

Race, Asthma, and Persistent Wheeze in Philadelphia Schoolchildren

ABSTRACT

Objectives. Many studies show asthma to be more common in Black than in White children. This study assessed how much of this difference remains after adjustment for other potentially race-associated predictors of asthma.

Methods. We assessed the predictors of active diagnosed asthma and persistent wheeze in 1416 Black and White Philadelphia children aged 9 to 11 years, as reported by parents.

Results. Black race remained a significant predictor of active diagnosed asthma (odds ratio [OR] = 2.3; 95% confidence interval [CI] = 1.3, 4.1) but not of persistent wheeze (OR = 1.0; 95% CI = 0.6, 1.8). The excess risk of asthma in Black children was not appreciably altered by adjustment for other demographic and environmental factors.

Conclusions. Black race is an important risk factor for active diagnosed asthma in these urban children, a relationship not explained by social factors. This finding and the lack of an association of race with persistent wheeze after adjustment for social factors suggest that race may be more important to the acquisition of an asthma diagnosis than to the prevalence of the symptoms. (*Am J Public Health.* 1996;86:1406-1409)

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Introduction

According to many reports, asthma is more common in Black children than in White children.¹⁻⁴ It remains unclear how much of this difference in prevalence can be explained by Black children's greater exposure to social and environmental risk factors for asthma compared with White children. Race remained a significant predictor of asthma after adjustment for other potential risk factors in some studies²⁻³ but not in others.⁴ Factors such as poverty,²⁻⁵ urban or inner-city residence,^{1,2,5} and household crowding^{4,6-7} have been associated with asthma in some studies, and Black children may be disproportionately exposed to such risk factors.

In this study, we adjusted for several social, health history, and environmental risk factors for asthma and persistent wheeze among 9- to 11-year-old Black and White children from the city of Philadelphia to determine whether race remained a significant predictor of asthma and/or persistent wheeze in urban children.

Methods

The data were collected in February and March of 1993 as part of a larger study of the respiratory health effects of air pollution on urban children.⁸ Three areas within the city of Philadelphia were selected on the basis of their proximity to air-monitoring stations, which were located near Presbyterian Hospital (6.1 km southwest of the city center), Temple University (3.4 km north of the city center), and Northeast Airport (18.4 km northeast of the city center). Schools within each study area were selected from among nearby schools until approximately 900 eligible children had been identified in each area. Health questionnaires were

distributed to children in the fourth and fifth grades in the selected schools within each area. Participants were children who returned a questionnaire completed by a parent or guardian.

The outcomes of interest were current doctor-diagnosed asthma and persistent wheeze. Asthma was considered to be present if the respondent indicated that the child had ever been diagnosed with asthma by a physician or other health practitioner and had experienced asthma symptoms within the past year. Persistent wheeze was chosen as a marker of asthma symptoms and was determined from the answers to two questions about the child's wheezing during the past year. Children with a positive response to wheezing "apart from colds" and/or to wheezing for 3 or more days of the week for a month or longer were considered to have persistent wheeze.

The questionnaire also obtained information on potential predictors of asthma. Demographic and physical factors included the child's sex, age, area of residence, body mass index (weight in kilograms/height in meters squared), and race. An unambiguous assessment of race was not possible for all children, and only

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TABLE 1—Crude and Adjusted Relative Odds (and 95% Confidence Intervals [CI]) for Asthma and Persistent Wheeze for Black and White Children Aged 9 to 11 Years in Philadelphia, 1993

	% of Black Children	% of White Children	Relative Odds			
			Asthma		Persistent Wheeze	
			Crude	Adjusted ^a (95% CI)	Crude	Adjusted ^a (95% CI)
Black	100***	...	1.9**	2.3 (1.3, 4.1)	1.4	1.0 (0.6, 1.8)
Male	46	47	2.0**	1.4 (0.9, 2.4)	1.4	1.1 (0.7, 1.8)
Birthweight <5 lb	9**	5	1.9*	2.2 (1.0, 5.1)	2.1*	2.4 (1.1, 5.3)
Severe respiratory illness before age 2	9	9	7.1***	5.6 (3.2, 9.9)	5.5***	3.9 (2.2, 7.0)
Parental history of asthma	18	14	5.8***	3.6 (2.1, 6.2)	5.0***	3.7 (2.2, 6.4)
Parental history of allergy	39*	44	3.5***	1.3 (0.8, 2.3)	3.2***	1.4 (0.8, 2.4)
Child's history of allergy	20**	26	5.4***	3.5 (2.1, 5.9)	6.2***	4.3 (2.6, 7.1)
Residence near city center ^b	76***	37	1.6*	1.5 (0.9, 2.7)	1.2	1.2 (0.7, 2.0)
Family income <\$15 000	34***	21	0.8	0.6 (0.3, 1.3)	0.9	0.9 (0.5, 1.8)
Parental post-high school education	51	55	1.4	1.0 (0.6, 1.7)	2.2***	2.0 (1.2, 3.6)
Single-parent family	51***	25	1.2	1.1 (0.6, 1.9)	1.2	2.3 (1.3, 4.0)
Family home ownership	35***	59	1.3	1.5 (0.9, 2.6)	1.0	1.2 (0.7, 2.0)
No private health insurance	62***	41	0.8	0.8 (0.4, 1.6)	0.9	0.8 (0.4, 1.4)

^aAdjusted for all other factors listed in the table by multiple logistic regression.

^bTemple and Presbyterian sites combined. Reference group is children from the Northeast site.

* $P < .05$; ** $P < .01$; *** $P < .001$ for chi-square test of homogeneity (for Black vs White comparisons) or for Wald test (for crude odds ratios only, using logistic regression).

children who were reported to be White only or Black only were included in the analysis. On the basis of results of preliminary analyses, children from the Temple and Presbyterian sites were combined into a single category (children living near the city center) and were compared with children from the Northeast site.

Socioeconomic factors about which information was available included parental education (beyond high school for at least one parent, yes or no), presence of a second parent in the home (yes or no), family home ownership (yes or no), family receipt of public assistance (yes or no), respondent's primary language (English, yes or no), the child's health insurance status (private health insurance, yes or no), and category of family income (less than \$15 000 per year, \$15 000 through \$29 999, \$30 000 through \$49 999, \$50 000 or more, and income specified as "unknown" or not reported). In final analyses, family income was collapsed into two categories ([1] less than \$15 000 per year or [2] \$15 000 or more per year or unknown).

Health history factors of interest included birthweight (under 5 lb, yes or no), premature birth (yes or no), a severe respiratory illness before age 2 (yes or no), history of allergies (yes or no), parental

history of asthma (yes or no), and parental history of allergies (yes or no).

Home environmental factors included crowding (number of people per bedroom), presence of pets (yes or no), presence of household pests (yes or no), presence of cockroaches (yes or no), air conditioning (yes or no), history of home dampness (yes or no), current smoking in the home (by mother, father, or others, yes or no), and maternal smoking during pregnancy (yes or no).

The data were analyzed by logistic regression.⁹ Crude and adjusted odds ratios and 95% confidence intervals were calculated from the estimated regression coefficients for the independent variables and their associated standard errors. Comparisons of proportions were made with Pearson chi-square tests of homogeneity.

Results

A total of 2683 children were eligible to participate in the larger study, and questionnaires were returned for 2208 children (82%). Nineteen percent of children ($n = 412$) were not identified as White only or Black only and were excluded. Of the remaining 1796 children, 50 were not 9 to 11 years of age, and 330 were missing information on asthma or

persistent wheeze. The current analysis was restricted to the 1416 Black or White children 9 to 11 years old who returned a questionnaire and who had complete information on asthma and persistent wheeze.

Children who were excluded from the analysis only because they were missing information on the outcomes of interest or because they were not 9 to 11 years old ($n = 380$) were more likely to be Black (57% of excluded vs 47% of included; $P = .001$), to live in the central city (62% vs 56%; $P = .04$), and to live with a single parent (50% vs 37%; $P < .001$), and were less likely to have a parent with education beyond high school (40% vs 53%; $P < .001$), to have a family who owned their home (38% vs 48%; $P = .002$), and to have private health insurance (35% vs 49%; $P < .001$). The proportions of children from families receiving public assistance (54% vs 57%; $P = .4$) or with income less than \$15 000 per year (27% vs 27%; $P = .9$) were similar for the included and excluded groups. Since lack of information on symptoms was a criterion for exclusion, the proportion of excluded children with asthma and with persistent wheeze is not known. Information on asthma was available for about half of excluded subjects, and about one third of excluded children

had information on persistent wheeze. The proportions of asthma and wheeze among the excluded children who were not missing symptom data were similar to those observed among included children.

Among children included in this analysis, almost twice as many Black children as White children were reported to have asthma (9.4% vs 5.2%, respectively; $P < .01$). Reporting of persistent wheeze did not differ significantly by race (9.1% of Black children vs 6.8% of White children; $P = .12$). Among children reported to have persistent wheeze, Black children were more likely to be reported as asthmatic than White children (72% vs 57%; $P = .09$). Black children were of lower socioeconomic status than White children and were more likely to live near the city center (Table 1).

The crude odds ratios for asthma and persistent wheeze are presented in Table 1. Black race, male sex, residence near the city center, and several health history variables were associated with increased risk of asthma in univariate analyses. Similar variables were associated with increased risk of reported persistent wheeze, but race and sex were not statistically significant. Parental education was a significant predictor of wheeze but not of asthma.

After adjustment for race, sex, and the health history factors listed in Table 1, lack of private health insurance was a predictor of both asthma and persistent wheeze ($P < .10$). Income and home ownership were associated with asthma, and parental post-high school education and single-parent family were predictors of persistent wheeze ($P < .10$).

Race remained a significant predictor of asthma but not of persistent wheeze in the final model, which included additional adjustment for these socioeconomic factors (Table 1). The magnitude of the association of race with asthma did not change substantially and remained statistically significant after additional adjustment for age, body mass index, household crowding, pets, pests, cockroaches, air conditioning, history of home dampness, maternal smoking during pregnancy, current smoking in the home, receipt of public assistance, and respondent's primary language.

Similar results were obtained in analyses limited to subjects with complete information on family income and in analyses using multiple income categories (including income unknown) rather than a single indicator for low family income ($< \$15\,000$).

Discussion

Among 1416 Black and White children from the city of Philadelphia, race remained a significant predictor of active diagnosed asthma after adjustment for several social, health history, and home environmental factors. Black children were about twice as likely as White children to be reported as having active diagnosed asthma. Most of the socioeconomic and home environmental factors assessed were not significantly associated with the risk of asthma in these children, but health history measures such as severe respiratory illness before the age of 2, parental asthma, child's allergy history, and low birthweight were consistent predictors of asthma. Similar health history factors were associated with wheeze, as were parental education and single-parent family status, but race was not a significant predictor of persistent wheeze. This suggests that race may be more important to the acquisition of a diagnosis of asthma than to the prevalence of symptoms themselves.

The weak relationships of various socioeconomic factors with asthma and persistent wheeze are not surprising, given the inconsistency of previously reported associations of socioeconomic factors with respiratory symptoms. Although some authors have observed significant relationships between various measures of socioeconomic status and asthma,²⁻⁷ others have found a relationship with wheeze but not with diagnosed asthma,^{10,11} and still others have seen no significant difference in prevalence according to social status.¹²⁻¹⁴ Weiss and colleagues¹⁵ and Strachan et al.¹⁴ have suggested that socioeconomic status may be more important to differences in asthma severity than to differences in asthma prevalence.

The results concerning asthma are consistent with earlier reports by Schwartz et al.² and Gold et al.³ In both studies, Blacks had a significantly higher prevalence of asthma even after adjustment for other factors, with relative odds in the 1.6 to 1.7 range. In contrast to the present study, however, Blacks also had significantly higher prevalence of persistent wheeze, although the adjusted relative odds were lower for persistent wheeze than for asthma.

In another study, apparent racial differences in asthma failed to remain significant after adjustment for covariates. Weitzman et al. found that much of the difference in asthma by race could be explained by adjustment for social and

environmental factors such as poverty, maternal smoking, family size, home size, birthweight, and maternal education.⁴

Although more extensive information about socioeconomic status and home environmental factors was available in this study than in previous studies, adjustment for these factors did not substantially alter the estimated relative odds for race and asthma. Race was not a significant predictor of persistent wheeze, however, and it is interesting to note that a greater percentage of Black children than White children with persistent wheeze were reported to be asthmatic; this suggests that there may be important differences in the patterns of asthma diagnosis by race. Clinicians serving inner-city communities may be more apt than their suburban counterparts to use the label "asthma," so Black children, who were concentrated in the central city neighborhoods, may have been more likely than similarly symptomatic White children to receive a diagnosis of asthma. Adjustment for area of residence may not have been sufficient to remove the influence of any such differences in diagnostic practice. In addition, because of publicity about the high rates of asthma in Black communities, Black parents may have a higher level of awareness and may have been more likely to report the child's wheezing to a health practitioner and obtain a diagnosis of asthma.

The results of this study may be limited by the necessary exclusion of nonrespondents and children of unknown or mixed race. There were very few non-Black, non-White children, with the exception of a group of children reported as "other" and identified as "Hispanic." Although the experience of Hispanic children would certainly be of interest, it was not possible to ascertain the race of these children. On the other hand, some of the children reported to be Black only or White only may have also been Hispanic, but this information was not available for the children included in the study. Therefore, creation of a separate "Hispanic" category in this analysis would have been misleading at best.

Race was not known unless indicated on the questionnaire, so the total number of eligible Black and White children cannot be determined. Similarly, although eligible children excluded from the study were more likely to be Black and of lower socioeconomic status, it is not possible to know whether exclusion was related to the presence of asthma or persistent wheeze, since the relevant information was miss-

ing for more than half of excluded children. The similarity in the prevalence of asthma and persistent wheeze for included children and excluded children with information on outcomes provides some reassurance, however.

Because this study relied on parental reporting of asthma and wheeze, misclassification of these outcomes is of concern. The lack of an association of race with persistent wheeze may be due to greater nondifferential misclassification of wheeze than of asthma, which resulted in a bias toward the null. Misclassification of potential confounders is also of concern, but it seems unlikely that misclassification would be more (or less) strongly related to asthma than to persistent wheeze.

Although many of the socioeconomic and home environmental variables considered here were not significant predictors of asthma, there are likely to be other, unmeasured factors related to race that play a role in the risk of diagnosed asthma. In addition, the use of crude measures of exposure may have limited our ability to see differences for those factors for which we did have information in this study. The lack of a significant association of current smoking in the home with asthma or persistent wheeze, for example, may reflect earlier changes in parental behavior rather than an absence of risk. Perhaps more importantly, it is likely that there are complex interactions among risk factors that have not yet been adequately characterized. Racial identification itself is part genealogy and part social construct. Future work in this area may need to move beyond the structure of the standardized questionnaire as the means of assessing and measuring risk

factors. More qualitative approaches may also be in order, especially with regard to potential differences in diagnostic practice by race and neighborhood, as well as with regard to the possibility of differences in parental perceptions of symptoms. Such approaches may even assist us in better "quantifying" exposure, thereby reducing measurement error and allowing for more precise determinations of risk. Only then can we begin to understand which aspects of "race" are relevant to the risk of active asthma in children. □

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