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ORIGINAL ARTICLE



Sensitization to Aeroallergens in a Mexican Cohort with Allergic Conjunctivitis: A Cross-sectional Retrospective Study Conducted in Ángeles Puebla Hospital

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ABSTRACT

This study aims to evaluate the sensitization distribution of aeroallergens in patients with allergic conjunctivitis (AC) living in a temperate subhumid region and to describe the prevalence in a Mexican cohort. A total of 761 patient records were revisited, including the results of the skin prick test (SPT) for 45 aeroallergens. We found 292 patients with AC and a positive SPT in a 5-year period. The most frequent aeroallergens include dust mites (69.2% for *Dermatophagoides pteronyssinus* and 47.6% for *Dermatophagoides farinae*), trees (36% for cypress and 22.6% for ash), animals (33.9% for dogs and 26.7% for cats), and grasses (21.2% for *Paspalum notatum* and 19.9% for *Poa pratensis*). Among the studied population, a prevalence of 38.4% for the disease was calculated. House dust mites were responsible for most sensitizations found in the studied population. There is a high prevalence of AC in the selected cohort during the period studied.

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Aeroallergens; allergic conjunctivitis; Mexico; skin prick test

The external part of the eye is an ideal site for hypersensitive reactions. The immediate reaction is the most frequent type in this site of the body due to a large number of mast cells in the eyelids and the bulbar conjunctiva, in addition to the possible local synthesis of immunoglobulin E (IgE). Ocular allergy or AC consists of a disease group characterized by chronic regional inflammation.¹ Among the most frequent allergic diseases associated with ocular allergy is allergic rhinitis (AR) in up to 70% of individuals.² According to the classification for ocular allergy published by the European Academy of Asthma Allergy and Immunology (EAACI) in 2012, ocular surface hypersensitivity disorders are classified as ocular allergy (IgE-mediated and non-IgE-mediated) and non-allergic ocular hypersensitivity due to their pathophysiological mechanisms.^{3,4}

IgE-mediated ocular allergy includes seasonal and perennial allergic conjunctivitis. The associated immediate hypersensitivity reaction is characterized by the allergen IgE binding to the mast cell. This leads to degranulation and the release of preformed mediators located in the granules, such as histamine, tryptase, leukotrienes, cytokines, and the platelet-activating factor. This same reaction also triggers the synthesis of *de novo* inflammatory agents, such as eicosanoids. In sensitized patients, these mediators initiate the recruitment of inflammatory cells to the reaction site and stimulate nerve endings that produce vasodilation, causing immediate clinical symptoms, such as pruritus, hyperemia, and eyelid/conjunctival edema. Conjunctival mast cells express IL-4 and other cytokines that promote the recruitment of inflammatory cells and T-cell and B-cell stimulation, as well as the induction of IgE.^{1,5–8}

This type of conjunctivitis does not have an age predisposition, as it occurs both in children and adults, and the

distribution by sex is similar in both men and women. Clinically, we find symptoms such as pruritus, conjunctival hyperemia, epiphora, photophobia, and eyelid edema. Visual impairment is minimal, and there is no corneal involvement or papillary hypertrophy. In laboratory studies, total serum IgE is elevated, as well as eosinophils in corneal scraping. Finally, SPT and specific serum IgE are positive in most cases.⁹

The two spectrums of the disease that can be IgE-mediated and non-IgE-mediated (mixed ocular allergy) are vernal and atopic keratoconjunctivitis. At vernal keratoconjunctivitis, there is a massive infiltration of T cells, macrophages, neutrophils, and, above all, eosinophils. The direct activation of allergen-specific T cells or dendritic cells by alternate pathways initiates the reaction without specific evidence of IgE sensitization, which reveals a late response and explains why we identify specific IgE in half of these patients, supporting the concept of alternate and non-IgE activation pathways.^{1,6,8,10–14} Vernal keratoconjunctivitis occurs mostly in pediatric patients and is predisposed to males. Clinically the symptoms are similar to seasonal and perennial AC, such as intense itching, conjunctival hyperemia, mucous discharge, intense photophobia, and eyelid edema. In these cases, we can find corneal involvement and papillary hypertrophy (>1 mm) with moderate involvement of the limbus and visual impairment. The levels of total serum and the results of specific IgE and SPT are variable, while eosinophils in corneal scraping are typically found⁹

Atopic keratoconjunctivitis is the ocular manifestation of atopic dermatitis characterized by a mixed response (Th1, Th2, and Th17) including Toll-like receptors of the innate immune system involved in the chronic inflammatory response. High serum IgE concentrations and polysensitization are common findings, although they are not specific for

the disease, they may contribute to symptom persistence or poor response to treatment.^{1,6,14} This type of ocular allergy is frequently associated with dermatitis, asthma, and/or rhinitis. Adult males are the most affected in this case. We find classic symptoms such as pruritus, hyperemia, and photophobia, as well as corneal involvement, papillary hypertrophy (<1 mm), and severe visual discomfort. Eosinophils in the corneal scraping, positive SPT/serum specific IgE, and very high levels of total IgE.⁹

The only non-IgE-mediated spectrum of the disease is contact blepharoconjunctivitis, which is related to a delayed T-cell-mediated hypersensitivity reaction involving haptens (low molecular weight chemical), which are immunogenic only after they bind to tissue proteins.^{1,6,14–16} This condition is usually produced by a reaction to ophthalmic dosage forms (eye drops or ointments), cosmetics, chemicals, and some indoor plants. Typically, it occurs in adults without a sex-related predisposition for the disease. Clinically, pruritus and hyperemia are present but photophobia and ocular discharge are not found in all patients. There is no corneal involvement or papillary hypertrophy and the results in laboratory tests are highly variable.⁹

Aims

In addition to being one of the most common eye diseases in daily clinical practice, allergic diseases have a great economic and social impact within communities,^{3,17} for this reason, conducting population studies is very important to understanding the distribution of the disease, as well as elaborating projects for the prevention and control of specific exacerbations in the region. Therefore, we aimed to describe the sensitization pattern in a Mexican population with allergic conjunctivitis in the last 5 years.

Materials and methods

Study population

An observational, cross-sectional, descriptive, and retrospective study was carried out. The records of patients who underwent an SPT with aeroallergens in an allergic disease clinic at “Hospital Ángeles Puebla,” in the period from January 2016 to August 2021, were reviewed individually. All tests were executed by a pediatric allergist and interpreted by an immunologist. The study protocol was approved by the hospital’s research and ethics committees (approval number: CI-028-2021).

Diagnosis

The AC diagnosis is clinical and made up of symptoms and findings during the physical examination.⁴ There are no universally accepted diagnosis criteria; however, those proposed in the Consensus Document on Allergic Conjunctivitis (DECA) are perhaps the most widely accepted. For this reason, diagnosis was based on DECA criteria. At the time of reviewing the record signs or symptoms recorded in the survey for obtaining the clinical history and physical examination were intentionally

sought, especially of patients whose main diagnosis or reason for consultation is not related to ocular allergy.

Skin prick test

Nowadays, different complementary tools are used according to the pathophysiological mechanism involved. The DECA establishes that the diagnosis is confirmed with positive results in skin tests with suspected allergens or with specific serum IgE.⁹ The SPTs were reviewed according to the recommendations published by the European Academy of Allergy and Clinical Immunology in its practical guide for skin prick tests to aeroallergens in allergy.¹⁸ In our study, the Lincoln Diagnostics, Inc. brand Multi-Test II® device was used throughout the selected period. A sterile multiple applicator device that has reported reliable performance compared to other devices.¹⁹

The extracts that make up the aeroallergens panel of the clinic correspond to grasses and weeds (*Cynodon dactylon*, *Lolium Perenne*, *Triticum sativum*, *Phleum pratense*, *Zea Mays*, *Poa Pratensis*, *Paspalum notatum*, and *Sorghum holcus*), trees (*Cupressus arizonica*, *Fraxinus excelsior*, *Ligustrum vulgare*, *European Olea*, *Quercus robur*, *Schinus molle*, *Alnus spp*, *Populus*, *Prosopis spp*, *Eucalyptus spp*, and *Platanus occidentalis*), plants (*Rumex sp*, *Cosmos spp*, *Helianthus spp*, *Chenopodium albus*, and *Salsola pestifer*), dust mites (*Dermatophagoides pestifer* and *Dermatophagoides farinae*) insects (cockroach, mosquito, ant, bee, and wasp), fungi (*Alternaria alternata*, *Penicillium notatum*, and *Aspergillus fumigatus*), animals (dog, cat, rabbit, feather mix, horse, cattle, and goat), inhalants (latex, house dust, and wool), and colorants (tartrazine).

Statistical analysis

All data was analyzed using GraphPad Prism®, version 8, for Windows® and SPSS®, version 24, for Windows®. Descriptive statistics were used for the general data of the study population. For the quantitative variables with a normal distribution, the mean was used as the measure of central tendency and standard deviation ($\pm$) as a measure of dispersion. For those that showed a non-normal distribution, the median and the interquartile range or amplitude (IQR) should be calculated.

To determine the normality in the frequency distribution a Shapiro–Wilk test was performed, designed for samples with more than 50 participants. For categorical variables, the percentage was used as a proportion measure. The 95% confidence interval was used as a mean variability measure. All reported p-values from these analyses will be two-tailed with a significance level less than 0.05.

Results

During the period studied, 761 SPTs were performed at our Allergic Disease Clinic, of which 516 had a positive result and 245 a negative result. The distribution by sex was 53.1% (n = 404) for women and 47.9% (n = 357) for men. Out of the 761 patients included in the study, we calculated a prevalence of 38.4% (n = 292) in AC patients with a positive SPT confirmed diagnosis. On the other hand, of the total

Table 1. Patients with allergic conjunctivitis distribution by sex and age group.

	All AC patients[372] n	AC Patients with positive SPT [292] n	AC Patients with negative SPT [80] n	p-value
Sex				
Male	165	129	36	0.896
Female	207	163	44	
Age groups				
[2-5]	59	41	18	0.245
[6-11]	61	49	12	
[12-18]	41	35	6	
[18-66]	211	167	44	

records reviewed, 10.4% ($n = 80$) of the patients had clinical manifestations of AC but had a negative SPT, as shown in (Table 1).

Out of the 292 patients with a confirmed diagnosis of AC by an SPT included in this study, there was a 55.8% predisposition in the female sex and 44.2% in men ($p = .896$). Regarding age, patients from 2 to 66 years old were included, for AC, the median was 23.4 years (IQR 21.58–25.23). The age distribution was 14.1% in preschool children (2–5 years), 16.8% in school children (6–11 years), 12% in adolescents (12–18 years), and 57.1% in adults ($p = .245$). It is important to mention that the distribution of the ages among the total population included was similar for pediatric ($n = 391$) and adult ($n = 370$) patients and exactly the same between the 516 patients with a positive SPT (258 children vs 258 adults).

The most frequent allergens resulting in positive skin reactivity were dust mites; *Dermatophagoides pteronyssinus*, and

Dermatophagoides farinae, with a frequency of 69.2% and 47.6%, respectively. Subsequently, regarding the tree extracts studied, 36% of patients presented sensitization to cypress (*Cupressus arizónica*) and 22.6% to ash (*Fraxinus excelsior*). Of the animal epithelia tested, 33.9% of tests were positive for sensitization to dogs and 26.7% were positive for cats. Finally, for grasses and weeds, *Paspalum notatum* and *Poa pratensis* had sensitization frequencies of 21.2% and 19.9%, respectively. The most common aeroallergens found in this cohort are represented in (Figure 1). The remaining distribution of the aeroallergens studied is reported in (Table 2).

Polysensitization to two aeroallergens was the most frequently found in our study group with a frequency of 16.8% ($n = 49$). Monosensitization occurred in 7.5% ($n = 22$) of patients, the rest presented in (Table 3). Regarding multimorbidity, the most frequent association was rhinoconjunctivitis (67.7%), followed by the combinations AC + AR + allergic

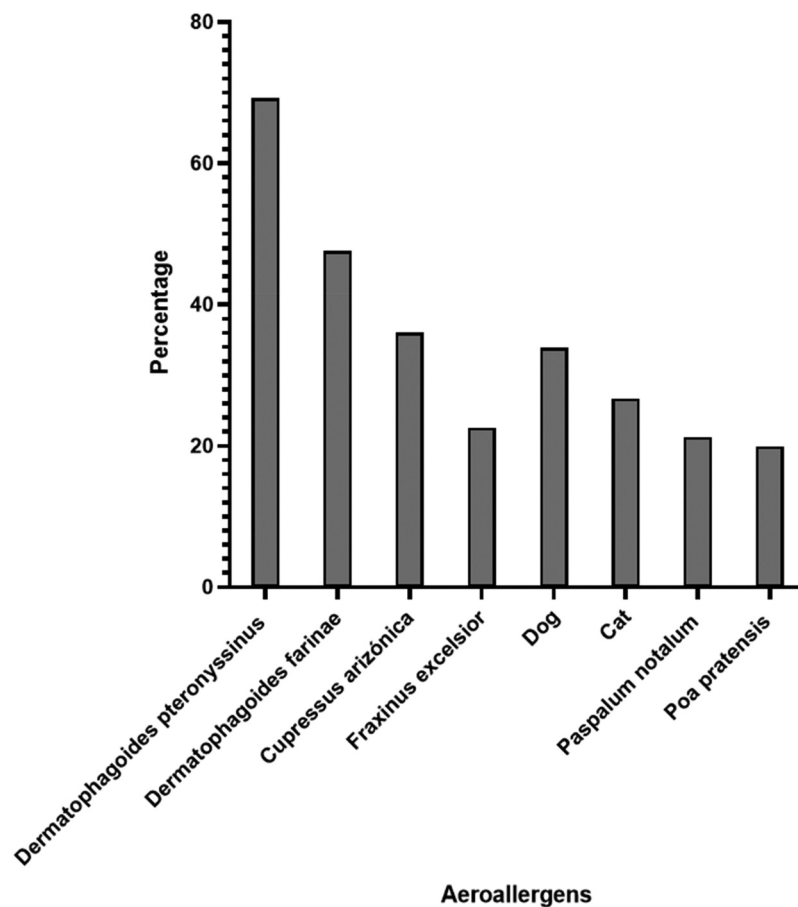
**Figure 1.** Most frequent aeroallergens in the studied Mexican cohort.

Table 2. Frequency of aeroallergens sensitization.

Aeroallergen	n (%)
Grasses and weeds	
<i>Paspalum notatum</i>	62 (21.2)
<i>Poa Pratensis</i>	58 (19.9)
<i>Cynodon dactylon</i>	48 (16.4)
<i>Lolium Perenne</i>	43 (14.7)
<i>Phleum pratense</i>	43 (14.7)
<i>Triticum sativum</i>	33 (11.3)
<i>Sorghum Holcus</i>	17 (5.8)
<i>Zea Mays</i>	13 (4.5)
Trees	
<i>Cupressus arizónica</i>	105 (36)
<i>Fraxinus excelsior</i>	66 (22.6)
<i>Quercus robur</i>	57 (19.5)
<i>Alnus spp</i>	50 (17.1)
<i>Olea europea</i>	36 (12.3)
<i>Ligustrum vulgare</i>	33 (11.3)
<i>Prosopis spp</i>	18 (6.2)
<i>Populus</i>	9 (3.1)
<i>Schinus molle</i>	7 (2.4)
<i>Platanus occidentalis</i>	7 (2.4)
<i>Eucalyptus spp</i>	0 (0)
Plants	
<i>Salsola pestifer</i>	14 (4.8)
<i>Helianthus spp</i>	11 (3.8)
<i>Chenopodium albin</i>	9 (3.1)
<i>Rumex spp</i>	4 (1.4)
<i>Cosmos spp</i>	4 (1.4)
Dust mites	
<i>Dermatophagoides pteronyssinus</i>	202 (69.2)
<i>Dermatophagoides farinae</i>	139 (47.6)
Insects	
Cockroach	34 (11.6)
<i>Culex</i> (mosquito)	30 (10.3)
Wasp	7 (2.4)
Ant	3 (1)
Bee	3 (1)
Fungi	
<i>Alternaria alternata</i>	12 (4.1)
<i>Penicillium notatum</i>	5 (1.7)
<i>Aspergillus fumigatus</i>	2 (0.7)
Animals	
Dog	99 (33.9)
Cat	78 (26.7)
Rabbit	8 (2.7)
Feather mix	4 (1.4)
Horse	3 (1)
Cattle	2 (0.7)
Goat	1 (0.3)
Inhalants	
House dust	22 (7.5)
Latex	2 (0.7)
Wool	0 (0)
Colorants	
Tartrazine	0 (0)

asthma (16.2%) and AC + AR + atopic dermatitis (5.5%). The rest of the allergic comorbidities combinations are presented in (Table 3). Only 2.7% (n = 7) of the studied patients tested positive in skin tests and had no other associated allergic disease. A slight positive correlation was found between the number of positive aeroallergens and the number of comorbidities (Rho = 0.151, p = .001).

Discussion

The International Study of Asthma and Allergies in Children (ISAAC) has provided epidemiological data on allergic disease prevalence in groups of children aged 6 to 7 and 13 to 14 throughout the world. This study used a methodology

validated and standardized through questionnaires applied in various collaborating centers in different countries.¹⁷ Phase 3 of the study (2002–2003) included 1,059,053 children from 98 countries and found an overall average of 14.6% of children aged 13–14 with rhinoconjunctivitis.²⁰ In Mexico, 11.3% of children aged 6 to 7 were diagnosed with rhinoconjunctivitis, a statistic obtained from average data collected from 8 centers located in different regions of the country, placing it 15th out of 61 in prevalence among countries that participated for this age group.²¹

In Mexico, few epidemiological studies describe the incidence of ocular allergy. In addition, the majority are carried out in Mexico city, leaving other regions without representation. A study carried out in a pediatric hospital in the state of

Table 3. A) Distribution of monosensitization and polysensitization b) Multimorbidity associated with allergic conjunctivitis (AC). Allergic rhinitis (AR); asthma (AA); atopic dermatitis (AD); urticaria (AU).

a)	Number of positive aeroallergens	n (%)
	1	22 (7.5)
	2	49 (16.8)
	3	47 (16.1)
	4	46 (15.8)
	5	26 (8.9)
	6	32 (11)
	7	17 (5.8)
	8	16 (5.5)
	9	13 (4.5)
	10	10 (3.4)
	11	6 (2.1)
	12	5 (1.7)
	13	0 (0)
	14	1 (0.3)
	15	0 (0)
	16	2 (0.7)
b)	Comorbidities combination	n (%)
	AC+AR	197 (67.7)
	AC+AA	2 (0.7)
	AC+AD	1 (0.3)
	AC+AR+AA	47 (16.2)
	AC+AA+AD	1 (0.3)
	AC+AR+AD	16 (5.5)
	AC+AR+AU	11 (3.8)
	AC+AR+AA+AD	2 (0.7)
	AC+AR+AA+AU	6 (2.1)
	AC+AR+AD+AU	1 (0.3)

Mexico, aimed to determine the frequency of AC in pediatric patients between 2005 and 2009, reporting a rate of 3.15 cases per 1000 inhabitants with a higher incidence in school children and boys.²² Pediatric patients tested in our study yielded similar results; school children accounted for 16.8% of the AC patients that tested positive, being the most affected pediatric group.

Compared to recent studies, the third edition of the epidemiological study on allergic diseases in Spain ("Alergológica 2015") reported a prevalence of 33.1% of AC among almost 3,000 child and adult patients.²³ In our Mexican cohort, the prevalence was slightly higher, at 38.4%. The Spanish population had a pediatric male predominance of 62%, data similar to the aforementioned Mexican pediatric population.²² In adults, however, most of the patients were female (57.4%).²³ We obtained the same demographic results: in our pediatric population, the male prevalence was 72 out of 125 (57.6%) and in our adult population, the female prevalence was 110 out of 167 (65%).

In this Spanish population, 88.4% of AC cases were associated with rhinitis (which is higher than our finding of 67.7%), making it the number one allergic disease associated with AC, followed by 38.2% of cases associated with Asthma, 8.3% with food allergy, and 3.5% with atopic dermatitis. AC with no associated comorbidities was diagnosed in only 4% of the Spanish cohort, similar to the 2.7% in our patients.²³ The comorbidities cannot be compared between studies because "Alergológica 2015" did not separate AC from rhinoconjunctivitis as separate entities and only reported one comorbidity and not the association of 3 or more.²³

Unfortunately, epidemiological data based on previous Mexican research does not always show similar results as the

ones we report. The allergy and clinical immunology department of the Centro Médico Nacional Siglo, XXI analyzed 672 patients who were diagnosed with AR or asthma in southern Mexico City over the span of 6 years. They found that 2.4% of their studied population had rhinoconjunctivitis.²⁴ As mentioned, the combination of AC plus AR was found in more than half of the studied population.

Recently published results of Congolese children with sensitization to vernal keratoconjunctivitis showed a statistically significant difference ($p < .05$) between positive SPT and negative SPT patients by sex (males $p = .0001$ and females $p = .01$) and age group (2–6 years $p = .0001$ and 6–11 years $p = .0002$).²⁵ In our study, we found no significant difference between patients with positive SPT and negative SPT by sex ($p = .89$) and age group ($p = .24$). This may be attributed to the fact that only vernal keratoconjunctivitis was studied in the Congolese pediatric population while in our study, the whole spectrum of the allergic ocular disease was included. In addition, their negative SPT patients were more than half (negative $n = 262$ vs positive $n = 138$), as stated in the introduction for vernal keratoconjunctivitis, unlike the distribution of our patients (negative $n = 80$ vs positive $n = 292$).

Environmental conditions are a determining factor for the appearance and persistence of allergic diseases in the general population. For example, air pollution is associated with a high incidence of superficial eye disorders, such as tear film break-up time shortening, tearing, redness, irritation, eye fatigue, and photophobia.²⁶ Furthermore, air pollutants exacerbate nasal and eye allergy symptoms in combination with pollen; some particles can absorb aeroallergens released by pollen grains and can prolong allergen retention to provide an exponential response mediated by IgE.^{27,28} There are currently around six systematic reviews and meta-analyses that summarize the existing evidence of the relationship between pollution and asthma, however, results for rhinoconjunctivitis are less consistent.

Environmental pollution refers to the presence of ozone, nitrogen dioxide, sulfur dioxide, and particulate matter (PM), among other things.²⁹ Regarding PM pollution, in 2013, Morales-García et al.³⁰ sought to identify the origin of polluting metals, generated by the decomposition of solid urban waste, and arsenic circulating as coarse PM $<10 \mu\text{m}$ in the city of Puebla's air. Compared to studies carried out in other regions of the country and other cities in the world, they found very high levels of areal arsenic. These levels are thought to be directly related to the proximity of the active volcano, Popocatepetl, which emits volcanic ash throughout the year. High levels of metals, such as cadmium, cobalt, chromium, copper, iron, and nickel, were also found with variable distributions according to the time of year and the area of the city.³⁰ This may be related to the high regional AC prevalence found in our study.

Regarding polysensitization, only a few studies have reported sensitization distribution to more than 10 allergens at once. Several years ago, skin reactivity was reported in Colombia, specifically in patients with AC. This study included 15 extracts (food and aeroallergens) and 92 patients of age groups similar to those in our study. Monosensitization was identified in 70.6% of the patients. The maximum number of sensitizations in one patient

was 6.³¹ Compared to our results, monosensitization was found only in 7.5% of our patients and two patients had sensitization to 16 aeroallergens. This inconsistency may be related to the number of allergens used in most studies, we calculate an average of 20.

Similarly, a cross-sectional study of Korean cohorts aimed to find a relationship between polysensitization to aeroallergens and allergic multimorbidity (asthma, AC, AR, food allergy, and eczema) mediated by IgE. Reactivity to 18 allergens was studied in 3,368 children aged 6–7 years, of which 1,987 had a negative test. It was found that 33.1% of sensitized patients tested positive for 2 or more aeroallergens, similar to the Colombian study (35.8%),³¹ but very different from ours (92.5%). Ha et al.³² concluded that polysensitization is weakly related to multimorbidity but a positive association was found between the number of allergens a child is sensitized to and the severity of IgE-mediated symptoms.³² However, we found a slight positive correlation between polysensitization and multimorbidity in our cohort. Other publications had reported evidence of a higher frequency in the development of allergic multimorbidity during childhood among preschoolers who have early polysensitization.³³

In other parts of the world, sensitization distribution for other allergic diseases is frequently reported, however updated studies focused on AC are scarce. In Qatar, 12 allergens were studied in children diagnosed with asthma and/or AR, with the most frequent sensitization were to dust mites and cats.³⁴ In a Chilean study where patients with rhinoconjunctivitis were recruited, *Dermatophagoides pteronyssinus* and a mixture of grasses were determined to be the most significant sensitizations.³⁵ In the city of Aguascalientes, Mexico, the most common allergens were *Cynodon dactylon* and *Dermatophagoides pteronyssinus* within a group of patients diagnosed with AR.³⁶

Regarding AC, the previously compared Congolese population with vernal keratoconjunctivitis had sensitization to *Dermatophagoides pteronyssinus*, *Blomia tropicalis*, and cockroaches as the most common allergens.²⁵ In the aforementioned Colombian study, the most frequent allergens were house dust mites, dog epithelium, and cockroaches.³¹ In a 2014 protocol from the Hospital General de México which sought to determine the sensitization frequency to aeroallergens, 85 patients were diagnosed with seasonal or perennial AC due to tree pollens primarily and *Dermatophagoides*, secondarily.³ In the Spanish patients with AC from “Alergológica 2015” pollens were the most frequent allergen detected followed by dust mites. Similar to our study, house dust mites are often the primary contributor to AC sensitization, but trees, animals, grasses and weeds also played an important role.

According to previous epidemiological studies carried out around the world, house dust mites are determined to be the most common indoor allergen associated with atopic diseases.³⁷ Allergen-containing particles of dust mites can induce sensitization by contacting the epithelium of the eyes. Various mite allergens have properties that include proteolytic activity, chitin-cleaving and chitin-binding activity, and homology with both the lipopolysaccharide-binding component of Toll-like receptor 4 and other invertebrate tropomyosins.³⁸ Mite proteases have direct epithelial effects including tight junction breaching and protease-activated receptors stimulation, the latter inducing pruritus, epithelial dysfunction, and cytokine release.³⁸

The sensitization percentage to mites can vary depending on the climate. The highest dust mite numbers in the northern USA occur during the humid summer months while the lowest numbers occur during the dry winter months.³⁸ In the state of Puebla, the predominant climate is temperate sub humid and is considered a humid area overall. Studies in more arid regions of Mexico have shown results in which the dust mite is not the main aeroallergen found.³⁶ A successful approach to prevent symptoms of allergy requires avoiding exposure to allergens. Specifically for dust mites, the clinical results deriving from avoidance studies remain conflicting because of the difficulty to distinguish the efficacy of single interventions.³⁹

Even though there are studies that describe different aeroallergen prevalence in the most relevant cities of Mexico, it is necessary to periodically update this data to obtain precise and useful information on each allergic pathology distribution by region. Furthermore, it is important to update specific allergen panels used in SPT and to elaborate projects for the prevention and control of specific exacerbations in the region. Despite the high prevalence of AC, it has been frequently ignored by both physicians and patients, which has resulted in underdiagnosed and undertreated patients, especially when it is associated with other allergic diseases such as rhinitis and/or asthma.²³

In conclusion, the house dust mites, as masters of allergenicity, are responsible for most sensitizations found in the studied population which may be due to the climatic characteristics of the city; however, trees and animals also play an important role. We cannot conclude that the high prevalence of AC is attributed solely to air pollution but it may be an important factor in the persistence of symptoms. Forty-five aeroallergens were used during the period studied when the average number of used allergens in other studies is less than half. This may be directly related to some patients of our study who are sensitized to several aeroallergens and with a high number of polysensitized patients.

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Disclosure statement

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Data availability statement

The data that support the findings of this study are in Mendeley data at DOI: 10.17632/s3djdhrvv6.1 under a CC BY 4.0 license. <https://data.mendeley.com/datasets/s3djdhrvv6>

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