Effect of Race on Asthma Management and Outcomes in a Large, Integrated Managed Care Organization

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Background: Morbidity from asthma disproportionately affects black people. Whether this excess morbidity is fully explained by differences in asthma severity, access to care, or socioeconomic status (SES) is unknown.

Methods: We assessed whether there were racial disparities in asthma management and outcomes in a managed care organization that provides uniform access to health care and then determined to what degree these disparities were explained by differences in SES, asthma severity, and asthma management. We prospectively studied 678 patients from a large, integrated health care delivery system. Patients who had been hospitalized for asthma were interviewed after discharge to ascertain information about asthma history, health status, and SES. Small-area socioeconomic data were ascertained by means of geocoding and linkage to the US Census 2000. Patients were followed up for subsequent emergency department (ED) visits or hospitalizations (median follow-up, 1.9 years).

Results: Black race was associated with a higher risk of ED visits (hazard ratio [HR], 1.93; 95% confidence interval [CI], 1.39-2.66) and hospitalizations (HR, 1.89; 95% CI, 1.30-2.76). This finding persisted after adjusting for SES and differences in asthma therapy (adjusted HR for ED visits, 1.73; 95% CI, 1.07-2.81; and adjusted HR for hospitalizations, 2.01; 95% CI, 1.33-3.02).

Conclusions: Even in a health care setting that provides uniform access to care, black race was associated with worse asthma outcomes, including a greater risk of ED visits and hospitalizations. This association was not explained by differences in SES, asthma severity, or asthma therapy. These findings suggest that genetic differences may underlie these racial disparities.

Arch Intern Med. 2007;167(17):1846-1852

Numerous studies have documented racial disparities in asthma management and outcomes. In particular, black patients have been shown to have worse asthma symptom control, increased hospitalization rates, and higher mortality rates compared with white patients. The underlying causes of these disparities are complex and have not been fully elucidated. Some proposed reasons include inadequate access to health care, lower socioeconomic status (SES), suboptimal use of asthma controller medications, environmental exposures, genetic and behavioral differences, and health care provider shortcomings (eg, poor communication or racial bias). Several studies have attempted to adjust for the effects of SES, and most have found that racial disparities in asthma care and outcomes persisted despite this adjustment. In these previous studies, adjustment for SES may have been incomplete, as only 1 or 2 measures were used (eg, income or educational attainment).

Controlling for differences in access to health care has also been a challenge when assessing racial disparities in asthma care. Several studies have examined whether racial differences exist among patients enrolled in managed care organizations as a method of controlling for access to care. These studies were limited by lack of information about asthma severity and health status and heterogeneity in access to and provision of care because many different managed care organizations were included in the individual studies.

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The Kaiser Permanente of Northern California (KPNC) asthma cohort was created to study the various determinants of asthma health outcomes. This cohort provided the opportunity to examine whether racial disparities in asthma management and outcomes can be attributed to factors other than differences in asthma severity, access to care, or SES because all patients received uniform health care, had comprehensive baseline assessments of...
general health and asthma status, and were followed up longitudinally for emergency health care visits related to asthma. In addition, this study attempted to achieve a better assessment of SES by measuring multiple socioeconomic characteristics at the individual level (eg, income and educational attainment) and the area level (eg, census block group data).

The goals of this study were 2-fold: (1) to examine whether there are racial disparities in asthma management and outcomes in a managed care organization that provides broad access to the full complement of primary to tertiary care services and (2) if racial disparities do exist, to determine the degree to which these disparities are explained by differences in SES, asthma severity, and asthma management.

METHODS

OVERVIEW

We identified members of KPNC who were hospitalized for asthma during a 4-year period. After hospital discharge, we conducted a cross-sectional study that included structured telephone interviews assessing asthma history, health status, and sociodemographic characteristics.10,11 In addition, we conducted a prospective cohort study with these same patients. Longitudinal follow-up was performed to gather data about emergency department (ED) visits and hospitalizations after the index hospitalization. In this analysis, we evaluated whether racial disparities existed in asthma management and outcomes among members of KPNC. The study was approved by the University of California, San Francisco, Committee on Human Research and the Kaiser Foundation Research Institute’s institutional review board.

PARTICIPANT RECRUITMENT

We studied adult members of Kaiser Permanente (KP), the nation’s largest nonprofit managed care organization. In northern California, the KP Medical Care Program provides the full spectrum of primary to tertiary care to approximately 3.1 million members; KPNC’s share of the regional population is 25% to 30%.12 The demographic characteristics of KPNC membership are similar to the overall northern California population, except for the extremes of income and educational attainment.13

Recruitment methods have been previously described in detail10,11,14,15 and are briefly summarized herein. To establish a cohort with moderate to severe asthma, we recruited adults after a recent hospitalization for asthma.14,16 To interview patients promptly after hospitalization, recruitment was conducted on a rolling monthly basis. Each month we identified all adult KPNC members (≥18 years) who were hospitalized at any northern California KP hospital with a principal international Classification of Diseases, Ninth Revision (ICD-9),20 discharge diagnosis code for asthma (codes 493.00-493.99) during a 4-year period beginning April 1, 2000. We also included KPNC members hospitalized with a secondary discharge diagnosis ICD-9 code for asthma and a principal ICD-9 code for acute asthma-related respiratory conditions. Persons with a primary or secondary discharge diagnosis ICD-9 code for chronic bronchitis (code 491.xx), emphysema (code 492.xx), or chronic airway obstruction (code 496.xx) were excluded. We validated the diagnosis of asthma in a stratified random sample of medical records.10,11,14,15 In addition, all the patients reported a physician diagnosis of asthma at the time of telephone interview.

The complete cohort included 865 individuals who underwent structured telephone interviews, which reflects completion of telephone interviews by 53% of eligible persons. Individuals who completed interviews were similar in age (P=.46), sex (P=.80), and race (P=.98) to those who did not complete interviews. Patients were followed up for a median of 1.9 years for subsequent ED visits and hospitalizations.

PREDICTOR VARIABLES

Sociodemographic Characteristics

Structured telephone interviews were conducted to ascertain age, sex, race/ethnicity, educational attainment, income, and marital status. We defined educational attainment as less than high school, high school, some college, or college/graduate degree. To determine race/ethnicity, respondents were asked whether they were of Latino or Hispanic descent. Patients further indicated their race/ethnicity by choosing from several categories: white, black/African American, Asian, Hawaiian/Pacific Islander, and other. We limited this analysis to patients identified as black or white, excluding those from other racial/ethnic groups.

Area-Level Socioeconomic Measures

Latitude and longitude coordinates were assigned to each patient’s address using an electronic street map database (MapMarker version 9.1; MapInfo Corp, Troy, New York), a process referred to as geocoding.21-23 Patients’ addresses were then linked to the 2000 US Census database on the block group level. Only 4 patients could not be geocoded. Of the patients analyzed, only 11% lived in the same census block group.

On the basis of our previous work in asthma, we selected a series of variables from the census that represented area-level measures of SES: income and poverty status; employment status; educational level; home value, age, and ownership; family configuration; and population density. Through principal components analysis, 2 factors were empirically derived that linked area-level SES and asthma status in a separate cohort of adults with asthma from northern California. In that analysis, factor 1 represented lower SES and was associated with poorer physical component scores on the 12-item Short-Form Health Survey and worse asthma quality of life and factor 2 represented suburban area-level SES and was associated with lower forced expiratory volume in 1 second.24

Asthma and General Health Status

A combined approach was used to measure disease severity using disease-specific and generic health status measurements. We measured asthma severity using a previously developed and validated 13-item disease-specific severity-of-asthma score based on frequency of current asthma symptoms (daytime or nocturnal), use of systemic corticosteroids, use of asthma medications other than systemic corticosteroids, and history of hospitalization and intubation.25-28 Possible total scores range from 0 to 28, with higher scores reflecting more severe asthma. Generic physical and mental health status was measured using the 12-item Short-Form Health Survey.27 The physical and mental component summary scores, which were defined from the original 8 subscales of the 36-item Short-Form Health Survey by means of factor analysis, measure underlying physical and mental dimensions of health. Higher scores reflect more favorable health status.
We assessed asthma-specific quality of life using the Marks Asthma Quality of Life Questionnaire, a validated 20-item questionnaire that measures the physical, emotional, and social impact of asthma. Higher scores represent poorer asthma-specific quality of life. As another measure of physical health status, daily activity restriction was ascertained using a question from the National Health Interview Survey. Specifically, respondents were asked to indicate how many days their activity was limited owing to a health condition during the past month.

Asthma Preventive Care

Based on the National Asthma Education and Prevention Program guidelines, we ascertained several health care measures that compose recommended preventive measures for asthma. These measures included long-term controller medications (inhaled corticosteroids, long-acting β-agonists, and leukotriene modifiers), monitoring strategies (peak flow meter use and action plan), and educational efforts (asthma education classes and instruction on metered-dose inhaler use). In addition, we ascertained whether patients were seen by an asthma specialist (pulmonologist or allergist) in the previous year or had contact with KPNC asthma care managers (pharmacists, nurses, and respiratory therapists). To supplement the self-reported medication use information, we also measured dispensing of long-term controller medications during the 3 months before the index date using the KPNC computerized pharmacy database.

Longitudinal Asthma Outcomes: Ambulatory Care and Urgent Care Visits for Asthma

We used KP’s computerized utilization databases to ascertain routine ambulatory care and urgent care visits for asthma that occurred after the index hospitalization. Urgent care visits were defined as those in which the appointment was made within 24 hours of the visit; all other ambulatory care visits were considered routine. Urgent care visits did not occur in the ED but rather in the ambulatory care setting.

Longitudinal Asthma Outcomes: Emergency Health Care Utilization for Asthma

We used KP’s computerized utilization databases to ascertain ED visits and hospitalizations for asthma that occurred after the index hospitalization. Asthma-related hospitalization was defined as 1 or more hospitalizations with a principal discharge diagnosis code for asthma (ICD-9 code 493.xx) or a secondary diagnosis code for asthma with a primary diagnosis of a related respiratory condition (see the “Participant Recruitment” subsection). Asthma-related ED visits were identified as 1 or more visits with an ICD-9 code for asthma (493.xx).

STATISTICAL ANALYSIS

Statistical analysis was conducted using a software program (SAS version 9.1; SAS Institute Inc, Cary, North Carolina). Bivariate analysis was performed using the unpaired t test for continuous variables and the χ² test for categorical variables. We used linear regression analysis to examine the associations between race and health status. In the multivariate linear regression analysis, we controlled for individual-level socioeconomic and behavioral factors that have been associated with worse asthma (age, sex, education, income, and smoking history) plus census-derived area-level socioeconomic measures that have been associated with worse asthma (see the “Area-Level Socioeconomic Measures” subsection). Body mass index and childhood history of asthma were not included in the multivariate model because in univariate analyses they were not significantly associated with ED visits, hospitalizations, or ambulatory care visits. To examine the association between race and asthma care measures, we used logistic regression to calculate odds ratios (ORs) using an indicator variable for black race, with white race as the reference group.

To take the variable follow-up time into account Cox proportional hazards analysis was used to evaluate the association of race with ambulatory care and urgent care visits. Cox proportional hazards analysis was also used to evaluate the association of race with ED visits and hospitalizations for asthma during follow-up. Participants were censored for termination of KP membership or death. In these analyses, the same approach described previously was used to control for the individual- and area-level socioeconomic factors that have been associated with worse asthma. To take clustering by census block groups into account (only 11% of patients lived in the same census block group), the robust sandwich estimate of Lin and Wei for the covariance matrix was used. Adjustment for clustering had essentially no effect on the results.

RESULTS

DEMOGRAPHIC, SOCIOECONOMIC, AND CLINICAL CHARACTERISTICS

The cohort included 865 adult patients with asthma. This analysis was limited to 678 patients, 524 white and 154 black, excluding 187 individuals of other racial/ethnic backgrounds. There were significant demographic differences between black and white patients (Table 1). White patients were older on average, and a larger proportion had college or graduate degrees. A larger proportion of black patients reported an annual household income of less than $20,000, and a larger proportion had not graduated from high school. The only significant clinical differences were that black patients had a higher mean body mass index and were more likely to report a childhood history of asthma (Table 1). Compared with our previous study of a population-based sample of Californians with asthma, the KP cohort was similar in race (59% white for both cohorts) and income level (16% with lowest income in the KP cohort compared with 15% in the population-based cohort). The KP cohort was older on average compared with the population-based sample (60 vs 40 years), which reflects differences in the inclusion criteria for age between the 2 studies.

ASTHMA STATUS AND GENERAL HEALTH STATUS

Asthma severity, physical health status, and the number of days of restricted activity were similar among black and white patients (Table 2). Black race was associated with poorer mental health status and asthma-specific quality of life. However, adjusting for individual-level and census-derived area-level SES covariates attenuated these effects as the 95% confidence intervals (CIs) did not exclude no effect.
Black patients were significantly more likely to have had asthma specialist care, as well as more likely to report using their peak flow meters regularly. In addition, the likelihood of having seen an asthma specialist during the previous year was similar in black and white patients. In this prospective cohort of patients with moderate to severe asthma and uniform access to health care, black race was associated with worse asthma outcomes, including a greater risk of ED visits and hospitalizations. This association was not explained by differences in asthma severity, SES, or asthma therapy. These findings support previous studies of managed care patients that demonstrated worse asthma outcomes for black patients compared with white patients. However, these findings differ in several important re-
Fewer asthma specialist consultations among blacks. The reasons underlying the racial disparities observed in this study are not clear, although they are likely to be complex. Although we used multiple measures of SES, including individual- and area-level data, there may be residual confounding by unmeasured socioeconomic factors. In addition, we did not collect information about comorbid diseases or specific health-related behaviors, such as diet or exercise. Therefore, we cannot exclude differences in these factors as possible explanations for the findings.

The association between black race and greater asthma morbidity and mortality rates has been well documented in the literature. For this reason, health care providers may be more likely to encourage black patients to seek emergency care if they experience an asthma exacerbation. This could explain the higher rate of ED visits among black patients, but this does not account for the higher hospitalization rate. Boudreaux and colleagues35 found that at similar symptom levels, black patients were more than twice as likely as white patients to be admitted to the hospital on presenting to the ED. Perhaps ED physicians have a lower threshold to admit black patients to the hospital given the perceived risk of worse asthma outcomes for blacks. The increased risk of ED visits and hospitalization for black patients may also be due to differences in behavioral or cultural beliefs about asthma. Previous work has also shown that black patients who receive asthma care in acute care settings tend to emphasize self-treatment of symptoms rather than seeking specialty care.

Table 3. Association of Race With Asthma Care Measuresa

<table>
<thead>
<tr>
<th>Care Measure</th>
<th>White Patients</th>
<th>Black Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controller medication use in the past 2 wk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhaled corticosteroid</td>
<td>0.74 (0.50 to 1.09)</td>
<td></td>
</tr>
<tr>
<td>Long-acting inhaled β-agonist</td>
<td>0.88 (0.59 to 1.31)</td>
<td></td>
</tr>
<tr>
<td>Leukotriene modifier</td>
<td>0.67 (0.35 to 1.27)</td>
<td></td>
</tr>
<tr>
<td>Any controller medication</td>
<td>1.00 (0.69 to 1.43)</td>
<td></td>
</tr>
<tr>
<td>Controller medication dispensing in the past 3 mo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhaled corticosteroid</td>
<td>0.83 (0.53 to 1.31)</td>
<td></td>
</tr>
<tr>
<td>Long-acting inhaled β-agonist</td>
<td>0.74 (0.47 to 1.17)</td>
<td></td>
</tr>
<tr>
<td>Leukotriene modifier</td>
<td>0.70 (0.30 to 1.63)</td>
<td></td>
</tr>
<tr>
<td>Any controller medication</td>
<td>0.79 (0.53 to 1.18)</td>
<td></td>
</tr>
<tr>
<td>Rescue medication use in the past 2 wk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-acting inhaled β-agonist</td>
<td>1.82 (1.19 to 2.79)</td>
<td></td>
</tr>
<tr>
<td>Nebulizer</td>
<td>1.59 (1.11 to 2.28)</td>
<td></td>
</tr>
<tr>
<td>Prednisone</td>
<td>1.28 (0.84 to 1.94)</td>
<td></td>
</tr>
<tr>
<td>Rescue medication dispensing in the past 3 mo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-acting inhaled β-agonist</td>
<td>2.22 (1.47 to 3.36)</td>
<td></td>
</tr>
<tr>
<td>Nebulizer</td>
<td>0.93 (0.57 to 1.50)</td>
<td></td>
</tr>
<tr>
<td>Prednisone</td>
<td>1.35 (0.90 to 2.03)</td>
<td></td>
</tr>
<tr>
<td>Asthma monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possesses peak flow meter</td>
<td>1.47 (0.93 to 2.34)</td>
<td></td>
</tr>
<tr>
<td>Uses peak flow meter ≥1 wk</td>
<td>1.52 (1.05 to 2.21)</td>
<td></td>
</tr>
<tr>
<td>Action plan</td>
<td>1.24 (0.85 to 1.82)</td>
<td></td>
</tr>
<tr>
<td>Asthma education in the past year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attended asthma class</td>
<td>1.02 (0.68 to 1.52)</td>
<td></td>
</tr>
<tr>
<td>Contact with Kaiser care manager</td>
<td>1.02 (0.66 to 1.58)</td>
<td></td>
</tr>
<tr>
<td>Direct instruction on metered-dose inhaler use</td>
<td>1.23 (0.53 to 2.87)</td>
<td></td>
</tr>
<tr>
<td>Seen by an asthma specialist in the past year</td>
<td>0.95 (0.62 to 1.47)</td>
<td></td>
</tr>
</tbody>
</table>

Data are presented as odds ratios (95% confidence intervals).

Table 4. Association of Race With Ambulatory Care and Urgent Care Visitsa

<table>
<thead>
<tr>
<th>Outcome</th>
<th>White Patients</th>
<th>Black Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine ambulatory care visits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>1.44 (1.16 to 1.78)</td>
<td></td>
</tr>
<tr>
<td>Adjusted</td>
<td>1.44 (1.13 to 1.85)</td>
<td></td>
</tr>
<tr>
<td>Urgent care visits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>1.30 (0.96 to 1.77)</td>
<td></td>
</tr>
<tr>
<td>Adjusted</td>
<td>1.42 (0.99 to 2.02)</td>
<td></td>
</tr>
</tbody>
</table>

Data are presented as hazard ratios (95% confidence intervals).

Table 5. Association of Race With Risk of Emergency Health Care Use for Asthmaa

<table>
<thead>
<tr>
<th>Outcome</th>
<th>White Patients</th>
<th>Black Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency department visits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>1.93 (1.39 to 2.66)</td>
<td></td>
</tr>
<tr>
<td>Adjusted</td>
<td>1.73 (1.07 to 2.81)</td>
<td></td>
</tr>
<tr>
<td>Hospitalizations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>1.89 (1.30 to 2.76)</td>
<td></td>
</tr>
<tr>
<td>Adjusted</td>
<td>2.01 (1.33 to 3.02)</td>
<td></td>
</tr>
</tbody>
</table>

Data are presented as odds ratios (95% confidence intervals).

References:

1. Krishnan and colleagues found that black patients were significantly less likely to have received asthma education about self-management techniques and avoidance of asthma triggers. These studies concluded that differences in care measures accounted for the racial disparities in asthma outcomes. In the present study, we found no differences in asthma preventive care measures between black and white patients. Black and white patients had similar rates of controller medication use (including inhaled corticosteroids), asthma education, and asthma specialist care visits. In fact, black patients were more likely to have been to ambulatory care visits for asthma. The latter observation argues against the increase in ED visits as simply reflecting a substitution for primary health care.

2. The reasons underlying the racial disparities observed in this study are not clear, although they are likely to be complex. Although we used multiple measures of SES, including individual- and area-level data, there may be residual confounding by unmeasured socioeconomic factors. In addition, we did not collect information about comorbid diseases or specific health-related behaviors, such as diet or exercise. Therefore, we cannot exclude differences in these factors as possible explanations for the findings.

3. The association between black race and greater asthma morbidity and mortality rates has been well documented in the literature. For this reason, health care providers may be more likely to encourage black patients to seek emergency care if they experience an asthma exacerbation. This could explain the higher rate of ED visits among black patients, but this does not account for the higher hospitalization rate. Boudreaux and colleagues found that at similar symptom levels, black patients were more than twice as likely as white patients to be admitted to the hospital on presenting to the ED. Perhaps ED physicians have a lower threshold to admit black patients to the hospital given the perceived risk of worse asthma outcomes for blacks. The increased risk of ED visits and hospitalization for black patients may also be due to differences in behavioral or cultural beliefs about asthma. Previous work has also shown that black patients who receive asthma care in acute care settings tend to emphasize self-treatment of symptoms rather than seeking specialty care.
tients. Federico et al found that black patients had differential adherence to medications among black and white patients. Therefore, we do not believe that racial disparities in asthma outcomes may have been misclassified as having asthma. Many previous studies have used ICD-9 discharge diagnoses to identify hospitalized patients with asthma. In addition, a study conducted at KP validated this approach against medical record review. The present medical record review also confirmed the high accuracy of the asthma diagnoses. Finally, all the patients in this study confirmed having a physician’s diagnosis of asthma when interviewed.

Black race is associated with worse asthma outcomes in a managed care population with equal access to health care. These findings were not explained by differences in asthma severity, asthma therapy, or SES. Further efforts to investigate the basis for these racial disparities should be undertaken, including closer examination of provider preferences or beliefs about caring for black patients, and more in-depth study of patient characteristics, including cultural beliefs and behaviors related to asthma. These findings also support genetic differences or predispositions, including β2-adrenergic receptor polymorphisms, as a possible explanation for racial disparities in asthma outcomes. Further investigation of genetic differences and gene-environment interactions in black populations is needed to better understand the reasons underlying these racial disparities in asthma morbidity.

Accepted for Publication: May 1, 2007.

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Author Contributions: Dr Eisner had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Erickson and Eisner. Acquisition of data: Blanc and Eisner. Analysis and interpretation of data: Erickson, Iribarren, Tolstykh, Blanc, and Eisner. Drafting of the manuscript: Erickson and Eisner. Critical revision of the manuscript for important intellectual content: Erickson, Iribarren, Tolstykh, Blanc, and Eisner. Statistical analysis: Erickson, Tolstykh, and Blanc. Obtained funding: Blanc and Eisner. Administrative, technical, and material support: Erickson and Blanc. Study supervision: Erickson, Iribarren, and Eisner.

Financial Disclosure: None reported.

Funding/Support: This study was supported by grant K23 HL04201 from the National Heart, Lung, and Blood Institute, National Institutes of Health.

Role of the Sponsor: The funding source had no role in the collection, analysis, or interpretation of the data or in the decision to submit the manuscript for publication.

Additional Contributions: Michael Shlipak, MD, assisted in the preparation of this manuscript.

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