

Sensitization and allergic histories differ between black and white pregnant women

Ganesa Wegienka, PhD,^a Christine L. M. Joseph, PhD,^a Suzanne Havstad, MA,^a Edward Zoratti, MD,^b Dennis Ownby, MD,^c and Christine Cole Johnson, PhD^a *Detroit, Mich, and Augusta, Ga*

Background: Racial differences in allergic diseases have been reported, with black subjects suffering disproportionately compared with white subjects, although such studies have been more commonly done in pediatric populations.

Objective: We sought to determine whether there are differences in rates of allergic sensitization or prior diagnoses of asthma, hay fever, or eczema in black and white pregnant women.

Methods: Women were recruited during pregnancy (regardless of allergic history) as part of a birth cohort study in the Detroit metropolitan area and were interviewed about prior doctors' diagnoses of asthma, hay fever/nasal allergies/allergic rhinitis, and eczema. Blood samples were collected, total IgE levels were determined, and specific IgE levels were measured for *Alternaria alternata*, cat, cockroach, dog, *Dermatophagoides farinae*, short ragweed, timothy grass, and egg.

Results: Black women (n = 563) were more likely than white women (n = 219) to have had at least 1 specific IgE level of 0.35 IU/mL or greater (62.5% vs 40.2%, $P < .001$). Black women had higher total IgE levels (geometric mean, 47.8 IU/mL [95% CI, 42.5-53.8 IU/mL] vs 20.0 IU/mL [95% CI, 16.2-24.6 IU/mL]; $P < .001$, Wilcoxon rank sum test). Black women were more likely to have had a prior doctor's diagnosis of asthma (22.7% vs 16.0%, $P = .04$) and eczema (21.9% vs 14.8%) but not hay fever (white women: 17.5% vs black women: 15.7%, $P = .55$). Associations persisted for total IgE levels, having 1 or more positive allergen-specific IgE levels, and eczema after adjusting for common socioeconomic or environmental variables.

Conclusions: Racial differences in allergic sensitization and diagnoses were present, even after controlling for various factors. Future research should focus on prevention to ameliorate these disparities. (J Allergy Clin Immunol 2012;■■■:■■■-■■■.)

Key words: Pregnancy, IgE, atopy, asthma, eczema, allergic rhinitis, race, ethnicity

Abbreviations used

NHANES: National Health and Nutrition Examination Survey

SES: Socioeconomic status

sIgE: Allergen-specific IgE

WHEALS: Wayne County Health, Environment, Allergy and Asthma Longitudinal Study

Racial differences in allergic diseases (prevalence and severity) have been reported, with black/African American subjects suffering disproportionately compared with white subjects.¹⁻⁸ Few data exist to detail any racial differences in allergic diseases in adult women. A previous report demonstrated that women from minority groups in the Boston area tended to have higher total IgE levels and were more likely to be sensitized to aeroallergens than white women in the same area.⁶ The women from minority groups were also more likely to have had a prior asthma diagnosis but were less likely to have had a prior diagnosis of hay fever or eczema than white women.⁶ The authors also reported that race was more strongly associated with allergic diseases than were current socioeconomic status (SES) indicators from census group blocks in which the women resided, including income and education. However, few individual-level variables were considered in these analyses, and by design, the study population was enriched for women with allergies and asthma.

By using our cohort of women recruited during pregnancy for longitudinal study of their children, our goal was to examine whether pregnant black and white women living in the same region (urban and suburban Detroit, Michigan) were sensitized to the same allergens at similar rates and whether the groups had received a prior doctor's diagnosis of asthma, hay fever, and eczema at the same rates. In these epidemiologic analyses we also compared total IgE levels between these groups and within subgroups based on a prior doctor's diagnosis. We then explored whether any observed differences could be explained, either fully or in part, by various components of current SES or other environmental factors measured at the individual level.

METHODS

Study population

These analyses used a National Institutes of Health and institutionally funded cohort study, the Wayne County Health, Environment, Allergy and Asthma Longitudinal Study (WHEALS), that enrolled pregnant women receiving care at Henry Ford Health System obstetrics clinics in urban and suburban Detroit, Michigan. The primary objective for the original cohort study was to examine early-life exposures related to childhood allergic diseases in the offspring of the enrolled pregnant women. These pregnant women serve as the source population for these secondary analyses. WHEALS includes interview data about the women during pregnancy,

From ^athe Department of Public Health Sciences and ^bthe Division of Allergy and Clinical Immunology, Henry Ford Hospital, Detroit, and ^cthe Department of Pediatrics, Georgia Health Sciences University, Augusta.

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Corresponding author: Ganesa Wegienka, PhD, 1 Ford Place, 3E, Detroit, MI 48202.

E-mail: gwegien1@hfhs.org.

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coincident with several postpartum home visits, and during a clinic visit for her child at age 2 years. Most women provided a blood sample during pregnancy at the time of enrollment in the obstetrics clinic. Dust samples were collected at the home visits, and analyses of these data are incorporated into the present analyses. We have previously published details of the cohort's creation.^{9,10}

The last WHEALS birth was in December 2007 after enrolling 1258 pregnant women. Of the 1258 women enrolled, 290 identified themselves as "Caucasian/white" and neither Hispanic nor Middle Eastern (hereafter referred to as white) and 777 self-identified as "African American/black" (hereafter referred to as black). We collected 219 (75.5%) and 563 (72.5%) blood samples from the white and black women, respectively. Blood sample collection during pregnancy, which was not part of the original hypotheses of WHEALS, was not attempted for all women enrolled because financial resources did not permit the collection and processing of blood samples for all women. Thus women who were not asked to provide a blood sample during pregnancy were recruited during a specific time period, and their lack of a sample was not tied to any maternal or clinical characteristics. The women included in the present analyses have results on total IgE and allergen-specific IgE (sIgE) measurement. Women enrolled in WHEALS who were included and not included (no blood sample) in the analyses are compared to assess differences.

Data collection

The baseline interview at recruitment during pregnancy included questions about maternal marital status, educational status, household income, smoking status, and whether she paid for housing (made monthly rental or mortgage payments). The interview also included the following questions that serve as the source of outcomes for the analyses: "Did a doctor ever diagnose you with hay fever, nasal allergies or allergic rhinitis?"; "Did a doctor ever diagnose you with asthma?"; and "Did a doctor ever diagnose you with eczema or atopic dermatitis?" Current asthma was defined as ever having a doctor's diagnosis of asthma plus having an asthma attack, having taken asthma medications, or both in the last 12 months.

The woman's address at recruitment was used to determine whether the residence was "urban" (Detroit, Hamtramck, or Highland Park) or "suburban" (all other settings). As part of the WHEALS protocol, dust samples were collected from the children's bedroom floors in the first year of life, and the samples were analyzed for cat allergen (Fel d 1), dog allergen (Can f 1), cockroach allergen (Bla g 2), and endotoxin using methods we have previously published.¹¹ No dust samples were collected during pregnancy, and the samples collected postpartum were used as an approximation of the prenatal dust.

Blood was collected to determine levels of total IgE and sIgE (dust mite [*Dermatophagoides farinae*], dog, cat, timothy grass, ragweed, *Alternaria alternata*, egg, and German cockroach [*Blattella germanica*]). Measurement of total IgE and sIgE levels was performed according to the manufacturer's standard protocols by using the Pharmacia UniCAP system (Pharmacia-Upjohn Diagnostic Division, Kalamazoo, Mich). A positive sIgE level was defined as 0.35 kU/L or greater.

Statistical analyses

Analyses were performed with SAS software (version 9.2; SAS Institute, Cary, NC), and a *P* value of less than .05 was considered statistically significant. Likelihood ratio χ^2 and *t* tests were used to compare characteristics of participants who were included and excluded from the analyses. Percentages (positive sIgE level; doctor's diagnosis of hay fever/nasal allergies/allergic rhinitis, asthma, and eczema; and current asthma) and geometric means (total IgE levels) were used to describe the frequency of diseases and distributions of total IgE levels. Wilcoxon rank sum and χ^2 tests were used to compare the frequency of diseases and distributions of total IgE levels between black and white women. A Jonckheere-Terpstra test for trend was used to compare the distribution of the total number of allergens to which the women were sensitized. Logistic regression models were used to investigate binary outcomes (≥ 1 positive sIgE level, doctors' diagnoses, and current asthma), and linear regression was used to model continuous data (log-transformed total IgE levels)

TABLE I. Descriptive statistics and percentages for baseline doctors' diagnoses, allergic sensitization, and race*

	White women	Black women	<i>P</i> value†
No.	219	563	
Total IgE level (IU/mL), geometric mean (95% CI)	20.0 (16.2-24.6)	47.8 (42.5-53.8)	<.001
Had ≥ 1 sIgE ≥ 0.35 kU/L	88 (40.2%)	352 (62.5%)	<.001
	No. (%)	No. (%)	
sIgE ≥ 0.35 kU/L			
Dog	32 (14.6%)	130 (23.2%)	.008
Cat	38 (17.4%)	128 (22.9%)	.097
<i>Alternaria alternata</i>	26 (11.9%)	150 (26.8%)	<.001
Cockroach	12 (5.5%)	109 (19.5%)	<.001
Dust mite (<i>Dermatophagoides farinae</i>)	50 (22.8%)	131 (23.4%)	.86
Short ragweed	45 (20.6%)	214 (38.3%)	<.001
Timothy grass	38 (17.4%)	175 (31.4%)	<.001
Egg	2 (0.9%)	12 (2.1%)	.37
Doctors' diagnoses			
Ever had doctor's diagnosis of hay fever/nasal allergies/allergic rhinitis	38 (17.5%)	87 (15.7%)	.55
Ever had doctor's diagnosis of asthma	35 (16.0%)	128 (22.7%)	.037
Current asthma (ever doctor's diagnosis plus either attack or asthma medications in last 12 mo)	21 (9.6%)	48 (8.5%)	.64
Ever had doctor's diagnosis of eczema	32 (14.8%)	122 (21.9%)	.025

*Totals vary because of some missing data: 16 missing responses for a doctor's diagnosis of hay fever/nasal allergies/allergic rhinitis, 1 missing response for a doctor's diagnosis of asthma and current asthma, and 9 missing responses for a doctor's diagnosis of eczema.

†*P* values test differences in percentages of each outcome between black and white women.

to determine whether SES and other individual-level factors could explain any observed racial differences. Data were transformed as needed to meet model assumptions. Changes in effects criteria of 20% were used to evaluate confounders.

No single definition of SES has proved to explain racial disparities in allergic diseases. We used numerous factors to represent SES in our analyses, including household income, education, and whether the woman paid for housing. We also considered additional factors not necessarily considered SES markers in the analyses, including whether the woman was exposed to indoor pets during pregnancy, maternal age, and marital status (married/living as married or not). We included additional models restricted to women who had dust samples with individual adjustments for the samples (endotoxin, dog allergen, cat allergen, and cockroach allergen) and for simultaneous adjustment for all variables, including results from the dust analyses.

Our analyses considered how the association between race and the diseases varied in models with the addition of indicators of SES and other factors. Because our focus was on the association between race and outcomes, our modeling strategy was to assess the change in the association (coefficient) for race for each outcome (allergic disease or total IgE level) from the unadjusted model to models that were first adjusted for each potential confounder individually and then all potential confounders simultaneously. We could not adjust for whether the woman lived in an urban or suburban location because 140 (24.9%) black women lived in a suburban setting and 89% of white women lived in a suburban setting; thus race was highly correlated with

TABLE II. Logistic regression analyses (ORs with 95% CIs) measuring associations between dependent variables and race (black vs white) adjusted for covariates

	≥1 Positive sIgE level	Doctor's diagnosis of hay fever/nasal allergies/allergic rhinitis	Doctor's diagnosis of asthma	Doctor's diagnosis of eczema
OR for race (95% CI)	2.48 (1.80-3.42)*	0.88 (0.58-1.34)	1.55 (1.03-2.33)*	1.62 (1.06-2.48)*
OR (95% CI) for race adjusting for each of the following individually				
No. of prior pregnancies	2.64 (1.91-3.66)*	0.87 (0.57-1.33)	1.56 (1.03-2.36)*	1.53 (1.00-2.36)*
Report of household income	2.69 (1.92-3.77)*	0.94 (0.61-1.46)	1.41 (0.92-2.16)	1.79 (1.15-2.78)*
Maternal education	2.59 (1.85-3.62)*	1.04 (0.67-1.62)	1.46 (0.95-2.23)	1.71 (1.10-2.66)*
Make monthly mortgage or rental payments	2.39 (1.74-3.31)*	0.84 (0.54-1.27)	1.52 (1.01-2.31)*	1.70 (1.11-2.61)*
Prenatal indoor pet(s)	2.61 (1.85-3.69)*	0.88 (0.56-1.38)	1.56 (1.01-2.42)*	1.67 (1.06-2.63)*
Mother was married or living as married during pregnancy	2.46 (1.75-3.47)*	1.00 (0.64-1.56)	1.24 (0.79-1.92)	1.62 (1.03-2.55)*
Women smoked	2.48 (1.80-3.41)*	0.87 (0.57-1.32)	1.56 (1.04-2.36)*	1.62 (1.06-2.47)*
Home is in urban setting	2.41 (1.63-3.56)*	0.97 (0.58-1.62)	1.38 (0.84-2.26)	1.70 (1.02-2.81)*
Maternal age at enrollment	2.45 (1.77-3.39)*	0.94 (0.61-1.43)	1.49 (0.98-2.26)	1.66 (1.08-2.56)*
OR for race (95% CI) adjusted for above variables†	2.59 (1.67-4.03)*	1.02 (0.58-1.82)	1.14 (0.66-1.97)	1.73 (0.99-3.04)
For women who had dust samples				
Endotoxin (n = 583)	2.61 (1.83-3.74)*	0.81 (0.51-1.28)	1.18 (0.76-1.84)	1.79 (1.11-2.89)*
Dog allergen (n = 611)	2.78 (1.93-4.02)*	0.80 (0.50-1.28)	1.14 (0.73-1.80)	1.74 (1.06-2.84)*
Cat allergen (n = 610)	3.07 (2.08-4.53)*	0.90 (0.55-1.47)	1.38 (0.86-2.23)	1.93 (1.15-3.24)*
Cockroach allergen (n = 604)	2.83 (1.98-4.05)*	0.80 (0.51-1.26)	1.24 (0.80-1.93)	1.77 (1.09-2.86)*
OR for race (95% CI) adjusted for all variables, including dust‡ (n = 564)	3.35 (1.96-5.73)*	1.20 (0.62-2.34)	1.16 (0.61-2.21)	2.31 (1.18-4.55)*

OR, Odds ratio.

* $P < .05$.

†Variables are number of prior pregnancies, income, education, rental/mortgage payments, pets in the home during pregnancy, whether the mother was married or living as married during pregnancy, maternal smoking status, urban residence, and maternal age at enrollment.

‡Variables are number of prior pregnancies, income, education, rental/mortgage payments, pets in the home during pregnancy, whether the mother was married or living as married during pregnancy, maternal smoking status, urban residence, and maternal age at enrollment. Models also adjusted for levels of endotoxin and dog, cat, and cockroach allergen from home samples.

residence setting in our data. This correlation reflects the metropolitan Detroit area's demographic patterns.

RESULTS

Among enrolled white women, those who provided a blood sample were no different ($P > .05$) than those who did not with respect to any of the study characteristics, including number of prior pregnancies, income, education, payment for housing, indoor pet keeping during pregnancy, marital status, smoking status, urban residence, and age at enrollment (see Table E1 in this article's Online Repository at www.jacionline.org). Black women included in the study had higher incomes than black women not included in the study ($P = .009$, χ^2 test).

Among women included in the analyses, white women had fewer prior pregnancies, had greater income and education, and were more likely to make payments for housing than black women. White women also were more likely to have indoor pets, have breast-fed their child, and have been married or been living as married and currently living in the suburbs. The black women tended to be younger (see Table E1).

sIgE

Black women were more likely to have had at least 1 positive specific IgE level of 0.35 IU/mL or greater compared with white women (62.5% vs 40.2%, $P < .001$, Table I). Compared with white women, black women in WHEALS were statistically significantly more likely to be sensitized to each of the specific allergens (dog, cat, *A. alternata*, cockroach, short ragweed, and timothy

grass), with the exception of dust mite ($P = .86$, χ^2 test) and egg ($P = .37$, χ^2 test; Table I).

Overall, black women were sensitized to more allergens than white women ($P < .01$, test for trend; see Table E2 in this article's Online Repository at www.jacionline.org). However, the number of total allergens to which the women had a positive sIgE level were not different between black and white women when the groups were limited to only those who had at least 1 positive sIgE level ($P = .11$, test for trend; see Table E2). After adjusting for each SES factor and other factors individually and simultaneously, the difference in the odds of having at least 1 positive sIgE level between black and white women persisted (Table II).

Doctors' diagnoses of allergic diseases

In our study population the rates of doctors' diagnoses of hay fever did not differ between white (17.5%) and black (15.7%) women ($P = .55$, Table I). After adjusting for SES and other factors individually and simultaneously, there was no evidence of difference in the odds of having a doctor's diagnosis of hay fever between black and white women (Table II).

Black women were more likely than white women to have ever had a doctor's diagnosis of asthma (22.7% vs 16.0%, $P = .04$); however, the rates of current asthma were similar (Table I). The odds ratio (1.55; 95% CI, 1.03-2.33) was reduced after adjusting for SES and other factors individually (Table II). The association no longer persisted after adjusting for each factor simultaneously (Table II).

TABLE III. Regression coefficient (β) with 95% CIs in the linear regression model for race (black vs white) and log-transformed total IgE levels (the crude estimate is included, as are estimates adjusted for various SES variables and other selected factors)*

	Log-transformed total IgE level	Average % increase in total IgE level (for a black woman compared with a white woman)
No.	782	
Regression coefficient (β) for race (95% CI)	0.87 (0.64-1.10)	139%
Regression coefficient (β [95% CI]) for race adjusting for each of the following individually		
No. of prior pregnancies	0.89 (0.66-1.12)	144%
Report of household income	0.85 (0.61-1.09)	134%
Maternal education	0.83 (0.59-1.07)	129%
Make monthly mortgage or rental payments	0.87 (0.64-1.10)	139%
Prenatal indoor pet(s)	0.86 (0.62-1.11)	136%
Mother was married or living as married during pregnancy	0.84 (0.60-1.09)	132%
Women smoked	0.88 (0.65-1.11)	141%
Home is in urban setting	0.82 (0.53-1.10)	127%
Maternal age at enrollment	0.85 (0.61-1.08)	134%
Regression coefficient (β) for race (95% CI) adjusted for above variables†	0.78 (0.48-1.09)	118%
For women who had dust samples		
Endotoxin (n = 583)	0.84 (0.59-1.10)	132%
Dog allergen (n = 611)	0.82 (0.56-1.08)	127%
Cat allergen (n = 610)	0.89 (0.62-1.16)	144%
Cockroach allergen (n = 604)	0.87 (0.62-1.13)	139%
Regression Coefficient (β) for race (95% CI) adjusted for all variables, including dust‡ (n = 564)	0.88 (0.52-1.24)	141%

*Total IgE level was log transformed to meet model assumptions. The regression coefficient (β) should be interpreted as the ($e^{\beta} - 1$) percentage increase in the mean total IgE level for black compared with white women.

†Variables are number of prior pregnancies, income, education, rental/mortgage payments, pets in the home during pregnancy, whether the mother was married or living as married during pregnancy, maternal smoking status, urban residence, and maternal age at enrollment.

‡Variables are number of prior pregnancies, income, education, rental/mortgage payments, pets in the home during pregnancy, whether the mother was married or living as married during pregnancy, maternal smoking status, urban residence, and maternal age at enrollment. Models also adjusted for levels of endotoxin and dog, cat, and cockroach allergen from home samples.

Black women were also more likely to have ever had a doctor's diagnosis of eczema (21.9% vs 14.8%, $P = .025$, Table I). Black women were still more likely to have had the diagnosis, even after adjusting for each SES factor and other factor individually, as well as simultaneously (Table II).

Total IgE

Compared with white women, black women in WHEALS had higher total IgE levels at enrollment (geometric mean, 47.8 IU/mL [95% CI, 42.5-53.8 IU/mL] vs 20.0 IU/mL [95% CI, 16.2-24.6 IU/mL]; $P < .001$, Wilcoxon rank sum test; Table I). On the basis of a linear regression model, the unadjusted regression coefficient (β) for race in the model of log-transformed total IgE levels was 0.87 (95% CI, 0.64-1.10). This suggests that black women have a total IgE level that is approximately 139% higher than their white counterparts.

Adjusting for any individual factor or all factors simultaneously did not appreciably alter this association (Table III). The regression coefficient (β) should be interpreted as the ($e^{\beta} - 1$) percentage increase in the mean total IgE level for black women compared with white women. All regression coefficients for race had a P value of greater than .05. We also compared total IgE levels between black and white women within subgroups defined by whether they had positive results for at least 1 sIgE, had a doctor's diagnosis of asthma, had current asthma, had a doctor's diagnosis of hay fever, and had a doctor's diagnosis of eczema (Table IV). Regardless of whether the women had at least 1 positive sIgE level or a prior diagnosis, black women still tended to have higher total IgE levels than white women (all $P < .05$), except for women

who had current asthma. Although the total IgE geometric mean level was higher for black women compared with white women with current asthma, the difference was not statistically significantly different ($P = .83$, Table IV).

DISCUSSION

In our cohort of pregnant women in the urban and suburban areas of metropolitan Detroit, black women had higher total IgE levels than white women, regardless of whether they were sensitized to allergens or had prior allergy-related diagnoses. In addition, black women were more commonly sensitized to at least 1 allergen than white women and were more likely to have ever had a doctor's diagnosis of eczema. In our population there were no specific allergens to which white women were more commonly sensitized than black women. None of the observed differences could be explained by current SES or other concurrent factors.

Our analyses and preliminary data from some of these women previously published in an analysis of genetic ancestry¹² demonstrate that racial differences in allergic sensitization exist in pregnant women in our region and that black women are disproportionately affected compared with white women. In their study of 882 pregnant women (169 were black and 577 were white) in the Boston, Massachusetts, area, Litonjua et al⁶ reported higher total IgE levels for black women compared with white women, but white women were more likely to have reported that a doctor told them they had hay fever (44.2% vs 27.9%) and eczema (22.8% vs 17.8%). They also reported that black women were more likely than white women to have been told by a doctor that they had asthma (50.9% vs 27.9%), as well as

TABLE IV. The geometric means (95% CIs) of total IgE levels (in international units per milliliter) within subgroups

	White women	Black women	P value*
≥1 Positive sIgE	n = 88 66.9 (52.0-85.9)	n = 352 93.8 (83.3-105.5)	.016
No positive sIgE	n = 131 8.9 (7.2-11.0)	n = 211 15.5 (13.3-18.2)	<.001
Doctor's diagnosis of asthma	n = 35 35.6 (18.1-70.1)	n = 128 78.5 (60.2-102.5)	.027
No doctor's diagnosis of asthma	n = 184 17.9 (14.5-22.1)	n = 435 41.3 (36.3-47.0)	<.001
Current asthma	n = 21 47.7 (16.3-139.7)	n = 48 56.4 (36.8-86.3)	.83
No current asthma	n = 198 18.2 (14.9-22.2)	n = 211 47.1 (41.6-53.3)	<.001
Doctor's diagnosis of hay fever	n = 38 33.6 (19.4-58.1)	n = 87 68.3 (51.5-90.5)	.033
No doctor's diagnosis of hay fever	n = 179 17.7 (14.2-22.1)	n = 466 43.8 (38.5-49.9)	<.001
Doctor's diagnosis of eczema	n = 32 29.2 (18.2-46.9)	n = 122 59.7 (45.4-78.5)	.013
No doctor's diagnosis of eczema	n = 185 18.8 (15.0-23.8)	n = 435 34.7 (30.8-39.1)	<.001

*Wilcoxon rank sum test.

being sensitized to each of the allergens examined (dust mite, dog, cat, cockroach, *Aspergillus* species, *Alternaria* species, ragweed, and ryegrass). Black women were approximately 2.5 times more likely than white women to be sensitized to 3 or more allergens. The racial differences were not explained by census block group-level SES variables. The overall sensitization and diagnostic rates for women in their study were higher than the rates in our study for both black and white women. In contrast, black women rather than white women were more likely to have a prior eczema diagnosis in our study, and differences in asthma rates between black and white women in our study did not remain statistically significant after adjustment. However, our study population was not enriched with women reporting an allergic history as in the Boston-area study. Also, census block group-level rather than individual-level data (as in our analyses) were used in the Boston study to adjust for differences in the groups. In our analyses the associations between race and allergic diseases persisted, even after adjusting for the common SES variables and other variables reported by the women.

Surprisingly, few other data have been published on racial differences in allergic diseases in adult women. Although not limited to pregnant women, National Health and Nutrition Examination Survey (NHANES) III data indicated that black subjects aged 6 to 59 years were more likely than white subjects to have had a positive skin prick test response to at least 1 of 10 allergens (adjusted odds ratio, 1.6; 95% CI, 1.4-1.9).¹ Data from NHANES 2005-2006 also demonstrated that total IgE levels were higher in black subjects than white subjects.¹³ On the basis of data from subjects of all ages in the National Health Interview Survey, female subjects (9.3%) had higher current asthma prevalence than male subjects (7.0%), and black subjects (11.1%) had higher rates than white subjects (7.8%).¹⁴ Another example is from NHANES data (2001-2002 and 2003-2004), in which McHugh et al¹⁵ reported that 14.0% (95% CI, 12.3% to 15.9%) of white women and 13.5% (95% CI, 11.2% to 16.2%) of black women aged 20

to 85 years in their study had a prior asthma diagnosis. Because risks for allergic diseases, including sensitization, might not be uniform across groups within a larger population, further insight is provided when associations are examined in subgroups (defined by characteristics such as race, sex, and age), as we have done in our population of black and white women of reproductive age.

We understand that diseases such as eczema, asthma, and allergic sensitization might more commonly be concordant in children than the results we see in our analyses. However, racial disparities in these outcomes have not been well studied in women of reproductive age. Our results could be due to a combination of factors. For example, it is often believed that the majority of childhood asthma is attributable to allergic sensitization. This might not be true of asthma in adult women. Also, there could be racial differences in medical treatment-seeking behaviors in our participants that could lead to differences in diagnoses. We did not capture information on this. These reasons provide further support for the need for a well-designed and executed study of racial disparities in adult women.

Our analyses focused on a large group of pregnant black and white women from the same region. Although our data do not allow us to identify specific underlying causes of allergic disease, our goal was to examine whether previously reported patterns in group-level variables also existed in our cohort that included individual-level data. Ideally, we would have examined the associations between race and allergic disorders separately for urban and suburban residents; however, this was not possible. This study is cross-sectional and uses data on current exposures and diseases; we could not establish that SES or other variables preceded incidence or establish risk factors for sensitization in the women. Furthermore, we did not have data on all environmental exposures, such as airborne particulates, and the dust samples were collected after the child's birth. Part of the analyses were based on sIgE levels, and sensitization does not necessarily indicate that symptoms occur in the presence of the allergen. However, sensitization is important because it is upstream of clinically apparent allergy in the causal pathway. Despite these limitations, we think there are many strengths of our study, such as inclusion of a large group of black women who were not selected based on increased risk for allergy. Our detailed data on individual variables and dust samples are additional assets to our analyses.

Although research continues on racial disparities in treatment efficacy for allergic diseases, such as asthma, investigation of sources of racial differences in the prevalence and incidence of these allergic diseases has been minimal. What could explain these racial differences? As Litonjua et al⁶ pointed out, allergies are associated with higher SES in European countries. However, adjustment for SES and other factors in our study did not ameliorate all observed racial differences. Although efforts to identify causation should be embraced, identification of modifiable factors is crucial. Furthermore, total IgE levels are higher in black women regardless of disease status. Thus not only do we need to know what causes this racial difference in total IgE levels, but we also need to understand whether there are racial differences in the role total IgE levels might or might not play in the development of allergic diseases. We agree, as Litonjua et al⁶ suggested, that gene-environment interactions, varying patterns of exposure to allergens and pollutants, and psychosocial stress might be sources of the racial differences. Recently, vitamin D deficiency has also emerged as an important area of opportunity for research

in allergic disease¹⁶⁻²⁵ and would be a logical pursuit given that black women of reproductive age can experience vitamin D “hypovitaminosis” (25[OH]D ≤15 ng/mL) at 10 times the rate of their white counterparts (42.3% vs 4.2%).²⁶

Racial differences in our large cohort-based cross-sectional study demonstrate that black women were more likely than white women to have increased sIgE levels and higher total IgE levels and to have had a prior doctor’s diagnosis of eczema but not hay fever or asthma (after adjustment of common variables). The associations between race and these diseases could not be explained by current family income, maternal education or marital status, payment for family housing, prenatal exposure to indoor pets, being a smoker, or a host of other factors. Although further evidence demonstrating the degree of racial differences in allergic diseases emerges, development of novel intervention strategies is essential. Our own group has suggested that prevention might be as important as disease management if racial disparities in asthma are to be eliminated.²⁷ To truly eliminate racial disparities in allergic diseases, we need to seriously focus on designing studies to address causation and identify modifiable factors. To better understand the sources of racial differences, longitudinal studies of racially, socially, economically, and residually diverse groups sufficient in size to allow subgroup analyses are needed (eg, urban-dwelling black subjects vs suburban-dwelling black subjects vs suburban-dwelling white subjects vs urban-dwelling white subjects). With the limited progress that has been made in reducing racial disparities in allergic diseases, radical new hypotheses and approaches are needed to tackle this critical public health problem.

Key message

- Racial differences in allergic sensitization and eczema in adult women require further research to identify causes and potential preventive measures.

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TABLE E1. Summary information on women enrolled in WHEALS*

	Included White women	Included Black women	Excluded White women	Excluded Black women
No.	219	563	71	214
Total IgE (IU/mL), geometric mean (95% CI)	20.0 (16.2-24.6)	47.8 (42.5-53.8)	—	—
<i>P</i> value (black vs white)	<.001			
Had ≥1 sIgE level ≥0.35 kU/L	88 (40.2%)	352 (62.5%)	—	—
<i>P</i> value (black vs white)	<.001			
Ever had doctor's diagnosis of hay fever/nasal allergies/allergic rhinitis	38 (17.5%)	87 (15.7%)	16 (22.9%)	23 (10.9%)
<i>P</i> value (black vs white)	.55		.012	
<i>P</i> value (included vs excluded by race)	.32	.09		
Ever had doctor's diagnosis of asthma	35 (16.0%)	128 (22.7%)	17 (24.3%)	42 (19.6%)
<i>P</i> value (black vs white)	.037		.40	
<i>P</i> value (included vs excluded by race)	.12	.35		
Current asthma (ever doctor's diagnosis plus either attack or asthma medications in last 12 mo)	21 (9.6%)	48 (8.5%)	6 (8.6%)	8 (3.7%)
<i>P</i> value (black vs white)	.64		.12	
Ever had doctor's diagnosis of eczema	32 (14.8%)	122 (21.9%)	7 (9.9%)	35 (16.4%)
<i>P</i> value (black vs white)	.025		.18	
<i>P</i> value (included vs excluded by race)	.30	.09		
No. of prior pregnancies (mean [SD])	1.5 (1.5)	2.2 (1.9)	1.4 (1.5)	2.3 (2.0)
<i>P</i> value (black versus white)	<.001		<.001	
<i>P</i> value (included vs excluded by race)	.49	.35		
Reported household income*				
<\$20,000	14 (7.0%)	78 (16.3%)	5 (7.6%)	52 (27.5%)
\$20,000-<\$40,000	30 (14.9%)	155 (32.4%)	11 (16.6%)	54 (28.6%)
\$40,000-<\$80,000	72 (35.8%)	153 (32.0%)	18 (27.3%)	45 (23.8%)
\$80,000-<\$100,000	40 (19.9%)	44 (9.2%)	12 (18.2%)	22 (11.6%)
≥\$100,000	45 (22.4%)	48 (10.1%)	20 (30.3%)	16 (8.5%)
<i>P</i> value (black vs white)	<.001		<.001	
<i>P</i> value (included vs excluded by race)	.63	.009		
Maternal education				
Less than high school graduate	7 (3.2%)	39 (6.9%)	4 (5.6%)	12 (5.6%)
High school graduate	29 (13.2%)	105 (18.7%)	12 (16.9%)	50 (23.4%)
Some college	82 (37.5%)	314 (55.8%)	24 (33.8%)	111 (51.9%)
At least a bachelor's degree	101 (46.1%)	105 (18.6%)	31 (43.7%)	41 (19.1%)
<i>P</i> value (black vs white)	<.001		.001	
<i>P</i> value (included vs excluded by race)	.66	.46		
Makes a monthly mortgage or rental payment (yes)	188 (90.8%)	410 (80.9%)	58 (85.3%)	159 (82.4%)
<i>P</i> value (black vs white)	.001		.58	
<i>P</i> value (included vs excluded by race)	.20	.65		
Indoor pet(s) during pregnancy (yes)	140 (63.9%)	141 (25.0%)	53 (74.6%)	51 (23.8%)
<i>P</i> value (black vs white)	<.001		<.001	
<i>P</i> value (included vs excluded by race)	.10	.73		
Ever breast-fed the child (yes)	125 (63.4%)	244 (51.2%)	39 (57.4%)	80 (42.3%)
<i>P</i> value (black vs white)	.004		.033	
<i>P</i> value (included vs excluded by race)	.37	.040		
Mother was married or living as married during pregnancy	189 (86.3%)	259 (46.0%)	56 (78.9%)	115 (53.7%)
<i>P</i> value (black versus white)	<.001		<.001	
<i>P</i> value (included vs excluded by race)	.13	.054		
Woman is a smoker	35 (16.0%)	66 (11.7%)	17 (23.9%)	19 (8.9%)
<i>P</i> value (black vs white)	.11		.001	
<i>P</i> value (included vs excluded by race)	.13	.26		
Home is in an urban rather than suburban setting	25 (11.4%)	423 (75.1%)	7 (9.9%)	169 (79.0%)
<i>P</i> value (black vs white)	<.001		<.001	
<i>P</i> value (included vs excluded by race)	.79	.24		
Maternal age at enrollment (y), mean (SD)	30.9 (4.6)	28.8 (5.3)	30.4 (4.8)	29.3 (5.4)
<i>P</i> value (black vs white)	<.001		.12	
<i>P</i> value (included vs excluded by race)	.47	.30		

Included women who had a blood sample collected at recruitment during pregnancy, and excluded women who did not.

*Totals vary because of some missing data.

TABLE E2. Comparison of the total number of sIgE levels of 0.35 kU/L or greater between white and black women

	White women	Black women	
	No. (%)	No. (%)	P value*
All women			<.001
0	131 (60.4%)	211 (38.0%)	
1	27 (12.4%)	81 (14.6%)	
2	22 (10.1%)	75 (13.5%)	
3	11 (5.1%)	73 (13.2%)	
≥4	26 (12.0%)	115 (20.7%)	
Has ≥1 sIgE level ≥0.35 kU/L			.11
1	27 (31.4%)	81 (23.6%)	
2	22 (25.6%)	75 (21.8%)	
3	11 (12.8%)	73 (21.2%)	
≥4	26 (30.2%)	115 (33.4%)	

*The *P* value is for a test for trend comparing the total number (continuous) of sIgE levels of 0.35 kU/L or greater between white and black women.