

## ABSTRACT

**Objectives.** This study described relations between socioeconomic factors and race/ethnicity as risk factors for asthma mortality.

**Methods.** A cross-sectional study was conducted of US mortality records from 1991 through 1996.

**Results.** Higher standardized mortality ratios were seen for Blacks vs Whites (3.34 vs 0.65), low vs high educational level (1.51 vs 0.69), and low vs high income (1.46 vs 0.71). Excess mortality for Blacks vs Whites was present in the highest and lowest quintiles of median county income and educational level. The disparity in asthma mortality rates according to median county income and education remained after control for race/ethnicity.

**Conclusions.** Black race/ethnicity appears to be associated, independently from low income and low education, with an elevated risk for asthma mortality. (*Am J Public Health.* 2000;90:1923–1925)

# The Relation of Socioeconomic Factors and Racial/Ethnic Differences in US Asthma Mortality

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Asthma mortality rates are known to vary by age, geographic region, and race/ethnicity,<sup>1–4</sup> with higher rates for Blacks than for Whites. Studies in several US cities have shown that low socioeconomic status (SES) is associated with small area variation in asthma mortality rates.<sup>5–7</sup> These studies have suggested that Black race/ethnicity and low SES may be independent risk factors for asthma mortality.

An inverse relation between median county income and asthma mortality has been described,<sup>8</sup> but to our knowledge, no studies of US mortality data have evaluated the relative contributions of both race/ethnicity and SES to asthma mortality. The purpose of this study was to examine whether socioeconomic factors—specifically, community income and education—contribute independently to the elevated risk for asthma mortality associated with Black race/ethnicity.

## Methods

US mortality data were obtained from the National Center for Health Statistics for the years 1991 through 1996. Case identification was based on asthma (*International Classification of Diseases, Ninth Revision [ICD-9]* external-cause-of-injury code 493) as an underlying cause of death. Only deaths for persons aged 5 to 34 years were included in the analysis, because previous reports reflected the accuracy of this specific diagnosis in this age group. Additional vital record information (including sex, race, county of residence, place of death, and whether autopsy was performed) also was obtained from the National Center for Health Statistics. Six years of data were aggregated to minimize the instability of rates for infrequent events. The National Center for Health Statistics does not report county identifiers for

deaths from counties with populations of fewer than 100 000 persons; therefore, deaths occurring in these counties were not included in the analyses. Income and educational level estimates were based on county-level data, available from the 1993 area resource file.<sup>9</sup> These income and education data were matched to individual mortality records based on county code. US census population estimates of the 1993 non-institutionalized civilian population were used to derive rates for this analysis.

Data are presented as crude mortality rates and standardized mortality ratios (SMRs). The significance of differences in SMRs between demographic groups was calculated with  $\chi^2$  tests. Also, multiple regression was performed to explore the relative effect of age, race/ethnicity, sex, income, and education.

## Results

Among individuals aged 5 to 34, an average of  $449.7 \pm 55.0$  asthma deaths occurred annually from 1991 through 1996. During this period, an average of  $54.9 \pm 7.5\%$  of the asthma deaths were among males, and  $48.3 \pm 6.3\%$  of

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**TABLE 1—Demographic Characteristics of 2698 Individuals Aged 5–34 Years Who Died From Asthma, 1991–1996<sup>a</sup>**

	Year						6-Year Mean (±SD)
	1991	1992	1993	1994	1995	1996	
No. of Deaths							
Total	432	362	421	481	507	495	449.7 (55.0)
Race/Ethnicity							
Black	205	182	198	253	236	243	219.5 (28.4)
White	215	169	211	214	264	225	216.3 (30.4)
Other	12	11	12	14	7	27	13.8 (13.8)
Age, y							
5–14	76	66	101	86	93	108	88.3 (15.7)
15–34	356	296	320	395	414	387	361.3 (46.0)
Sex							
Male	235	208	215	283	288	253	247.0 (33.8)
Female	197	154	206	198	219	242	202.7 (29.1)
Autopsy performed <sup>b</sup>							
Yes	242	208	244	269	...	...	240.8 (25.1)
No	177	143	164	197	...	...	170.3 (22.7)
Unknown	13	11	13	15	...	...	13.0 (1.6)
Site of death							
In hospital	377	316	381	423	440	424	393.5 (45.6)
Nonhospital	52	44	36	52	62	66	52.0 (11.1)
Unknown	3	2	4	6	5	5	4.2 (1.5)

<sup>a</sup>Based on counties with populations ≥ 100 000 persons, representing 70.9% of the US population in this age group (see “Methods” section).

<sup>b</sup>Four-year average for 1991 to 1994 (autopsy data not available for 1995 and 1996).

the individuals who died were Black. Additional demographic characteristics of the individuals who died from asthma are shown in Table 1.

The wealthiest counties had a mean income of \$50 142 ± \$5253, and the poorest counties had a mean income of \$28 234 ± \$2671. For educational level, the mean proportion of persons with a high school education or greater was 86.6 ± 2.3% in the highest quintile and 67.9 ± 4.9% in the lowest quintile.

In Table 2, crude mortality rates and SMRs are shown by race, sex, and quintile of county educational level and median income. The SMRs during this period were approximately 5 times higher for Blacks than for Whites (3.34 vs 0.65, *P* < .001). SMRs were similar for males and females. Higher mortality rates were associated with low vs high county educational level (1.51 vs 0.69, *P* < .001) and low vs high county income (1.46 vs 0.71, *P* < .001).

The stratified analysis of SES indicators by race, adjusted for age and sex, is also shown in Table 2. Among Whites, for county educational level, the highest and lowest educational quintile differed by 43.1% (*P* < .001). For Blacks, the difference in SMRs between highest and lowest educational quintiles was 76.7% (*P* < .001). For income, among Whites, the SMRs in the highest and lowest quintile of median county income varied by 49.1% (*P* < .001). Among Blacks, the absolute difference in SMR according to quintile of county income was 50.2% (*P* = .01).

For those in the highest quintile of county educational level, the absolute difference in SMRs between Blacks and Whites

**TABLE 2—Asthma Mortality Rates Among Individuals Aged 5–34 Years, by Race/Ethnicity, Sex, and Quintile of Educational Level and Median County Income Level, 1991–1996<sup>a</sup>**

	Crude Mortality Rate (per 100 000 Population)	Standardized Mortality Ratio <sup>b</sup>	<i>P</i> *
Total	0.55	1.07	
Race/Ethnicity			
White	0.34	0.65	< .001
Black	1.69	3.34	
Sex			
Male	0.60	1.08	.50
Female	0.50	1.05	
Educational level			
Highest quintile	0.35	0.69	< .001
Lowest quintile	0.78	1.51	
Median income			
Highest quintile	0.37	0.71	< .001
Lowest quintile	0.75	1.46	
By race/ethnicity and educational level			
White			
Highest quintile	0.26	0.51	< .001
Lowest quintile	0.48	0.94	
Black			
Highest quintile	1.50	2.91	< .001
Lowest quintile	1.86	3.68	
By race/ethnicity and median income			
White			
Highest quintile	0.26	0.50	< .001
Lowest quintile	0.51	0.99	
Black			
Highest quintile	1.29	2.52	< .05
Lowest quintile	1.52	3.02	

<sup>a</sup>Based on counties with populations ≥ 100 000 persons, representing 70.9% of the population in this age group (see “Methods” section).

<sup>b</sup>Standardized to 1993 US rates by age and sex.

\**P* for differences in standardized mortality ratios.

was 240.5% ( $P < .001$ ). In the lowest quintile of county educational level, the Black–White difference in SMRs was 274.1% ( $P < .001$ ). For median county income, the absolute difference in SMRs associated with Black vs White race/ethnicity was 202.3% for the highest income quintile ( $P < .001$ ) and 203.4% ( $P < .001$ ) for the lowest income quintile.

To further examine interactions between race/ethnicity and SES while controlling for age and sex as potential confounders, we performed multiple linear regression. This analysis also showed that Black race/ethnicity and low county educational levels remained independently associated with a higher 6-year mean asthma mortality rate.

## Discussion

In this study, we examined the relation between socioeconomic variables and race/ethnicity-specific asthma mortality rates and found that race/ethnicity appears to exert an effect independent of that of SES. The mortality gradient between Blacks and Whites was present at both the highest and the lowest quintiles of SES indicators.

The effect of SES was shown for both Blacks and Whites and was related to both median county income and educational level. For Blacks, the effect of educational level was more powerful than for Whites, and educational level appeared to exert a stronger effect than income.

Racial/ethnic disparities in asthma death rates are well described.<sup>1,3,4</sup> Of particular concern is recent evidence that from 1980 to 1994, rates of increase have been greater for Blacks than for Whites among those aged 5 to 34 years.<sup>3</sup>

Our findings relating asthma mortality to SES and race/ethnicity are in many ways similar to those of previous local or regional studies of the relation between hospitalizations for asthma, race/ethnicity, and SES. In New York City, both race/ethnicity and community income level contributed independently to community hospitalization rates.<sup>6</sup> A study in Maryland found that large racial/ethnic differences in asthma hospitalization rates were better explained by poverty than by race/ethnicity.<sup>10</sup> Much as in studies of asthma hospitalizations, in several studies of asthma prevalence, racial/ethnic differences remained after correction for socioeconomic and environmental factors.<sup>11–15</sup>

Inequalities in many health outcomes related to SES have been well established.<sup>16–19</sup> Examination of the complex mechanisms that may relate Black race/ethnicity and low SES to poor asthma outcome is beyond the scope

of this study, but these mechanisms have recently been discussed elsewhere.<sup>20–23</sup>

Several limitations of this study should be noted. First, the socioeconomic variables studied were not individual-specific. Yet, several recent studies have shown the importance of community socioeconomic indicators in mortality, with poverty-area residence being associated with an elevated risk for mortality after adjustment for several individual socioeconomic characteristics.<sup>24,25</sup> Second, the exclusion of counties with populations of fewer than 100 000 persons may have resulted in inherent bias. Third, risk factors for asthma mortality may not reflect risk factors associated with asthma prevalence, morbidity, or severity. Last, the accuracy of death certificate data may be questioned, but this study was limited to the 5- to 34-year age group, for which the accuracy of these data for asthma has been verified.<sup>26</sup>

In conclusion, this analysis suggests that both low SES (as measured by an ecologic variable) and Black race/ethnicity are independently associated with excess asthma mortality and that the independent contribution of race/ethnicity may be greater than that of SES. The aspects of Black race/ethnicity that may be involved and their interaction with socioeconomic factors need to be further elucidated. □

## Contributors

E. N. Grant contributed to the study conception and design and data interpretation, conducted the literature review, and wrote the paper. C. S. Lyttle conducted the data analysis and contributed to data interpretation and the writing of the paper. K. B. Weiss conceptualized the study and supervised data analysis and manuscript preparation.

## References

- Evans R, Mullally DI, Wilson RW, et al. National trends in the morbidity and mortality of asthma in the US: prevalence, hospitalization, and death from asthma over two decades: 1965–1984. *Chest*. 1987;91(suppl):65S–74S.
- Weiss KB, Wagener DK. Changing patterns of asthma mortality: identifying target populations at high risk. *JAMA*. 1990;264:1683–1687.
- Sly RM, O'Donnell R. Stabilization of asthma mortality. *Ann Allergy Asthma Immunol*. 1997;78:347–354.
- Mannino DM, Homa DM, Pertowski CA, et al. Surveillance for asthma—United States, 1960–1995. *MMWR Morb Mortal Wkly Rep*. 1998;47:1–27.
- Marder D, Targonski P, Orris P, Persky V, Addington W. Effect of racial and socioeconomic factors on asthma mortality in Chicago. *Chest*. 1992;101(suppl):426S–429S.
- Carr W, Zeitel L, Weiss K. Variations in asthma hospitalizations and deaths in New York City. *Am J Public Health*. 1992;82:59–65.
- Lang DM, Polanski M. Patterns of asthma mortality in Philadelphia from 1969 to 1991. *N Engl J Med*. 1994;331:1542–1546.
- Weiss KB, Gergen PJ, Wagener DK. Breathing better or wheezing worse? The changing epidemiology of asthma morbidity and mortality. *Annu Rev Public Health*. 1993;14:491–513.
- Health Resources and Services Administration, Bureau of Health Professions. Area Resource File (ARF) System. Fairfax, Va: Quality Resource Systems Inc; September 1993.
- Wissow LS, Gittelsohn AM, Szklo M, Starfield B, Mussman M. Poverty, race and hospitalization for childhood asthma. *Am J Public Health*. 1988;78:777–782.
- Schwartz J, Gold D, Dockery DW, Weiss ST, Speizer FE. Predictors of asthma and persistent wheeze in a national sample of children in the United States: association with social class, perinatal events, and race. *Am Rev Respir Dis*. 1990;142:555–562.
- Weitzman M, Gortmaker S, Sobol A. Racial, social, and environmental risks for childhood asthma. *Am J Dis Child*. 1990;144:1189–1194.
- Turkeltaub PC, Gergen PJ. Prevalence of upper and lower respiratory conditions in the US population by social and environmental factors: data from the second National Health and Nutrition Examination Survey, 1976 to 1980 (NHANES II). *Ann Allergy*. 1991;67:147–154.
- Cunningham J, Dockery DW, Speizer FE. Race, asthma and persistent wheeze in Philadelphia schoolchildren. *Am J Public Health*. 1996;86:1406–1409.
- Nelson DA, Johnson CC, Divine GW, Strauchman C, Joseph CL, Ownby DR. Ethnic differences in the prevalence of asthma in middle class children. *Ann Allergy Asthma Immunol*. 1997;78:21–26.
- Greenwald HP, Borgatta EF, McCorkle R, Polis-sar N. Explaining reduced cancer survival among the disadvantaged. *Milbank Q*. 1996;74:215–238.
- Pappas G, Queen S, Hadden W, Fisher G. The increasing disparity in mortality between socioeconomic groups in the United States, 1960 and 1986. *N Engl J Med*. 1993;329:103–109.
- Cantwell MF, McKenna MT, McCray E, Onorato IM. Tuberculosis and race/ethnicity in the United States: impact of socioeconomic status. *Am J Respir Crit Care Med*. 1998;157:1016–1020.
- Mackenback JP, Kunst AE, Cavelaars AE, et al. Socioeconomic inequalities in morbidity and mortality in Western Europe: the EU Working Group on Socioeconomic Inequalities in Health. *Lancet*. 1997;349:1655–1659.
- Grant EN, Weiss KB. Socioeconomic risk factors for asthma mortality. In: Sheffer A, ed. *Fatal Asthma*. New York, NY: Marcel Dekker Inc; 1998:237–254.
- Rose R, Weiss KB. The impact of poverty on asthma. *Pediatr Asthma Allergy Immunol*. 1994;8:157–163.
- Smith LA, Finkelstein JA. The impact of socio-demographic factors on asthma. In: Weiss KB, Buist AS, Sullivan SD, eds. *Asthma's Impact on Society*. New York, NY: Marcel Dekker Inc; 1999: 219–243.
- Gergen P. Social class and asthma—distinguishing between the disease and the diagnosis. *Am J Public Health*. 1996;86:1361–1362.
- Waizman NJ, Smith KP. Phantom of the area: poverty-area residence and mortality in the United States. *Am J Public Health*. 1998;88:973–976.
- Anderson RT, Sorlie P, Backlund E, Johnson N, Kaplan G. Mortality effects of community socioeconomic status. *Epidemiology*. 1997;8:42–47.
- British Thoracic Society. Accuracy of death certificates in bronchial asthma. *Thorax*. 1984;39:505–509.