



# Epidemiologic Features of House Dust Mite and Pollen Sensitizations in Patients with Allergic Rhinitis in Istanbul (1993-2006)

Istanbul'da Alerjik Rinit Tanısı Alan Hastalarda, Ev Tozu Akarı ve Polen Sensitizasyonu Epidemiyolojik Özellikleri (1993-2006)

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Abstract / Özet

**Objective:** The gold standard for diagnosis of allergic rhinitis is the skin prick test (SPT). House dust mite (HDM)s and pollens play a predominant role in the development of allergic diseases. In this study, we aimed to identify the distribution of HDM and pollen sensitizations and its specific epidemiologic features among patients with symptoms of chronic rhinitis who had been evaluated with SPT.

**Methods:** Nine thousand, eight hundred and eight patients with symptoms of chronic rhinitis for more than 6 months were evaluated with skin prick testing from 1993 to 2006. Responders to the negative control and nonresponders to the positive control were excluded from the study. Antigens of HDMS and specific pollens (grass, cereal, tree, weed, sweet vernal grass, olive, pellitory and bermuda grass) were used in skin prick testing. Patients were examined in 6 groups according to age intervals: <8 years, 9-16 years, 17-25 years, 26-35 years, 36-45 years and >45 years. Subjects with HDM and/or pollen sensitization were examined in terms of age, gender and year distribution.

**Results:** Four thousand and fifty-two (41.3%) patients demonstrated allergic sensitization to at least one allergen in SPT. 3216 of these patients (79.3%) were found to be sensitized to HDMS, 1825 patients (45%) to pollens and 989 patients (24.4%) to both HDMS and pollens. The most common allergen encountered in SPT in our study was *Dermatophagoides pteronyssinus* (74.8%), followed by *Dermatophagoides farinae* (72.7%). The most common pollen sensitization was grass (28.2%), followed by cereal (25.8%). The 17-25 age interval seems to be the most commonly affected age group. The least number of patients with skin prick test reactivity was present in the years 2000 and 2001.

**Conclusion:** HDMS were the leading cause of allergic sensitization in our study, followed by grass pollen. Our study reveals some important epidemiological data about the distribution of HDM and pollen sensitizations in Istanbul from 1993 to 2006.

**Key Words:** Skin prick test, house dust mite, pollen, allergic sensitization, age, gender

**Amaç:** Deri prick testi (DPT), alerjik rinit tanısında altın standart olarak kabul edilmektedir. Ev tozu akarları (ETA) ve polenler alerjik hastalıkların oluşumundaki en önemli faktörlerdir. Bu çalışmada, DPT ile değerlendirilmiş kronik rinit şikayetleri olan bireylerde ETA ve polen sensitizasyonlarının dağılımı ve spesifik epidemiyolojik özellikleri incelenmeye çalışılmıştır.

**Yöntemler:** 1993 ve 2006 yılları arasında, en az 6 aydır kronik rinit şikayetleri olan, 9808 hasta DPT ile değerlendirilmiştir. Negatif kontrole cevap verenler ve pozitif kontrole cevap vermeyenler çalışmadan çıkarılmıştır. Prick testinde ETA ve spesifik polen (çayır, tahıl, ağaç, yabancı ot, tatlı ilkbahar otu, zeytin, sarmaşık ve domuz ayrığı) antijenleri kullanılmıştır. Hastalar yaşlarına göre 6 gruba ayrılmışlardır: <8 yaş, 17-25 yaş, 26-35 yaş, 36-45 yaş ve >45 yaş. ETA ve/veya polen sensitizasyonu olan hastalar yaş, cinsiyet ve yıl dağılımı olarak incelenmiştir.

**Bulgular:** DPT'de, 4052 hastanın (%41.3) en az bir alerjene sensitizasyon gösterdiği tespit edilmiştir. Bu hastaların 3216'sında (%79.3) ETA, 1825'inde (%45) polen, 989'unda (%24.4) ise hem ETA hem polen sensitizasyonu bulunmuştur. DPT'de en sık sensitizasyona neden olan alerjenler *Dermatophagoides pteronyssinus* (%74.8) ve *Dermatophagoides farinae* (%72.7) olarak gözlemlenmiştir. Polen sensitizasyonu oluşturan en sık etkenler ise çayır (%28.2) ve tahıl (%25.8) polenleri olarak ortaya koyulmuştur. 17-25 yaşlar arası en sık etkilenen yaş aralığı olarak bulunmuştur. DPT reaktivitesine sahip en az sayıda hasta 2000 ve 2001 yıllarında tespit edilmiştir.

**Sonuç:** Çalışmamızda en sık sensitizasyon oluşturan alerjenler ETA ve çayır polenleriydi. Çalışmamız İstanbul'da 1993-2006 yılları arasında ETA ve polen sensitizasyonu ile ilgili önemli epidemiyolojik bilgeleri açığa çıkarmıştır.

**Anahtar Kelimeler:** Deri prick testi, ev tozu akarı, polen, alerjik sensitizasyon, yaş, cinsiyet

## Introduction

Allergic rhinitis (AR), which is considered as the most common allergic disease, is a significant health and financial problem and may considerably impair the quality of life (1-4). The prevalence of AR ranges from 19% to 44%, which is gradually increasing all over the world (3, 5, 7-11). Moreover, it is frequently associated with other allergic diseases which bear a similar pathophysiology. The offending allergens, which are foreign substances capable of provoking an immunoglobulin (Ig) E mediated response, vary according to the geographic characteristics. Traditionally, the allergens are categorized into indoor and outdoor types, which are responsible for perennial and seasonal rhinitis, respectively. House dust mites (HDM) and pollens are the commonest allergens in most parts of the world (12).

Allergic sensitization can be demonstrated by the skin prick test (SPT) or an increase in total or serum specific immunoglobulin E (IgE). SPT provides important data for demonstrating sensitivity to the investigated allergens. SPT evaluates the presence of specific IgE antibodies on skin mast cells, the reactivity of these cells and the reaction of end organs to released mediators. Low cost, increased sensitivity and the rapidity of results are the main advantages of SPTs. It does have some disadvantages, including the inability to be performed in patients with dermatographism and extensive eczema, poor tolerance in many children, the inhibitory effects of certain drugs such as antihistamines on skin reactivity and the risk of systemic reactions (7).

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Since HDM and pollens are among the most common allergens encountered in airway reactivity, these allergens are almost always included in skin prick tests. In this paper, we investigated the epidemiological features of HDM and pollen sensitizations in people living in Istanbul from the years 1993 to 2006.

## Methods

Nine thousand eight hundred and eight subjects who were referred to the Cerrahpasa Medical School Otolaryngology Department with the provisional diagnosis of allergic rhinitis were investigated between 1993 and 2006. All the subjects had had complaints of rhinitis (nasal obstruction, running nose, postnasal dripping, sneezing, nasal itching or eye complaints) for more than 6 months. Physical examination, including anterior rhinoscopy and nasal endoscopy, was performed. SPT was performed in all of the subjects. Subjects with positive SPT results were considered to have allergic rhinitis, while those with negative SPT reactivity were considered to have nonallergic rhinitis.

SPTs were performed between 9:00 and 11:00 am by the same nurse through 14 years, on the volar surface of the forearm with an ALK prick lancet. The reactions were read 20 minutes following allergen administration. Patients were asked not to use theophylline or an antihistamine for 24 hours, an oral  $\beta_2$  agonist for 18 hours, an inhaled bronchodilator for 6 hours, a systemic steroid for 14 days, a nasal steroid for 7 days and nonsteroidal anti-inflammatory drugs for 24 hours before the skin prick test. The size of the wheal reaction was used for evaluation of sensitization. Histamine and physiologic saline were used as positive and negative controls, respectively. The reaction was accepted positive if the diameter of the wheal was at least 5 mm or equal to or greater than half of the histamine response. Responders to the negative control (greater than 2 mm) and nonresponders to the positive control were excluded. SPT panel included the allergen extracts of house dust mites, pollens and moulds. The investigated house dust mites were *Dermatophagoides pteronyssinus* (Dp) and *Dermatophagoides farinae* (Df). The pollen panel included extracts of grass, 3 tree allergen groups (T3, T4, T5), weed and cereal. Pellitory (*Parietaria judaica*), bermuda grass (*Cynodon dactylon*), olive (*Olea Europea*) and sweet vernal grass (*Anthoxanthum odoratum*) were evaluated as separate extracts. T3 group included hazel (*Corylus avellana*), black poplar (*Populus nigra*) and black alder (*Alnus glutinosa*); T4 included ash (*Fraxinus excelsior*) and willow (*Salix viminalis*); T5 included oak (*Quercus ilex*) and hornbeam (*Carpinus betulus*). Weed extracts were nettle (*Urtica dioica*), sorrell (*Rumex acetosella*) and mugwort (*Artemisia vulgaris*), whereas cereal extracts were wheat (*Triticum sativum*), oat (*Avena sativa*) and rye (*Secale cereale*).

The age and sex of the participants were recorded. The subjects were examined in 6 groups in terms of age interval: those under 8 years, between 9 and 15 years, 16 and 25 years, 26 and 35 years, 36 and 45 years and over 45 years. The age intervals, as well as other parameters, were determined according to characteristics of the patient at the time of first presentation, data of the patients being on follow-up were not taken into consideration. HDM sensitization was examined in 3 groups: those cases sensitized to Dp only, to Df only and to both Dp and Df. The distribution of HDMs and pollens were investigated in each age and gender group according to each year and also totally.

## Results

Of the 9808 subjects examined with skin prick testing, 4052 (41.3%) were found to have allergic sensitization and enrolled into the study. The remaining 5756 subjects were diagnosed to have nonallergic rhinitis. The mean age of the 4052 patients with allergic sensitization was  $30.96 \pm 14.73$  (range from 2 to 85). 56.60% of them were female, whereas 43.40% were males.

Three thousand two hundred and sixteen patients (79.3% of those with SPT sensitization) were demonstrated to have allergic sensitization to house dust mites, 1825 (45%) to pollens and 989 (24.4%) to both HDMs and pollens via skin prick testing. The mean age of the patients with HDM sensitization was  $28.66 \pm 13.55$  (range, 2-85), whereas of those with pollen sensitization was  $29.55 \pm 16.77$  (range, 15-62). Female and male ratios of patients with HDM and pollen sensitizations were 56.6% - 43.3% and 56.1% - 43.8%, respectively. The number and gender distributions of HDM and pollen sensitizations are given in detail in Table 1. The distribution of HDM and pollen sensitizations in corresponding age intervals are given in Table 2.

The changes in the number of patients with HDM and specific pollen sensitizations in each year from 1993 to 2006 are given in Figure 1 and Figures 2-3, respectively.

## Discussion

The prevalence of allergic rhinitis varies widely from one population to another. However, it is well known that the prevalence is increasing worldwide (3, 6, 7, 13, 14). The difference in prevalence depends on many factors, including potency and composition of the allergen preparations, methods used to diagnose allergic diseases, selection criteria of subjects for diagnostic tests, age of the

**Table 1. The number and gender distributions of patients with specific allergen sensitization**

	n	ratio*	F	M
Dp only	267	6.5%	68%	32%
Df only	183	4.5%	55.5%	44.5%
Dp + Df	2766	68.2%	68.8%	31.2%
G	1145	28.2%	54%	46%
T3	349	8.6%	51%	49%
T4	314	7.7%	57%	43%
T5	166	4%	66.9%	33.1%
W	539	13.3%	55.1%	44.9%
C	1049	25.8%	52%	48%
SVG	503	12.4%	48.5%	51.5%
BG	248	6.1%	49.2%	50.8%
O	427	10.5%	62.3%	37.7%
P	455	11.2%	58%	42%

No sex data was found in 6 patients (6 missed patients in sex records).

M: Male ratio, n: number of patients, F: Female ratio

\*denotes ratio of specific allergen sensitization in patients with at least one skin prick test positivity.

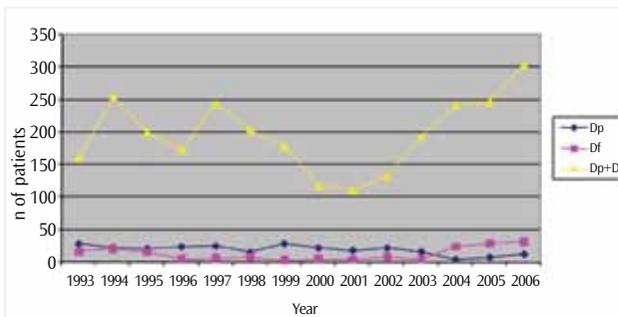
BG: Bermuda grass, C: Cereal, Df: Dermatophagoides farinae, Dp: Dermatophagoides pteronyssinus G: Grass, O: Olive, P: Pellitory SVG: Sweet vernal grass, T3, T4, T5: Tree pollens; W: Weed

**Table 2. Distribution (number and ratio) of allergen sensitizations according to age intervals**

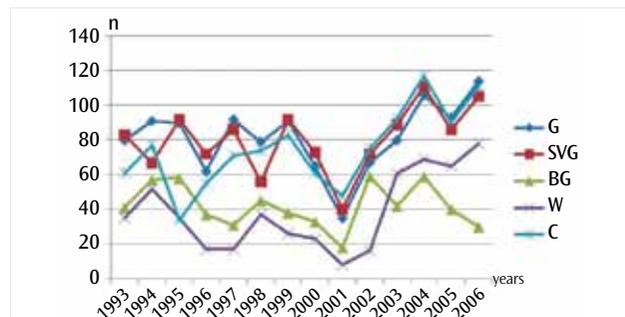
	<8y	9-15 y	16-25 y	26-35 y	36-45 y	>45 y
Dp only	12 (8.9%)	27 (7.8%)	75 (7.4%)	70 (9.1%)	47 (9.8%)	33 (8.7%)
Df only	2 (1.4%)	10 (2.8%)	37 (3.6%)	46 (6%)	39 (8.1%)	41 (10.8%)
Dp + Df	120 (89.5%)	309 (89.3%)	894 (88.8%)	649 (84.8%)	393 (82%)	303 (80.3%)
G	27 (2.4%)	92 (8%)	402(35.1%)	291 (25.4%)	187 (16.3%)	104 (9.1%)
T3	6 (1.7%)	22 (6.3%)	92 (26.4%)	92 (26.4%)	64 (18.3%)	60 (17.2%)
T4	8 (2.5%)	15 (4.8%)	78 (24.8%)	68 (21.7%)	73 (23.2%)	57 (18.2%)
T5	0 (0%)	5 (3%)	43 (25.9%)	38 (22.9%)	41 (24.7%)	33 (19.9%)
W	7 (1.3%)	19 (3.5%)	167 (31%)	147 (27.3%)	107 (19.9%)	76 (14.1%)
C	21 (2%)	83 (7.9%)	368 (35.1%)	271 (25.8%)	165 (15.7%)	106 (10.10%)
SVG	3 (1.2%)	23 (9.3%)	90 (36.3%)	61 (24.6%)	38 (15.3%)	28 (11.3%)
BG	3 (1.2%)	23 (9.3%)	90 (36.3%)	61 (24.6%)	38 (15.3%)	28 (11.3%)
O	6 (1.4%)	15 (3.5%)	139 (32.6%)	110 (25.8%)	86 (20.1%)	58 (13.6%)
P	12 (2.6%)	27 (5.9%)	111 (24.4%)	121 (26.6%)	99 (21.8%)	62 (13.6%)

No age data was found in 109 patients with HDM sensitization.

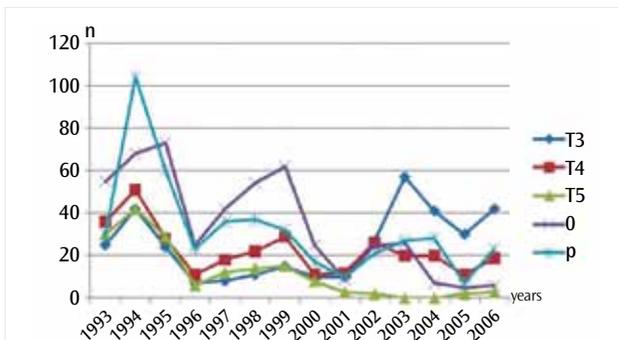
BG: Bermuda grass, C: Cereal, Dp: Dermatophagoides pteronyssinus, Df: Dermatophagoides farinae, G: Grass, O: Olive, P: Pellitory, SVG: Sweet vernal grass, T3, T4, T5: Tree pollens, W: Weed



**Figure 1.** Graphical representation of sensitization to house dust mite (HDM)s by years. The change in the number of patients with sensitization to HDMs (Dp, Df and Dp+Df) is given. The sensitization to both Dp+Df changes independently from Dp or Df sensitization alone Dp: Dermatophagoides pteronyssinus, Df: Dermatophagoides farinae



**Figure 3.** The change in the number of patients sensitized to grass, sweet vernal grass, bermuda grass, weed and cereal from 1993 to 2006 BG: Bermuda grass, C: Cereal, G: Grass, n: number of patients SVG: Sweet vernal grass, W: Weed



**Figure 2.** The change in the number of patients sensitized to T3, T4, T5, olive and pellitory from 1993 to 2006 n: number of patients, T3, T4, T5: Tree pollens, O: Olive; P: Pellitory

subjects, the subjects performing the tests and environmental factors (15). Increased urbanization may be considered to be related to a higher prevalence of allergic rhinitis in some studies (8). However, according to some other studies, allergic sensitization is not less frequent in rural areas (13).

Skin prick testing, which is generally considered to be the gold standard for diagnosis of allergic rhinitis, is known to be safe and effective as a routine diagnostic test and is used frequently to assess specific sensitization and to verify the diagnosis of allergic (IgE mediated) disease in symptomatic subjects (16). Allergen skin reactivity has long been recognized to be associated with allergic respiratory diseases (11). Although positive SPT is interpreted as a sign of allergy, the clinical relevance of a positive SPT in a subject with no allergic symptoms is not clear. The main symptoms of allergic rhinitis, including sneezing, running nose or nasal obstruction and itchy nose etc., may be shared by other nasal diseases, collectively called chronic rhinitis. Skin prick testing is required to diagnose allergic rhinitis, as the initial investigation tool (17). In our study, 41.3% of the subjects with symptoms of chronic rhinitis were documented to have sensitization to at least one allergen via skin prick testing. In a similar study performed by Yuen et al. (18), 67% of the patients with symptoms of chronic rhinitis were found to have positive SPT reactions. Akcakaya et al. (19), reported that 60% of the children with asthma had a documented positive reaction to at least one allergen.

The allergens used in SPT vary from one region to another. It depends on the plant life and other environmental conditions of that particular region. With the change of environmental factors (air pollution, etc.) the frequency of commonly encountered allergens may also change.

As a well known entity, HDMs play a predominant role in the development of allergic diseases, and they are considered as the major source of allergens in house dust (20, 21). HDMs were reported as the most common allergens in many other studies as well (18, 19, 22-24). One of the exceptions was published in a study carried out in the Aegean region of Turkey in which pollens were reported as the most frequent allergens demonstrated by SPT (25). The most common allergen encountered in SPT in our study was *Dermatophagoides pteronyssinus* (Dp), followed by *Dermatophagoides farinae* (Df). The change in sensitization of these two house dust mites by years was almost identical. The ratio of house dust mite sensitization in all patients with at least one allergic sensitization was 79.3% (3033 subjects), whereas those of Dp, Df and both Dp and Df were 74.8%, 72.7% and 68.2, respectively in our series. Results of some studies on allergen sensitization are given in Table 3 (18, 19, 22, 25-28).

Actually, HDMs belong to the family of Pyroglyphidae (20, 29). Many species of HDMs were identified other than Dp and Df, including *Blomia tropicalis*, *Dermatophagoides microceras* and *Euroglyphus maynei* (20, 30). House dust mites other than Dp and Df are rare in Turkey. *Blomia tropicalis* is found mostly in tropical and subtropical areas, for example, in Brazil (20, 31, 32). This was the reason why we investigated only Dp and Df. Dp and Df were reported to be the most frequent HDMs associated with allergic diseases in temperate countries, such as Turkey (27). Human skin scale is the food source of the HDMs and the feces of HDM is their antigenic product (32). HDM growth and proliferation depend on specific environmental factors, especially temperature and humidity (20). Istanbul, the city in which this study was carried out, is almost at sea level and thus has a relatively high humidity ratio and temperature, factors compatible with mite growth.

Although the number of female patients with HDM sensitization is higher than that of males, the ratio of identification of HDM sensitivity in females with symptoms of chronic rhinitis is lower than in males in this study. In other words, the symptoms of chronic rhinitis are less related to allergy in females than in males. It is clear

from this paper that yearly changes of Dp (alone) and Df (alone) sensitivities do not differ (including statistically), but sensitivity to both Dp and Df showed a significant increase over the last years (from 2002 to 2006) (Figure 1). According to another point of view, combined Dp and Df sensitization increased independently of Dp and Df sensitizations alone.

Humans are exposed to a variety of pollens in the atmosphere. These aeroallergens are the leading cause of seasonal allergic rhinitis. They represent an inevitable allergen source (339). The type and role of pollens change according to environmental factors such as climate and pollution (34). However, to establish a correlation between these factors and allergy is a complex task. Air pollution can influence the allergen content of plants and can change pollen production and allergenic proteins of pollen grains (34). Climate changes can also influence plant characteristics and pollen distribution.

Knowledge of the specific pollen types in different seasons is very important for physicians interested in allergic respiratory diseases (33). Pollen calendars are used for this purpose. Grass pollens are considered the most common cause of seasonal allergic rhinitis in Turkey, in parallel with other countries (35). On the other hand, many investigations performed in various parts of Turkey have shown that tree pollens comprised the majority of the pollen load, whereas grass and weed pollens contributed less than 10% of total yearly pollen counts (35). Allergy to tree pollens has become more significant during recent years, with a contemporary decrease in allergy to grasses (34). They are also considered as one of the most important allergens leading to allergic rhinitis, however, they are not as allergenic as grass pollens (22). In our study, tree pollens were also demonstrated to be common causes of sensitization. If we take all 3 tree pollens in account, the sensitization ratio is 20.4% (total of 829 patients for T1, T2 and T3).

Although the pollen grains are present constantly in the atmosphere of Istanbul, pollen count increases in the Spring and begins to decrease in the Summer. A small number of pollen grains are still detectable from late Autumn to early Spring (12). In our study, the most common cause of pollen sensitization was grass (28.2%), followed by cereals (25.8%). Sweet vernal grass, olive and pellitory were other less common allergenic pollens. Grass pollens are considered as the leading cause of seasonal allergic rhinitis in Turkey and also in other countries with similar climatic characteristics (22, 35-37). This finding is consistent with the findings of a study performed by Anastassakis et al. in central Greece (1).

Olives may deserve additional emphasis. Olive pollens, which may easily become airborne, are highly allergenic, however they are found very commonly in the Aegean part of Turkey, not in Istanbul. Sensitivity to *Olea europaea* was given as 30% in a study performed in the Aegean part of Turkey, whereas it was 23% in our study (25).

One of the most important findings in our study is the relatively common sensitization to cereal pollens. These include oat, rye and wheat. They were also demonstrated to cause higher degree of wheal reaction than grass pollens. Actually, cereal pollens are not considered as major pollens responsible for sensitization, such as grass, trees and weed (38). However, our results point to the necessity of including cereal allergens into the prick test panel.

**Table 3. The most commonly identified allergen sensitizations reported by some authors**

Authors	n	Allergen*	Year
Yuen et al. (18)	977	HDM, 63%**	2007
Akcakaya et al. (19)	5080	Dp, 50%	2005
Misiroglu et al. (22)	3025	HDM, 63.3%**	2007
Tezcan et al. (25)	5055	Dp, 42%	2003
Hendrick et al. (26)	656	Df, 82%	1975
Baqueiro et al. (27)	101 (459 beds)	B. tropicalis, 71.8%	2006
Fereidouni et al. (28)	356	Weed, 77%	2009

n denotes the number of patients participated in corresponding study.

\*Most commonly identified allergen and its ratio

\*\*Not further specified as Dp or Df

Weeds are clinically more important in terms of sensitization in the south and west of Turkey. However, pellitory sensitization, which was investigated as separate from the weed extracts in our study, was almost as common as other weed extracts. This finding supports the fact that individual investigation of commonly encountered allergen extracts may more appropriate. Weed pollens are known to stay for longer periods in the atmosphere than other types of pollens and some authors prefer to investigate them as perennial allergens (39).

The age interval between 17 and 25 years seems to be the most commonly affected age group demonstrating pollen sensitization (except for those patients with pellitory sensitization) and HDM sensitization (except those sensitized to Df only).

## Conclusion

If we examine the change of pollen sensitizations year by year, we notice that the least sensitization rate was encountered in 2001 for almost all pollens and in 2000 and 2001 for HDMs. The years 2000 and 2001 were among the most arid years, in which the average rainfall was relatively less. Also, the temperature was at higher levels. Actually, these two factors (decreased rainfall and higher temperature) were expected to cause a higher level of pollen and HDM sensitizations. The reason for this paradoxical situation is not fully understood, but it may be due to other factors that affect the atmospheric pollen count.

Our study, one of the largest population series, reveals important data about the epidemiology of HDM and pollen sensitizations in Istanbul.

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## Conflict of Interest

No conflict of interest was declared by the authors.

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