# Prevalence of specific aeroallergen sensitivity on skin prick test in patients with allergic rhinitis in Westchester County

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**Citation**

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**Abstract**

Allergic rhinitis is the most common cause of rhinitis, and is often the diagnosis prompting referral to the allergist for skin prick tests (SPT). The prevalence of positive SPT to different aeroallergens varies with the geographic setting. Westchester County is located in the state of New York, and there are no local data to date reflecting the prevalence of positive SPT. We therefore undertook a study to determine the reactivity to aeroallergens in the local population. The results of SPT to 48 aeroallergens and 2 controls were analyzed in 100 patients referred for allergic rhinitis. 65% had a positive SPT to at least 1 aeroallergen. Amongst the molds, alternaria positivity was noted in 8%, cat hair reacted in 18%, birch antigen was positive in 20% and reactivity to grass mix antigen was observed in 24%. The antigen showing the greatest SPT positivity was the house dust mite (30%). Sensitization rates for other antigens are presented.

## BACKGROUND

Allergic rhinitis is a highly prevalent allergen induced upper airway inflammatory disease, characterized by hyperreactive airway mucosa and episodes of acute exacerbation. [1] The incidence of upper respiratory allergy has increased since the past decade, posing a heavy burden on health care systems. [2] The skin prick test (SPT), is the most widely used allergy test, and can be performed during the initial consultation with a variety of allergens. [3] This study was undertaken to find the prevalence of skin test positivity to different aeroallergens in patients referred with allergic rhinitis in Westchester County.

## METHODS

A retrospective chart review was done on 100 consecutive patients referred to an ambulatory allergy office for symptoms of allergic rhinitis without asthma, during March 2006 to February 2007. Complete patient confidentiality was meticulously maintained. The results of skin puncture test to 48 different airborne allergens were analyzed. The allergens were divided into 4 groups. Group 1 included tree and leaf antigens, group 2 included grasses and weeds, group 3 constituted different molds, and group 4 antigens were of animal origin. A detailed history of symptoms and the presence of possible sources of allergens at home were taken. For skin puncture tests, Quintest ® multiple skin test system (Hollister-Stier Laboratories) was used. Normal saline and histamine served as negative and positive controls respectively. The skin prick testing device which comes in a kit, is made of molded plastic with 5 probes arranged linearly, each probe ending in a 1mm steel lancet tip that dip into a numbered reservoir containing a particular antigen. The allergens FAPP, HASH, and Special mold mix were obtained from ALK-Abelló, while all other allergens were obtained from Greer Laboratories. None of the patients were on any medications suppressing the immune system and all antihistaminics had been stopped 5 days prior to testing. The test area was cleaned with alcohol and allowed to dry. A Quintest ® test device was removed from a prepared tray containing the antigens, pressed down on the skin with medium pressure, and discarded. Subsequent testing sites were at least 3 cm apart from the initial test sites, to avoid the axon reflex. The results were read at 15 minutes, and a test site showing a wheal of 3 mm or more, and erythema of more than 10 mm was considered a positive reaction. [4] Dermatographism was excluded during the physical examination prior to SPT, and all patients included in the study had a positive histamine reaction. MS Excel was used as the graphing software.

## RESULTS

100 patients, 48 males and 52 females, aged 6 – 83 years (mean age 40.92 years) were tested for skin prick test reactivity. The population included 68 whites, 11 blacks, 19

Hispanics and 2 patients of Asian origin.

Amongst the 100 patients tested, 65 patients had a positive test to at least 1 aeroallergen. Of these 65 patients, 42 white (61.7%), 14 Hispanic (73.6%) and 9 black (72.7%) had positive SPT.

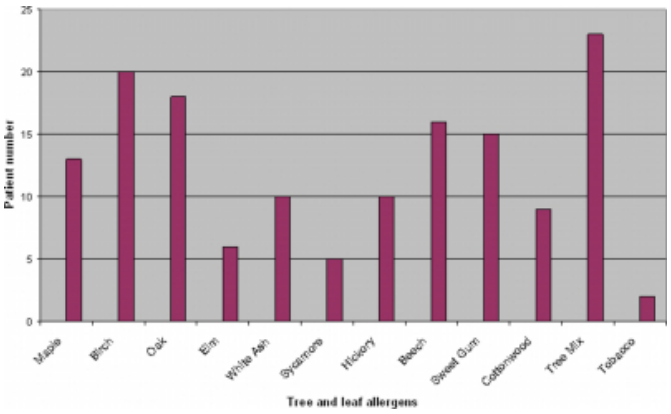
### Figure 1

Table 1: Composition of antigen mixes (scientific names in italics)

| Grass Mix | Tree Mix | Weed Mix |
|---|---|---|
| Kentucky Blue/June (*Poa pratensis*)<br>Meadow Fescue (*Festuca pratensis*)<br>Orchard (*Dactylis glomerata*)<br>Perennial Rye (*Lolium perenne*)<br>Red Top (*Agrostis gigantea*)<br>Sweet Vernal (*Anthoxanthum odoratum*)<br>Timothy (*Phleum pretense*) | American Beech (*Fagus grandifolia*)<br>American/Eastern Sycamore (*Platanus occidentalis*)<br>American Elm (*Ulmus Americana*)<br>Black Walnut (*Juglans nigra*)<br>Black Willow (*Salix nigra*)<br>Eastern Cottonwood (*Populus deltoides*)<br>Red Oak (*Quercus rubra*)<br>Red/River Birch (*Betula nigra*)<br>Shagbark Hickory (*Carya ovata*)<br>Sugar/Hard Maple (*Acer saccharum*)<br>White Ash (*Fraxinus Americana*) | Eng. Plantain (*Plantago lanceolata*)<br>Cocklebur (*Xanthium strumarium*)<br>Lambs Quarter (*Chenopodium album*)<br>Marsh Elder (*Iva frutescens*) |
| **FAPP mix** | **HASH mix** | **Special Mold mix** |
| Fusarium<br>Aspergillus<br>Penicillium<br>Phoma | Helminthospora<br>Alternaria<br>Cladosporium<br>Drechslera | Rhizopus<br>Epicoccum<br>Mucor<br>Pullularia |

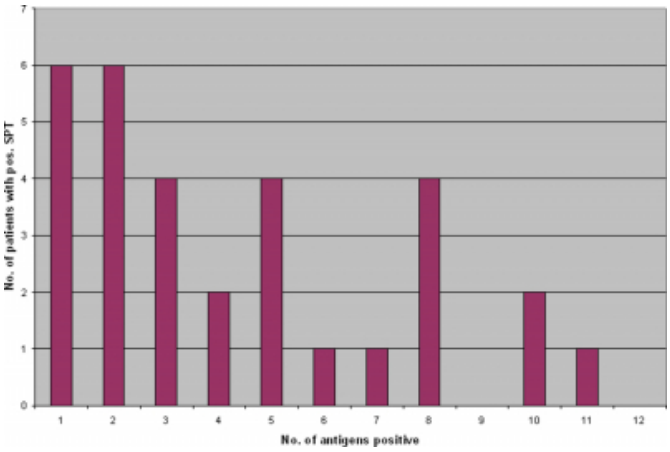
### Figure 2

Figure 1: Skin prick test reactivity to tree and leaf antigens




### Figure 3

Figure 2: Skin Prick Test overlap with tree and leaf antigens




31 patients had a positive reaction to one or more tree antigens. Among these patients, 23% were positive to a mixture of tree antigens, 20% to birch and 18% to oak. The remaining antigens were positive in the range of 2-16% (Fig.1). Of the above 31 patients, 6 patients reacted to a single allergen, while the rest showed considerable overlap with other antigens (Fig.2). None reacted to all 12 antigens, and the tree mix allergen (Table.1) positivity was observed in all patients reacting to tree antigens.

### Figure 4

Figure 3: Skin prick test reactivity to grass and weed antigens.

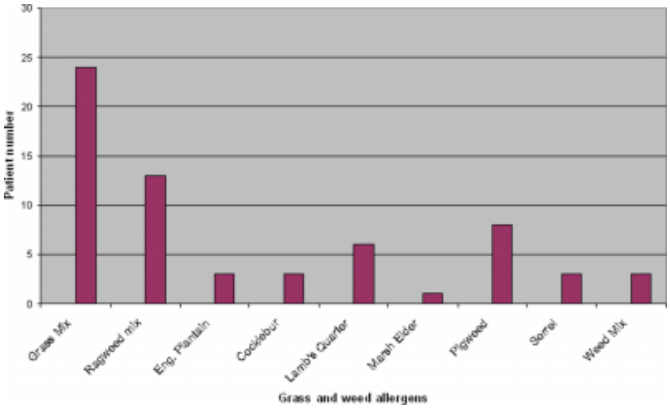
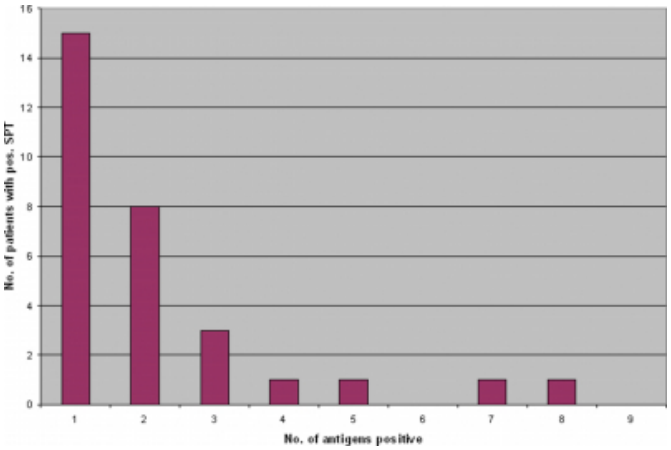


**Figure 5**

Figure 4: Skin Prick Test overlap with grass and weed




Nine antigens were tested for grass and weed allergy, and 30 patients were noted to be positive. Grass mix antigen positivity accounted for 24%, and ragweed antigen was positive in 13%. Other weed antigens were positive in 1-8% (Fig.3) 15 of the above 30 patients reacted to a single antigen while the remaining patients were noted to react to 2 or more allergens, which included the weed mix antigen (Fig 4).

9 out of 100 patients tested reacted to molds. Amongst mold antigens, alternaria positivity was observed in 8%, while other molds like aspergillus, fusarium and mucor reacted in 1% patients (Fig.5). 3 patients reacted to a single antigen while the rest had an overlap with other mold antigens including mold mixes, HASH and FAPP antigens (Fig.6).

**Figure 6**

Figure 5: Skin prick test positivity to molds

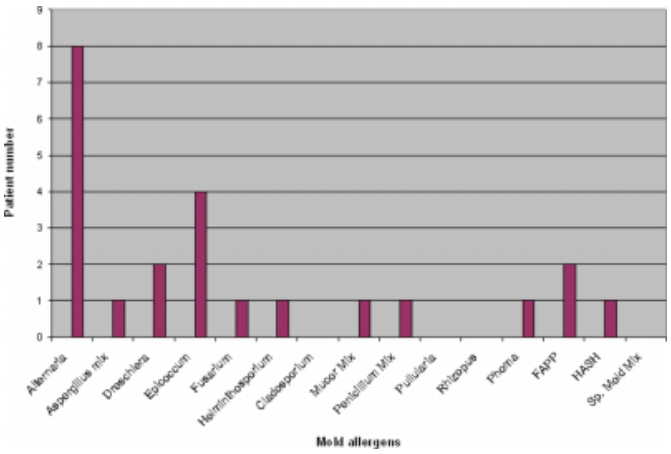



**Figure 7**

Figure 6: Skin Prick Test overlap with fungal antigens.

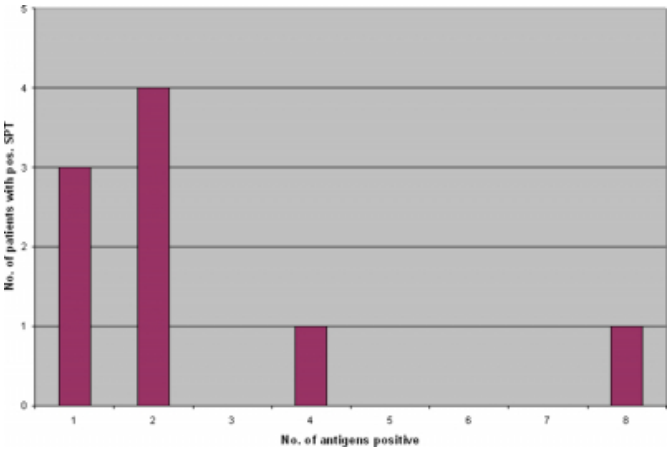



**Figure 8**

Figure 7: Skin prick test positivity with animal allergens

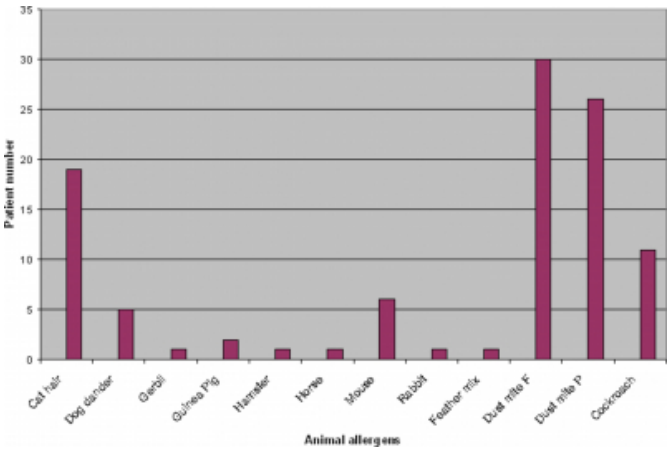
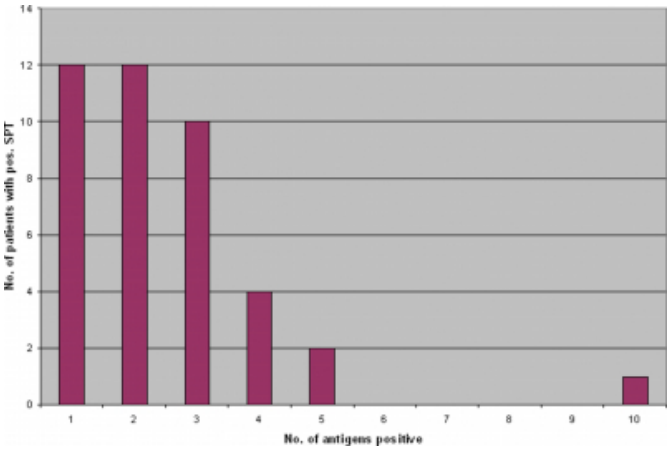



**Figure 9**

Figure 8: Skin prick test overlap with animal antigens




Cat hair reacted in 18% patients while dog dander and mouse antigens reacted in 5% and 6% respectively. Six out

of the 100 patients tested had one or more cats in their homes as pets. Of these 6 patients, cat allergy was observed in 3, compared to a positive test in 15 patients who did not own a cat. Thus 50% of patients with cat in the home were sensitive to cat antigen, vs 15.9% of patients without a cat in the home. Among the 5 patients who reacted to dog dander, an overlap with cat hair antigen was observed in 4 patients (80%). 12 patients owned one or more dogs, but none of them showed any reaction to dog antigen. House dust mite (HDM) reactivity was observed in 30% with the Df (Dermatophagoides farinae) variety being more positive than the Dp (Dermatophagoides pteronyssinus) type, followed by cockroach allergy in 11% (Fig.7). 12 patients had a reaction to a single animal antigen in contrast to 29 patients who reacted to more than one antigen (Fig.8). Of the 11 patients reacting to cockroach antigen, 5 patients (45.5%) reacted to Df, and 6 patients (54.5%) reacted to Dp. In the same group of 11 patients, 4 (36.6%) were positive to cat allergen and 7 (63.6%) did not react.

## DISCUSSION

An estimated 35 million Americans suffer from upper respiratory tract symptoms that are allergic reactions to airborne allergens. [5] Characteristics of allergic rhinitis include sneezing, watery rhinorrhoea, itchy palate and nasal congestion, and may coexist with allergic conjunctivitis, manifesting as itchy, red, and watery eyes. [6] Blockage of the Eustachian tubes, cough, and a sensation of pressure in the sinuses result from edema and venous engorgement of the nasal mucosa. [7,8] Allergic rhinitis occurs when inhaled allergens interact with IgE antibodies on cells in the airway, subsequently causing degranulation of mast cells and release of chemical medicators. [9] While allergic rhinitis is not a life-threatening condition (unless accompanied by severe asthma or anaphylaxis), complications can occur and the condition can significantly interfere with sleep, leisure, learning impairment, decreased cognitive functioning, and impair quality of life. [10] Estimates of the prevalence of allergic rhinitis in the United States range from 8.8 percent [11] to 16 percent [12] and has shown an upward trend over the last 10 years. [2] Allergy testing is performed in order to confirm which allergens are relevant to the symptoms and which should be included in immunotherapy regimens. Culpable allergens can be identified by skin or in vitro tests for the presence of allergen-specific IgE antibodies. [13]

Our results indicate 65 % patients tested positive to at least 1 allergen. Results of other studies have varied from 24.9-81.6%. [14,15,16] Diversity of populations tested with regard to urban or rural lifestyles, and their mobility accounted for the wide variation in numbers.

Trees in this region that produce pollen of allergenic importance include oak, ash, elm, hickory, pecan, box elder, and mountain cedar. [5] Over 50% of patients with persistent rhinitis are allergic to pollens. [17] A study from New England identified heaviest pollinators to be oak, pine, juniper, birch, hemlock and maple. [18] In the same study, the most common prick skin test reactions were observed with birch, oak, beech, maple, ash and willow. New England, with 50,000 square miles of forest, borders Westchester County, and it is not unusual for pollen to float on currents of air and be carried hundreds of miles away from its source. Not surprisingly our study indicated that the tree mix antigen had the highest rate of skin test positivity (23%).

Among North American plants, weeds are the most prolific producers of allergenic pollen. [5] Ragweed is the major culprit, but other important sources are sagebrush, redroot pigweed, lamb's quarters, Russian thistle (tumbleweed), and English plantain. [5] Some grasses of allergenic importance in the USA that produce pollen include Timothy grass, Kentucky bluegrass, Johnson grass, Bermuda grass, Redtop grass, Orchard grass, and Sweet vernal grass. [5] Although more than 1,000 species of grass grow in North America, only a few produce highly allergenic pollen. Studies in the US revealed 35% of the rural population tested positive to Ragweed allergen [19] and a lower prevalence (17%) was noted amongst people residing in the inner cities, [20] perhaps reflecting increased exposure in rural places, as ragweed grows well in areas of tilled soil. Our study revealed 13% positive to ragweed antigen, and a higher value for the mixed grass antigen 24%. Westchester County is adjacent to New York city with an essentially urban population, probably accounting for the low sensitivity to ragweed allergen. Lower sensitization to grass pollen alone (7.2%) is seen in the UK, [21] but our study correlates well with a German study that found 23.9% prevalence of sensitization to grass pollen. [22]

Like pollens, mold spores are important airborne allergens only if they are abundant, easily carried by air currents, and allergenic in their chemical makeup. Found almost everywhere, mold spores in some areas are so numerous they often outnumber the pollens in the air. Fortunately, however, only a few dozen different types are significant allergens. [5] Allergy to molds in our study was observed in 7% of all

positive SPT. Higher rates of sensitization to molds are found in tropical countries like Singapore and Malaysia, [23,24] perhaps underscoring the role of a climatic factor. Low rate of sensitization to Alternaria has been reported from Europe. [25] SPT pooled data from different segments of US population reveal high SPT positive rates for Alternaria. [16,19,26] In our study, though Alternaria sensitivity was the commonest amongst molds, the figure 8% indicates a low degree of sensitization in contrast to the NHANES III study which found Alternaria alternata sensitivity among the US population aged 6 to 59 years to be 12.9%. [26] The prevalence of Alternaria allergy varies between different regions, and is highest in areas of farms and grasslands. Other molds like Aspergillus and Penicillium are found indoors, and SPT to these allergens showed a low positive result in our study (1%), compared to other reports. [19]

Sensitivity to cat allergen by SPT vary amongst different studies from 12.9 – 33%. [22,26,27] Our study shows a result in between the above values (18%). Previous studies have indicated that even low amounts of cat allergens found in homes without cats may induce allergic sensitization and trigger respiratory symptoms in highly susceptible individuals. [28,29] Though our study suggest cat allergy to be statistically correlated to the presence of cats in the homes of patients, the number of patients included for the analysis is too small to draw a definite conclusion.

Cat and dog antigens are found in 100% of homes; even in those without resident pets. [30] Our study shows the prevalence of dog allergy (5%), to be much lower than cat allergy (18%). Other studies have found higher prevalence (20-33%) of positive SPT to dog allergens. [19,31] There is no current census on dog or cat ownership in Westchester, but intimacy of exposure may be a factor for sensitization. Cats may be more likely than dogs to cause allergic reactions because they lick themselves more, may be held more, and spend more time in the house close to humans. [5]

Allergy to cockroach antigens has been shown previously to have a high prevalence in urban areas, especially in patients of lower socioeconomic status. [32,33] In contrast it has been shown to be less common in suburban and rural areas because of less infestation of homes. [33] Previous studies demonstrated allergy to cockroach antigen varying from 7.9-33%. [22,26,27] In the National Survey of Lead and Allergens in Housing, a representative survey of US housing, it was shown that high-rise apartments, urban settings, pre-1940 constructions and households with incomes less than $20,000 per annum, had higher levels of cockroach allergens than newer homes. [34] We found SPT to cockroach antigen to be positive in 11% patients, the low level probably reflecting the paucity of high rise apartments and the relative affluence of the population in Westchester county. Westchester is one of the richest counties in the country, with a reported median household income of $77,763 as against the US average of $50,382 . [35]

HDM, which live in bedding, upholstered furniture, and carpets, thrive in summer and die in winter. In a warm, humid house, however, they continue to thrive even in the coldest of months. [5] 84.2% US homes have detectable levels of dust mite allergen. [36] Independent predictors of high levels are older homes, single-family homes, no resident children, lower household income, heating sources other than forced air, musty or mildew odor, and higher bedroom humidity. [36] In previous studies, 27.5- 61% of patients with respiratory symptoms have demonstrated an allergy to HDM. [26,27,37,38] HDM have been reported to have the highest rates of sensitization among patients with allergic rhinitis in Thailand, [39] Singapore [40] and Mexico City. [41] Our results also indicate HDM to have the highest positive rates of SPT, with high positive values for Df variety (30%) and Dp (26%). The high sensitization to both varieties of HDM is consistent with the ubiquitous nature of the allergen, and may also reflect cross reactivity between the 2 different species.

## CONCLUSIONS

Allergic rhinitis in a common condition in the US, with a prevalence of 8.8% to 16%. We found reactive SPT to at least one aeroallergen in 65% patients suffering from allergic rhinitis. Birch, oak and ragweed were amongst the top sensitizers amongst plant antigens. Low levels of sensitization were observed with molds, probably reflecting the urban habitat of the population tested. Cat and dog antigen are ubiquitous, and the prevalence of cat allergy was comparable to other parts of the world and the US. Dog allergy was surprisingly low and house dust mite continues to top the list of allergens. The SPT is considered the most convenient and least expensive screening test, and can reflect the presence of IgE antibodies in patients with reliable exposure histories. Our study did not separate the prevalence of SPT amongst different age groups, nor was seasonal variation of allergens taken into account. However it is a representation of the common allergens prevalent in this geographical area, which may be a useful reference to

counsel patients with allergic rhinitis.

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