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Aeroallergens sensitization in an allergic paediatric population of Stone city (Mardin), Turkey: Is it compatible with the previous atmospheric distribution analysis?

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Abstract

Aim: We aimed to determine the distribution of aeroallergen sensitization according to epidermal prick test results and to compare them with the previous atmospheric pollen analysis outcomes

Materials and Methods: We retrospectively scanned our patient data between December 2019 and May 2021. The patients with sensitivity to at least one aeroallergen in the epidermal prick test were recruited in the study.

Results: A total of 427 patients enrolled in the study and were clinically divided into three groups: 119 (27.9%) had allergic rhinitis, 181 (42.2%) had asthma and 127 (29.7%) had both allergic rhinitis and asthma. Concerning the whole study group, aeroallergen sensitivity was observed most against the grass pollen mixture (79.6%); other common aeroallergens were tree pollen (56.4%), weed pollen mixture (51.5%), house dust mites (16.9%), mold fungi (9.1%). Epidermal prick test pollen distribution was found compatible with previous atmospheric aeroallergen distribution.

Conclusions: This is the first study comparing the results of the epidermal prick test with the previous atmospheric pollen measurement results in our country and revealed that they are related.

Introduction

The interaction of genetic and environmental factors plays a role in the pathogenesis of respiratory allergic diseases. With the global increase in their frequency, respiratory allergic diseases have become a major health problem. Their increment has been associated with the rising in irritants and allergens exposure induced by the western lifestyle. Aero allergens are airborne organic substances that are responsible for allergenic diseases in hypersensitive individuals [1-4]. Aeroallergen exposure is a strong risk factor for sensitization, development, and severity of atopic diseases.

Indoor or outdoor aeroallergens vary according to geographic region, climate, and living conditions. One of the most important allergen groups is pollens that are blamed to cause allergic rhinitis, conjunctivitis, and asthma [2, 5]. Recent studies have revealed that the prevalence and severity of respiratory allergic diseases induced by pollens have been increased, too [6-8].

Allergic rhinitis (AR) is an IgE-mediated reaction after exposure to an inhaled allergen causing nasal congestion, nasal itching, runny nose, and sneezing [9]. Allergic rhinitis adversely affects productivity at work, social life, school performance of especially in patients with severe disease, and creates a significant economic burden on society. Though, it is important to know the risk factors of the disease to take preventive measures to combat it [10].

Similarly, allergic conjunctivitis is also an IgE mediated disease and generally manifested by rhinitis besides ocular problems such as itching, redness, watery discharge, eyelid edema should accompany the disease picture [11].

Asthma typically presents with intermittent cough, wheezing, and shortness of breath and is characterized by underlying chronic airway inflammation. Respiratory symptoms triggered by aeroallergen exposure in children with wheezing history should be considered as progression to asthma. Consequently, it is important to identify triggers for the treatment and management of asthma [12]. Identification of an asthmatic child's atopic status in early life has practical clinical and prognostic implications and sets the basis for future preventative strategies [13].

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The skin prick test is an essential test procedure for demonstrating underlying sensitivity in IgE-mediated allergic diseases. Since aeroallergen distribution differs according to geographic regions, standardization of skin test panels concerning location is an important issue for better outcomes [14, 15].

In this study, we aimed to extract the aeroallergen profile of Mardin province according to the epidermal prick test results of children with allergic diseases and to investigate whether it is compatible with the outcomes of the atmospheric pollen distribution study conducted before.

Materials and Methods

We retrospectively analyzed the files of the pediatric patients (aged between 0-18 years) who applied to pediatric allergy outpatient clinic between December 2019 and May 2021. Among the patients with a diagnosis of asthma, allergic rhinitis, allergic conjunctivitis, atopic eczema, only the patients with at least one allergen sensitivity on epidermal prick test are involved in the study. The patients' age of diagnosis, age of onset of symptoms, gender, familal atopy history, and the allergens that they found to be senstizied to were recorded. While patients with dermographism, anatomical disorders, genetic or chronic lung diseases; having immunotherapy or immunocompromised, and under medications with the potency of affecting test results were excluded from the study; a total of 427 eligible patients enrolled in.

Epidermal prick tests were formed with the 16 most common allergens in the region [16]. The Prick test panel contained aeroallergens such as house dust mites (HDM) (Dermatophagoides farinae, Dermatophagoides pteronyssunus), mold fungi (Alternaria tenuis, Penisilium notatum, Aspergillus Fumigatus), tree pollen (Plane tree, Arizona cypress, Juniper, Birch, Willow tree, Olive tree), weed pollen (cereals mixture), wild herb (Wall pellitory), grass pollen (Grasses), cat (Cat epithelia), cockroach (Blatella germanica). The cereals pollen mixture consisted of hordeleum vulgare, avea sativa, secale cereale, triticum sativum. The grasses pollen mixture involved holcus lanatus, dactylis glomerata, lolium perenne, phleum pratense, poa pratensis, fescuta pratensis. Histamine was used as positive control and 0.9% NaCl solution was applied for negative control. The brand of the prick test solution used was Allergopharma. The prick tests were applied to the volar side of the forearms or back region after cleaning the areas with alcohol and procedures were performed with prick test applicators (Medblue one allergy 020013, Turkey). All epidermal prick tests were applied and evaluated by the same doctor to achieve proper standardization. The diameter of induration at 15 minutes of the tests was measured. An induration of 3 mm or more with respect to the negative control was considered as positive [14, 15]. Ethical approval was obtained from the local ethics committee (2020 / 9-5). The diagnosis of AR was determined according to ''Allergic rhinitis and Its Impact on Asthma" (ARIA) guidelines [17]. Asthma was diagnosed according to The Global Initiative for Asthma (GINA) [18].

Statistical Analysis

For continuous variables, results were indicated as means and standard deviations while they were mentioned as numbers and percentages for categorical variables. The normality of the disturbance of numerical variables was evaluated with histogram, q-q graphs, and Kolmogorov-Smirnov test, and variance of homogeneity was checked with the Levene test.

When the numeric variables had a normal distribution, the comparison of two independent groups was evaluated by the Independent Samples T-test. In comparing the differences between categorical variables according to the groups, Pearson Chi-Square was used in 2x2 tables with expected cells of 5 and above, and Fisher's Exact Test was used in tables with expected cells below 5.

Statistical analyses were performed using Jamovi project (2020), Jamovi (Version 1.6.7) [Computer Software] (Retrieved from https://www.jamovi.org), and JASP (Version 0.14) (Retrieved from https://jasp-stats.org). Values of $p < 0.05$ were considered to be statistically significant.

Results

Among the 427 patients enrolled in the study, 119 (27.9%) had allergic rhinitis,181 (42.2%) had asthma and 127 (29.7%) had both allergic rhinitis and asthma. The age at presentation, age at onset of the symptoms, gender, and family history of the atopic disease are given in Table 1.

In the whole study group, aeroallergen sensitivity was observed most frequent against the grass pollen mixture (79.6%); other common aeroallergens were weed pollen mixture (56.4%), tree pollen (51.5%), house dust mites (16.9%), and mold fungi (9.1%). Whole patients with tree pollen sensitivity had the olive tree, Arizona cypress, and Juniper sensitivity at the same time. In patients with house dust mite sensitivity, both D.farinae and D.pteronyssinus sensitivity were seen together. Sensitivity was observed only to Alternaria tenuis species in patients with mold sensitivity. Weed, pet, and cockroach sensitivity were not detected in the study group (Table 1). The frequencies of aeroallergens observed in the allergic rhinitis group were as follows: 83.2% grass pollen, 38.7% weed pollen, 42.9% tree pollen, 16.8% house dust mite, 8.4% mold fungus (Figure 1).

The rates of aeroallergens detected in the allergic asthma groups were: grass pollen 75.7%, weed pollen 72.4%, tree pollen 72.4%, house dust mites 16%, mold fungus 8.8% (Figure 2).

These rates of aeroallergens including grass pollen, weed pollen, tree pollen, house dust mite, mold fundus, in the asthma & allergic rhinitis group were 81.9%, 50.4%, 29.9%, 18.1%, 10.2%, respectively (Figure 3).

While the number of patients sensitive to weed pollen [131(72.4%), 46 (38.7%) vs 64 (50.4%); $p < 0.001$] and tree pollen [131 (72.4%), 51 (42.9%) vs 38 (29.9%) $p < 0.01$] were higher in the asthma group; there was no statically significant difference against grass pollen, HDM, and mold fungus between the three groups. (Table 1).

Table 1. Study Group Dermographic Characteristics and Aeroallergen Distributions

			Group		
	All Cases	Allergic rhinitis	Asthma	Allergic rhinitis	p-value
	(n=427)	(n=119)	(n=181)	&Asthma (n:127)	
Age at first admission	10 (6)	10 (7)	9 (6)	11 (6)	0.061***
Age at onset of the symptoms	7 (6)	7 (4)	4 (6)	9 (5)	< 0.001***
Gender					
Male	251 (58.7)	70 (58.8)	106 (58.6)	75 (59.1)	0.982**
Female	176 (41.3)	49 (41.2)	75 (41.4)	52 (40.9)	
Family history of atopy	215 (50.4)	41 (34.5)	101 (55.8)	73 (57.5)	< 0.001**
Grass pollen	340 (79.6)	99 (83.2)	137 (75.7)	104 (81.9)	0.216**
Weed pollen	241 (56.4)	46 (38.7)	131 (72.4)	64 (50.4)	< 0.001**
Tree pollen	220 (51.5)	51 (42.9)	131 (72.4)	38 (29.9)	< 0.001**
House dust mite	72 (16.9)	20 (16.8)	29 (16)	23 (18.1)	0.890**
Mold fungus	39 (9.1)	10 (8.4)	16 (8.8)	13 (10.2)	0.869**
Number of allergens thatindividuals found to be senstive					
One	95 (22.2)	19 (16)	49 (27)	27 (21.3)	0.074**
Two or more	332 (77.8)	100 (84)	132 (72)	100 (78.7)	

Values in table are presented as the number of patients with/without the percentage in parenthesis, as the median with the interquartile range (IQR) in parenthesis or as the mean ± standard deviation (SD), as appropriate **: Pearson Chi-square test was performed. ***: Mann Whitney U test was performed.

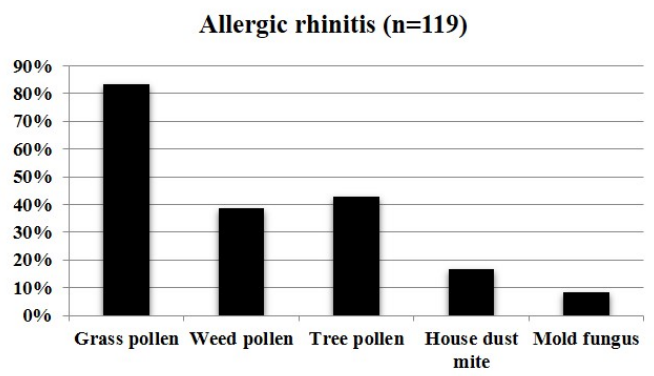

Figure 1. Distribution of Allergic Rhinitis Group Aeroallergens

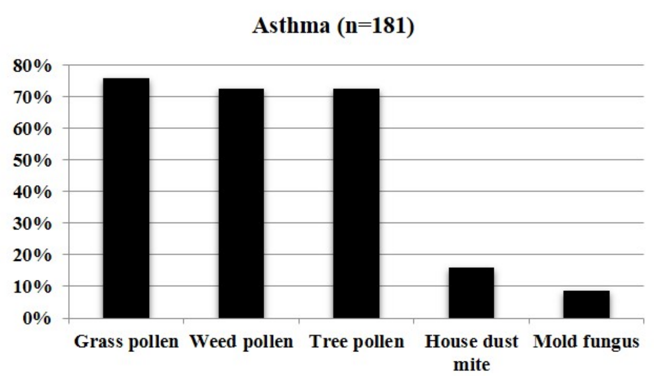

Figure 2. Distribution of Asthma Group Aeroallergens

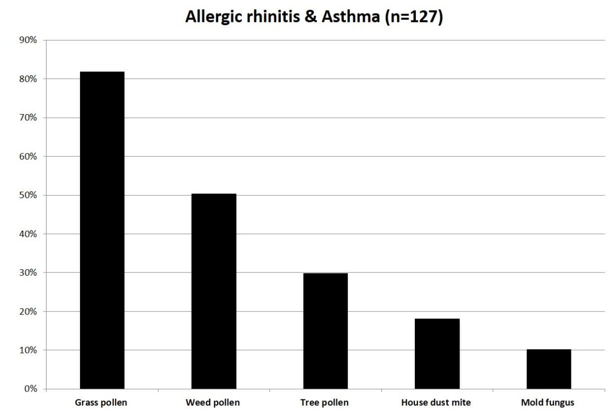

Figure 3. Distribution of Allergic Rhinitis and Asthma Group Aeroallergens

The monosensitization (16%, 27%, 21.3%) and the polysensitization rates (84%, 72%, 78.7%) were not significantly different between the groups (p=0.074).

Discussion

This is the first study comparing the outcomes of epidermal prick tests and atmospheric pollen measurements in our country. As far as we can evaluate, this is the second study in the literature.

Allergic diseases are complex diseases arising from interactions between genetic and environmental factors. Among the environmental factors, indoor and outdoor aeroallergens and air pollutants are the best-defined ones and play a critical role in etiopathogenesis [19]. In this study, sensitivity rates to aeroallergens in pediatric patients admitted to the Mardin State Hospital pediatric allergy clinic were analyzed and compared with the outcomes of the atmospheric pollen distribution studies of the same region.

HDM are considered the main aeroallergens involved in atopic manifestations [20, 21]. Visitsunthorn et al. [1] revealed that HDM were the most common inhalant allergen according to epidermal prick test results in pediatric patients with asthma and allergic rhinitis. Various studies performed in our country revealed that the most common aeroallergen for asthmatic patients was HDM [22-25]. However, the studies carried out in two different cities around Mardin demonstrated that HDM sensitivity was lower compared to other regions of the country [26, 27]. Parallel with these studies, we observed HDM sensitivity in a lower proportion. This situation can be attributed to the unsuitable living conditions for HDM like the arid climate, high air temperature, and low humidity.

Since mold fungus spores are very small, they can easily enter the respiratory tract and can be a trigger for allergic diseases [28]. There are different sensitivity rates for different fungal spores in the literature [23, 29]. In our study, this rate was found to be lower than those previously reported possibly due to the low humidity in the region. Although most studies found out more than one type of mould fungus to be a sensitizer, we observed sensitivity to Alternaria tenuis only. [23, 29]. This difference can be explained by the presence of a large number of fungal species, the large variation in the distribution of fungal species, and the difficulties in standardizing allergens.

Pet hair and epithelial allergens are other important factors and different sensitivity rates have been reported in the literature [30, 31]. In our study, no sensitivity was detected against pet hair and epithelial allergens. The habits and sociocultural differences about having a pet in this region can be the reason for this discrepancy.

Cockroach sensitivity is also important in allergic patients [24, 25]. Blattella germanica sensitivity was reported 41.6% to 20.2% in children population with asthma in Turkey [32-34]. We couldn't reveal any sensitivity to Blattella germanica; this can be attributed to the low humidity of our region preventing the habitation of such cockroaches. Besides, an evaluation of just blatella germanica allergen for a huge group of cockroaches may be a reason for the lack of positivity.

Pollen (grass, cereal, tree, and weed) are found in different densities in different regions depending on factors such as geographical features, climate, and vegetation (35). Although, previous studies from different cities of Turkey revealed that pollen was the second most common aeroallergens, we found them as primer allergens [23, 36, 37]. However, similar to previous studies, the most common type of pollen observed was grass pollen, followed by tree and weed pollen. This difference may be related to the inability of mites to survive due to the mentioned conditions of the region, as well as the increase in pollens with the increase in planting in parks, gardens in recent years. Besides, the high density of grain cultivation in the region may explain the high rate of cereals pollen mixture.

The atmospheric pollen concentrations of our region were determined in two different studies performed at the city center of Mardin in 3 consecutive years [16, 38]. According to these data, the highest rate was tree pollen (62.2%), and secondly, weed pollen (36.8%) and the most dominant pollen type detected was poaceae (21.21%). In the pollen calendar prepared for the region, it was observed that tree pollens were higher in the spring months and weed pollen in the summer months. In atmospheric measurement, the highest rate of tree pollen was the Platanus genus, followed by Arizona cypress, Juniper, and olive tree pollens [16]. Our analysis indicated that grass pollen, which is from the Poaceae family, was the most common aeroallergen. Also, in our study, tree pollen sensitivity was in second place (51.5%). Patients with tree pollen sensitivity all had a sensitivity to Arizona cypress, Juniper, and olive tree pollens, which are high in the region. Although it is common in atmospheric pollen analysis, we did not detect plane tree sensitivity that can be explained by the difference of study periods and the possible climate changes that may have been developed over the years.

Similarly, in another atmospheric pollen study conducted in the region, oleaceae (36.11%) from the tree pollen group was the most frequent pollen, and the second most common was poaceae (17.46%) from the grass pollen family [37]. The pollen grains of oleaceae and poaceae species are responsible for many pollination phenomena in the Mediterranean region and other parts of the world [39-41].

In the atmospheric pollen analysis carried out in Ankara and Zonguldak provinces, Poaceae pollens were found to be intense, similar to the atmospheric studies conducted in our region [42].

Subiza et al. [43] collected pollens from the Madrid atmosphere for 15 years and perform skin tests with these extracts. According to this study, the most important allergenic pollens were poacea, platanus, olive, and arizona cypress pollens. Identical to our results they also found similarity with epidermal prick test and atmospheric pollen measurements.

Many studies in the last few decades have shown that the production and distribution of pollen spores can vary according to pollen type, natural conditions, and region [44]. In light of these data, it should be considered that the current aeroallergen distribution in the region may differ in the future. For instance, in allergic rhinitis, sensitization to new allergens may develop over time, and existing sensitivity may also change [22, 45].

Different studies from Spain revealed high polysensitization rates (69.2%, 75%) [36, 47]. Comparably, the rate of polysensitization was high (77.8%) in our study group.

It has been reported that allergen-specific immunotherapy prevents the development of asthma and new allergen sensitization in children with allergic rhinitis [48, 49]. Depending on the aeroallergen type, the clinic, and treatment of allergic diseases may change [50]. Hence, to assign and treat allergic diseases, it is very important to determine the specific aeroallergy.

Our study has also some limitations. Our sample size was small and needs to be repeated with a larger study group. This may improve the correlation between atmospheric pollen concentrations and epidermal prick test results.

Conclusion

In conclusion, the distribution of aeroallergens may vary according to the region, climate, and lifestyle. Determining aeroallergen sensitivities with epidermal prick tests that include allergens suitable for the region increases the chance of defining the accurate allergen. Consequently, avoiding the responsible allergen and applying allergen-specific immunotherapy may be ensured. In this study, we showed the relationship between epidermal prick testing and atmospheric measurements in our region. Therefore, generating epidermal prick tests in accordance with atmospheric pollen measurements, if available, would increase their effectiveness.

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