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The Demographic, Clinical and Laboratory Characteristics of Patients with Allergic and Non-allergic Asthma in Van Province

Van İlindeki Alerjik ve Alerjik Olmayan Astımlı Hastaların Demografik, Klinik ve Laboratuvar Özellikleri

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Abstract

Introduction: Asthma is a prevalent disease that can cause different clinical features due to various underlying mechanisms. Detecting different types of asthma is important in disease management. We aimed to compare the features of allergic and non-allergic patients and to assess the clinical characteristics of patients with asthma in Van.

Materials and Methods: We included 302 adult patients with asthma with compatible history, physical examination and pulmonary function tests. We evaluated the demographic features and allergy test results in addition to clinical and laboratory findings on patients with asthma. The characteristics of the patients allocated into two groups with allergic and non-allergic, asthma were compared.

Results: Among the patients, 80% were women and the median age was 35 years. Allergy tests indicated that the most frequently observed inhalant agents were pollens (59%), followed by house dusts (55%), molds (6%) and animal epitheliums (3%). More than half (57%) of the patients exhibited allergic asthma. Non-allergic asthma was correlated with longer disease duration and more severe disease while the presence of a family history of an allergic disease was higher in patients with allergic asthma. Total IgE levels were significantly higher in allergic asthma, although there was no significant difference concerning eosinophil counts.

Conclusion: This study demonstrated that the majority of patients with asthma were allergic in Van, with pollen allergy being the most common. These findings can aid doctors in distinguishing asthma phenotypes. As a result, more successful treatments will be provided in managing patients with asthma.

Keywords: Asthma; allergy; allergens; Van

Özet

Amaç: Astım, altta yatan çeşitli mekanizmalara bağlı olarak farklı klinik özelliklere sahip yaygın bir hastalıktır. Hastalığın yönetiminde astımın fenotipini belirlemek önemlidir. Bu çalışmada Van'daki astımlı hastaların klinik özelliklerini değerlendirmeyi ve alerjik olan ve olmayan astımlı hastaların özelliklerini karşılaştırmayı amaçladık.

Gereç ve Yöntem: Öykü, fizik muayene ve solunum fonksiyon testleri astım ile uyumlu 302 hasta çalışmaya dahil edildi. Hastaların klinik ve laboratuvar bulguları yanında demografik özellikleri ve alerji testleri değerlendirildi. Hastaların klinik özellikleri alerjik ve alerjik olmayan astım olarak 2 gruba ayrılarak karşılaştırıldı.

Bulgular: Hastaların %80'i kadın ve ortanca yaşı 35 idi. Alerji testlerinde en sık gözlenen solunumsal alerjenler polenler (%59) iken, bunu ev tozları (%55), küfler (%6) ve hayvan tüyleri (%3) takip etmekteydi. Hastaların yarısından fazlasında astım alerjik olarak saptandı (%57). Alerjik olmayan astımlı hastalarda hastalık süresi daha uzun ve hastalık daha şiddetli seyrederken; ailede alerjik hastalık öyküsünün varlığı ise alerjik astımlı hastalarda daha yüksek oranda bulundu. Alerjik astımda total IgE düzeyleri belirgin olarak yüksek iken; eozinofil sayısı açısından ise anlamlı bir fark gözlenmedi.

Sonuç: Bu çalışma Van ilinde astımlı hastaların çoğunluğunun alerjik olduğunu ve polen alerjisinin en sık görülen alerjen tipi olduğunu ortaya koymuştur. Bu çalışmanın bulguları hekimlere astım fenotiplerini ayırt etmede yol gösterebilir ve bunun sonucu olarak astımlı hastaların yönetiminde daha başarılı tedavilere olanak sağlayacaktır.

Anahtar Kelimeler: Astım; alerji; alerjenler; Van

Introduction

Asthma presents with wheezing, shortness of breath, and cough as its defining symptoms (1). The frequency and severity of these symptoms vary among patients and can fluctuate within the same patient over time (1). While the prevalence of asthma-like symptoms was 8.6%, the prevalence of asthma was 4.2% in the world; its prevalence in Turkey aligns with the global average (1, 2). On the contrary, a study conducted

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among the adult population in Van found the prevalence of asthma-like symptoms and asthma was found to be 12.1% and 1% respectively (3). Asthma negatively affects the quality of life of patients forcing a significant social and economic burden on patients and health insurance costs (2, 4). Accurate diagnosis and treatment of asthma are of paramount importance given its global prevalence and significant impact on patients' daily lives (2). Differentiating allergic asthma from non-allergic asthma is crucial and allergy tests play an essential role in this process (1). To diagnose allergic asthma, demonstrating an inhalant allergen sensitization with the skin prick test (SPT) or specific immunoglobulin E (IgE) is necessary (1). Distinguishing whether asthma is allergic or not plays an important role in its accurate diagnosis and management (5). Although there are studies related to allergic asthma and non-allergic asthma, comparing their characteristics remain limited (6-8). In addition, no study to date has evaluated the exact distribution of sensitization to common aeroallergens among adult patients with asthma in Van. This study aims to describe the sensitization pattern in adult patients with asthma in Van province, considering patient demographic characteristics and clinical and laboratory findings. Furthermore, it aims to compare the features of patients with allergic and non-allergic asthma.

Materials and Methods

Study groups and study design: The adult population of Van was 782,147 and the frequency of asthma-like symptoms in adults was 12.1% (3). The calculated minimum sample size was 163, determined using a web-based program. The study included patients with asthma who were admitted to the our adult allergy outpatient clinic between January 2022 and June 2023. Ashtma diagnosis was confirmed through a combination of medical history, physical examination, pulmonary function tests and the presence of compatible clinical symptoms for at least 1 year. In cases of allergic asthma, at least one skin test or specific IgE positivity including a common inhalant allergen is required. Demographic data and clinical features of the patients were retrospectively screened. This included information such as age, sex, smoking history, body mass index (BMI), family history, systemic and allergic comorbidities, asthma duration, the severity of symptoms, seasonal pattern, medications for asthma and other diseases. Moreover, assessments were made for pulmonary function tests, eosinophil counts and total IgE values of the patients. The forced expiratory volume in one second (FEV1) and forced vital capacity (FVC) measurements were evaluated in the pulmonary function tests. The severity of asthma was categorized as mild, moderate and severe based on the stage of the controller therapy (5).

Diagnostic work-up for allergy: SPTs were performed using a positive control (histamine dihydrochloride 0.1%), a negative control (NaCl, 0.9 %) and aeroallergen solutions (Allergopharma® Reinbek, Germany and Lofarma® Milan, Italy) including house dust mites (*Dermatophagoides farinae, Dermatophagoides pteronyssinus*), molds (*Aspergillus fumigatus, Alternaria alternata*), pollens (grass mix, cereals mix, birch, olive tree, wall pellitory, ragweed and english plantain) and animal epithelium (cat, dog and bird). The grass mix contained orchard grass, timothy grass, Kentucky blue grass, meadow grass, perennial rye grass and meadow fescue. The cereals mix contained wheat, rye, barley and oat. The bird epithelium was a budgerigar feather. A wheal of 3 mm or more was classified as a positive SPT. While all patients underwent 13 prick test panels, tests involving animal epithelium were exclusively administered to patients who either housed animals or maintained consistent contact with them. A specific IgE value of ≥0.35 kUA/L was defined positive. If prick tests were negative or incompatible, specific IgE was requested. The presence of more than one allergen positivity in the SPT or/and specific IgE was determined as polysensitization (9).

Ethical approval: All the study participants provided written informed consent and the study was approved by the Ethics Committee of University of Health Sciences (Van Training and Research Hospital) with the reference number 2023/17-01. This study was conducted in accordance with the principles of the Helsinki Declaration.

Statistical analysis: The statistical evaluation was performed using the program SPSS 24.0 (SPSS Inc., Chicago, IL, USA). Descriptive data were presented as percentages and median with interquartile range (IQR) based on the data distribution. The variables were investigated using analytical methods (Kolmogorov-Smirnov test/Shapiro-Wilks test) to determine whether they were normally distributed or not. The chi-square test or Fisher's exact test (when chi-square test assumptions did not hold due to low expected cell counts) was used to compare the categorical features between different groups. For numerical variables comparisons, the Mann-Whitney U test was used. A p-value of less than 0.05 was denoted statistically significant. Graphs were generated

using GraphPad Prism version 8.4.3 software(GraphPad Software Inc., San Diego, CA, USA). The minimum sample size was calculated with a 95% confidence level using a web-based program (XLSTAT by Lumivero).

Results

Demographic and clinical characteristics of patients: We included a total of 302 patients with asthma and the median age (IQR) was 35 (27–45) years; the majority of the patients (80%) were women and the median (IQR) BMI value was 23,8 (22,4 – 25,6). Of the total, 37 (12%) patients were active smokers with an average smoking history of 13 pack-years and 102 (33.7%) patients had a family history of at least one allergic disease. The median (IQR) duration of asthma of these patients was 3 (2-10) years. When categorizing patients with asthma based on severity, 130 (43%) were in mild, 61 (20%) were in moderate and 111 (37%) were in severe groups; 184 (61%) patients reported consistent symptom severity throughout the year, while 21 (7%) experienced seasonal symptoms only and 97 (32%) had symptoms all year with exacerbation in the seasonal period. The number of patients who had a pet at home or had a history of frequent contact was 37 (12%). Specifically, 24 participants had cats, 12 had birds and 1 had dog. While more than half (60%) of the patients were presented with accompanying allergic comorbidities, the rate of accompanying non-allergic comorbidities was only 25%. The most common allergic comorbidities were allergic rhinitis (49.6%) and allergic conjunctivitis (11.2%). Allergic rhinitis and conjunctivitis were observed together in 34 patients. A total number of 29 (10%) patients had mild rhinitis and 121 (40%) patients had the moderate/severe allergic rhinitis. The median duration of rhinitis in patients with allergic rhinitis was 5 (2-10) years while the median duration of ocular disease in patients with allergic conjunctivitis was 4 (2-6) years. The most common non-allergic comorbidity was chronic rhinosinusitis (18.8%). In total, 20 (6%) patients were diagnosed with asthma-chronic obstructive pulmonary disease overlap syndrome and 2 were identified with allergic bronchopulmonary aspergillosis. The other common allergic and non-allergic comorbidities are summarized in Table 1.
The median FEV1 values of the patients were 2.63 L (1.89-3.40) and 95% (72-113). The median value of FEV1/FVC (%) was 84 (77-91). The median value of asthma control tests was 21 (17-22).

Skin prick test and laboratory outcomes: More than half (57%) of the patients exhibited allergic asthma, with 88% having allergic asthma being polysensitized. The median number of allergens found positive was 2 (2-3). The most frequently observed inhalant agents having allergic asthma in allergy tests were pollens (59%), followed by house dust (55%), mold (6%) and animal epithelium (3%).

Table 1: The concomitant allergic and non-allergic diseases of patients

Allergic comorbidities	**n (%)**
Allergic rhinitis	150 (49.6)
Allergic conjunctivitis	34 (11.2)
Nasal polyps	31 (10.2)
Chronic urticaria/ angioedema	28 (9.2)
Drug allergy	21 (6.9)
Food allergy	12 (3.9)
Venom allergy	6 (1.9)
Non-allergic comorbidities	
Chronic rhinosinusitis	57 (18.8)
Gastroesophageal reflux	44 (14.5)
Hypertension	36 (11.9)
Diabetes mellitus	32 (10.5)
Atherosclerotic heart disease	25 (8.2)
Thyroid diseases	21 (6.9)
Chronic obstructive pulmonary disease	20 (6.6)

*****Patients have more than one allergic or non-allergic comorbidity.

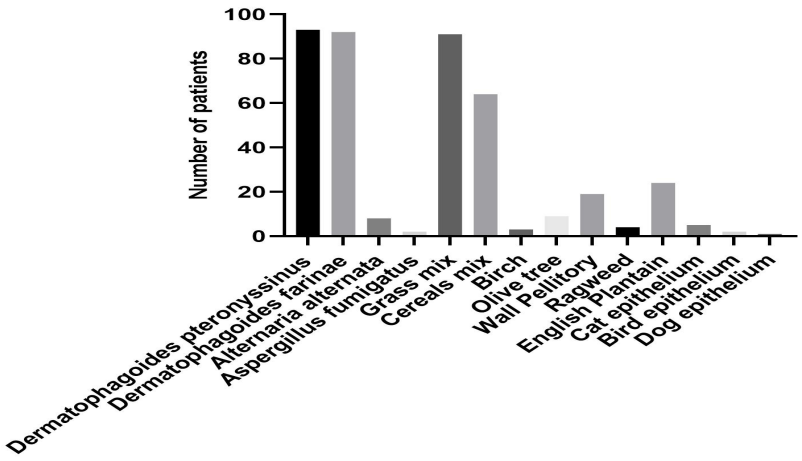

Figure 1. The distribution of sensitization to inhalant allergens

Table 2: The results of the skin prick test and specific IgE value of the patients

Skin prick test results	**n / N (%)**
Grass mix	86 / 302 (28.5)
Dermatophagoides farinae	77 / 302 (25.5)
Dermatophagoides pteronyssinus	77 / 302 (25.5)
Cereals mix	64 / 302 (21.2)
English plantain	23 / 302 (7.6)
Wall pellitory	22 / 302 (7.3)
Olive tree	9 / 302 (3)
Ragweed	4 / 302 (1.3)
Birch	3 / 302 (1)
Alternaria alternata	2 / 302 (0.7)
Aspergillus fumigatus	2 / 302 (0.7)
Cat	3 / 24 (12.5)
Bird	1 / 11 (8.3)
Dog	1 / 1 (100)
Specific IgE results	
Grass mix	7 / 31 (22.6)
Dermatophagoides farinae	20 / 161 (12.4)
Dermatophagoides pteronyssinus	22 / 161 (13.7)
Cereals mix	1 / 1 (100)
Alternaria alternata	5 / 163 (3.1)
Aspergillus fumigatus	0 / 4 (0)
Cat	2 / 21 (9.5)
Bird	1 / 10 (10)

***n=**the number of positive patients, **N=**the number of patients evaluated

During the detailed evaluation, the most common aeroallergens were *Dermatophagoides pteronyssinus* (54%) followed by *Dermatophagoides farinae* (53%), the grass mix (52%), the cereals mix (37%), english plantain (14%), wall pellitory (11%), olive tree (5%), *Alternaria alternata* (5%), ragweed (2%), birch (2%), cat (2%), *Aspergillus fumigatus* (1%), bird (0.5%) and dog (0.5%) (Figure 1). Among the patients who had cats, 4 (22%) tested positive for allergy. The allergy tests for 1 (14%) patients among those who had birds and 1 (100%) who owned a dog were positive. The SPT was positive for 51% (n=155) of the patients. One-third of the patients (n=102, 33%) did not require the specific IgE test. This test was evaluated for 195 patients while 5 patients did not perform the test. Among these patients 14 % tested positive. The SPT and specific IgE results of the patients are presented separately in Table 2. Eosinophil counts were evaluated for all patient, revealing a median

Table 3: The distribution of inhaler treatments and antihistamines used by patients

Types of inhaler medication for as needed therapy	n (%)
Ipratropium + Salbutamol*	68 (22)
Salbutamol*	37 (12)
Only Salbutamol	28 (9)
Budesonide + Formoterol	24 (8)
Beclometasone + Formoterol	12 (4)
Types of inhaler medication for as controller therapy	
Fluticasone + Salmeterol	73 (24)
Budesonide + Formoterol	72 (23)
Beclometasone + Formoterol	40 (13)
Fluticasone + Vilanterol	24 (8)
Budesonide + Formoterol + Tiotropium	7 (2)
Fluticasone + Salmeterol + Tiotropium	5 (2)
Fluticasone + Formoterol	4 (1)
Fluticasone + Vilanterol + Umeclidinium	4 (1)
Budesonide + Formoterol + Glycopyrronium	3 (1)
Beclometasone + Formoterol + Tiotropium	2 (1)
Fluticasone + Vilanterol + Tiotropium	2 (1)
Beclometasone + Formoterol + Glycopyrronium	1 (0.3)
Fluticasone + Vilanterol + Glycopyrronium	1 (0.3)
Types of antihistamine therapy	
Desloratadine	123 (40)
Levocetirizine	105 (35)
Fexofenadine	12 (4)
Cetirizine	12 (4)
Bilastine	11 (3)
Rupatadine	5 (2)
Ebastine	3 (1)

***** In addition to any controller therapy.

eosinophil value of 220 (120-400) cells/mL. A high eosinophil count was observed in only 18% (n=54) of the patients when the upper limit of eosinophils was defined as 500 cells/mL, while a high eosinophil was found in 37% (n=113) of the patients when the upper limit of eosinophils was defined as 300. Total IgE was evaluated in 62% (n=115) of the patients and the median value for the evaluated patients was 126 (42-370) IU/mL. A high total IgE level was found in 56% (n=104) of the patients when the upper limit of 100 IU/mL was defined as high total IgE in the assessed patients. A high total IgE level was found in 81% (n=152) of the patients when the upper limit of 30 IU/mL was described as high total IgE in the evaluated patients. While the rate of allergic asthma was 49% in patients who were evaluated in total IgE, this rate was found to be 70% in patients who were not evaluated.

Pharmacological managements in the treatment of the disease: In total, 90% of patients were receiving antihistamines while 241 (80%) patients were using montelukast. The most commonly used antihistamines among patients were desloratadine (n=123, 40%) and levocetirizine (n=105, 35%). In the controller therapy group, the most commonly used inhaler therapy was fluticasone + salmeterol combination (n=73, 24%) while in the as-needed therapy group, ipratropium + salbutamol combination (n=68, 22%) was the most commonly used type. Other inhaler therapies and types of antihistaminic treatments received by the patients are listed in Table 3. Allergen immunotherapy was planned for 73 (40%) patients in the allergic asthma group. The planned immunotherapies were only house dust (n=38, 22%), only pollen (n=18, 6%), both pollen and house dust (n=15, 5%) and cat (n=2, 1%) in patients with allergic asthma. Additionally, 10 (3%) patients were receiving oral theophylline. Among 111 patients afflicted with severe asthma, 56 (50%) were using omalizumab and 29 (26%) were using mepolizumab; 26 patients were unfavorable for any biologic agent.

Comparison of the findings of patients with allergic and non-allergic asthma: While patients with allergic asthma are younger, the patients exhibited similarity in terms of gender, smoking and BMI (p=0.004, p=0.311, p=0.671, p=0.410, respectively). The moderate/severe The family history of allergic diseases was more common in patients with allergic asthma and the duration of

Table 4: The comparison of demographic, clinical and laboratory features of patients with allergic and non-allergic asthma

Demographic and clinical characteristics	Allergic (n=173)	Non-allergic (n=129)	p
Age (year, median, IQR)	33 (26-43)	38 (30-49)	0.004
Sex (male/female, n)	32/141	30/99	0.311
Smokers (%)	11.5	13.1	0.671
BMI (median, IQR)	24.1 (22.4–25.6)	23.6 (22.1-25.6)	0.410
Family history of allergic diseases (%)	44	20	0.001
Asthma duration (year, median, IQR)	2 (1-5)	5 (2-10)	0.001
Asthma severity (%)			0.001
Mild	52.6	30.3	
Moderate	25.5	13.2	
Severe	21.9	56.5	
Time Pattern of Symptoms			0.001
Same throughout the year (%)	42.8	85.3	
Only seasonal (%)	11.5	0.8	
All year with exacerbation in the seasonal period (%)	45.7	13.9	
Allergic Comorbidities			
Nasal polyps (%)	15	3.8	0.002
Chronic urticaria/ angioedema (%)	13.8	3.1	0.001
Drug allergy (%)	10.9	1.5	0.001
Food allergy (%)	6.3	0.7	0.014
Venom allergy (%)	2.3	1.5	0.639
Non-allergic Comorbidities			
Chronic rhinosinusitis (%)	26	9.3	0.001
Gastroesophageal reflux (%)	13.8	15.5	0.691
Hypertension (%)	10.9	13.1	0.560
Diabetes mellitus (%)	9.2	12.4	0.378
Atherosclerotic heart disease (%)	6.3	10.8	0.638
Thyroid diseases (%)	8	5.4	0.368
Chronic obstructive pulmonary disease	2.3	12.4	0.001
Laboratory Results			
Eosinophils (cells/mL, median, IQR)	220 (120-400)	210 (120-450)	0.936
Total IgE (IU/ml, median, IQR) †	269 (90-463)	65 (18-201)	0.001
FEV1 (median, IQR)	2.77 (2.03-3.4)	2.36 (1.7-3.39)	0.026
FEV1 (%, median, IQR)	98 (78-114)	91 (68-111)	0.047
FEV1/FVC (%, median, IQR)	85 (78-92)	84 (75-90)	0.173
Asthma control test (median, IQR)	21 (19-23)	18 (16-21)	0.001

*** IQR=**interquartile range, **BMI=**body mass index, **FEV1=**forced expiratory volume in one second, **FVC=**forced vital capacity

****** The chi-square test was used for categorical variables and the Mann-Whitney U test was used for numerical variables

† Those results were calculated only for the patients for whom that test was evaluated

Table 5: The comparison of asthma treatments according to main groups in patients with allergic and non-allergic asthma

	Allergic (n=173)	Non-allergic (n=129)	p
Only as needed SABA (%)	15	1	0.001
Only as needed ICS + LABA (%)	15	7	0.054
ICS + LABA (%)	66	75	0.073
ICS + LABA + LAMA (%)	3	14	0.001

*** SABA**=Short-acting beta-2 agonist, **ICS=** Inhaled corticosteroids, **LABA=**Long acting beta-2 agonist, **LAMA=**Long acting muscarinic antagonist

the disease was longer in the non-allergic group (p=0.001 and p=0.001, respectively). Allergic asthma was more frequently accompanied by nasal polyp, urticaria/angioedema, food allergies and drug allergies (p=0.002, p=0.001, p=0.014 and p=0.001, respectively). While chronic rhinosinusitis was more common in the allergic group, chronic obstructive pulmonary disease was more common in the non-allergic group (p=0.001 and p=0.001). Levels of total IgE were found to be significantly higher in patients with allergic asthma although there was no difference between the 2 groups in terms of eosinophil counts (p=0.001, p=0.936, respectively). Comparisons of demographic and clinical characteristics and laboratory findings of patients with allergic and non-allergic asthma are shown in Table 4. Triple therapy is needed more in the non-allergic asthma group and the comparison of allergic and non-allergic asthmatic patients according to the main treatment classification is summarized in Table 5.

Discussion

To our knowledge, this is the first study to demonstrate the pattern of sensitization to aeroallergens among adult patients with asthma within the province of Van. Additionally, it was important for comparing the features of patients with allergic and non-allergic asthma. The most significant finding in our study was the high prevalence of sensitivity to pollens, particularly grass and cereal mixes. Another important finding was that patients were mostly in the allergic group and chronic rhinosinusitis was more common in patients with allergic asthma. Conversely, non-allergic patients displayed an extented duration and greater severity of the disease. Furthermore, total IgE values were found to be significantly higher in the allergic group. Gür et al. (10) conducted a study in 2017, investigating the inhalant allergen sensitivity in Van. However, their research solely focused on cases of allergic rhinitis. Only SPTs were performed and the number of allergens evaluated was very low in this study (10). Additionally, it was not evaluated if the patients were accompanied by asthma and it remains unknown if the results found were compatible with the patients' complaints (10). Therefore, it did not completely reflect the sensitization pattern of the Van region. In addition to SPT, our study also measured the specific IgE values when deemed necessary in patients. Furthermore, test results that were consistent with the patients' complaints were included in our study. We speculate that the aeroallergen sensitization pattern of the region was determined with 13 allergens evaluated in this study. House dust, mold and pollen load and their diversity vary due to different climates in different regions of Turkey (11). Thus, understanding the aeroallergen sensitivities in the residency area is necessary for achieving a more accurate diagnosis. Distinguishing between allergic and non allergic asthma is important, as treatments vary (5, 12). This approach applies not only for severe asthma given biologics, but also for patients with mild to moderate asthma who might benefit from allergen immunotherapy (13, 14). The most frequently found inhalant allergen was pollen according to the main group in our study. House dust and mold sensitization changes due to heat differences because temperature and humidity increases are more favorable conditions for house dust and molds (15, 16). The pollen sensitivity has taken the lead among house dust and molds, which is consistent with results in other regions similar to the climate condition in our region (17). Severe asthma is as low as 4%-6% of all asthma patients (18). In our study, this rate was 37%. This may be because we operate as a tertiary care center where patients with severe asthma are referred. Similar to our study, a study predominantly involving tertiary care centers reported a high rate of severe asthma (19). In addition, this can be explained by the low admission rate of mild and moderate patients with asthma to allergy outpatient clinics since such patients are mostly treated in pulmonology outpatient clinics. Desloratadine and levocetirizine were major antihistamines while inhaler treatments were very diverse. This suggests that physicians prefer combination preparations with montelukast to avoid polypharmacy. After the 2019 update, Global Initiative for Asthma (GINA) did not recommend the use of short-acting beta-2 agonist (SABA) alone in asthma (20). However, the rate of only SABA use was 9 % in our study. We believe that this rate will remain high although 4 years have passed since the issuance of these recommendations. In the literature, more than half of the patients had allergic asthma while the ones with non-allergic were more severe (7, 21, 22). Allergic conditions such as urticaria, nasal polyps, food allergies and drug allergies were observed more frequently in patients with allergic asthma similar to previous studies (7, 21, 22). The presence of one allergic situation increases the risk of the development of others, resulting in the additive characteristic of the atopic march (23). These findings in our study seem to be compatible with atopic march. Another noteworthy finding was that one-third of the patients exhibited eosinophil cut-off value

above 300 for starting mepolizumab. Furthermore, 4 out of 5 patients exhibited a total IgE cut-off value above 30 for administering omalizumab. This finding indicates that a biologic agent can most likely be added to the treatment of patients with asthma when their disease worsens in the older age.

Study limitations: Specific IgE values were not assessed in all patients who needed the test. However, this rate was only 2% of the patients. In addition, total IgE were not measured across the entire patient population. Nonetheless, we believe that the results are consistent, as it was evaluated in the majority of patients. However, the number of years the patients had lived in this region was not questioned. There may be patients who have lived in another city for a long time and recently relocated, this circumstance is a valid for all regions in real life.

Conclusion

Our study exhaustively indicated the patterns of aeroallergen sensitivity in adult patients with asthma in Van. The majority of the patients had allergic asthma and pollen was the most common allergen. This study will be a guide for pulmonologists who are especially interested in asthma, as it reveals the inhalant sensitivity pattern in patients with asthma and compares the characteristics of patients with allergic and non-allergic asthma.

Ethical approval: All the study participants provided written informed consent and the study was approved by the Ethics Committee of University of Health Sciences (Van Training and Research Hospital) with the reference number 2023/17-01. This study was fully according to the principles of the Helsinki Declaration.

Conflict of interest: The authors have no conflict of interest regarding this study.

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Author contributions: Concept (AD, SL, MN), Design (SL, AB, CD), Data Collection and/or Processing (AB, BC, CD), Analysis and/or Interpretation (BC, CD, DE)

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