zealand, the Netherlands (Geleen), and the United Kingdom (except Cambridge). It was lower in Scandinavia (Umea, south Sweden, Odense), Spain (Albacete, Galdakao, Oviedo), Iceland, Italy, in one center in Germany (Erfurt), and in France (Montpellier).²¹

In the GA²LEN survey,²² areas with a higher prevalence of positive SPT results to *D. pteronyssinus* tended to also have a higher prevalence of positive SPT results to *D. farinae*. The prevalence was higher in middle Europe (United Kingdom, Amsterdam, Ghent, Duisburg). The highest prevalence of a positive SPT to any HDM was in Coimbra in Portugal.²²

A study to identify the predictors of HDM allergen concentrations in the United States found that the Northeast had the highest mean HDM concentration of all regions, whereas the West had the lowest concentrations.²³ In eastern Europe and in Russia, there are a few studies that reported significant risk factors for AR and asthma, but, in these epidemiologic studies, aeroallergens or sensitizing agents were not documented.^{24,25}

Turkey has coasts on the Mediterranean, Black, and Aegean Seas, and is the second largest among countries with part of their territory in Europe after Russia. The prevalence of AR has been investigated in a number of studies conducted in different regions of Turkey, with the majority that investigated the prevalence of disease in children by using the standardized ISAC test (Phadia, Sweden).^{14,26–29} One study assessed the prevalence of AR in the Turkish adult population and reported that the prevalence of AR detected by physicians varied between 16.6 and 23.4%.¹⁴ This same study showed that the prevalence of AR was as high as 20.9% in the eastern Black Sea region, but, despite this high prevalence, there were no data regarding the most important aeroallergens in adult patients with AR in the area.

Kalpakioglu *et al.*³⁰ conducted a large-scale study on the presence of the HDMs in various regions of Turkey. The rate was very low in some regions inland but was detected in 46% of the samples obtained from the Black Sea region.³⁰ This study was consistent with our findings regarding the high rate of sensitivity to HDMs, which we detected in the eastern Black Sea region. In our country, it was found that sensitivity to HDMs was high in coastal regions, where humidity is also high and sensitivity to pollens was higher inland, where the air is relatively dry.^{27,31–34}

We recently published a study on asthma in patients with AR in otorhinolaryngology practices in the eastern Black Sea region.³⁵ In total, 267 patients recently diagnosed with AR were evaluated regarding the new onset and diagnosis of asthma. This investigation showed that, in both patient with newly diagnosed AR and patients with AR plus asthma, the most common sensitivity was to *D. farinae* and *D. pteronyssinus*. These results were consistent with the current study.

Several studies demonstrated that, beyond geographic and genetic factors, air pollution and socioeconomic factors also affect the sensitization to aeroallergens and the emergence of AR symptoms.^{36–38} Air pollution is not a very important problem in the urban areas of the eastern Black Sea region. Because of the characteristics of the region, urban and rural areas are socially and geographically interconnected. There is also no significant difference between these two areas regarding socioeconomic parameters. We determined that, in both groups, the most common sensitization was to HDMs, followed by grass pollens. However, sensitization to *D. farinae* was higher in patients who lived in the rural areas (83%) than in patients who lived in urban areas (75.9%) ($p = 0.025$).

In the present study, sensitization to epidermal mix and mold mix was higher among female than the male patients. Keeping a pet is not a common habit in this region. Because many female patients deal with stock farming in stalls close to their houses in some areas of the eastern Black Sea region, this may provide an explanation as to why sensitization to epidermal mix and mold mix were more common

among female than male patients. A comparison of patients with AR across the age groups showed that the highest sensitization to aeroallergens was in the age group of 20–40 years, which was consistent with other studies conducted in different regions of Turkey.^{31,33} In our study, it was demonstrated that sensitization to weed and epidermal aeroallergens increased with age.

AR affects the development of several comorbidities in the area of otolaryngology. Thus, a cost-effective and fast diagnosis of AR, which is encountered often by the otorhinolaryngologists, is important in terms of the treatment of AR and these comorbidities.^{9,39–42} The aggregate evidence profile for “environmental controls” was deemed to be grade B in the Clinical Practice Guideline (2015) for Allergic Rhinitis, published by The American Academy of Otolaryngology—Head and Neck Surgery Foundation.⁴² An SPT with a panel that includes HDMs and mixed extracts is a cost-effective method for the diagnosis of AR and avoids unnecessary testing in otorhinolaryngology practice in this region. A major limitation of this study was that it was a hospital-based retrospective study. However, our hospital is a tertiary center in the eastern Black Sea Region in Turkey and provides diagnosis and treatment not only to the patients who live in our city but also to the patients in neighboring cities.

CONCLUSION

This study showed a high prevalence of sensitization to HDMs in the eastern Black Sea region of Turkey, a country that bridges Asia and Europe. Epidemiologic research is important for determining environmental control strategies for AR. Our study may help in developing environmental control strategies to address AR.

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