

Original article

The relationship between seroatopy and symptoms of either allergic rhinitis or asthma

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Background: Epidemiologic data on allergic rhinitis and asthma are frequently based on self-reported symptoms. **Objective:** This cross-sectional study examined the relationship between self-reported symptoms and histories of allergic rhinitis or asthma and a marker of allergic sensitization, allergen-specific IgE.

Methods: We surveyed 702 pregnant women in Michigan. Blood samples were analyzed for specific IgE to 9 allergens: dust mites (*Dermatophagoides farinae* and *Dermatophagoides pteronyssinus*), cat, dog, cockroach, ragweed, timothy grass, egg, and *Alternaria alternata*. Seroatopy was defined as a specific IgE greater than or equal to 0.35 kU/L to any allergen.

Results: Seroatopy was found in 66.7% of those with hay fever symptoms, 68.3% with a physician's diagnosis of asthma, and 72.1% of those with both conditions. These results differed significantly from asymptomatic subjects, where 49.8% of patients without hay fever and 50.4% without asthma were seroatopic. Race and education did not modify the relationships. Symptoms related to specific exposures were modest predictors of positive specific IgE to related allergens (positive predictive values from 26.5% to 50.3%).

Conclusion: Self-reported symptoms of allergic rhinitis or asthma were significantly associated with allergic sensitization, but the odds ratios were of relatively low magnitude for this historical information to be considered evidence of current allergic sensitization. A 66% to 68% probability existed that those with symptoms of allergic rhinitis or asthma would have a positive specific IgE test.

Clinical implications: Self-reported histories of hay fever or asthma alone are only modest predictors of allergic sensitization. When knowledge of allergic sensitization is important, information beyond self-reported symptoms is necessary. (J Allergy Clin Immunol ■■■■;■■■:■■■-■■■.)

Key words: Allergic rhinitis, asthma, self-reported history, seroatopy, allergen-specific IgE

Many epidemiologic studies of asthma and allergic rhinitis use self-reported symptoms or physician diagnoses of hay fever, perennial rhinitis, and asthma.¹⁻⁵ It is clear that both allergic and nonallergic forms of rhinitis and asthma exist, and sole reliance on survey responses alone as estimates of the presence of allergic sensitization induces potential error. In the past decade, when the overall prevalence of allergic sensitization has increased, few large population-based studies have evaluated biologic markers of allergic sensitization in relationship to self-reported histories of allergic disease symptoms.^{5,6} Detailed information on the relationships between self-reported allergic disease and allergic sensitization would allow better estimation of the extent of potential misclassification of atopic conditions in studies that rely on survey data.

Some studies have suggested that rhinitis symptoms are a reliable predictor of allergic rhinitis as defined by symptoms and positive skin tests or increased allergen-specific IgE.⁷⁻¹⁰ Others have shown that self-reported or physician-diagnosed hay fever/rhinitis were not associated with atopic disease specifically.¹¹ Many of these studies have been performed outside the United States, have involved convenience samples, or have been limited to 1 racial group (such as European whites).¹²⁻¹⁴ The aim of this study of a large population-based cohort of adult women was to define the relationship between a woman's self-reported history of symptoms or a diagnosis of allergic rhinitis and asthma and allergen-specific IgE. We also examined whether these relationships differ by race and level of education and whether reported nasal or asthma symptoms after specific exposures were associated with sensitization to specific allergens.

METHODS

Study population

Data for this study were collected as part of the Wayne County Health, Environment, Allergy, and Asthma Longitudinal Study (WHEALS). Analyses included pregnant women with due dates from September 1, 2003 through November 7, 2005, who were in their second trimester or later, seeing a Henry Ford Health System

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Abbreviations used

NPV: Negative predictive value

OR: Odds ratio

PVV: Positive predictive value

practitioner at 1 of 5 clinics, aged 21–49 years, and living in a predefined geographic area in western Wayne County that included the western portion of the city of Detroit as well as the suburban areas immediately west of the city. No medical insurance requirements existed, but the women were required to comprehend English well enough to provide written informed consent. All aspects of this research were approved by the institutional human subjects boards of review of all participating institutions.

Assessment of symptoms

At the time of recruitment, each woman was interviewed face-to-face about her asthma and allergy history. The specific questions were as follows: (1) “Do you have nasal allergies including hay fever and allergic rhinitis?” Those who said “yes” were then asked: (2) “Did a doctor ever diagnose you with hay fever, nasal allergies or allergic rhinitis?”; (3) “When you are near animals such as cats, dogs, or horses, do you ever start to cough, wheeze, get a feeling of tightness in your chest, start to feel short of breath, get a runny or stuffy nose or start to sneeze?”; (4) “When you are in a dusty part of your house, or near pillows or duvets, do you ever start to cough, wheeze, get a feeling of tightness in your chest, start to feel short of breath, get a runny or stuffy nose or start to sneeze, get itchy watery eyes?”; (6) “Do you have any symptoms such as coughing, wheezing, tightness in your chest, shortness of breath, runny stuffy nose or sneezing, itchy, watery eyes when you are around freshly mowed grass?”; and (7) “Have you ever had asthma?” For those who said “yes” we then asked: (8) “Did a doctor ever diagnose you with asthma?” Additional questions about self-reported race using the US census categorization and education level were asked.

Using these questions, we defined self-reported hay fever as a “yes” response to question 1, physician-diagnosed hay fever as a “yes” response to question 2, self-reported asthma as a “yes” response to question 7, and physician-diagnosed asthma as a “yes” response to question 8.

Assessment of allergen-specific IgE

Venous blood was collected at the time of recruitment for assessment of allergen-specific IgE. After collection, samples were then stored at -80°C until assayed.

Measurements of allergen-specific IgE were performed following the standard manufacturer’s protocols using the Pharmacia UniCAP system (Pharmacia-Upjohn Diagnostic Division, Kalamazoo, Mich). Allergen-specific IgE was analyzed for *Dermatophagoides farinae*, *D pteronyssinus*, cat, dog, *Blatella germanica* (German cockroach), *Ambrosia artemisiifolia* (ragweed), *Phleum pratense* (timothy grass), hens’ egg, and *Alternaria alternata*. One percent of all assays were repeated in a different assay run on a different day to provide estimates of interassay reliability. The geometric mean coefficient of interassay variation was 5.9% for all 9 allergens. We evaluated the possibility that some women with isolated tree pollen sensitization were missed by testing with the 9 chosen allergens; however, we

found no evidence for isolated tree pollen sensitization (see data in this article’s Online Repository at www.jacionline.org).

Statistical analysis

Seroatopy was defined as 1 or more positive allergen-specific IgE results (≥ 0.35 kU/L). We used allergen-specific IgE to cat and dog for data analysis related to symptoms around animals, *D pteronyssinus* and *D farinae* for symptoms in a dusty environment, and ragweed and timothy for symptoms around pollen and grass.

The symptoms and individual allergens were compared using a χ^2 test. A *P* value less than or equal to .05 was considered statistically significant. The analysis was performed on all subjects and repeated stratifying by race (black, white) and education (high-school graduate or less, some education beyond high school) when sample size permitted because we hypothesized that these variables might influence the relationship between recall of symptoms and sensitization. The odds ratios (ORs) were estimated directly from the 2-by-2 tables with standard deviation for the log OR used to compute the 95% CIs. Sensitivity, specificity, and the 2 predictive values were estimated assuming a full multinomial model as the study was cross-sectional. Logistic regression models were developed for multiple variable analyses. In the logistic regression models, the exponentiated coefficient was used to estimate the OR and the Wald method was used to estimate the CI.

RESULTS

At the time of this analysis, 1918 study introduction letters had been mailed to potentially eligible women and we could approach 1422 to discuss participation. Of these women, 127 (8.9%) were ineligible for various reasons and 79 (5.5%) did not comprehend English well enough to provide informed consent. Of the remaining 1216, 702 (58%) were interviewed and 417 of these women identified themselves as black (59%); 201 (29%) as white, non-Hispanic; and 84 (12%) as belonging to other ethnic/racial groups. The average age of the black women was 28.6 (SD 5.1) years, and the average age of the white women was 30.7 (SD 4.8) years. Of the black women, 94 (23%) reported allergic rhinitis, 62 (15%) reported physician-diagnosed allergic rhinitis and 87 (21%) reported physician diagnosed asthma. Among white women, 60 (30%) reported history of allergic rhinitis, 35 (18%) reported physician-diagnosed allergic rhinitis, and 35 (18%) reported physician-diagnosed asthma. Of the 140 individuals reporting ever having had asthma only, 7 (2 whites, 5 blacks) failed to also state that a physician had provided a diagnosis.

Table I shows the prevalence of symptoms among participants. White women were more likely to report hay fever symptoms, but the prevalence of reported physician-diagnosed hay fever did not differ by race. Black women were more likely to report symptoms around pollen and freshly mowed grass.

Of the 702 who were interviewed, adequate plasma samples were obtained for measurement of all study allergens for 629 (90%) of the women. In 4 additional women, partial testing was completed. Table II shows the prevalence of positive allergen-specific IgE tests by allergen. Of the 633 women with allergen-specific IgE information, 341 (54%) were seroatopic. Black women were

TABLE I. Prevalence of symptoms among the 702 participating women

Variable	Total, % (95% CI)	White, % (95% CI)	Black, % (95% CI)	P value*
Self-reported hay fever	24.5 (21.3-27.8)	30.2 (23.9-37.1)	22.6 (18.7-26.9)	.047
Physician-diagnosed hay fever	15.1 (12.5-18.0)	17.7 (12.6-23.7)	15.0 (11.7-18.9)	.410
Self-reported asthma	20.0 (17.1-23.1)	18.5 (13.4-24.6)	22.1 (18.2-26.4)	.342
Physician-diagnosed asthma	19.0 (16.1-22.1)	17.5 (12.5-23.5)	20.9 (17.1-25.1)	.388
Physician-diagnosed asthma and self-reported hay fever	9.8 (7.3-12.8)	13.9 (8.7-20.6)	8.5 (5.5-12.4)	.093
Symptoms around animals	27.7 (24.4-31.2)	27.4 (21.4-34.1)	27.0 (22.8-31.5)	.923
Symptoms in dusty environment	51.8 (48.0-55.6)	47.0 (39.9-54.2)	53.0 (48.1-57.9)	.170
Symptoms around pollen	56.2 (52.5-60.0)	47.5 (40.4-54.7)	61.5 (56.6-66.2)	.005
Symptoms around mowed grass	29.1 (25.7-32.6)	23.0 (17.4-29.5)	33.6 (29.0-38.4)	.008

*P value is for comparison of white and black women by χ^2 test.

TABLE II. Prevalence of detectable allergen-specific IgE among the 633 participating women*

Allergen	Total, % (95% CI)	White, % (95% CI)	Black, % (95% CI)	P value†
Any allergen (seroatopy)	54.0 (50.1-58.0)	42.0 (34.7-49.5)	62.4 (57.2-67.4)	.001
<i>D farinae</i>	23.6 (20.3-27.1)	23.2 (17.3-330.0)	24.3 (20.0-29.1)	.831
<i>D pteronyssinus</i>	25.0 (21.6-28.5)	24.2 (18.1-31.1)	25.9 (21.5-30.7)	.678
Cat	20.8 (17.7-24.2)	17.7 (12.4-24.0)	24.2 (19.8-28.9)	.099
Dog	18.8 (15.8-22.1)	13.2 (8.6-19.0)	22.6 (18.4-27.3)	.008
Cockroach	13.5 (10.9-16.4)	4.4 (1.9-8.5)	18.2 (14.3-22.6)	.001
Ragweed	30.5 (26.9-34.3)	19.8 (14.3-26.3)	46.0 (40.4-57.7)	.001
Timothy	23.8 (20.5-27.3)	17.0 (11.9-23.2)	30.5 (25.8-35.5)	.001
Egg	1.9 (1.0-3.3)	0.5 (0-3.0)	2.5 (1.1-4.7)	.177
<i>Alternaria</i>	19.6 (16.6-22.9)	9.3 (5.5-14.5)	31.9 (26.8-37.4)	.001

*Detectable IgE defined as ≥ 0.35 kU/L.

†P value for comparison of white and black women by χ^2 test.

more likely to be seroatopic than white women, and they had higher prevalences of positive tests for dog, cockroach, ragweed, timothy grass, and *Alternaria* allergens.

Sixty-seven percent of those self-reporting hay fever symptoms and 68.3% of those with physician-diagnosed asthma had a positive specific IgE to at least 1 allergen (Table III). Women who reported hay fever symptoms were significantly more likely to demonstrate seroatopy when compared with women without hay fever symptoms (OR 2.02; 95% CI, 1.38-2.96; $P=.001$). Similarly, women reporting physician-diagnosed asthma were also more likely to be seroatopic when compared with those without physician-diagnosed asthma (OR 2.12; 95% CI, 1.39-3.22; $P=.001$). Therefore, the positive predictive value (PPV) of self-reported hay fever symptoms in predicting seroatopy was 66.7%, and the negative predictive value (NPV) was 50.2% (30.8% sensitivity and 81.9% specificity). Similarly, asthma symptoms had a PPV for seroatopy of 68.3% and an NPV of 49.6% (25.3% sensitivity and 86.2% specificity).

As shown in Table III, patients reporting hay fever symptoms were significantly more likely to have a positive allergen-specific IgE to cat, dog, ragweed, timothy, and *Alternaria* when compared with individuals without hay fever. Those women with a physician diagnosis of asthma had significantly higher prevalences of positive allergen-specific IgE to dust mites, cat, dog, ragweed, timothy, and *Alternaria*, when compared with those without a

physician diagnosis of asthma. When sensitivities to each of the 9 allergens were evaluated in a multivariable model with hay fever, adjusting for all other allergic sensitivities, the only sensitivities significantly related to hay fever were cat and ragweed (OR 2.78, 95% CI, 1.47-5.24; and OR 1.83, 95% CI, 1.08-3.10, respectively). In a similar model for asthma, the only significant allergen sensitivities were cat and *Alternaria* (OR 2.28, 95% CI, 1.19-4.38; and OR 2.10, 95% CI, 1.17-3.47, respectively).

Participants with self-reported symptoms of hay fever around animals, freshly mowed grass, and during pollen seasons were significantly more likely to have positive allergen-specific IgE to the presumably responsible allergens when compared with women without symptoms (Table IV). For example, women reporting symptoms around animals were significantly more likely to have increased allergen-specific IgE to cat (OR 6.20; 95% CI, 4.02-9.44), dog (OR 6.63; 95% CI, 4.29-10.24), and either cat or dog (OR 6.13, 95% CI, 4.11-9.15) when compared with asymptomatic individuals. Interestingly, women who reported symptoms around dust did not have significantly increased risks of having positive allergen-specific IgE to either of the 2 species of dust mites. When all relationships shown in Table IV were evaluated for interactions with race, the only relationships that differed by race were with cats and dogs. For both cats and dogs, the ORs for having a positive test for specific IgE were larger for whites than blacks (cat, 16.44 vs 4.14, $P=.01$; dog,

TABLE III. Prevalence of detectable allergen-specific IgE in participants with self-reported hay fever or a physician diagnosis of asthma compared with those without disease

Variable	Self-reported hay fever				Physician diagnosis of asthma				Hay fever and diagnosis of asthma			
	No (%) (n = 462)	Yes (%) (n = 154)	OR (95% CI)	P value	No (%) (n = 493)	Yes (%) (n = 124)	OR (95% CI)	P value	No (%) (n = 493)	Yes (%) (n = 124)	OR (95% CI)	P value
Seroatopy*	46.3	66.7	2.32 (1.57, 3.43)	.001	46.3	68.3	2.50 (1.62, 3.84)	.001	46.3	72.1	2.99 (1.49, 6.01)	.002
<i>D farinae</i>	20.3	24.7	1.28 (0.82, 2.00)	.296	20.3	37.4	2.34 (1.50, 3.65)	.001	20.3	39.5	2.56 (1.32, 4.96)	.007
<i>D pteronyssinus</i>	21.8	25.3	1.21 (0.78, 1.88)	.426	21.8	37.9	2.18 (1.41, 3.38)	.001	21.8	39.5	2.34 (1.21, 9.52)	.014
Cat	12.2	36.2	4.09 (2.60, 6.43)	.001	12.2	39.8	4.78 (2.97, 7.68)	.001	12.2	52.4	7.94 (4.02, 15.66)	.001
Dog	12.3	30.1	3.06 (1.93, 4.85)	.001	12.3	33.9	3.64 (2.25, 5.89)	.001	12.3	41.9	5.12 (2.60, 10.08)	.001
Cockroach	11.6	15.7	1.42 (0.83, 2.44)	.199	11.6	17.7	1.65 (0.95, 2.89)	.091	11.6	18.6	1.75 (0.76, 4.01)	.216
Ragweed	23.6	45.1	2.66 (1.79, 3.95)	.001	23.6	41.9	2.34 (1.52, 3.58)	.001	23.6	48.8	3.09 (1.62, 5.87)	.001
Timothy	19.5	34.4	2.16 (1.42, 3.29)	.001	19.5	33.3	2.06 (1.31, 3.24)	.002	19.5	46.5	3.58 (1.87, 6.87)	.001
Egg	1.6	2.0	1.25 (0.31, 5.06)	.720	1.6	3.2	2.08 (0.58, 7.51)	.270	1.6	2.3	1.49 (0.17, 12.66)	.830
<i>Alternaria</i>	14.4	25.5	2.03 (1.28, 3.22)	.004	14.4	33.9	3.04 (1.90, 4.85)	.001	14.4	34.9	3.18 (1.59, 6.33)	.002

*Seroatopy is detectable allergen-specific IgE to any of the 9 allergens tested.

TABLE IV. ORs, sensitivity, specificity, and positive and negative predictive values for a history of increased symptoms predicting the presence of detectable IgE specific for the allergen(s) likely to be present during specific environmental exposures

Exposure	Specific IgE	No. symptoms (%) with positive specific IgE	Yes symptoms (%) with positive specific IgE	OR (95% CI)	P value	Sensitivity	Specificity	PPV	NPV
Animals	Cat	11.5 (51/442)	44.7 (76/170)	6.20 (4.07-9.44)	.001	59.8	80.6	44.7	88.5
	Dog	9.9 (44/445)	42.1 (79/171)	6.63 (4.29-10.24)	.001	62.1	80.2	42.1	90.1
	Cat or dog	14.5 (64/443)	50.9 (87/171)	6.13 (4.11, 9.15)	.001	57.6	81.9	50.9	85.6
Dusty environment	<i>D farinae</i>	22.3 (65/291)	24.4 (79/324)	1.12 (0.77-1.63)	.57	54.9	48.0	24.4	77.7
	<i>D pteronyssinus</i>	22.6 (66/292)	26.5 (86/325)	1.23 (0.85-1.78)	.30	56.6	48.6	26.5	77.4
	<i>D farinae</i> or <i>D pteronyssinus</i>	23.7 (69/291)	27.5 (89-324)	1.22 (0.85, 1.73)	.31	56.3	48.6	27.5	76.3
	Ragweed	14.7 (40/272)	43.7 (150/343)	4.51 (3.03-6.71)	.001	79.0	54.6	43.7	85.3
Pollen seasons	Timothy	12.2 (33/271)	33.0 (113/342)	3.56 (2.32-5.46)	.001	77.4	51.0	33.0	87.8
Freshly mowed grass	Ragweed	22.6 (97/430)	50.3 (90/179)	3.47 (2.40-5.03)	.001	48.1	78.9	50.3	77.4
	Timothy	16.8 (72/429)	40.5 (72/178)	3.37 (2.28-4.98)	.001	50.0	77.1	40.5	83.2

23.41 vs 4.55, $P=.01$; and either cat or dog, 15.1 vs 4.26, $P=.01$, respectively).

The PPV of symptoms predicting specific IgE to related allergens was not greater than 51% for any allergen (ranging from 24.4% for symptoms around dust to 51.0% for symptoms around freshly mowed grass; [Table IV](#)). The NPVs were higher than the PPVs; however, these were all modest. For example, in the absence of symptoms to pets, 88.5% and 90.1% of these women had negative allergen-specific IgE to cats and dogs, respectively, compared with PPVs of 44.7% and 42.11%, respectively.

The relationships between symptoms and seroatopy after stratifying the participants by race and education are shown in [Table V](#). The ORs for seroatopy in relationship to hay fever symptoms and asthma are all similar and significant for both blacks and whites. These stratum-specific risk estimates did not differ between black and white women as indicated by the nonsignificant interaction terms

($P=.16-.79$). The results after stratifying by highest level of education (high-school level or less vs some formal education after high school) are also shown in [Table V](#). Overall, 164 (23%; 34 white and 113 black) women had a high-school education or less and 538 (77%; 167 whites and 304 blacks) had an education beyond high school. The ORs after stratification by race and level of education are virtually the same as reflected by the P values for interaction. The differences in statistical significance for the educational strata result from the small number of individuals in the category of high-school education or less.

DISCUSSION

Our data show that a history of either self-reported hay fever symptoms or physician-diagnosed hay fever or asthma are significantly but only modestly associated

TABLE V. Association between seroatopy and hay fever and asthma stratified by race and education

Category	Variable	Strata	OR (95% CI)	P value	P value for interaction term
Race	Self-reported hay fever	White	2.99 (1.49, 6.01)	.007	.821
		Black	2.76 (1.57, 4.88)	.001	
	Physician-diagnosed asthma	White	4.20 (1.79, 9.83)	.001	.206
		Black	2.19 (1.26, 3.79)	.006	
	Hay fever and physician-diagnosed asthma	White	4.08 (1.57, 14.64)	.006	.547
		Black	3.02 (1.08, 8.42)	.044	
Education	Self-reported hay fever	High-school graduate or less	2.39 (0.90, 6.33)	.103	.976
		Beyond high school	2.35 (1.52, 3.61)	.001	
	Physician-diagnosed asthma	High-school graduate or less	1.57 (0.68, 3.61)	.304	.207
		Beyond high school	2.93 (1.77, 4.86)	.001	
	Hay fever and physician-diagnosed asthma	High-school graduate or less	1.39 (0.30, 6.56)	.715	.284
		Beyond high school	3.60 (1.63, 7.93)	.001	

with the presence of detectable allergen-specific IgE in this multiracial cohort of women. These results are generally consistent with those of previous studies,^{6,15} but they are unique in 2 important aspects: (1) The data are from a large, geographically defined, diverse, mid-western population of women; and (2) the data have been obtained at a time after the prevalence of allergic sensitization has dramatically risen among people living in the US. These data show that when parental histories of “allergic” disease, such as hay fever and asthma, are used in epidemiologic studies examining the risks of developing allergic disease and asthma in children, the information provided probably has more to do with many factors influencing the perception of disease than with the ability to produce allergen-specific IgE antibodies.¹⁻³ These findings also suggest that measuring allergen-specific IgE has little, if any, clinical value unless the results are appropriately correlated with a clinical history.^{6,15,16}

The 54% prevalence of at least 1 positive specific IgE in our study population is higher than that found in previous studies.¹³ This high incidence of seroatopy is probably partly from the observed increase in allergic sensitization over the past few decades. Our findings are consistent with those of the most recently published National Health and Nutrition Examination Survey III (NHANES III), conducted from 1988 to 1994, which showed that 54.3% of the US population had 1 or more positive skin test response to 10 common allergens.¹⁷ Linneberg et al⁸ showed that the prevalence of specific IgE to at least 1 allergen increased significantly from 1990 to 1998 (26.5% vs 33.9%).

The discrepancies we observed between symptom histories and specific IgE are similar to those observed by others. Burrows et al¹⁸ found that approximately 30% of subjects who have completely negative skin test response reported symptoms of hay fever. In France, Vervloet et al¹¹ found that only 41.8% of those with hay

fever and 51.8% with asthma were seroatopic, whereas 14.8% of asymptomatic subjects were seroatopic. They did not find a correlation between nasal symptoms and education level. In The Netherlands, Droste et al¹⁰ found that the prevalence of seroatopy was 14.5% in subjects without nasal symptoms, 36.6% in subjects with symptoms after exposure to indoor allergens only, 41.5% in subjects with symptoms after exposure to outdoor allergens only, and 57.7% in subjects with symptoms after exposure to both types of allergens. They tested IgE specific for *D pteronyssinus*, cat, *Cladosporium herbarum*, timothy grass, and birch, but they did not test for dog, cockroach, and *Alternaria*, which we found to be important allergens. Furthermore, both studies were performed in Europe where allergen exposures are different from those in the United States.

Our findings that black women were more likely than white women to have allergen-specific IgE to dog, cockroach, ragweed, timothy, and *Alternaria* are similar to the findings in Connecticut children with asthma, which shows that African American children were more likely than whites to be skin test reactive to mixed trees, mixed grasses, mugwort/sage, and ragweed.¹⁹ We have also previously reported racial differences in the prevalence of sensitization to specific allergens among children with asthma.²⁰

Our study had several limitations. Only pregnant women from 1 area of the United States were studied. In the European Community Respiratory Health Study, large variations were found in the relationship between atopy and asthma in different locations.²¹ These findings from Europe suggest that the relationship we found between seroatopy and asthma might not be found in other areas of the United States. More women in our study population had asthma than would be expected from national surveys. It is conceivable that, given their motivation to be in this study, the women reporting hay fever and asthma in our population may be more likely to have allergen-specific

IgE than would be found in the general population of affected women. If this possibility were true, the relationships we reported would likely be biased upward. Another potential limitation is that we used a single limited panel of allergens. The limited number of allergens means that associations between symptoms and specific IgE to other allergens may have been missed. Also, a concern exists that pregnant women may report more nonallergic rhinitis symptoms than nonpregnant women or men. Rhinitis of pregnancy would have influenced the self-reported rhinitis symptoms but should not have influenced the reports of a physician's diagnosis of hay fever or asthma. Age of onset of symptoms and treatment information were not considered. Even though our total sample was relatively large, when the sample was stratified, the modest numbers of individuals in each group within the stratum provided less than ideal statistical power. Also, we could not collect adequate blood samples on all women for IgE testing, but it is unlikely that a relationship exists between success in obtaining blood samples and the presence of IgE antibodies.

The question of whether the pregnancy could affect a woman's atopic status has not been well studied. The NHANES III study found that 49.2% of all women had at least 1 positive skin test response, which is very close to the 54.0% prevalence of seroatopy in our participants, which suggests that pregnancy alone did not dramatically alter IgE production.¹⁷

Many studies have used parent history of allergic rhinitis or asthma as a marker for atopy.^{1-4,22,23} However, in this study, we found that self-reported history of hay fever or physician-diagnosed asthma are only modestly associated with seroatopy. Race and education did not modify the relationships between self-reported symptoms nor physician-diagnosed hayfever/asthma and seroatopy status.

Our data support the finding of Barbee et al¹⁴ who studied 1600 white non-Mexican male and female Americans. In their study, 67% of subjects who skin test results were positive reported symptoms of allergic rhinitis, whereas 36% of subjects who skin test results were negative reported symptoms of allergic rhinitis.

In conclusion, we found that self-reported history of hay fever or physician-diagnosed hay fever and asthma were only modestly associated with seroatopy. Stratifying by either highest level of education or race did not appreciably alter the degree of association between history and seroatopy. If investigators need information concerning parental predisposition toward allergen-specific IgE production, then it is necessary to directly determine the presence of allergen-specific IgE by either skin testing or *in vitro* testing.

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