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Racial, Ethnic, and Socioeconomic Differences in Adolescent Food Allergy

E.R. Coulson, MD[1,2], **S.L. Rifas-Shiman, MPH**[3], **J.E. Sordillo, ScD**[3], **S. Bunyavanich, MD, MPH**[4], **C.A. Camargo Jr., MD, Dr.PH**[5,6], **T.A. Platts-Mills, MD**[7], **B.A. Coull, Ph. D**[8], **H. Luttmann-Gibson, Ph. D**[8], **E. Oken, MD, MPH**[3], **D.R. Gold, MD, MPH**[6], **M.B. Rice, MD, MPH**[2]

[1]Division of Allergy and Immunology, Dept. of Medicine, University of Michigan, Ann Arbor, MI

[2]Dept. of Medicine, Beth Israel Deaconess Medical Center, Boston, MA

[3]Division of Chronic Disease Research Across the Lifecourse, Dept. of Population Medicine, Harvard Medical School and Harvard Pilgrim Health Care Institute, Boston, MA

[4]Division of Allergy and Immunology, Dept. of Pediatrics and Dept. of Genetics and Genomic Sciences, Icahn School of Medicine at Mount Sinai, New York, NY

[5]Dept. of Emergency Medicine, Massachusetts General Hospital, Boston, MA

[6]Channing Division of Network Medicine, Dept. of Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA

[7]Asthma and Allergic Diseases Center, University of Virginia Health System, Charlottesville, VA

[8]Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, Massachusetts, USA

To the Editor:

Food allergy is a growing and serious health problem in the US(1). However, the relationships between demographic characteristics, socioeconomic status (SES), and food allergy are unclear. Racial disparities have been identified in the prevalence of food specific IgE(2) and in the clinical practice of allergy-related healthcare(3).

To evaluate socioeconomic and racial/ethnic disparities in food allergy, we investigated associations of race/ethnicity and SES factors during pregnancy with both food-specific IgE and allergic-type symptoms to common food allergens (milk, egg, peanut, soy, and wheat) in adolescents in a large Boston-area cohort.

The study participants were 1,148 adolescents from Project Viva, a prospective pre-birth cohort. Participant's mothers were enrolled at their initial prenatal visit (between April 1999 and July 2002). Further details about the cohort, exposure and outcome assessment, and statistical analyses are described in this article's online repository.

Corresponding Author: Elise Coulson, MD, UM Allergy/Clinical Immunology, 24 Frank Lloyd Wright Drive, Suite H-2100, Ann Arbor, MI 48106, coulsone@med.umich.edu.

We examined the following indicators of SES: maternal education, smoking by the mother during pregnancy and by anyone in the home during the child's first year of life, household income, and median household income from the neighborhood census tract. We determined the race/ethnicity of the adolescent by asking the mother to choose one or more racial/ethnic groups for her child

For those participants with sufficient blood samples to measure specific IgE levels by Phadia ImmunoCAP, we examined sensitivity to each of these 5 common food allergens (milk, egg, peanut, soy, and wheat). We also evaluated IgE-mediated symptoms (hives, wheeze, dyspnea, itchy throat, cough, rhinitis, eczema, nausea/vomiting, diarrhea, loss of consciousness) following food intake, as reported by maternal questionnaire. We assessed associations of adolescent race/ethnicity and SES with allergy symptoms and allergen-specific IgE using logistic regression models. For high prevalence outcomes (peanut and wheat-specific IgE, with prevalence of >27% among non-Hispanic black and "other" participants), we also determined prevalence ratios. All models adjusted for age, sex, race/ethnicity and parental history of atopy.

See online repository Table E1 for participant characteristics. Of the 647 adolescents with sufficient blood samples, 31% had food specific IgE >0.35 k/UL to at least one of the 5 foods (See Table E2 in this article's online repository).

Associations of race/ethnicity and SES indicators with allergic sensitization are reported in Table 1. Non-Hispanic black teens had higher risk of sensitization to each of the 5 foods, reaching statistical significance for peanut (prevalence ratio 2.29, 95% CI 1.54, 3.39) and wheat (prevalence ratio 1.64, 95% CI 1.15, 2.34).

Adolescents whose mothers had less than a college degree vs. a graduate degree had higher odds of sensitization to milk (OR 3.00, 95% CI 1.46, 6.16) and adolescents whose mothers had a college degree vs. a graduate degree had higher odds of sensitization to wheat (OR 1.73, 95% CI 1.06, 2.81). Associations between low maternal education and each of the other 3 foods were also positive however confidence intervals were wide and included 1.0. Adolescents from homes with annual household income ≤$40,000 vs. >$70,000 also had greater odds of sensitization to milk, egg, peanut, and soy, although comparisons did not reach statistical significance. Similarly, this pattern was observed for milk, peanut, soy, and wheat in adolescents from households with incomes $40,001-$70,000 vs. >$70,000, reaching statistical significance for soy (OR 2.02, 95% CI 1.05, 3.89). Maternal prenatal smoking was associated with a higher odds of peanut sensitization (OR 1.80; 95% CI 0.97, 3.34), but the lower confidence limit did cross 1.0. Otherwise exposure to smoking and living in lowest quartile of census tract income were not associated with allergic sensitization.

The prevalence of food allergy symptoms is reported in online repository E2. Of the 1,145 participants, 83 (7.2%) reported allergic-type symptoms to any food. Associations of race/ethnicity and SES with allergic symptoms upon food ingestion are shown in Table 2. There were no convincing patterns of association for any measures of SES with food allergy symptoms. However, non-Hispanic black adolescents had a higher odds of maternal

reporting of allergic symptoms to peanut (OR 2.41, 95% CI 1.12, 5.17) compared to non-Hispanic white adolescents.

In this prospective pre-birth cohort residing in the Northeastern U.S., there was a pattern of higher odds of sensitization to all 5 foods studied in association with non-Hispanic black race. Lower household income was associated with higher odds of sensitization to soy, and lower maternal educational attainment was associated with higher odds of sensitization to milk and wheat.

Current theories to explain the increasing prevalence of food allergies have focused on hygiene, microbiome, diet, and allergen exposure(4), but have not generally focused on racial/ethnic or socioeconomic disparities underlying this growing childhood health problem. One possible explanation may be early childhood diet. While the LEAP randomized trial demonstrated a reduced risk of developing a peanut allergy in high risk infants if peanuts are introduced at an early age(5), CDC data has shown that early childhood nut consumption varies by race and SES. Specifically, non-Hispanic black youths and those from lower income households consume fewer nuts than white children and those in higher income households(6). These dietary patterns may help explain the higher prevalence of nut allergy observed in our study and others among non-Hispanic black youth.

Our findings are in agreement with other studies in the U.S. that have found a higher prevalence of food sensitization among non-Hispanic blacks(1,7) and in those from lower SES homes(7), although interestingly self-report of food allergy has been found to be less common in these groups(8). Despite an overall decline in food allergy prevalence with age, we demonstrate that racial disparities in food allergen sensitization persist into the teenage years.

Together with evidence of racial disparities in diagnosis and treatment of food allergies(2,3,7) our findings indicate a need to educate both the scientific and lay community about demographic risk factors for food allergy in adolescents.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Clinical Implications:

Our study indicates the existence of racial/ethnic and socioeconomic differences in the prevalence of food allergy among adolescents. These results further the concern that food allergy may be under-diagnosed and under-treated among racial minorities and economically disadvantaged youth.

Table 1:
Associations of Race/Ethnicity and SES with Food-Specific IgE

Data from 647 adolescents participating in Project Viva who had IgE samples

	Milk	Egg	Peanut	Soy	Wheat
	Adjusted odds ratio or prevalence ratio* (95% CI) for food specific IgE >0.35 k/UL				
Adolescent race/ethnicity					
. Non-Hispanic White	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
. Non-Hispanic Black	1.42 (0.75, 2.68)	1.78 (0.84, 3.77)	**2.29 (1.54, 3.39)**	1.68 (0.86, 3.28)	**1.64 (1.15, 2.34)**
. Hispanic	1.55 (0.73, 3.27)	1.75 (0.72, 4.26)	1.28 (0.70, 2.23)	1.32 (0.55, 3.12)	0.66 (0.33, 1.31)
. Other	0.96 (0.39, 2.37)	1.80 (0.74, 4.39)	**2.25 (1.41, 3.58)**	1.94 (0.87, 4.31)	1.45 (0.92, 2.28)
Maternal education					
. <College	**3.00 (1.46, 6.16)**	1.53 (0.68, 3.46)	1.70 (0.94, 3.07)	1.31 (0.63, 2.69)	1.23 (0.69, 2.17)
. College graduate	1.68 (0.85, 3.35)	1.30 (0.61, 2.75)	1.53 (0.89, 2.63)	1.13 (0.58, 2.19)	**1.73 (1.06, 2.81)**
. Graduate degree	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Smoked during pregnancy (yes v. no)	0.76 (0.31, 1.84)	0.86 (0.32, 2.31)	1.80 (0.97, 3.34)	1.76 (0.84, 3.71)	1.37 (0.73, 2.54)
Annual household income					
. <$40,000	1.42 (0.63, 3.20)	1.33 (0.51, 3.42)	1.37 (0.67, 2.77)	1.22 (0.48, 3.13)	0.63 (0.30, 1.32)
. $40,001-70,000	1.29 (0.68, 2.48)	0.91 (0.40, 2.08)	1.61 (0.92, 2.81)	**2.02 (1.05, 3.89)**	1.30 (0.78, 2.18)
. >$70,000	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Any smokers at home in first year (yes v. no)	0.80 (0.36, 1.78)	0.44 (0.15, 1.32)	0.69 (0.34, 1.37)	1.17 (0.54, 2.56)	0.86 (0.46, 1.62)
Census tract median household income (lowest quartile v. upper 3 quartiles)	1.24 (0.65, 2.38)	1.59 (0.75, 3.39)	0.78 (0.44, 1.36)	0.90 (0.44, 1.81)	0.72 (0.41, 1.25)

All models adjusted for adolescent age, sex, and race/ethnicity and parental history of atopy

* Prevalence ratio used in models with common outcomes instead of odds ratio (associations of adolescent race/ethnicity with peanut and wheat IgE)

Table 2:
Associations of Adolescent Race/Ethnicity and Maternal SES with Allergic Symptoms

Data from 1145 adolescents participating in Project Viva who had allergic symptoms data

	Milk	Egg	Peanut	Wheat
	Adjusted OR (95% CI) for allergic symptoms			
Adolescent race/ethnicity				
. Non-Hispanic White	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
. Non-Hispanic Black	1.41 (0.38, 5.29)	2.66 (0.63,11.28)	**2.41 (1.12, 5.17)**	0.72 (0.09, 6.03)
. Hispanic	NA	NA	1.44 (0.48, 4.35)	NA
. Other	1.52 (0.32, 7.16)	1.35 (0.16,11.66)	**4.14 (1.90, 8.99)**	2.29 (0.45,11.50)
Maternal education				
. <College	1.85 (0.38, 9.14)	0.44 (0.07, 2.98)	0.82 (0.34, 1.99)	0.85 (0.14, 5.18)
. College graduate	2.23 (0.56, 8.84)	0.60 (0.13, 2.80)	1.76 (0.85, 3.66)	0.77 (0.17, 3.52)
. Graduate degree	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Smoked during pregnancy (yes v. no)	1.67 (0.36, 7.63)	1.29 (0.16,10.58)	1.16 (0.44, 3.08)	1.25 (0.15,10.22)
Annual household income				
. <$40,000	0.57 (0.06, 5.57)	NA	0.34 (0.12, 1.01)	2.14 (0.32,14.13)
. $40,000-70,000	2.67 (0.86, 8.27)	0.99 (0.18, 5.40)	**0.15 (0.03, 0.64)**	NA
. >$70,000	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Any smokers at home during first year (yes v. no)	1.06 (0.23, 4.95)	0.89 (0.10, 7.68)	0.90 (0.36, 2.22)	0.91 (0.11, 7.56)
Census tract median household income (lowest quartile v. upper 3 quartiles)	0.78 (0.17, 3.64)	0.18 (0.02, 1.79)	1.29 (0.61, 2.74)	0.44 (0.04, 4.47)

All models adjusted for adolescent age, sex, and race/ethnicity and parental history of atopy. NA indicates insufficient prevalence of outcome to estimate OR (95% CI).