ASTHMA ALLERGY IMMUNOLOGY
ASTIM ALERJİ İMMÜNOLOJİ

doi: 10.21911/aai.2024.555
Asthma Allergy Immunol 2024;22:243-252

RESEARCH ARTICLE

Received: 22.04.2024 • Accepted: 30.10.2024
Online Published: 09.12.2024

Evaluation of Sensitization to Aeroallergens in Pediatric Patients with Allergic Rhinitis and Asthma in North Cyprus

Azize Pinar METBULUT

Division of Pediatric Allergy and Immunology, Dr. Burhan Nalbantoğlu Hospital, Nicosia, Cyprus

Corresponding Author: Azize Pinar Metbulut ✉ pinar298@yahoo.com

ABSTRACT

Objective: Allergic diseases have rapidly increased over the last decades. Allergic sensitization is a key step in developing allergic diseases, and sensitization to airborne allergens is consistently the strongest identified risk factor for asthma and allergic rhinitis (AR).

Our study aims to elucidate the prevalence of various allergens leading to AR and asthma through skin prick tests (SPTs) in North Cyprus.

Materials and Methods: This retrospective study was conducted between April 2023 and March 2024 at our Hospital's Pediatric Immunology and Allergy outpatient clinic, involving pediatric patients diagnosed with AR and asthma, and aged under 18 years. SPT was performed to detect aeroallergen sensitization.

Results: A total of 261 patients were included in this study, with 55.20% (n=144) being male. The median age of the patients was 85 months (IQR:57.5-116). Allergic rhinitis, wheezy child, and asthma were diagnosed in 70.10% (n=183), 26.80% (n=70), and 35.20% (n=92) of the patients, respectively. Out of the 261 patients, 62.10% (n=162) had SPT positivity. The most frequent allergen was house dust mite (HDM) at 41% (n=107). The second most frequent allergen was tree pollen (26.40%, n=69), followed by grass allergen (24.50%, n=64). Patients under 6 years of age showed higher SPT negativity with aeroallergens, while patients above 6 years of age showed higher SPT positivity with aeroallergens (p=0.020). Patients having both asthma and allergic rhinitis showed higher SPT positivity with aeroallergens (p=0.035). The percentage of patients who were positive with Ambrosia artemisifolia, Artemisia vulgaris, and Fraxinus excelsior allergens was higher in patients diagnosed with asthma, and both asthma and allergic rhinitis (p=0.027, 0.001, and 0.042, respectively). Patients who had mold, Alternaria alternate, and Secale cereale allergen positivity were more common in non-controlled asthma (p=0.029, 0.049, and 0.028, respectively). Patients having dog and grass allergens positivity were more common in persistent AR (p=0.044, and 0.036 respectively).

Conclusion: In conclusion, patients diagnosed with asthma and/or allergic rhinitis in North Cyprus most frequently showed allergen sensitization to house dust mites, followed by pollens.

Keywords: Allergen, child, asthma, allergic rhinitis, Cyprus

INTRODUCTION

Over the past few decades, there has been a marked increase in the prevalence of allergic diseases globally, likely driven by both environmental and lifestyle changes (1). Asthma is the most common chronic disease seen in children, and its prevalence has been increasing (2). Childhood asthma prevalence ranges from 2.1% in developing to 32.2% in developed countries (3), and allergic rhinitis (AR) prevalence was 18.1% (4). In Cyprus, the prevalences of asthma and allergic rhinoconjunctivitis in children were observed as 8.7-11.4%, and 2.6-4.9% respectively (5).

The risk factors for asthma, and AR include genetic, environmental, and host factors (4, 6). The leading causes of the high prevalence of asthma and/or AR are considered to be air pollution and industrialization (7, 8). It has been determined that there is a statistically significant risk

ORCID Azize Pinar Metbulut / 0000-0001-8823-5960

Copyright © 2024 The Author(s). This is an open-access article published by Turkish National Society of Allergy and Clinical Immunology under the terms of the Creative Commons Attribution License (CC BY NC) which permits unrestricted use, distribution, and reproduction in any medium or format, provided the original work is properly cited. No use, distribution or reproduction is permitted which does not comply with these terms.

of atopic diseases and allergic sensitization when children are exposed to ambient particulate matter (9). Allergic sensitization is a key step in developing allergic diseases (10). The most common allergens are house dust mites (HDMs), grasses, trees, weed pollens, animal dander, and molds (11). Identifying the allergen helps in the treatment and relieving the symptoms of AR and/or asthma (12).

It is important to determine the allergens that cause sensitization specific to different geographical regions in atopic individuals. The frequency of allergens detected in the test varies according to the countries and regions. There are studies documenting prick test results from different regions of Turkey (12-21), and from Italy which has a Mediterranean climate (22). According to our findings, sensitization to aeroallergens in North Cyprus has not been published to date. Cyprus is the third largest island in the Mediterranean sea and has a subtropical climate. Cyprus is at an altitude of 108 meters above sea level with an average relative humidity of 62%. This humidity eases the growth of mites in indoor environments.

Our study aims to elucidate the prevalence of various allergens leading to AR and/or asthma through skin prick tests (SPTs) in North Cyprus.

MATERIAL and METHODS

This study constitutes a retrospective analysis involving pediatric patients diagnosed with AR and/ or asthma and aged under 18 years who presented to the Pediatric Allergy and Immunology outpatient clinic between April 2023 and March 2024.

Eligible participants met the clinical diagnostic criteria for asthma and AR as defined by the Global Initiative for Asthma (GINA), and the Allergic Rhinitis and Their Impacts on Asthma (ARIA) guidelines respectively (23,24). Patients met the criteria for a wheezing child who had episodic and multiple-trigger wheezing. Transient, persistent, and late-onset wheezing cases were included in the study (23).

Skin prick tests (SPTs) were performed according to the World Allergy Organization position paper (25). SPT is a diagnostic test that helps detect allergen sensitization in IgE-mediated Type 1 immunological reactions. A positive skin prick test indicates the presence of specific IgE on dermal mast cells (25). SPT is indicated in atopic dermatitis, urticaria, allergic rhinoconjunctivitis, asthma, food allergy, and anaphylaxis (26). Allergen solutions were administered as drops on the inner surface of the forearm at 2 cm intervals. Then, epidermal picure was applied to the application areas with the help of 1 mm tip lancets without bleeding the skin. A different lancet was used for each allergen. The evaluation was made 20 minutes later. The test was considered valid if the positive control was >3mm and the negative control was <3mm. Skin reactions to allergens with an induration diameter that was ≥3mm larger than negative control were considered positive (25). We used the Lofarma® (Lofarma S.p.A, Milan, Italy) skin prick test kit that consisted of a total of 27 allergens; Dermatophagoides farinae, Dermatophagoides pteronyssinus, mold mix (Alternaria alternate, Chaetomium globosum, cladosporium, Helminthosporium sativum), aspergillus mix (Aspergillus fumigatus, Aspergillus niger), Alternaria alternata, Cladosporium herbarium, Candida albicans, Felis domesticus, Canis familiaris, Blatella germanica, Pariteria judaica, Ambrosia artemisifolia, Artemisia vulgaris, Lollium multiflorum, Urtica dioica, Ambrosia artemisifolia, Plantago lanceolata, Cynadon dactylis glomerata, Salsalo kali, 6 mix grass allergen (dactylis, festuca, lolium, phleum pratense, poa, avena), Secale cereale, Olea europaea, Tilia europea (lime), Betula pendula, Platanus occidentalis, Phleum pratense, Cupressus arizonica, Fraxinus excelsior). For the skin prick test, a detailed anamnesis of each patient was taken, and the patients were questioned for age, gender, presence of concomitant allergic and chronic diseases, and the medications they regularly use. The SPT was not performed in the presence of active infection, active allergic disease, in patients with dermographism; in patients using medications such as antihistamines, steroids, or immunosuppressives that would negatively affect the prick test results; and in patients not giving consent for performing the test. Before the SPTs, informed consent was obtained from each of the patients' parents, including the information that the test data could be used for study purposes.

We collected data from medical records including medical history, demographic information such as age, gender, having additional allergic disease and chronic disease, and symptoms, physical examination, laboratory findings, treatment, and hospitalization for wheezing. For symptom control analysis, the GINA assessment of asthma control was used (23). For types and severity of AR, ARIA guidelines were used (24).

This study was approved on 15.04.24 by our hospital's Ethics Committee (approval number: E.K.15/24). Informed consent was obtained from all participants.

Statistical Analysis

SPSS 22 (SPSS Inc., Chicago, IL, USA) was used for statistical analyses. Results were expressed as percentiles (absolute numbers), means and standard deviations, or as medians and interquartile ranges (IQRs), as required. A chi-square test was performed to compare the categorical variables. P-values < 0.050 were considered to be statistically significant.

RESULTS

Study Population

A total of 261 patients were included in this study, with 55.20% (n=144) being male. The median age of the patients was 85 months (IQR:57.5-116). Allergic rhinitis, wheezy child, and asthma were diagnosed in 70.10% (n=183), 26.80% (n=70), and 35.20% (n=92) of the patients, respectively, Patients diagnosed with both asthma and allergic rhinitis made up 19.90% (n=52) of patients (Table I). Patients having concomitant allergic disease made up 9.10% (n=24) of the patients, and the most frequent was allergic conjunctivitis with 8% (n=21). Patients having concomitant chronic disease constituted 2.70% (n=7) of the patients, and the most frequent was epilepsy. Family members having allergic disease made up 29.10% (n=76) of patients, and the most frequent was asthma (16.10 %, n=42) (Table I).

According to the GINA symptom control assessment, well-controlled, partially controlled, and non-controlled asthma rates were 5.40% (n=14), 27.60% (n=42), and 28.70% (n=75) of the patients, respectively (Table I). Patients using maintenance treatment are shown in Table I.

Out of the 183 (70.10%) patients who were diagnosed with AR, they were classified as persistent and intermittent AR with 23% (n=43) and 76.50% (n=140) of the patients, respectively. Mild and moderate-severe AR were seen in 81.40% (n=139), and 18.60% (n=34) of the patients, respectively (Table I).

Prevalence of Aeroallergen Sensitization

Out of the 261 patients, 62.10 % (n=162) had SPT positivity. The percentages of patients having single and multiple aeroallergen positivity were 23.40% (n=61) and 38.70% (n=101), respectively, and the most frequent allergen was HDM with 41% (n=107). The second most frequently detected allergen was tree pollen allergen with 26.40% (n=69), followed by grass pollen allergens (24.50%, n=64) (Figure 1A,B).

Gender and Age Groups According to Allergen Sensitization

There was a statistically significant association between age and SPT positivity with aeroallergens (p=0.005). Patients under 6 years old showed higher SPT negativity with aeroallergens (46%), while patients above 6 years old showed higher SPT positivity with aeroallergens (67.9%) (p=0.020) (Table II). Patients above 6 years of age showed higher HDM and cat dander sensitivity (p=0.009, and 0.033, respectively).

There was no statistically significant association between gender and SPT positivity (Table II).

Table I: Characteristics of the study population.

Gender, n (%)	
Male	144 (55.20)
Female / Male	0.81
Age	
Age (months), median, IQR, min-max	85, 57.5-116
Diagnosis of allergic diseases, n (%)	
Allergic rhinitis	183 (70.10)
Asthma	92 (35.20)
Wheezy child	70 (26.80)
Allergic rhinitis and asthma	52 (19.90)
Patients diagnosed with asthma, n (%)	
GINA score assessment of symptom control, n (%)	
Well-controlled patients	14 (5.40)
Partially controlled patients	72 (27.60)
Non-controlled patients	75 (28.70)
Patients diagnosed with allergic rhinitis, n (%)	
Having intermittent symptoms	140 (76.50)
Having persistent symptoms	43 (23)
Having mild AR	139 (81.40)
Having moderate and severe AR	34 (18.6)
Patients using medications, n (%)	103 (39.5)
Using inhaler corticosteroids	94 (36)
Using leukotriene antagonist	26 (10)
Using both inhaler corticosteroid and long acting beta agonist	6 (2.3)
Using nasal steroids	67 (25.7)
Using antihistaminics	19 (7.3)
Family member having allergic disease, n (%)	76 (29.10)
Asthma	42 (16.10)
Allergic rhinitis	38 (14.60)

Table II: Evaluation of allergen positivity according to characteristics of patients.

	Positive SPT, n(%) 162 (62.10)	Negative SPT, n(%) 99 (37.90)	p-value
Age (mean±SD), months	98±48	80±37	**0.005****
Age groups, n (%)			
Under 6 years old	52 (32.10)	46 (46.50)	**0.020***
>6 years old	110 (67.90)	52 (52.5)	
Gender, n (%)			
Female	74 (45.70)	43 (43.40)	0.723
Male	88 (54.30)	56 (56.60)	
Diagnosis of allergic disease, n (%)			
Only Allergic rhinitis	114 (70.4)	69 (69.70)	0.908
Only Asthma	65 (40.10)	27 (27.30)	**0.035***
Only wheezing child	41 (25.30)	29 (29.30)	0.481
Allergic rhinitis and asthma	39 (24.10)	13 (13.10)	**0.030***

*Chi-square test, **Mann-Whitney test

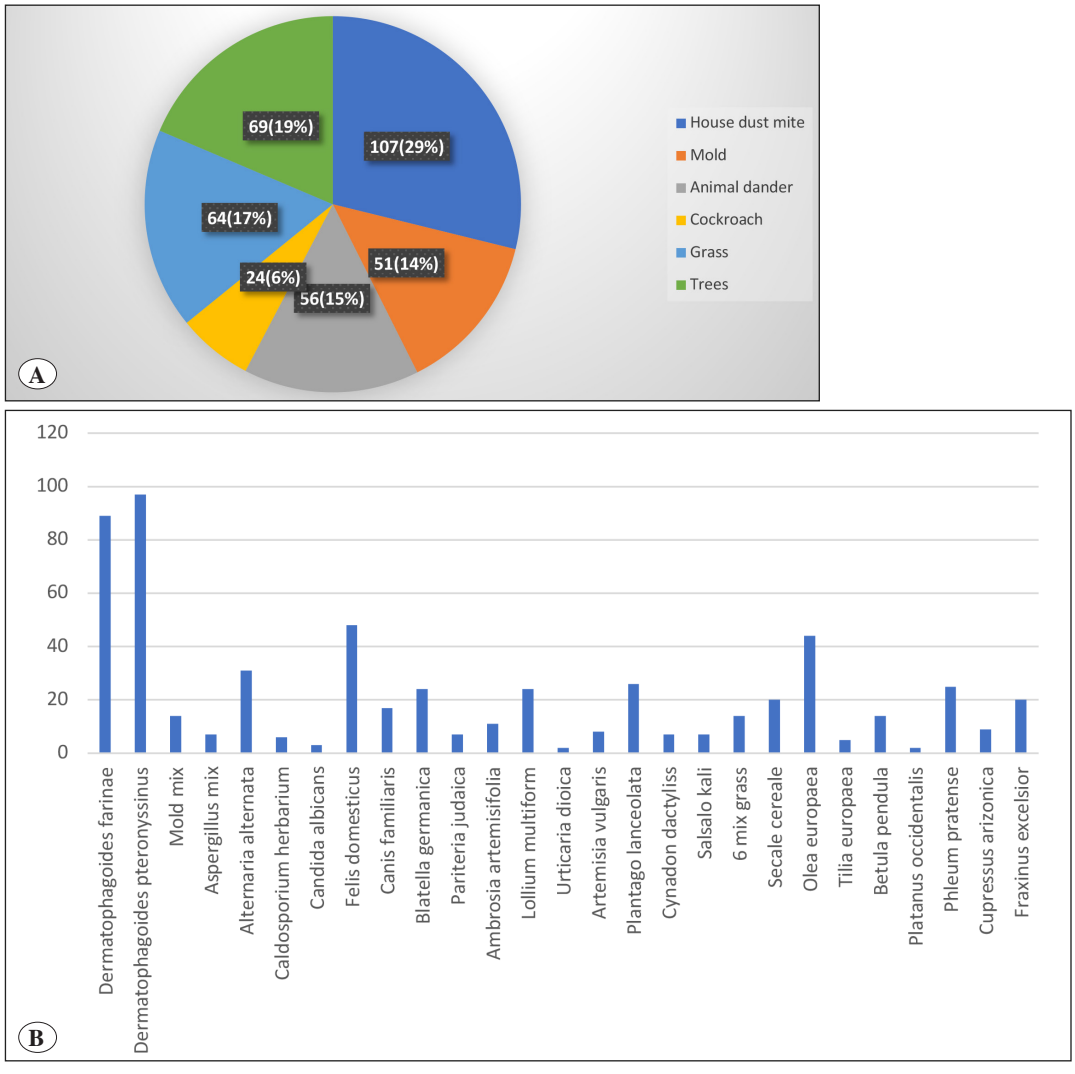

Figure 1. A) Evaluation of skin prick tests, **B)** Evaluation of skin prick tests.

Asthma and/or Allergic Rhinitis Diagnosis According to Common Allergen Sensitization

In patients who were diagnosed with only asthma, and only AR, 70.7% (n=65), and 62.30% (n=114) of the patients had positivity with SPTs with aeroallergens respectively. In the patients having both an asthma and AR diagnosis, 75% (n=39) had positivity with SPT. There was a statistically significant association between allergic disease, and SPT positivity (p=0.035). Patients having both asthma and allergic rhinitis showed higher SPT positivity with aeroallergens (p=0.035) (Table III).

Table III: Evaluation of allergen sensitization according to allergic diseases.

Aeroallergen sensitization positivity	Patients having asthma	Patients having allergic rhinitis	Patients having asthma and allergic rhinitis	p-value
Having SPT positivity, n (%)	65 (70.70)	114 (62.30)	39 (75)	**0.035*****
House dust mite, n (%)	47 (51.10)	79 (43.20)	29 (55.80)	0.365
D. farinae	40 (43.50)	67 (36.60)	26 (50)	0.723
D. pteronyssinus	45 (48.90)	72 (39.30)	27 (51.90)	0.505
Mold, n (%)	20 (21.70)	31 (16.90)	11 (21.20)	0.684
Mold mix	4 (4.30)	8 (4.40)	2 (3.80)	0.669
Cladosporium herbarium	3 (3.30)	6 (3.30)	3 (5.80)	0.333
Candida albicans	1 (1.10)	2 (1.10)	1 (1.90)	0.726
Aspergillus mix	4 (4.30)	4 (2.20)	2 (3.80)	0.648
Alternaria alternata	14 (15.20)	18 (9.80)	8 (15.40)	0.522
Animal dander, n (%)	27 (29.30)	42 (23)	20 (38.50)	0.227
Cat	24 (26.10)	39 (21.30)	19 (36.50)	0.212
Dog	10 (10.90)	9 (4.90)	6 (11.50)	0.069
Insect, n (%)	7 (7.60)	16 (8.70)	7 (13.50)	0.142
Blatella germanica	7 (7.60)	16 (8.70)	7 (13.50)	
Grasses, n (%)	29 (31.50)	44 (24)	17 (32.70)	0.528
Pariteria judaica	3 (3.30)	5 (2.70)	2 (3.80)	0.977
Ambrosia artemisifolia	9 (9.80)	6 (3.30)	5 (9.60)	**0.027*****
Lollium multiflorum	10 (10.90)	18 (9.80)	7 (13.50)	0.701
Plantago lanceolata	14 (15.20)	15 (8.20)	7 (13.50)	0.239
Cynadon dactyliss	3 (3.30)	4 (2.20)	2 (3.80)	0.931
Salsalo kali	4 (4.30)	3 (1.60)	1 (1.90)	0.152
Six mix grass allergen	9 (9.80)	8 (4.40)	4 (7.70)	0.148
Urticaria dioica	1 (1.10)	1 (0.50)	17 (32.70)	0.460
Artemisia vulgaris	5 (5.40)	2 (1.10)	17 (32.70)	**0.001*****
Secale cereale	8 (8.70)	13 (7.10)	4 (7.70)	0.968
Trees, n (%)	26 (28.30)	54 (29.50)	16 (30.80)	0.424
Olea europaea	16 (17.40)	37 (20.20)	10 (19.20)	0.652
Lime/ Tilia europea	27 (29.30)	5 (2.70)	17 (32.70)	0.143
Betula pendula	6 (6.50)	10 (5.50)	2 (3.80)	0.078
Platanus occidentalis	0	2 (1.10)	0	0.484
Phleum pratense	7 (7.60)	21 (11.50)	5 (9.60)	0.373
Cupressus arizonica	2 (2.20)	3 (1.60)	0	0.091
Fraxinus excelsior	12 (13)	14 (7.70)	7 (13.50)	**0.042*****

***One-way Anova test, Bonferroni alpha (0.016)

Patients who had positivity with Ambrosia artemisifolia allergen were more common among patients diagnosed with asthma, and both asthma and allergic rhinitis (p=0.027). Patients who had positivity with Artemisia vulgaris allergen were shown to be more common among patients diagnosed with both asthma and allergic rhinitis (p=0.001). Patients who had positivity with Fraxinus excelsior allergen were shown to be more common among patients diagnosed with asthma, and both asthma and allergic rhinitis (p=0.042). There was no statistically significant difference between the positivity rates of the remaining allergens and having asthma, having AR, and having both asthma and AR diagnoses (Table III).

Asthma Severity, Allergic Rhinitis Types, and Common Allergen Sensitization

There was a statistically significant association between the asthma symptom control score according to GINA, and SPT positivity with aeroallergens (p=0.011). Patients who had non-controlled asthma showed higher SPT positivity with aeroallergens (p=0.011) (Table IV).

Patients who had mold, Alternaria alternate, and Secale cereale allergen positivity were shown to be more common in non-controlled asthma (p=0.029, 0.049, and 0.028, respectively). There was no statistically significant difference between the positivity rates of remaining allergens and asthma symptom control according to GINA (Table IV).

There was no statistically significant association between SPT positivity with aeroallergens, and AR severity and type. Patients having dog and grass allergens positivity were more common in persistent AR (p=0.044, and 0.036 respectively) (Table V).

DISCUSSION

It is important to avoid specific aeroallergens that may cause the exacerbation of symptoms of allergic disease. Aeroallergen sensitivity varies between geographical areas (13). According to Bıcakcı and Tosunoğlu, various pollens are detected in the 5 geographical regions (north, west, south, central, and east) in Turkey (27). Alternaria alternata (28) in Hatay province and weeds in İzmir were the most common allergens (29). According to Kalpaklıoglu, et al., the presence of mite was related to an increase both in the mean temperature (> 15 degrees C) and in humidity (> or = 40%) as well as low altitude (< 300 m). The highest prevalence of HDM was detected in the most humid regions of Turkey: the Mediterranean (48.4%), and the Black Sea (46%) (18). The sensitization to HDM increased in subtropical, and tropical areas due to the warm, and humid environment (25°C to 30°C and a relative humidity of 70%), particularly Blomia tropicalis (30). In a study from the Mediterranean coast of Turkey, Antalya, the most detected allergen was D. pteronysinus in 1180 children (31). In studies from Turkey, from the western area, house dust mite allergen was the most common allergen (28, 32). Similarly, in Italy, a Mediterranean country, HDM, especially D. pteronysinus, was the most frequent allergen detected in SPT (33). Cyprus is at an altitude of 108 meters above sea level with an average relative humidity of 62%. This humidity eases the growth of mites in indoor environments. Similarly, in our study, HDM was the most frequently detected allergen with 41% (n=100).

In studies, the male gender had statistically significantly higher sensitization to HDM in adults (34, 35), and pollens in children (34). In another adult study, there was no statistically significant difference between gender, and aeroallergen sensitivity (36). In our study, there was no statistically significant association between gender and SPT positivity. In a study, school-age children had a statistically significant higher prevalence of aeroallergen sensitivity than preschool-age children (37). There was a statistically significant association between HDM, mold, grass, and mulberry allergen sensitization, and the age of children. The cockroach and tree were the most frequent allergens in children aged 6-12 years, and 3-6 years, respectively (38). In our study, patients above 6 years of age, showed higher SPT negativity with aeroallergens (p=0.020). Patients above 6 years of age, showed higher HDM, and cat dander sensitivity (p=0.009, and 0.033, respectively)

In a study, HDM was the most frequent allergen in asthma-diagnosed children (39). In an adult study, mild asthma cases had statistically significant sensitization to olive pollen, and, mild and moderate asthma cases had statistically significant sensitization to D. farinae (40). Moderate-severe asthma cases in children have statistically significant sensitization to Aspergillus fumigatus (41). In our study, patients who had mold, Alternaria alternata, and Secale cereale allergens positivity were more common in non-controlled asthma (p=0.029, 0.049, and 0.028, respectively). Similarly, allergic rhinitis-diagnosed children had statistically significant sensitization to HDM (42, 43). In another study, moderate-severe intermittent rhinitis

cases had statistically significant sensitization to Artemisia vulgaris and Ambrosia artemisifolia (44). In our study, patients having dog and grass allergens positivity were shown to be more common in persistent AR (p=0.044, and 0.036 respectively).

Considering the high prevalence of house dust mite sensitivity, carefully explaining house dust precautions to parents and patients, and taking environmental control measures in terms of house dust will make a significant positive contribution to symptom and disease control in these patients.

Table IV: Evaluation of allergen sensitization according to asthma GINA symptom score.

Aeroallergen sensitization positivity	Well-controlled asthma	Partially-controlled asthma	Non-controlled asthma	p-value
Having SPT positivity, n (%)	44 (58.70)	47 (65.30)	14 (100)	**0.011*****
House dust mite, n (%)	27 (36)	30 (41.7)	11 (78.6)	0.502
D. farinae	24 (32)	25 (34.7)	9 (64.3)	0.796
D. pteronyssinus	26 (34.7)	25 (34.7)	10 (71.4)	0.281
Mold, n (%)	9 (12)	22 (30.6)	5 (35.7)	**0.029*****
Mold mix	4 (5.3)	3 (4.2)	1 (7.1)	0.183
Cladosporium herbarium	0	4 (5.6)	1 (7.1)	0.400
Candida albicans	1 (1.3)	0	1 (7.1)	0.158
Aspergillus mix	1 (1.3)	3 (4.2)	1 (7.1)	0.906
Alternaria alternata	3 (4)	17 (23.6)	4 (28.6)	**0.049*****
Animal dander, n (%)	17 (22.7)	17 (23.6)	4 (28.6)	0.797
Cat	12 (16)	15 (20.8)	4 (28.6)	0.266
Dog	8 (10.7)	4 (5.6)	3 (21.4)	0.120
Insect, n (%)	3 (4)	7 (9.7)	5 (35.7)	0.414
Blatella germanica	3 (4)	7 (9.7)	5 (35.7)	0.414
Grasses, n (%)	13 (17.3)	25 (34.7)	6 (42.9)	0.074
Pariteria judaica	1 (1.3)	5 (6.9)	6 (42.9)	0.350
Ambrosia artemisifolia	4 (5.3)	4 (5.6)	3 (21.4)	0.201
Lollium multiforum	6 (8)	6 (8.3)	1 (7.1)	0.291
Plantago lanceolata	6 (8)	9 (12.5)	5 (35.7)	0.117
Cynadon dactyliss	1 (1.3)	3 (4.2)	1 (7.1)	0.848
Salsalo kali	1 (1.3)	4 (5.6)	1 (7.1)	0.771
Six mix grass allergen	1 (1.3)	7 (9.7)	2 (14.3)	0.308
Urticaria dioica	0	1 (1.4)	0	0.694
Artemisia vulgaris	1 (1.3)	6 (8.3)	0	0.233
Secale cereale	1 (1.3)	8 (11.1)	4 (28.6)	**0.028*****
Trees, n (%)	13 (7.3)	23 (31.9)	4 (28.6)	0.122
Olea europaea	9 (12)	11 (15.3)	4 (28.6)	0.107
Lime/ Tilia europea	1 (1.3)	24 (33.3)	0	0.377
Betula pendula	2 (2.7)	3 (4.2)	1 (7.1)	0.815
Platanus occidentalis	1 (1.3)	0	0	0.377
Phleum pratense	6 (8)	8 (11.1)	0	0.292
Cupressus arizonica	2 (2.7)	5 (6.9)	0	0.580
Fraxinus excelsior	1 (1.3)	10 (13.9)	2 (14.3)	0.059

***One-way Anova test, Bonferroni alpha (0.016)

Table V: Evaluation of allergen sensitization according to allergic rhinitis severity and type.

Aeroallergen sensitization positivity	Mild allergic rhinitis	Moderate and severe allergic rhinitis	p-value	Persistent allergic rhinitis	Intermittent allergic rhinitis	p-value
Having test positivity, n (%)	25 (73.50)	91 (60.3)	0.148	89 (62.70)	26 (61.90)	0.928
House dust mite, n (%)	59 (41.50)	20 (47.60)	0.304	16 (47.10)	64 (42.40)	0.545
D. farinae	50 (35.20)	17 (40.50)	0.894	14 (41.20)	54 (35.80)	0.854
D. pteronyssinus	53 (37.30)	19 (45.20)	0.600	15 (44.10)	58 (38.40)	0.820
Mold, n (%)	25 (17.60)	7 (16.70)	0.907	6 (17.60)	26 (17.20)	0.651
Mold mix	8 (5.60)	1 (2.40)	0.357	1 (2.90)	8 (5.30)	0.489
Cladosporium	4 (2.80)	2 (4.80)	0.451	1 (2.90)	5 (3.30)	0.885
Candida albicans	2 (1.40)	0	0.440	0	2 (1.30)	0.483
Aspergillus mix	4 (2.80)	0	0.258	0	4 (2.60)	0.304
Alternaria alternata	13 (9.20)	5 (11.90)	0.360	4 (11.80)	14 (9.30)	0.568
Animal dander, n (%)	32 (22.50)	10 (23.80)	0.815	11 (32.40)	31 (20.5)	0.360
Cat	29 (20.40)	10 (23.80)	0.315	11 (32.40)	28 (18.50)	0.284
Dog	9 (6.30)	0	0.058	11 (32.40)	9 (6)	**0.044***
Insect, n (%)	13 (9.20)	3 (7.10)	0.662	1 (2.90)	15 (9.90)	0.117
Cockroach	13 (9.20)	3 (7.10)	0.662	1 (2.90)	15 (9.90)	0.117
Grasses, n (%)	38 (26.80)	6 (14.30)	0.070	14 (41.20)	30 (19.90)	**0.036***
Pariteria	5 (3.50)	0	0.345	0	5 (3.30)	0.105
Ambrosia	6 (4.20)	0	0.295	2 (5.90)	4 (2.60)	0.932
Lollium	14 (9.90)	4 (9.50)	0.167	7 (20.60)	11 (7.30)	0.402
Plantago lanceolata	14 (9.90)	1 (2.4)	0.333	7 (20.60)	8 (5.30)	0.128
Cynadon dactyliss	4 (2.80)	0	0.405	2 (5.90)	2 (1.30)	0.413
Salsalo kali	3 (2.10)	0	0.476	0	3 (2)	0.220
Six mix grasses	7 (4.90)	1 (2.40)	0.918	2 (5.90)	6 (4)	0.647
Urticaria dioica	1 (0.70)	0	0.688	0	1 (0.70)	0.490
Artemisia vulgaris	1 (0.70)	1 (2.40)	0.125	0	2 (1.30)	0.323
Secale cereale	11 (7.70)	2 (4.80)	0.827	6 (17.60)	7 (4.60)	0.186
Trees, n (%)	43 (30.30)	11 (26.20)	0.587	15 (44.10)	39 (25.80)	0.128
Olea	30 (21.10)	7 (16.70)	0.849	7 (20.60)	30 (19.90)	0.064
Lime	4 (2.80)	1 (2.40)	0.983	1 (2.90)	4 (2.60)	0.720
Betula	7 (4.90)	3 (7.10)	0.363	4 (11.80)	6 (4)	0.298
Platanus	2 (1.40)	0	0.476	0	2 (1.30)	0.384
Phleum	17 (12)	4 (9.50)	0.931	7 (20.6)	14 (9.30)	0.391
Cupressus arizonica	3 (2.10)	0	0.373	2 (5.90)	1 (0.70)	0.115
Fraxinus excelsior	10 (7)	4 (9.50)	0.353	4 (11.80)	10 (6.60)	0.899

*Chi-square test

The limitation of our study was its retrospective nature. Due to the retrospective nature of the study, missing data or bias in patient selection may have affected the findings. Nevertheless, its strength lies in being the first report investigating the aeroallergen sensitization in asthma and/or allergic rhinitis-diagnosed children in North Cyprus.

CONCLUSION

In conclusion, patients diagnosed with asthma and/or allergic rhinitis in North Cyprus most commonly had allergen sensitization to house dust mites, followed by tree and grass pollens.

Due to changing climatic conditions across countries and their regions, aeroallergen sensitivities change, and result in varying aeroallergen sensitivity rates in patients diagnosed with asthma and/or allergic rhinitis. There is a need to conduct such studies and further research to improve the management of allergic diseases, prevent symptoms from being triggered by allergen exposure, and regulate the content of inhaler allergen tests to be cost-effective in these societies.

Acknowledgement

None

Conflict of Interest

The authors declare that they have no conflict of interest.

Funding

None

Author Contributions

Concept: **Azize Pinar Metbulut,** Design: **Azize Pinar Metbulut,** Data collection or processing: **Azize Pinar Metbulut,** Analysis or Interpretation: **Azize Pinar Metbulut,** Literature search: **Azize Pinar Metbulut,** Writing: **Azize Pinar Metbulut,** Approval: **Azize Pinar Metbulut.**

REFERENCES

1. Asher MI, Montefort S, Bjorksten B, Lai CKW, Strachan DP, Weiland SK, et al. Worldwide time trends in the prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and eczema in childhood: ISAAC Phases One and Three repeat multicountry cross-sectional surveys. Lancet 2006;368:733-48.
2. Akinbami LJ, Simon AE, Rossen LM. Changing Trends in Asthma Prevalence Among Children. Pediatrics 2016;137(1):1-7.
3. Asher MI, Weiland SK. The International Study of Asthma and Allergies in Childhood (ISAAC). ISAAC Steering Committee. Clin Exp Allergy 1998; 28(suppl 5):52-66.
4. Licari A, Magri P, Silvestri AD, Giannetti A, Indolfi C, Mori F, et al. Epidemiology of Allergic Rhinitis in Children: A systematic review and meta-analysis. J Allergy Clin Immunol Pract 2023;11(8):2547-56.
5. Lamnisos D, Moustaki M, Kolokotroni O, Koksoy H, Faiz M, Arifoğlu K, et al. Prevalence of asthma and allergies in children from the Greek-Cypriot and Turkish-Cypriot communities in Cyprus: a bi-communal cross-sectional study. BMC Public Health 2013:13:585.
6. Stern J, Pier J, Litonjua AA. Asthma epidemiology and risk factors. Semin Immunopathol 2020;42(1):5-15.
7. Cohen AJ, Ross Anderson H, Ostro B, Pandey KD, Krzyzanowski M, Künzli N, et al. The global burden of disease due to outdoor air pollution. J Toxicol Environ Health A 2005;68:13-4.
8. Tiotiu Al, Novakova P, Nedeva D, Chong-Neto HJ, Novakova S, Steiropoulos P, et al. Impact of Air Pollution on Ashtma Outcomes. Int J Environ Res Public Health 2020;17(17):6212.
9. Morgenstern V, Zutavern A, Cryrs J, Brockow I, Koletzo S, Kramer U, et al. Atopic diseases, allergic sensitization, and exposure to traffic-related air pollution in children. Am J Respir Crit Care Med 2008;177(12):1331-7.
10. Rönmark E, Bunne J, Bjerg A, Perzanowski M, Winberg A, Anderson M, et al. Prevalence and risk factors for allergic sensitization: 3 cross-sectional studies among schoolchildren from 1996 to 2017. J Allergy Clin Immunol Glob 2023;2(4):100150.
11. Farrokhi S, Gheybi MK, Mohamed A, Tahmasebi R, Iranpour D, Fatemi A, et al. Common aeroallergens in patients with asthma and allergic rhinitis living in southwestern part of Iran: based on skin prick test reactivity. Iranian Journal of Allergy, Asthma and Immunology 2015;14(2):133.
12. Özkaya E. Alerjik Deri Hastalıklarında Tanı Testleri. 1st ed. İstanbul: Nobel Tıp Kitabevi; 2015.
13. Ayvaz A, Baki A, Gedik Y. Doğu Karadeniz Bölgesindeki Çocuklarda Allerji Deri Testi (Skin Prick Test) Sonuçları. Turkiye Klinikleri Journal of Allergy & Asthma. 2003;5(2):80-4.
14. Çölgecen E, Özyurt K, İntepe Y, Gencer ZK, Özkırış M, Ede G, et al. Yozgat yöresinde atopik semptomlu hastalarda deri prick testi sonuçları. Journal of Clinical and Experimental Investigations 2014;5(1):64-8.
15. İğde M, İğde F, Sancak R, Ozturk F. Orta Karadeniz Bölgesindeki çocuklarda allerji deri testi sonuçları. Turkiye Klinikleri Journal of Pediatrics 2009;18(2):82-90.
16. Çiçek D, Kandi B, Bakar Dertlioğlu S, Ucak H. Elazığ yöresinde allerjik astma, allerjik rinit, allerjik konjunktivit, kronik ürtiker ve atopik dermatitli olgularda prick test sonuçlarının değerlendirilmesi. Fırat Üniversitesi Sağlık Bilimleri Tıp Dergisi 2008;22(4):193-6.
17. Havlucu Y, Özdemir L, Yurtman D, Özdemir B. Hatay/Dörtyol Bölgesindeki Alerjik Semptomlar ile Başvuran Hastalarda Atopi Varlığının Değerlendirilmesi. Türk Toraks Dergisi 2011;12(12):5-8.
18. Kalpaklioğlu AF, Emekçi M, Ferizli A, Misirligil Z; House-Dust Mite Working Group. A survey of acarofauna in Turkey: comparison of seven different geographic regions. Allergy Asthma Proc 2004;25(3):185-90.
19. Karabıçak H, Arıkan O, Bayar M. Kırıkkale Şehrindeki Alerjik Rinitli Hastaların Prick Test Sonuçları. Bidder Tıp Bilimleri Dergisi 2011;3:1-8.
20. Yeğin Y, Şimşek B, Çelik M, Kayhan TF. İstanbul Bakırköy'de alerjik rinitli hastalara uygulanan deri prick test sonuçlarının mevsimsel dağılımı. KBB Uygulamaları 2016;4(3):97-104.

21. Öztürk Ö, Tokmak A, Güçlü E, Yıldızbaş Ş, Gültekin E. Düzce'de allerjik rinitli hastalarda prick testi sonuçları. Düzce Tıp Fakültesi Dergisi 2005;1(1):11-4.
22. Cicco M, Tufo ED, Fasola S, Gracci S, Marchi MG, Fibbi L, et al. The Effect of outdoor aeroallergens on asthma hospitalizations in children in North-Western Tuscany, Italy. Int J Environ Res Public Health 2022;19(6):3586.
23. https://ginasthma.org/gina-reports/
24. Bousquet J, Schünemann HJ, Togias A, Bachert C, Erhola M, Hellings PW, et al. Next-generation Allergic Rhinitis and Its impact on Asthma (ARIA) guidelines for allergic rhinitis based on Grading of Recommendations Assessment, Development and Evaluation (GRADE) and real-world evidence. J Allergy Clin Immunol 2020;145(1):70-80.e3.
25. Ansotegui IJ, Melioli G, Canonica GW, Carabello L, Villa E, Ebisawa M, et al. IgE allergy diagnostics and other relevant tests in allergy, a World Allergy Organization position paper. World Allergy Organ J 2020;13(2):100080.
26. Heinzerling L, Mari A, Bergmann KC, Bresciani M, Burbach G, Darsow U, et al. The skin prick test - European standards. Clin Transl Allergy 2013;3(1):3.
27. Bıçakçı A, Tosunoğlu A. Allergenic Pollens in Turkey. Asthma Allergy Immunology 2019;17:7-24.
28. Çiftçi İH, Çetinkaya Z, Atambay M, Kiyildi N, Aycan OM, Daldal N. House dust mite fauna in Western Anatolia, Turkey. Korean Journal of Parasitology 2006;44(3):259-64.
29. Bılgır F, Uzum Y, Balıkcı O, Korkmaz UB, Dede B. Allergen Sensitivity in Patients with Allergic Respiratory Tract Symptoms in Izmir and its Environs, Aegean Region of Turkey. Asthma Allergy Immunology 2023;21:120-7.
30. Acevedo N, Zakzuk J, Caraballo L. House Dust Mite Allergy Under Changing environments. Allergy Asthma Immunol Res 2019;11(4):450-69.
31. Basaran AE, Karataş Torun N, Kocacık Uygun DF, Bingöl A. Distribution of aeroallergens on skin prick tests of atopic children living in the Akdeniz region, Turkey. Asthma Allergy Immunol 2018;16:132-7.
32. Budak S, Ozbilgin N. Acar fauna of the house-dust in Aegean Region. Acta Parasitol Turcica 1988;12:47-53.
33. Dottorini ML, Bruni B, Peccini F, Bottini P, Pini L, Donato F, et al. Skin prick-test reactivity to aeroallergens and allergic symptoms in an urban population of central Italy: a longitudinal study. Clin Exp Allergy 2007;37(2):188-96.
34. Arshad SD, Tariq SM, Matthews S, Hakim E. Sensitization to common allergens and its association with allergic disorders at age 4 years: a whole population birth cohort study. Pediatrics 2001;108(2):E33.
35. Ezeamuzie CL, Thompson MS, AL-Ali S, Dowaisan A, Khan M, Hijazi Z. Asthma in desert: spectrum of the sensitizing aeroallergens. Allergy 2000;55:157-62.
36. Wang IJ, Tung TH, Tang CS, Zhao ZH. Allergens, air pollutants, and childhood allergic diseases. Int J Hyg Environ Health 2016;219(1):66-71.
37. Thao NTV, Kien TG, Tuan TA, Duc NM, Hoang PM, Vu LT. Indoor aeroallergen sensitization and associated factors in hospitalized children with asthma exacerbations. Med Arch 2023;77(5):338-44.
38. Ying X, Qi X, Yin Y, Wang H, Zhang H, Jiang H, et al. Allergens sensitization among children with allergic diseases in Shanghai, China: age and sex difference. Respir Res 2022;23(1):95.
39. Visitsunthorn N, Chaimongkol W, Visitsunthorn K, Pacharn P, Jirapongsanuruk O. Great flood and aeroallergen sensitization in children with asthma and/or allergic rhinitis. Asian Pac J Allergy Immunol 2018;36(2):69-76.
40. Ediger D, Günaydın FE, Erbay M, Şeker Ü. Trends of sensitization to aeroallergens in patients with allergic rhinitis and asthma in the city Bursa, South Marmara Sea Region of Turkey. Turk J Med Sci 2020;50(2):330-6.
41. Knutsen AP, Vijay HM, Kumar V, Kariuki B, Santiago LA, Graff R, et al. Mold-sensitivity in children with moderate-severe asthma is associated with HLA-DR and HLA-DQ. Allergy 2010;65(11):1367-75.
42. Sritipsukho P. Aeroallergen sensitivity among Thai children with allergic respiratory diseases: a hospital based study. Asian Pac J Allergy Immunol 2004;22(2-3):91-5.
43. Nae A, Heffernan CB, Colreavvy M. Allergic rhinitis facts from an Irish pediatric population. World J Otorhinolaryngol Head Neck Surg 2023;9(4):333-9.
44. Li J, Huang Y, Lin Xiaoping, Zhao D, Tan G, Wu J, et al. Influence of degree of specific allergic sensitivity on severity of rhinitis and asthma in Chinese allergic patients. Respir Res 2011;12(1):95.