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ORIGINAL ARTICLE

Ethnic Disparities in Asthma Morbidity in Chicago

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Rationale. The role of ethnicity and socioeconomic status in explaining variations in asthma morbidity is unclear. **Objectives.** To describe the magnitude of ethnic disparities in asthma morbidity in Chicago and to determine whether differences in socioeconomic status explain these disparities. **Methods.** We conducted a survey of 561 school-age children and 353 young adults with asthma and measured their self-reported ethnicity, socioeconomic status (using 11 variables), and asthma morbidity (symptom frequency, asthma-specific quality of life, and frequency of severe asthma exacerbations). **Measurements and Main Results.** White children and adults had better asthma-specific quality of life and fewer severe asthma exacerbations compared to black and Hispanic children and adults. White children also had fewer days with asthma symptoms, but among adults there were no ethnic differences in the frequency of asthma symptoms. Socioeconomic status explained a large portion of the ethnic disparities in asthma quality of life but explained little of the disparities in other aspects of asthma morbidity. **Conclusions.** There are large disparities across ethnic groups in Chicago in asthma quality of life and in the frequency of severe exacerbations. Differences in socioeconomic status do not fully explain these disparities.

Keywords asthma, epidemiology, ethnic disparities, socioeconomic status

INTRODUCTION

Ethnicity, sex, and socioeconomic status can be as contentious in the study of asthma as in any other social intercourse (1–3), but there is no denying their impact on human behavior and well-being. The role of ethnicity and socioeconomic status in asthma has been hotly debated, some suggesting that one or the other of these two factors best explains the dramatic disparities in asthma outcomes across geography and demographic groups (4–11). It is still unclear, however, to what extent these disparities are due to differences in genetic, socioeconomic, cultural, behavioral, clinical, or environmental factors.

This report contributes to the debate by examining a large representative sample of children and young adults with asthma in Chicago, the city leading the country in asthma mortality rates (12). We describe variations in asthma morbidity by ethnic group, which define the magnitude of ethnic disparities for these outcomes. Then we reexamine those relationships after adjusting for socioeconomic status, using 11 variables that assess income, education, employment, home ownership, insurance status, and other measures of wealth and social standing.

We were particularly sensitive to the notion that ethnicity is a social construct tightly entangled with a myriad of social, cultural, and economic factors that are impossible to fully enumerate, let alone account for in any analysis. Yet we believe that any plan to reduce disparities in health outcomes across social groups—however the groups are defined—must start with the important first step of accurately measuring the magnitude of disparity.

METHODS

Study Design

We conducted a cohort study of school-age children and young adults with asthma and used the baseline data for this report. The study protocol was approved by Chicago's public and Catholic Archdiocese school boards and the institutional review boards of the two collaborating research institutions.

Setting and Participants

Families with children attending 105 selected Chicago public or Catholic schools during the 2003–2005 school years were surveyed in Spanish or English to identify eligible family members with asthma (13). Schools were selected using a combination of population-proportionate random sampling and cluster sampling, after first stratifying schools based on percentage of African American students and percentage of students receiving subsidized or free lunch. Eligibility requirements included age 8 to 14 or 18 to 40 years; asthma diagnosis by a physician (self-report); use of asthma medications for 8 or more weeks during the preceding 12 months;

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fluency in spoken English; residence within metropolitan Chicago; and access to a telephone. The maximum participants per family were one child and one adult (but not the child's primary caregiver). After a telephone screening interview, 1,332 subjects were considered eligible and agreed to a detailed face-to-face interview and testing, which was completed after written informed consent by 561 children with asthma and their primary caregivers and by 353 adults with asthma.

Measures and Data Collection

During a 1-hour face-to-face interview, we collected data on the demographic, economic, and psychosocial characteristics of the individual and household, as well as data on asthma-related symptoms, knowledge, behaviors, and use of health services. For the adults, literacy was assessed using the Rapid Estimate of Adult Literacy in Medicine (REALM), a read-aloud list of 66 health-related words (14). Pronouncing 60 or fewer words correctly is associated with a reading proficiency lower than a 9th-grade level, which we considered low literacy for adults.

Ethnicity

Adults reported their race/ethnicity and caregivers reported on the child's. Ethnicity was then collapsed into three categories: non-Hispanic black/African American, Hispanic/Latino, and non-Hispanic white/other.

Socioeconomic Status

The variables used to measure socioeconomic status included annual household income (<\$15,000, \$15,000–\$30,000, \$30,000–\$50,000, >\$50,000); education (less than high school graduate, high school graduate, some college, college graduate), literacy (low, average), currently employed for pay, current home ownership, home density (number of people living together in the same home), current private health insurance (two aspects: how medicines are paid for, and how other medical bills are paid for), any loss of health insurance during the past year, government assistance during the past year (receipt of food stamps, public aid, foster care subsidy), and identification of a personal physician. For children, these variables pertain to the child's caregiver, with the exceptions of personal physician and health insurance.

Asthma Morbidity

Our three primary measures of asthma morbidity were (1) asthma quality of life, (2) symptom frequency, and (3) the occurrence of one or more severe asthma exacerbations that required urgent medical care in the preceding 12 months. For adults, we used Juniper's 15-item Mini Asthma Quality of Life Questionnaire (MiniAQLQ) (15), which measures the impact of asthma on four domains over the past 2 weeks (mean of 15 items, each measured on a 7-point scale; higher values are better). The scale has documented reliability, construct validity, and responsiveness, with a difference of 0.5 or greater considered clinically important (16).

Caregivers responded to a 23-item subset of the Children's Health Survey for Asthma (CHSA), a validated measure of the quality of life of children with asthma over the past 2 weeks (17, 18). We used all items measuring the child ac-

tivity, family activity, and child emotional health subscales, and 7 of the 15 items for the physical activity subscale (mean of 23 items; each measured on a 5-point scale; higher values are better).

Asthma symptom frequency was measured as the sum of the number of days and the number of nights in the past 2 weeks that the person experienced wheezing, chest tightness, cough, or shortness of breath (range, 0–28).

The occurrence of a severe asthma exacerbation required a reported hospitalization, emergency department visit, or same-day visit to a doctor's office for urgent asthma treatment within the past 12 months.

Statistical Analysis

For adults, asthma quality of life had a nearly normal distribution; therefore, linear regression was used to assess differences among groups. For children, asthma quality of life was truncated at the right (higher quality of life); we therefore used linear regression with bootstrapped standard errors.

For symptom frequency, we used a negative binomial model because it fit the count data better than the Poisson or zero-inflated Poisson models. We used logistic regression to model the dichotomous outcome of experiencing a severe asthma exacerbation requiring urgent medical care in the past year.

For each of the three measures of asthma morbidity, we first measured differences between white and black subjects and between white and Hispanic subjects, adjusting for age and sex. These differences described the magnitude of the ethnic disparities in asthma morbidity—the total effect of ethnicity on asthma outcomes—standardized to the age and sex distribution of white subjects.

We then determined to what extent these differences were the result of the lower socioeconomic status in the non-white ethnic groups. Ethnicity can potentially influence many of the socioeconomic variables; these socioeconomic variables are thus intermediate variables on the pathway between ethnicity and asthma outcomes. Several authors have described how to estimate the effect of one variable on an outcome while controlling for an intermediate variable (19–21); such effects are referred to as “controlled direct effects.” We used marginal structural models (22) to estimate the controlled direct effects of ethnicity on asthma outcomes, controlling for socioeconomic status, an approach suggested by van der Laan and Petersen (23). In particular, we estimated what the difference in asthma morbidity between ethnic groups would have been had subjects in the black and Hispanic groups had the same socioeconomic status as whites. This “controlled direct effect” of ethnicity on asthma outcomes effectively isolates the residual effect of ethnicity on outcome (direct effect) that is not mediated through socioeconomic status. We also calculated the proportion of the total effect of ethnicity that could be eliminated if an intervention were possible to set the socioeconomic status in the black and Hispanic populations to the same distribution as in the white population (19).

As noted above, we used marginal structural models to carry out these analyses. For the marginal structural models, we first created a continuous latent variable representing socioeconomic status by performing principal components

TABLE 1.—Characteristics of study subjects.

Characteristic	n (percent)	
	Adults (N = 347)	Children (and Caregivers)* (N = 541)
Ethnic Group		
Black/African American	198 (57)	315 (58)
Hispanic/Latino	97 (28)	133 (25)
White/Other	52 (15)	93 (17)
Age median yrs (min, 25th, 75th, max)	31 (18, 27, 36, 40)	10 (8, 9, 12, 14)
Female sex	269 (78)	226 (42)
Household Income \$1000 per yr		
<15	96 (28)	111 (21)
15–30	89 (26)	153 (28)
30–50	63 (18)	101 (19)
>50	99 (28)	176 (33)
Education highest level		
Less than high school graduate	58 (17)	72 (13)
High school graduate	233 (67)	365 (68)
College graduate	56 (16)	104 (19)
Unemployed	131 (38)	193 (36)
Low literacy (REALM score $\leq$ 60)	113 (33)	156 (29)
No private health insurance	189 (54)	279 (52)
Not covered by insurance or Medicaid (anytime during past 12 mo.)	75 (22)	46 (9)
Home owner	101 (29)	190 (35)
Monthly government assistance (food stamps, etc)	200 (58)	296 (55)
Personal physician	279 (80)	490 (90)
Household size median (25th, 75th percentile)	5 (4, 6)	4 (4, 6)

*Characteristics of the child are presented except for the following variables, which are characteristics of the child's caregiver: education, employment, literacy, home ownership, and government assistance.

analysis of the 11 socioeconomic variables described earlier. We next calculated two probabilities for use in defining the analytic weights. The first probability was each subject's likelihood of being in their identified ethnic group given their age and sex, obtained by logistic regression. The second probability was each subject's likelihood of their own socioeconomic status (represented by the principal components score) given their age, sex, and ethnicity, obtained by linear regression. The inverse of the product of these two probabilities was used for the analytic weights (inverse probability weighting), which is an essential feature of marginal structural models. We used stabilized weights, as suggested by Robins et al. (22). A weighted regression (using the inverse probability weights) was then used to regress each outcome on ethnicity and socioeconomic status. We also included interactions between ethnic group and socioeconomic status in each model; although for children, most of these interactions were not significant and were thus discarded.

Bootstrap resampling methods were used to calculate p values and confidence intervals for the estimates. We used Stata statistical software, version 10.0 (StataCorp, Inc, College Station, TX) for all analyses.

RESULTS

Subject Characteristics

Table 1 describes the characteristics of the 347 of 353 young adults (98%) and 541 of 561 children (96%) in the sample with complete data. Because we purposefully oversampled schools from low- and middle-income neighborhoods of Chicago, the self-identified ethnicity for a majority

of the sample was black/African American and a quarter was Hispanic/Latino. Approximately half of all subjects were in households where the annual income was less than \$30,000. Over a third of the adults and caregivers were unemployed, and over half did not have private health insurance.

Ethnic Disparities in Asthma Morbidity

For both adults and children, there were significant disparities in asthma morbidity across ethnic groups (Figure 1, Tables 2 and 3). The one exception was asthma symptom frequency among adults, where there was no significant difference among groups. The general pattern was that white adults and children suffered less from asthma. For most measures of asthma morbidity, Hispanic and black subjects were similar.

Asthma Quality of Life

White adults with asthma had a higher asthma quality of life than black adults (difference: 0.6, $p = 0.001$) and Hispanic adults (difference: 0.8, $p < 0.001$). These ethnic disparities in asthma quality of life exceeded the minimally important difference of 0.5. There was no important difference between Hispanic and black adults. The pattern was the same for children. The difference between white children and children of the other two groups was 0.5 (both, $p < 0.001$).

For both adults and children, controlling for socioeconomic status eliminated over 50% of the difference in asthma quality of life between white and black subjects, leaving a residual difference of 0.2–0.3 (Tables 2 and 3). For the white–Hispanic difference, controlling for socioeconomic status had a smaller effect: explaining only 19% of the adult white–Hispanic disparities in quality of life. The residual difference of 0.6 in quality of life scores between white and Hispanic adults would still be considered important (Table 2).

Severe Asthma Exacerbations Requiring Urgent Medical Care

For both adults and children, white subjects were less likely to experience a severe asthma exacerbation requiring urgent medical care in the past year compared to black subjects (adults: 24 percentage-point difference; children: 13 percentage-point difference; for both, $p < 0.05$). The white–Hispanic differences were intermediate and not statistically significant for children.

After controlling for socioeconomic status, these differences did not change substantially, and the disparities between white and black subjects remained statistically significant and clinically important (Figure 1, Tables 2 and 3).

Asthma Symptom Frequency

The differences across ethnic groups in the frequency of asthma symptoms had a different pattern for adults and children. This is in contrast to the other two measures of asthma morbidity, where the patterns of responses for adults and children were similar. For adults, there were no significant differences among the three ethnic groups in the sum of days and nights with asthma symptoms over the previous 2 weeks, with an average of 8 to 9 symptomatic days or nights for all three groups ($p = 0.85$). Controlling for socioeconomic status had no important impact.

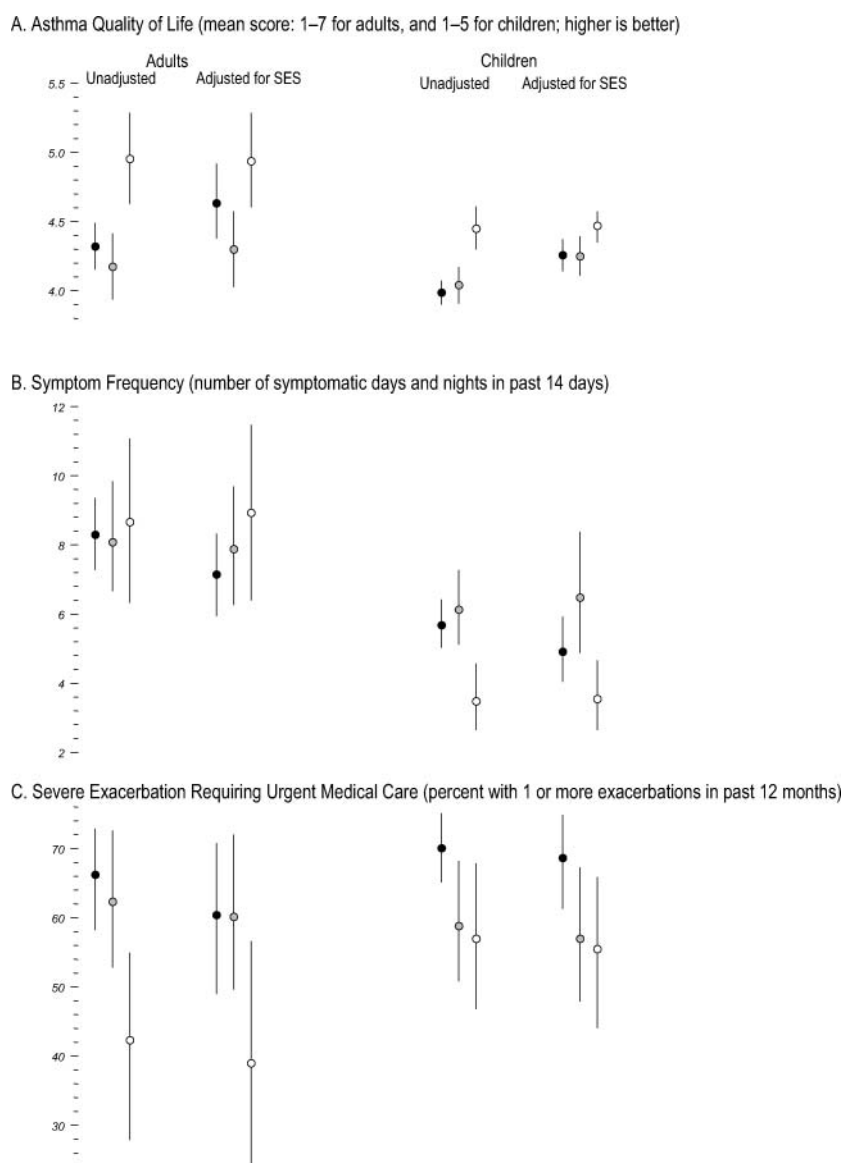


FIGURE 1.—Differences across ethnic groups, before and after adjustment for socioeconomic status, for three measures of asthma morbidity among adults and children: (A) asthma quality of life, (B) asthma symptom frequency, and (C) severe asthma exacerbations requiring urgent medical care. The black circles represent black/African American subjects, white circles represent white/other subjects, and grey circles represent Hispanic/Latino subjects.

Unlike adults, for children there were significant ethnic disparities in the frequency of asthma symptoms (Table 3). White children had 2 to 3 fewer days or nights with asthma symptoms compared with black and Hispanic children ($p < 0.001$). Significant disparities persisted after controlling for socioeconomic status. But controlling for socioeconomic status had disparate effects: attenuating the black–white difference by 38%, while augmenting the Hispanic–white difference by 11% (Table 3).

DISCUSSION

This study demonstrates disparities in asthma morbidity across ethnic groups, with white adults and children doing better than Hispanic and black adults and children on most measures of morbidity. Socioeconomic status appears to ex-

plain a large portion of the ethnic disparities in asthma quality of life but appears to play little role in explaining the disparities in other aspects of asthma morbidity. The high burden of symptoms among participants signified poor asthma control for most subjects in this urban sample.

Among adults, we found no disparities across ethnic groups in symptom frequency. There are several possible reasons why the findings for symptom frequency are discrepant from the other measures of asthma morbidity. First, it might be owing to errors in recall; measurement error can blur real differences between groups. The second possibility is that there are no real differences in symptom frequency across groups, but there might still be differences in symptom severity. For example, when symptoms do occur, they might be more severe among black and Hispanic subjects. Such a scenario would be consistent with the ethnic differences in

TABLE 2.—Asthma morbidity among adults by ethnic group, with and without adjustment for socioeconomic status.*

Asthma Quality of Life (range: 1–7; higher is better; smallest important difference = 0.5)							
	Adjusted for age and sex	Total effect of ethnicity [†] (reference: white subjects)	Adjusted for age, sex, and SES	Direct effect of ethnicity [‡] (reference: white subjects)	Percentage of total effect eliminated by controlling for SES	P value for total effect	P value for direct effect
Black/African American	4.3	0.6	4.6	0.3	52%	<0.001	0.13
Hispanic/Latino	4.2	0.8	4.3	0.6	19%	0.001	0.001
White/Other	5.0	—	4.9	—	—	—	—
Severe Asthma Exacerbation Requiring Urgent Medical Care (% with at least 1 in past 12 months)							
	Adjusted for age and sex	Total effect of ethnicity [†] (reference: white subjects)	Adjusted for age, sex, and SES	Direct effect of ethnicity [‡] (reference: white subjects)	Percentage of total effect eliminated by controlling for SES	P value for total effect	P value for direct effect
Black/African American	66%	24	60%	21	11%	0.001	0.03
Hispanic/Latino	62%	20	60%	21	–5%	0.01	0.03
White/Other	42%	—	39%	—	—	—	—
Asthma Symptom Frequency (sum of days and nights with asthma symptoms in past 2 wks; range: 0–28)							
	Adjusted for age and sex	Total effect of ethnicity [†] (reference: white subjects)	Adjusted for age, sex, and SES	Direct effect of ethnicity [‡] (reference: white subjects)	Percentage of total effect eliminated by controlling for SES	P value for total effect	P value for direct effect
Black/African American	8.3	–0.4	7.2	–1.9	NA	0.78	0.19
Hispanic/Latino	8.1	–0.7	7.9	–1.1	NA	0.69	0.50
White/Other	8.7	—	8.9	—	—	—	—

*All analyses are standardized to the age and sex distribution of the White subjects.

[†]Difference in outcome between Black or Hispanic subjects and the reference group, White subjects.

[‡]After controlling for socioeconomic status (SES) using a marginal structural model, the difference in outcome between Black or Hispanic subjects and the reference group, White subjects.

NA = not applicable because no disparity between ethnic groups for this outcome.

asthma quality of life and the differences in likelihood of a severe exacerbation.

A third possible reason is cultural differences in symptom perception or attribution. For example, coughing at night might be more often overlooked as a symptom of asthma

among black and Hispanic subjects compared to white subjects, although coughing, wheezing, and dyspnea are considered equivalent indicators of disease activity. The finding that words used to describe asthma symptoms are known to vary by ethnic group (24) lends support to this alternative

TABLE 3.—Asthma morbidity among children by ethnic group, with and without adjustment for socioeconomic status.*

Asthma Quality of Life (range: 1–5; higher is better)							
	Adjusted for age and sex	Total effect of ethnicity [†] (reference: white subjects)	Adjusted for age, sex, and SES	Direct effect of ethnicity [‡] (reference: white subjects)	Percentage of total effect eliminated by controlling for SES	P value for total effect	P value for direct effect
Black/African American	4.0	0.5	4.3	0.2	55%	<0.001	0.004
Hispanic/Latino	4.0	0.5	4.2	0.2	47%	<0.001	0.01
White/Other	4.5	—	4.5	—	—	—	—
Severe Asthma Exacerbation Requiring Urgent Medical Care (% with at least 1 in past 12 months)							
	Adjusted for age and sex	Total effect of ethnicity [†] (reference: white subjects)	Adjusted for age, sex, and SES	Direct effect of ethnicity [‡] (reference: white subjects)	Percentage of total effect eliminated by controlling for SES	P value for total effect	P value for direct effect
Black/African American	70%	13	69%	13	0.2%	0.03	0.04
Hispanic/Latino	59%	2	57%	1	NA	0.79	0.84
White/Other	57%	—	56%	—	—	—	—
Asthma Symptom Frequency (sum of days and nights with asthma symptoms in past 2 wks; range: 0–28)							
	Adjusted for age and sex	Total effect of ethnicity [†] (reference: white subjects)	Adjusted for age, sex, and SES	Direct effect of ethnicity [‡] (reference: white subjects)	Percentage of total effect eliminated by controlling for SES	P value for total effect	P value for direct effect
Black/African American	5.7	2.2	4.9	1.4	38%	<0.001	0.06
Hispanic/Latino	6.1	2.7	6.5	2.9	–11%	<0.001	0.006
White/Other	3.5	—	3.5	—	—	—	—

*All analyses are standardized to the age and sex distribution of the White subjects.

[†]Difference in outcome between Black or Hispanic subjects and the reference group, White subjects.

[‡]After controlling for socioeconomic status (SES) using a marginal structural model, the difference in outcome between Black or Hispanic subjects and the reference group, White subjects.

NA = not applicable because no disparity between ethnic groups for this outcome.

explanation. In addition, cultural differences in the meaning of asthma as illness might create either incentives or disincentives for accurately monitoring signs of illness.

Finally, it is possible that the lack of ethnic disparity in symptom frequency among adults accurately reflects the lack of ethnic disparity in all aspects of asthma morbidity; that is, the *apparent* ethnic differences in the other two measures of asthma morbidity might be misleading, reflecting cultural differences in health beliefs, attitudes, and perceptions, as described above, rather than true differences in disease severity.

Does socioeconomic status mediate the ethnic disparities in asthma morbidity? Among the three measures of asthma morbidity, only one—asthma quality of life—had strong evidence supporting a mediating role for socioeconomic factors. Although ethnicity is, in general, an important marker for adverse socioeconomic conditions in the United States, in our study we oversampled from low- and middle-income neighborhoods, thereby blunting the differences in socioeconomic status across groups. In some circumstances, socioeconomic status is likely to be more than a marker. Through racial and ethnic discrimination (past or present), for example, ethnicity can act as a causal risk factor for unfavorable socioeconomic conditions, which, in turn, might lead to worse quality of life.

Low socioeconomic conditions are also associated with more symptoms of depression (25). It is possible, therefore, that lower scores on an asthma-specific quality of life scale, which measures how “bothersome” symptoms are, primarily reflect a more depressed mood, and might cause even minor symptoms to be interpreted as more bothersome. Hence, the impression of a direct relationship between socioeconomic status and asthma quality of life might reflect variation in symptom perceptions without variation in objective measures of disease activity.

The differences across ethnic groups in the use of health services for severe asthma exacerbations, even after controlling for socioeconomic status, are consistent with other research. For example, even within a managed care population, there are ethnic differences in use of services for severe asthma exacerbations (26, 27). Similar findings are described for children with asthma covered by Medicaid (28). The reasons for these ethnic disparities when access to medical care is presumably equal might be because of differences in quality of care, health behaviors, environmental triggers, or biology, among others (27).

We found that socioeconomic differences explain, at most, only some of the variation in asthma outcomes. Although some studies found that socioeconomic variables accounted for most or all of the differences in asthma outcomes across ethnic groups (5), our study results were mixed. Possible explanations for the residual variation in asthma outcomes include psychosocial factors (stress, depression, social support, coping style, health beliefs), behavioral factors (smoking, trigger avoidance, medication adherence), clinical factors (quality of medication prescribing, asthma education, doctor–patient partnering in chronic care), environmental factors (smoke, dust, pollution, neighborhood violence), and biological factors (lung function, atopy). We plan to evaluate the relative importance of many of these factors in our cohort study.

One might conclude that the socioeconomic-adjusted differences represent the “direct” effects of ethnicity on disease,

having removed the “indirect” effects mediated by income, education, and other socioeconomic factors through statistical adjustment. But this interpretation is controversial and only valid under several assumptions. Kaufman and Cooper contend that “despite the popularity of this approach, it is highly prone to providing misleading inference. Not only is this method likely to suggest spurious direct effects of race due to misspecification of the intermediates, but it is also prone to bias because adjustment for intermediates does not generally provide valid estimates of direct effects” (29), owing to unmeasured confounding of the mediator–outcome relationship. Their first point highlights how crude and imperfect measurements of constructs such as income and education leave room for residual confounding. Their second point is more subtle: Using standard regression techniques to adjust for variables that are partly influenced by ethnicity (such as income and education and other socioeconomic factors), even if perfectly measured, can actually exaggerate confounding, causing the “direct” (adjusted) effect of ethnicity on asthma outcomes to appear either falsely large or falsely low or even have the wrong sign (29, 30). To interpret adjusted differences—adjusting for an intermediate variable—as a controlled direct effect, one must additionally assume that there are no unmeasured confounders of the mediator–outcome relationship (that is, factors that jointly affect socioeconomic status and asthma outcomes).

For several of the statistical models, we identified significant interactions between ethnicity and socioeconomic status (models of symptom frequency and asthma quality of life among adults, and model of symptom frequency among children). In each of these analyses, socioeconomic status had the largest affect on asthma outcomes among white subjects and the least affect among Hispanic subjects. That is, a decline in socioeconomic status had a worse affect on asthma quality of life among white subjects, and less of an adverse affect among black and Hispanic subjects.

From a health policy perspective, more attention should be directed to the *unadjusted* analyses that appropriately capture the asthma-specific burden of suffering across ethnic groups. Elucidating the causes for these differences is another matter. Fortunately, as noted above, estimating controlled direct effects (e.g., using marginal structural models with inverse probability weighting) can provide valid causal inference for describing the direct effects of ethnicity on asthma outcomes.

This study has several limitations. One limitation, shared with all studies that include socioeconomic status as a variable of interest, is the absence of an agreed-upon method for measuring this construct. However, our approach goes beyond a simple consideration of education and income and includes a variety of other related variables, including home ownership, insurance, literacy, and having a personal physician. Despite it being a more comprehensive assessment of socioeconomic status, and, hence, having greater face and content validity, there will always be measurement error, which can bias results. Another limitation is the small number of subjects who described their ethnicity as white. Besides the imprecision from having a small number of subjects in the reference group, another problem with the white/other group is that many people from the low-income neighborhoods from which we sampled were recent immigrants from Eastern Europe, the Middle East, or Asia. Thus, our findings might

not be generalizable to white-black and white-Hispanic disparities reflected in other settings, such as from the National Health Interview Survey. Also, we had no independent confirmation of self-reported interview responses. Finally, it is very likely that disparities identified between the white and Hispanic/Latino ethnic groups would have been larger if we had included people who did not speak English.

IMPLICATIONS

We have demonstrated important ethnic disparities in asthma morbidity in Chicago. The health disparities are only partly explained by disparities in socioeconomic status (under the caveat that our measure of socioeconomic status is imperfect). Future research on the same topic must confront two important challenges: first, ethnicity is becoming more difficult to measure as groups intermingle and diversify, and second, the appropriate measurement of socioeconomic status is an unresolved conundrum with wide fluctuations over time for many individuals. But future research should now be focused primarily on identifying the causes for ethnic disparities that are amenable to intervention and change, especially access to health care, quality of care, and health behaviors.

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