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COMPARISON OF ALLERGEN SENSITIZATION ACCORDING TO AGE AND SEX USING SKIN PRICK TEST IN PATIENTS WITH ALLERGIC RHINITIS

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ABSTRACT

The aim of the present study was to investigate inhalant allergen sensitivity in adult patients with allergic rhinitis (AR) and to compare allergen sensitization based on age and sex under ecological conditions of urban areas.

In this cross-sectional study, 2391 patients diagnosed with rhinitis symptoms in the Istanbul area were evaluated. Skin prick test (SPT) with standard extracts, including house dust mite, pollen, fungal allergen, and animal dander, was performed. Patients with sensitization were divided into four different age groups with 10-year intervals for evaluation.

Of the 2391 patients with rhinitis, 1586 (66.3%) had at least one allergen sensitization on SPT, whereas 805 (33.7%) had no allergen sensitization. The most common sensitization (57.1%) was observed for pollen allergens. Multiple allergen sensitizations were lowest (38.8%) in the animal dander-sensitive group. The percentage of allergen sensitization was highest in age group 2 and lowest in age group 4 for both the sexes.

The data obtained from this study are important for monitoring allergen sensitivity in patients with rhinitis under ecological conditions of a large city. Allergen sensitization decreased with increasing age in all the study groups, and the percentage of sensitization changed according to age and sex. Monitoring allergen sensitization according to age and sex is important for environmental regulation, design of living spaces, working conditions, and preventive health services.

KEYWORDS:
Skin prick test, allergic rhinitis, inhalant allergens

INTRODUCTION

Allergic rhinitis (AR), also known as hay fever, is an allergic disease which is mostly affected by environmental factors [1]. AR is a heterogeneous dis-order with high prevalence and often remains undiagnosed for a long time. It is characterized by one or more symptoms of rhinitis, such as sneezing, itching, nasal congestion, and rhinorrhea [2]. Seasonal AR is relatively easy to identify because of the rapid onset and offset of symptoms due to pollen exposure, whereas perennial AR is more difficult to detect because of overlapping symptoms with sinusitis, respiratory infections, and vasomotor rhinitis [2]. According to the World Health Organization (WHO), hundreds of millions of people in the world are affected by allergic disease. AR affects the quality of life and is an important disease in terms of community health, affecting socio-economic well-being [1].

Allergic disease prevalence varies depending on environmental allergen variation and the level of exposure to or inhalation of allergens. In recent years, the prevalence of allergic diseases has increased in both developed and developing countries [1]. In industrialized countries, sensitivity to aeroallergens within the general population ranges from 25% to 50% [3, 4]. In the literature, the prevalence of AR in the community varies between 2.9% and 54.1%, depending on the race, age, and geographical region [5]. AR is a major health problem that concerns the general public.

Global climate change and air pollution increase the release and production of weed and tree pollen mix. Rising temperatures increase the growth of molds and fungi, which are important allergens for people with rhinitis [6].

Skin prick test (SPT) is used for the measurement of allergen reactivity. The recommended method for SPT includes the appropriate use of specific allergen extracts, maintenance of positive and negative controls, and interpretation of the test results 15–20 min after application [4, 5]. SPTs are minimally invasive, easy to apply, and produce a response to multiple allergens at once, which are important advantages of the test. The most useful allergens for testing inhalant allergies are house dust mites (HDMs), such as dermatophagoides, animal dander, and fungi (molds). Many causative agents have been associated with AR, including pollen, mold, dust mite, and animal dander.
The present study was conducted using the data from SPTs of 2391 patients who visited our ENT clinic due to rhinitis symptoms and 1586 of patients were found to be positive for AR and the results were evaluated in accordance with age and sex.

MATERIALS AND METHODS

The diagnosis of AR was made according to Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines from the European Forum for Research and Education in Allergy and Airway Diseases [7]. Retrospective data were collected from patients with rhinitis who visited an ENT clinic in Istanbul between March 2008 and August 2015. A total of 2391 adult patients were diagnosed with rhinitis who visited an ENT clinic in Istanbul between March 2008 and August 2015. A total of 2391 adult patients were diagnosed with rhinitis symptoms based on medical history and physical examination findings, such as sneezing, nasal congestion, frequent and transparent watery runny nose, nasal itching, and burning in the eyes. Those who had at least one allergen sensitization on SPT were included in this study. The ages of both male and female patients were in the range of 20–59 years, and patients were divided into four different age groups for analysis and comparison. Group 1 included patients aged 20–29 years, group 2 included those aged 30–39 years, group 3 included those aged 40–49 years, and group 4 included those aged 50–59 years. Patients aged >60 years and older were not included in this study because of lack of homogeneity due to current secondary diseases and medication. SPT was administered to all the patients who had rhinitis symptoms. To avoid false-negative results, patients using antihistamine medications, immunosuppressive drugs, and antidepressants were not included in the study because these drugs may interfere with test results [2].

The recommended method of prick testing included the appropriate use of specific allergen extracts, maintenance of positive and negative controls, and interpretation of the test results 15–20 min after application. A positive result was defined as a wheal of ≥3 mm in diameter than the wheal diameter of the negative control [8].

SPT was used for allergens Allergo-pharma (Reinbek, Germany), which were investigated in terms of both individual responses and types (tree pollen mix, olive, poplar, red oak, grass pollen, grain pollen, weed pollen, Alternaria alternata, Aspergillus fumigatus, Dermatophagoides farinae, D. pteronyssinus, dog epithelium, and cat epithelium).

Statistical analysis was performed using the SPSS for Windows, version 21.0 (SPSS Inc., USA). The Kruskal–Wallis test was performed to determine the significance of differences in allergen sensitivity according to age and sex. Significant relationships between age groups and allergen sensitivities were compared using the Tukey’s test, and p < 0.05 was considered significant.

RESULTS

Patients and allergen sensitization. In this study, the SPT data of 2391 adult patients with rhinitis were evaluated, and 1586 (66.3%) had at least one allergen-positive SPT response to allergens, such as pollen, house dust, fungi, or animal dander. Of those with positive test results due to allergen sensitization, 1023 (64.5%) were female and 563 (35.5%) were male. These patients were diagnosed with AR. The average age of females was 37.13 ± 9.96 years, while that of men was 36.99 ± 9.28 years. SPT results showed that 805 (33.7%) patients with rhinitis had no allergen sensitization. Of those with negative test results, 556 (69.1%) were female and 249 (30.9%) were male, and these patients without allergen sensitization were not included in the analysis and comparison.

The number of allergen sensitizations for each allergen type is provided in Figure 1. The results showed sensitization to pollen in 905 patients, house dust in 667, mold in 443, and animal dander in 298 (Figure 1). The detailed number of patients, allergen types, and multiple sensitization data are also provided in Figure 1. Sensitization to only one type of allergen is indicated by A1 (1039 patients; 65.5%). Patients who showed positive response to only two allergens are indicated by A2 (386; 24.3%), those who showed positive response to only three allergens are indicated by A3 (142; 9.0%), and those who showed positive response to four allergens (pollen, HDM, mold, and animal dander) are indicated by A4 (19; 1.2%).

The percentage of patients with multiple allergen sensitizations was lowest (38.8%) in the group of patients with positive response to animal dander and was highest in groups of patients with positive responses to pollen, HDM, and mold (63.6%, 62.3% respectively) (Figure 1).

Sensitization to allergen groups and types. More than half of the patients (57.1%) had sensitization to pollen (tree pollen mix, grass pollen, grain pollen, wild herb pollen, olive tree pollen, poplar pollen, and red oak pollen). Sensitization to house dust (D. farinae and D. pteronyssinus) was seen in 42.1% of the patients, whereas that to mold (A. alternata and A. fumigatus) was seen in 27.9%; furthermore, 18.8% of patients had sensitization to animal dander (cat and dog dander) (Figure 2).
The number of sensitive patients according to each allergen type is presented in Figure 2. The highest number of patients were sensitive to D. farinae and lowest to dog dander (Figure 2). Interestingly, the most prevalent allergen types in Istanbul were Dermatophagoides (D. pteronyssinus + D. farinae) and tree pollen mix (Figure 2).
TABLE 1

<table>
<thead>
<tr>
<th>Allergen type</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
</tr>
<tr>
<td>Pollen</td>
<td>M 53 (17.43%)</td>
<td>125 (41.12%)</td>
<td>89 (29.28%)</td>
<td>37 (12.17%)</td>
<td>0.00</td>
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<td></td>
<td>F 145 (24.13%)</td>
<td>209 (34.78%)</td>
<td>165 (27.45%)</td>
<td>82 (13.64%)</td>
<td>0.36</td>
</tr>
<tr>
<td></td>
<td>All 198 (21.88%)</td>
<td>334 (36.91%)</td>
<td>254 (28.07%)</td>
<td>119 (13.15%)</td>
<td>0.05</td>
</tr>
<tr>
<td>HDM</td>
<td>M 71 (28.98%)</td>
<td>93 (37.96%)</td>
<td>51 (20.82%)</td>
<td>30 (12.24%)</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>F 122 (28.91%)</td>
<td>128 (30.33%)</td>
<td>99 (23.46%)</td>
<td>73 (17.3%)</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>All 193 (28.94%)</td>
<td>221 (33.13%)</td>
<td>150 (22.49%)</td>
<td>103 (15.44%)</td>
<td>0.12</td>
</tr>
<tr>
<td>Mold</td>
<td>M 30 (25.49%)</td>
<td>64 (41.83%)</td>
<td>36 (23.53%)</td>
<td>14 (9.15%)</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>F 80 (27.59%)</td>
<td>95 (32.76%)</td>
<td>79 (27.24%)</td>
<td>36 (12.41%)</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>All 119 (26.86%)</td>
<td>159 (35.89%)</td>
<td>115 (25.96%)</td>
<td>50 (11.29%)</td>
<td>0.06</td>
</tr>
<tr>
<td>Animal dander</td>
<td>M 32 (33.68%)</td>
<td>40 (42.11%)</td>
<td>16 (16.84%)</td>
<td>7 (7.37%)</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>F 62 (30.54%)</td>
<td>76 (37.44%)</td>
<td>45 (22.17%)</td>
<td>20 (9.85%)</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>All 94 (31.54%)</td>
<td>116 (38.93%)</td>
<td>61 (20.47%)</td>
<td>27 (9.06%)</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>M 130 (23.09%)</td>
<td>230 (40.85%)</td>
<td>139 (24.69%)</td>
<td>64 (11.37%)</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>F 264 (25.81%)</td>
<td>349 (34.12%)</td>
<td>268 (26.2%)</td>
<td>142 (13.88%)</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>All 394 (24.84%)</td>
<td>579 (36.51%)</td>
<td>407 (25.66%)</td>
<td>206 (12.99%)</td>
<td>0.15</td>
</tr>
</tbody>
</table>

M: Male, F: Female, n: number of patients, p: Kruskal–Wallis test

Allergen sensitization according to age and sex. Patients were divided into four different age groups with 10-year intervals. Age groups 1, 2, 3, and 4 had 394, 579, 407, and 206 individuals, respectively. The highest sensitization to all allergen groups was observed in group 2 (36.5%) and the lowest was in group 4 (13.0%) (Table 1). The highest sensitization in male patients was observed in group 2 (40.9%) and lowest in group 4 (11.4%). Sensitization in female patients was also highest in group 2 (34.1%) and lowest in group 4 (13.9%) (Table 1). There was no significant difference in terms of allergen sensitization between males and females in the same age groups (p > 0.05) (Table 1). Additionally, allergen sensitization to pollen, HDM, mold, and animal dander was highest in group 2 and lowest in group 4 in both the sexes (Table 1).

DISCUSSION

Our results show that 66.3% of patients (total, 1586) with rhinitis symptoms had AR based on at least one sensitive response on SPT; i.e., two of three patients with rhinitis may have an atopic reaction. Therefore, SPT is one of the main tests for the diagnosis of patients with AR with an atopic reaction. These results were similar to the results on SPT and percentage of patients with sensitization reported in a study in a small city 150 km away from Istanbul [9, 10].

Most patients (65.5%) have sensitization to only one type of allergen (pollen, HDM, mold, or animal dander); multiple allergen sensitizations were lowest (38.8%) for animal dander and highest (68.2%) for pollen (Figure 1). Therefore, results of the current study showed that patients affected with indoor allergens have a lower number of multiple allergen sensitizations. This may be a result of repeated exposure to indoor allergens in living areas, affecting the patient’s immune system and developing tolerance to the allergens. However, pollen exerts a stimulating effect on the immune system, and cross reactions to other allergens may develop.

Sensitivity to allergens is associated with many factors, such as climate, geography, lifestyle, and humidity. These factors affect allergen responses of the population to pollen, HDM, fungi, and animal dander. The results observed in the city of Bushehr in the southwestern part of Iran are consistent with the results of the current study on allergen sensitization [11]. In the study in Iran, pollen was the most common allergen in a rural region, but the percentage of indoor allergens, such as HDMs, was lower than that in the current study. Lifestyle and local climate, especially humidity, may have resulted in this difference [12, 13].

HDMs live on carpets, soft furnishings, and bedding. They thrive at approximately 25–30°C with relative humidity between 75% and 80% [14, 15]. Istanbul’s temperature and humidity rates constitute a suitable environment for mites. Animal-borne allergens at home and workplace are of clinical importance. Hair, urine, and saliva of cats and dogs are sources of allergy, in addition to dander. In European and Western countries, there is a higher sensitivity to these allergens [2]. In European and North American countries, sensitivity to cat and dog dander is an important consideration for common aeroallergens [1, 16].

Indoor allergens, such as HDMs, are the most prevalent, affecting more than 56% of sensitive patients (e.g., Mexico City) [17]. Outdoor allergens, such as pollen, are the most prevalent in Istanbul re-
region, affecting approximately 57.1% of sensitive patients, which may be explained by the characteristics of various flora, climatic factors, such as wind rate and high humidity; and regional geographical conditions.

The high rate of sensitivity to pollen allergens, pollen-bearing trees, grass, and flowers may be attributed to their heavy presence throughout the year in Istanbul. Indeed, airborne allergens, such as pollen and spores, have been suggested as the main cause of allergic respiratory problems in temperate countries [18]. Grass, weeds, and tree pollen mix are spread by the wind rather than by insects, and the clinical significance of pollen varies depending on the geographic location [19].

The least common sensitive allergens in Istanbul were animal dander (Table 1). The overall sensitization to cats and dogs in the European population is very similar, but regional differences are found. Cat dander sensitization was seen in an average of 26.3% (range, 16.8%–49.3%) of patients. The rate of sensitization to dog allergens was 27.2% (range, 16.1%–56%) [20]. House-dwelling animals are not common in Istanbul compared with Europe. The current results showed that sensitization to animal dander was observed in 18.8% of patients, which was lower than the lowest ranges in European countries. This difference may be attributed to the lifestyles of individuals in Istanbul [20]. Living arrangements, mostly apartments, do not allow for coexistence of animals with humans in indoor settings in Istanbul.

Sensitivity to inhalant allergens and its clinical presentation are affected by age, and the number of studies including age and sensitivity has been increasing worldwide [21]. The symptoms of AR often begin in adolescence but may start at any age [22]. The allergen sensitization in our study was found to be highest (36.5%) in group 2 (age range, 30–39 years) and lowest (13%) in group 4 (age range, 50–59 years) (p < 0.01; Table 1). There are many parameters influencing decreased sensitization in older age. The most probable causes are lifestyle, senescence of immunity inducing tolerance, and long-term exposure to allergens that triggers a state ofergy to immunogens. In a recent study from Iran, there was a significant difference between different age groups with respect to the frequency of AR (p = 0.006) [11].

The main difference according to sex was increased sensitization to HDM and animal dander in males compared with females in group 2 (Table 1). This difference may have resulted due to occupational, lifestyle, and hormonal differences. Exposure to HDMs and animal dander occurs at home. In Istanbul, males aged 20–29 years generally spend lesser time at home than females, which may have resulted in the differences in results. Lifestyle changes in males in this age range, such as getting married and working, may result in increased exposure to indoor allergens (Table 1).

The cases in our study reflected age and sex characteristics of the population of our region. An additional prospective study is in progress to include comparisons of sensitization for variations in occupation, lifestyle, and climatic conditions.

In conclusion, this study was important for monitoring allergen sensitivity of patients with rhinitis in a large city. It also showed that sensitization decreases with increasing age for all types of allergens, and the percentage of sensitization may change according to the age and sex of the patient. Monitoring patients with allergen sensitization according to age groups and sex is important for environmental regulation, design of living spaces, working conditions, and physical and biological materials in the living space. These data will be useful for the evaluation of ecological effects of global climate change and environmental conditions on allergic diseases and regulation of preventive health services.

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