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Allergy History Does Not Predict Skin Test Reactivity in Asthmatic Children

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ABSTRACT

We prospectively assessed how well patient report of allergy to cat, dust mite, and grass predicted the results of skin prick testing to those allergens in 95 asthmatic children. Children between 4 and 18 years old with physician-documented asthma provided a detailed standardized allergy history and then underwent skin prick testing. The children were categorized by asthma severity. The diagnostic accuracy, which was the primary outcome measure, as well as sensitivity, specificity, and positive and negative predicted values were calculated for allergy history with regards to skin test reactivity. The diagnostic accuracy of allergy history in identifying skin test reactivity was 65%, 50%, and 56% for cat, dust mite, and grass, respectively. Asthma severity did not affect

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the diagnostic accuracy. Allergy history was a poor predictor of skin test reactivity in this group of asthmatic children.

INTRODUCTION

The association between allergy and asthma is well documented, and cat dander, dust mite, and grass pollen have all been linked with increased asthma prevalence and symptoms (1–4). The National Heart, Lung, and Blood Institute Expert Panel Report 2 (NHLBI EPR-2) recommends that every asthmatic child be queried concerning the common aeroallergens and that those children with persistent asthma be assessed for allergy with either skin tests or in vitro testing (5). However, little is known concerning how well allergy history actually agrees with skin testing, a recognized standard for diagnosing allergy. In addition, although there is no consensus on what constitutes a “true allergy,” both allergy history and results of skin testing are frequently used to determine whether a patient is “allergic.”

There are only a few studies that have specifically addressed the relationship between patient report of allergy (allergy history) and skin test reactivity. Murray and Milner evaluated how well a simple set of allergy questions concerning cat, dog, dust mite, and grass and tree pollen predicted skin test reactivity to those allergens in children presenting to their allergy clinic with nose, eye, or chest symptoms (6). They found that the accuracy of the individual questions in predicting skin test results ranged from 71% to 85%. Murray et al. reported “a highly significant association between a positive prick test to mite antigen and aggravation of nose or chest symptoms during “domestic activity” in 285 children who presented to their clinic with presumed asthma (7). However, Hendrick et al. found that 61% of 656 adult asthmatic patients who denied being allergic to dust actually had positive skin tests to *Dermatophagoides farinae*, whereas 43% of those with negative skin tests gave a positive history (8). Ferguson and Murray evalu-

ated the relationship between skin test reactivity and clinical allergy to cats in 168 children and reported that 33% (20/59) of patients with skin test reactivity to cat antigen had a negative history for cat allergy (9).

To further clarify the relationship between allergy history and skin test reactivity in asthmatic children, we determined how well a history of allergy to grass, cat, or dust mite predicted skin test results for those aeroallergens in patients presenting to a pulmonary clinic.

METHODOLOGY

Setting and Patients

Our pediatric pulmonary clinic, located in a tertiary care military medical center, comprises a broad mix of asthmatic children. We manage many severe asthmatics, but we also provide primary care to a large number of patients with mild to moderate persistent asthma and receive referrals for input on the treatment of children with intermittent asthma. All children between the ages 4–18 years with a diagnosis of asthma, based on NHLBI definitions (10), who presented to the clinic for evaluation were eligible for the study. The exclusion criteria were a history of adverse reaction to skin testing and refusal to discontinue antihistamine medications. This study was approved by the medical center’s institutional review board, and a parent and the child, if older than 6 years of age, gave written informed consent. Between August 1995 and September 1996, we enrolled 95 patients. Their mean age (standard deviation) was 8.9 (3.4) years; 60% were males, 58% were Caucasian, 27% were African American, and the other 15% were primarily Asian or Caucasian–African-American. We assigned asthma severity using criteria that were the same as those defined by the NHLBI EPR-2 (5).

Allergy History

Patients and parents answered the following questions concerning allergy to grass, cat, and dust mite: "Do you have itchy watery eyes, sneezing, or nasal stuffiness when around cats, dust (dust mite), or grass? Do you have increased cough, chest tightness, or wheezing around cats? Do you have nasal or chest symptoms which are worse in bed at night or in the early morning, or when exposed to vacuuming, sweeping, dusting, or making the bed? Does yard mowing cause increased chest, eye, or nose symptoms? Do you think that you are allergic to cats, dust (dust mite), and/or grass? Do you think that cat, dust (dust mite), and/or grass make your asthma worse?" We considered a "yes" response to any question concerning an allergen as a positive history for that allergen.

Skin Prick Testing

Patients discontinued short-acting antihistamines a minimum of 72 hr and long-acting preparations at least 1 week before skin testing. We used the modified skin prick technique with the pricks applied to the volar aspect of the arms (11). We used the following extracts: cat dander (10,000 Bau/mL; Hollister Steir, Spokane WA), dust mite (*D. pteronyssinus* and *D. farinae* both at concentrations of 5000 Au/mL; Hollister Steir), and grass (timothy grass pollen extract, 1/20 w/v; Berkeley Biologics, Berkeley, CA). Histamine, 1 mg/mL, was the positive control, and the negative control was 50% glycerin. A skin test was positive if it produced a wheal 3 mm larger than that of the negative control. We considered patients to be skin test positive to dust mite if they had positive reactions to either of the two dust mite antigens.

Statistical Analysis

Our primary objective was to determine the diagnostic accuracy of the allergy history in correctly categorizing patients with respect to skin test reactivity. The diagnostic accuracy was defined as (true positives + true

negatives)/total number of patients. We also computed the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for allergy history with regard to skin test reactivity. We used the χ^2 test to assess differences in these computations between the asthma severity groups, and the χ^2 test for trend to determine whether prevalence of skin test reactivity was associated with asthma severity.

RESULTS

All 95 patients successfully completed both skin prick testing and the allergy history intake. There were comparable numbers of patients in each of the asthma severity groups (Table 1). The prevalence of skin test reactivity to cat and grass, but not to dust mite, increased with worsening asthma severity (Table 1). Patient report of being allergic to cat, grass, or dust mite was a poor predictor of skin test reactivity (Table 2). The diagnostic accuracy did not differ significantly between the asthma severity groups (cat: $p = 0.43$, dust mite: $p = 0.37$, grass: $p = 0.63$), so for each antigen we combined the subgroup data and reported them for the total group. Only 37% (18/48) of patients with positive skin tests to dust mite, 47% (26/55) of those positive to cat dander, and 49% (26/53) who were skin test positive to grass gave a history of being allergic to those allergens. Forty-six percent (29/63) of patients with a negative allergy history for cat, 50% (30/60) of those with a negative history for dust mite, and 50% (27/54) who had a negative allergy history for grass actually had positive skin tests to their respective antigens.

DISCUSSION

In our study, patient/parent report of allergy was no better than chance alone in predicting skin test reactivity to cat, dust mite, and grass. We chose to study these allergens because they are common and have been implicated in asthma morbidity (1–4). Asthma severity was associated with an increased

Table 1. Prevalence of Positive Skin Tests in 95 Asthmatic Children

GROUP	(n)	ANY+, ^a n (%)	+CAT, n (%)	+DUST MITE, n (%)	+GRASS, n (%)
Intermittent	(28)	15 (54%)	8 (29%)	12 (43%)	10 (36%)
Mild persistent	(20)	14 (70%)	10 (50%)	8 (40%)	10 (50%)
Moderate persistent	(28)	22 (79%)	22 (79%)	17 (61%)	16 (57%)
Severe persistent	(19)	18 (95%)	15 (79%)	11 (58%)	17 (89%)
Total	(95)	69 (73%)	55 (58%)	48 (51%)	53 (56%)

^a"Any +" refers to patients who had positive skin tests for any of the three antigens. The prevalence of skin test reactivity to cat and grass, but not to dust mite, increased with increasing asthma severity (χ^2 test for trend: $p < 0.001$ for both cat and grass, and $p = 0.15$ for dust mite).

prevalence of positive skin tests, but it did not influence the relationship between allergy history and skin test reactivity. The results of our study suggest that allergy history is an inaccurate predictor of skin test reactivity and should be used with caution for determining allergen control strategies.

We found that allergy history was less successful in predicting skin test response than did Murray et al. in three similarly designed studies (6,7,9). Murray and Milner noted that a standard battery of simple allergy questions was able to predict skin test reactivity with an accuracy of approximately 85% for cat, 75% for grass pollen, and 72% for dust mite in children presenting for evaluation of nose, eye, or chest symptoms (6). Using the raw data from the report by Ferguson and Murray, we calculated the accuracy of clinical cat allergy in predicting skin test reactivity in that study to be 80% (9). Potential reasons for the discrepancies in the results between these studies and ours

include differences in patient populations, presenting complaints, and the definition of a positive skin test. The children in their studies were referred specifically for allergy evaluation, whereas our patients presented for treatment of asthma. Our patients all presented with chest symptoms, and many of those in the other studies had nose and eye symptoms but did not have asthma. In addition, Murray et al. used a less stringent criterion for skin test reactivity, wheal size ≥ 2 mm vs. our criterion of ≥ 3 mm. We do not believe that differences in the allergy questions explain the discrepancies between our results and those of the other investigators because we based our questions on those used in their studies (6,7,9).

There were limitations to our study. First, each clinic has a different asthma population with a different prevalence of skin test reactivity, so it is difficult to extrapolate our findings to other patient populations. Second, the relationship between responses to allergy

Table 2. Sensitivity, Specificity, Predictive Values, and Accuracy of Patient Report of Allergy to Grass, Dust Mite, or Cat with Regards to Skin Test Reactivity in 95 Asthmatic Children

ALLERGEN	SENSITIVITY (%)	SPECIFICITY (%)	PPV (%)	NPV (%)	ACCURACY (PERCENT OF PATIENTS CORRECTLY CATEGORIZED)
Cat	47	85	81	54	65
Dust mite	38	64	51	50	50
Grass	49	64	63	50	56

Values for the individual severity groups (intermittent, and mild, moderate, and severe asthma) were similar, so the subgroup data were combined.

questions and skin test reactivity is strongly influenced by how the history is taken. Nevertheless, there are several reasons we feel that our findings are not unique to our clinic and may have more general implications. We attempted to standardize our allergy history, the patients in our study were equally distributed among asthma severity groups, and we showed that asthma severity did not significantly affect the diagnostic accuracy. In addition, the prevalence of positive skin tests in our group of patients was similar to that noted in asthmatic patients from other temperate climates (7,8,12). Furthermore, we found that the prevalence rate of positive skin tests did not affect the diagnostic accuracy of allergy history in predicting skin test reactivity. Thus, our results should apply to geographical areas where the frequency of skin test reactivity differs from that of our asthmatic population.

The fact that allergy history is not predictive of skin test reactivity raises the important question of what constitutes a true allergy—patient response, positive result of skin testing, or some other standard yet to be determined. Our study did not address this issue, but it suggests that allergy history and skin test reactivity are not closely linked. One possible explanation for this discrepancy is that some patients who are sensitized to an allergen may not have acute symptoms when exposed to that allergen at the present time, but continued exposure to the allergen could result in airways inflammation and influence long-term asthma control. Sporik et al. showed that dust mite exposure early in life is associated with the development of asthma in children (3). Thus, in susceptible children it might be important to avoid allergens to which they are sensitized before these allergens actually cause symptoms. Another possible explanation for the poor relationship between allergy and skin test reactivity is that skin test reactivity is not a good predictor for true allergy, i.e., skin tests may result in a false positive diagnosis of allergy. Until further research clarifies the reasons for the poor correlation of skin test reactivity with allergy symptoms, it is important to consider both skin test results and allergy history when devising an allergen avoidance plan.

CONCLUSIONS

We found that patient report of allergy to cat, grass, and dust mite was a poor predictor of skin test reactivity. These results suggest that the clinician should be cautious in determining a patient's allergy status based upon history alone. This study also supports the recommendation of the NHLBI EPR-2 to perform skin prick or radioallergosorbent testing (RAST) on children with persistent asthma. Because allergy history and skin testing can give discordant results, it is important to consider both of these when evaluating asthmatic children for allergy. Further studies are necessary to determine whether allergy history, skin test reactivity, or a combination of these is the best measure of true allergy in children with asthma.

REFERENCES

1. Sporik R, Ingram JM, Price W, Sussman JH, Honsinger RW, Platts-Mills TAE: Association of asthma with serum IgE and skin test reactivity to allergens among children living at high altitude. *Am J Respir Crit Care Med* 151:1388 (1995).
2. Peat JK, Tovey E, Toelle BG, Haby MM, Gray EJ, Mahmic A, Woolcock AJ: House dust mite allergens: A major risk factor for childhood asthma in Australia. *Am J Respir Crit Care Med* 153:141 (1996).
3. Sporik R, Holgate ST, Platts-Mills TAE, Cogswell JJ: Exposure to house dust mite allergen (*Der p 1*) and the development of asthma in childhood. *N Engl J Med* 323:502 (1990).
4. Suphioglu C, Singh MB, Taylor P, Bellomo R, Holmes P, Puy R, Knox RB: Mechanism of grass pollen induced asthma. *Lancet* 339:569 (1992).
5. National Asthma Education Program: Expert Panel 2 Report: National Heart, Lung, and Blood Institute guidelines for the diagnosis and management of asthma. Publication No. 97-4051. NHLBI, Bethesda, MD, April 1997.
6. Murray AB, Milner RA: The accuracy of features in the clinical history for predicting atopic sensitization to airborne allergens in children. *J Allergy Clin Immunol* 96:588 (1995).
7. Murray AB, Ferguson AC, Morrison BJ: Diagnosis of house dust mite allergy in asthmatic children: what constitutes a positive history? *J Allergy Clin Immunol* 71:21 (1983).
8. Hendrick DJ, Davies RJ, D'Souza MF, Pepys J: An analysis of skin prick test reactions in 656 asthmatic patients. *Thorax* 30:2 (1975).
9. Ferguson AC, Murray AB: Predictive value of skin

- prick tests and radioallergosorbent tests for clinical allergy to dogs and cats. *CMAJ* 134:1365 (1986).
10. National Asthma Education Program: Expert Panel Report: National Heart, Lung, and Blood Institute guidelines for the diagnosis and management of asthma. Publication No. 91-3042. NHLBI, Bethesda, MD, August 1991.
 11. Bousquet J, Francois-Bernard: In vivo methods for study of allergy. In *Allergy: Principles and Practice* (Middleton E Jr, Reed CE, Ellis E, Adkinson N Jr, Yunginger J, Busse W, editors). St. Louis, Mosby, 1993, p. 578.
 12. Zimmerman B, Feanny S, Reisman J, Hak H, Rashed N, McLaughlin FJ, Levison H: Allergy in asthma I. The dose relationship of allergy to severity of childhood asthma. *J Allergy Clin Immunol* 81:63 (1988).