

Regional and racial disparities in asthma hospitalizations in Mississippi

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Background: In the United States, asthma hospitalization rates are disproportionately high among blacks compared with other racial/ethnic groups and vary by geographic region. These disparities among asthma hospitalizations might be affected by social, environmental, and health-care access factors.

Objective: To determine demographic risk factors for asthma hospitalizations in urban versus rural areas of Mississippi.

Methods: A cross-sectional study using data from the Mississippi Asthma Surveillance System was conducted to compare asthma hospitalizations in the urban Jackson metropolitan statistical area and rural Delta regions of Mississippi from 2003 to 2005. Factors including race, sex, age, and household income that might be associated with multiple hospitalizations for asthma (3 or more during the study period) were assessed using logistic regression.

Results: Asthma hospitalization rates were significantly higher among all demographic groups in the rural Delta region compared with the urban Jackson Metropolitan Statistical Area ($P < .001$). In both regions, hospitalization rates were higher among blacks and females ($P < .001$). Asthma hospitalization rates were highest among children (0-17 years) and older adults (≥ 65 years). In both regions, blacks were more likely to have 3 or more asthma hospitalizations ($P < .001$). Residents of the Delta had higher odds for multiple hospitalizations controlling for race, sex, age, and household income ($P < .05$).

Conclusion: Blacks with asthma are more likely to have multiple asthma hospitalizations in Mississippi. Higher odds of multiple asthma discharges for Delta residents were not explained by race, sex, age, or income, indicating that other contributing factors (eg, environmental, social, and access to care factors) need further investigation. (*J Allergy Clin Immunol* 2010;125:636-42.)

Key words: Asthma, hospitalization, race, urban, rural, disparity

Asthma, a leading cause of chronic illness in children and young adults,^{1,2} is a health condition with substantial race and sex disparities. Differences in US asthma hospitalizations and mortality were described during the 1970s³ and more recently in 1995.⁴ Blacks have a higher prevalence of asthma (12.5% and 7.6% among children age 0-17 years and adults age 18 years and older compared with 7.7% and 6.7%, respectively), are 3 times more likely to be hospitalized (33.5 per 10,000 compared with 10.0 per 10,000), and are 2 times more likely to die of asthma (27.4 per million population compared with 12.8 per million population) than non-Hispanic whites.⁵

National Hospital Discharge Survey Database data for 1995 to 2002 illustrated a narrowing of the disparity between blacks and whites in asthma hospitalization rates for children age <10 years; however, racial/ethnic disparity in asthma hospitalizations among youths age 10 to 17 years and among adults age ≥ 18 also narrowed until 2000 but has started to widen since then.⁴

Asthma hospitalizations are disproportionately high among boys age 0 to 17 and women among all racial groups, mirroring sex-based prevalence trends in asthma.⁵ Identification of factors contributing to hospitalizations is complicated because of the influence of multiple demographic indicators, particularly race and income, and system-level considerations such as hospital admission and prescription policies that may vary at the local level.^{6,7} Although 21% of the US population lives in rural areas, there are almost no US studies on differences between rural and urban asthma morbidity using race and socioeconomic covariates.⁸ Identifying geographic disparities in asthma hospitalizations is critical to implement prevention strategies, reduce morbidity, and improve health care financing for clinical asthma treatment.^{9,10}

To date, no study has explored disparities among asthma hospitalizations in Mississippi, especially differences between rural and urban settings. The purpose of this study is to characterize the racial and regional characteristics in population-based asthma hospitalization rates and to assess demographic predictors of multiple asthma hospitalizations in the Jackson Metropolitan Statistical Area (JMSA) and the Delta from 2003 to 2005.

METHODS

Study population

A cross-sectional study of asthma hospital discharges in the urban JMSA and rural Delta regions of Mississippi from 2003 to 2005 was conducted to investigate regional demographic factors affecting repeat hospitalizations. The JMSA, Mississippi's largest metropolitan area, is composed of the following 5 counties: Copiah, Hinds, Madison, Rankin, and Simpson. During the 3-year study period, the JMSA had a higher proportion of black residents compared with the state population (53% vs 37%, respectively). The 2005 median income for the JMSA residents was \$35,433, higher than the statewide median household income of \$33,090 but lower than the United States median

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Abbreviations used

ED: Emergency department
JMSA: Jackson Metropolitan Statistical Area
MASS: Mississippi Asthma Surveillance System
MSDH: Mississippi State Department of Health

household income of \$46,326.¹¹ The Delta region is typically defined as an 18-county region in the upper-western part of the state. For this study, the Delta includes 11 counties: Coahoma, Bolivar, Sunflower, Leflore, Holmes, Humphreys, Yazoo, Sharkey, Issaquena, Washington, and Warren. These Mississippi counties are part of the Lower Mississippi River Delta, a region with a population characterized by a higher concentration of black residents, higher poverty rates, lower educational attainment, and higher rates of disease than the nation as a whole.¹² From 2003 to 2005, the Delta population included in the study had a higher proportion of black residents compared with the JMSA and the state population (64% vs 52% and 37%, respectively). The 2005 median household income for residents of the 11 Delta counties included in this study was \$24,297, lower than both the statewide and the US medians. Residents of the 7 counties in which 1 or more hospital per county failed to report asthma hospitalization data to the Mississippi State Department of Health (MSDH) for ≥ 1 year were excluded from the study. The population of the excluded Delta counties had a lower proportion of black residents than the included counties (31% black in the 7 excluded counties vs 64% black in the 11 included counties). The 2005 median household income of the excluded counties was \$29,917, higher than the \$24,297 median income of the included Delta counties.¹¹

Data collection

Asthma hospital discharge information for Mississippi was extracted from the Mississippi Asthma Surveillance System (MASS). MASS collects record-level details regarding patient characteristics, diagnoses, and residence location for every asthma hospital, emergency department (ED), and outpatient discharge in Mississippi that is reported to the MSDH. Within MASS, outpatient discharges are defined as discharge from an outpatient clinic associated with an acute care hospital. In this study, an asthma discharge was defined as having had a principal hospital discharge diagnosis with an International Classification of Diseases—Ninth Revision¹³ code of 493. Population estimates used for calculating the population-based asthma hospital, ED, and outpatient discharge rates were obtained from the US Census Bureau.

Inclusion criteria

Records were included in the study on the basis of 3 criteria: (1) primary discharge diagnosis of asthma (International Classification of Diseases—Ninth Revision 493); (2) discharge within the 3-year period from January 1, 2003, to December 31, 2005; and (3) patient residence within 1 of the selected 16 (11 Delta and 5 JMSA) Mississippi counties. Characteristics documented in the data included the patient's unique medical record number, race (white, black, or other), sex, date of birth, date of hospital discharge, and zip code of residence. No ethnicity data were included in the study.

All hospital discharge records ($N = 5794$) that met the study inclusion criteria included a unique patient identifier. Discharge records were matched by unique identifier to identify patients ($n = 4242$) residing in selected JMSA and Delta counties who had been discharged from the hospital with a primary diagnosis of asthma from 2003 to 2005. Among those patients, 2150 were from JMSA counties and 2092 were from Delta counties.

Data analysis

Address of residence from asthma hospital discharge data was matched with census block group economic data estimates for 2005 from the US Census Bureau.¹¹ Approximately 99% of the sample was matched to the block group data from the census. Six patient records from the JMSA were not

matched because of records having included only city and state of residence (street address and zip code were missing). Median household income for the census block group of the asthma patient's residence provided a proxy for the patient's household income, similar to a method using zip code data in a similar study.⁶

Crude and age-adjusted asthma hospital, ED, and outpatient discharge rates were calculated by using the Direct Method.¹⁴ The 2000 US Standard Population was used to calculate age-adjusted rates.¹⁵ SEs for the age-adjusted population-based rates were calculated as weighted linear combinations, assuming the denominator was a constant.⁵ SEs were used in statistical significance tests, and relative SEs were used to identify unreliable estimates. Differences between summary statistics were considered statistically significant if their associated P value was $<.05$.

To investigate factors associated with repeat asthma hospitalizations among residents of the JMSA and Delta regions, 3 regression models were developed. Logistic regression was used to estimate the logits in which the outcome was 3 or more asthma hospitalizations for the same patient in the 3-year period with covariates race, sex, age, income, and geography (JMSA vs Delta). The income logit was set at the 25th percentile for the respective samples (JMSA, \$25,266; Delta, \$19,053; and combined JMSA/Delta, \$21,452) to assess the probability of 3 or more asthma discharges among residents with household income in the lowest 25% of the sample compared with residents with incomes in the upper 75% of the sample. The first model controlled for age and sex to demonstrate the racial gap in multiple hospitalizations. The second model controlled for age, sex, and median household income for the patient's census block group of residence. The third model controlled for race, age, sex, and median household income to assess the role of region of residence (JMSA vs Delta) in predicting multiple asthma hospitalizations. Race, household income, and residence of asthma patients were associated; however, interaction terms were not statistically significant ($P >.05$) when included in the models and were therefore removed.

Models 1 and 2 were tested for residents of the JMSA and residents of the Delta separately. To test the effect of region of residence on odds of multiple (3 or more) asthma hospitalizations, JMSA and Delta samples were combined, and a dummy variable for region (0 = JMSA; 1 = Delta) was developed. The 3 regression models, described above, were applied to the combined data set. The first model included race, sex, and age. The second model included all variables in the first model plus median household income. The third model included the region dummy variable in addition to the variables in the second model, indicating patient residence in the JMSA or the Delta. All 3 models were statistically significant ($P <.001$).

Logit results were confirmed with Poisson regression for the count of repeat hospitalizations with the same covariates. Odds ratios with a P value $<.05$ were considered statistically significant. Because they represented only a small portion of the population and lacked descriptive data (during 2003–2005, MASS coded race in only 3 categories: “black,” “white,” or “other”), patients of race/ethnicity other than white or black ($n = 57$) were excluded from regression analyses.

RESULTS

From 2003 to 2005, a total of 4242 residents of the JMSA ($n = 2150$) and the Delta ($n = 2092$) were discharged from a Mississippi hospital 1 or more times with a primary diagnosis of asthma. Hospitalizations were significantly ($P <.05$) higher among blacks, males, and persons age 0 to 17 years living in the Delta compared with the JMSA (Table I).

Population-based rates of asthma hospitalization were significantly higher among all demographic groups living in the Delta compared with demographic groups living in the JMSA (Table II). Within both geographic regions, asthma hospitalization rates were higher among black residents and female residents. In JMSA, rates were highest among children age 0 to 17 years, and in the Delta, rates were highest among adults age ≥ 65 years. Sex differences are age-specific, with rates among children age 0

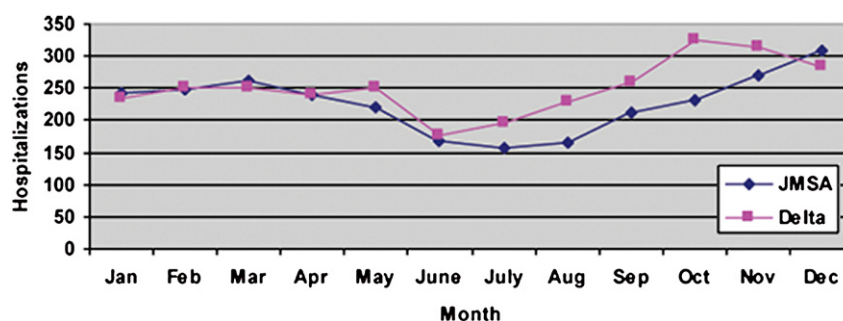


FIG 1. Number of asthma hospitalizations by month, JMSA, and Delta regions of Mississippi, 2003 to 2005.

TABLE I. Characteristics of patients hospitalized for asthma in the JMSA¹ and Delta regions, Mississippi, 2003-2005

Characteristics	JMSA	Delta	Total	Rate ratio ¹
Total no. of patients	2,150 (51%)	2,092 (49%)	4,242 (100%)	
Race				
White	714 (33%)	519 (25%)	1,233 (29%)	0.8*
Black	1,406 (66%)	1,546 (74%)	2,952 (70%)	1.1*
Other	30 (1%)	27 (1%)	57 (1%)	
Sex				
Male	855 (40%)	917 (44%)	1,772 (42%)	1.1*
Female	1,295 (60%)	1,175 (56%)	2,470 (58%)	0.9*
Age (y)				
0-17	813 (38%)	880 (42%)	1,693 (40%)	1.1*
18-44	529 (25%)	453 (22%)	982 (23%)	0.9*
45-64	475 (22%)	406 (19%)	881 (21%)	0.9*
≥65	333 (15%)	353 (17%)	686 (16%)	1.1

¹Jackson Metropolitan Statistical Area = reference group.

**P* < .05.

to 14 years higher among boys than girls and rates among adolescents and adults age ≥15 years higher among female than male residents (data not shown). Asthma ED discharge rates were significantly higher among all demographic groups in the Delta compared with the JMSA (Table III). Asthma outpatient discharge rates were significantly higher among all demographic groups in the JMSA versus the Delta except adults age ≥65 years (Table IV).

One hundred thirty-six residents of the JMSA and 174 residents of the Delta had ≥3 asthma hospital discharges during the study period. In both the JMSA and the Delta, more black patients (108 in the JMSA and 141 in the Delta) than white patients (28 in the JMSA and 33 in the Delta) had 3 or more hospitalizations for asthma from 2003 to 2005 (*P* < .001). Of JMSA residents with ≥3 asthma hospital discharges, 11.0% also had ≥3 asthma ED discharges compared with 34.5% of Delta residents (*P* < .001). Of JMSA residents with ≥3 asthma hospital discharges, 22.1% also had ≥3 outpatient asthma discharges compared with 15.8% of Delta residents (*P* < .001).

The proportion of hospitalizations accounted for by repeat hospitalizations (1 or more) was similar for each of the 3 years included in the study sample. In 2003, approximately 18% of asthma hospitalizations for both regions were repeat visits, compared with 19% in 2004 and 16% in 2005. This measure provides an overview of the distribution of repeat visits by year and differs from the multiple hospitalization (3 or more) measure.

TABLE II. Asthma hospital discharge rates per 10,000 population by selected demographic characteristics, Mississippi, 2003-2005

Characteristics	JMSA ¹	Delta	<i>P</i> value
Race			
White	10.4 (9.7-11.1)	22.2 (20.5-23.9)	<.001
Black	26.8 (25.6-28.1)	37.9 (36.3-39.6)	<.001
Sex			
Male	14.6 (13.7-15.4)	27.6 (26.0-29.1)	<.001
Female	20.8 (19.8-21.8)	35.8 (34.1-37.5)	<.001
Age (y)			
0-17	25.0 (23.4-26.5)	42.4 (39.9-44.9)	<.001
18-44	12.0 (11.1-12.9)	20.4 (18.9-21.9)	<.001
45-64	17.4 (16.1-18.8)	29.4 (27.1-31.8)	<.001
65+	23.9 (21.6-26.3)	54.4 (50.0-58.9)	<.001
Total	18.1 (17.4-18.7)	32.4 (31.2-33.5)	<.001

¹Jackson Metropolitan Statistical Area.

Distribution of asthma hospitalizations by month was consistent in the JMSA and Delta regions, with peak visits for both regions occurring from October to December (Fig 1).

Results of the 2 regression models for patients are listed in Table V. Models 1 and 2 for both regions had overall significance of *P* < .001. Results of logistic regression indicate that race was significant in predicting multiple hospitalizations in both regions, even after sex, age, and household income were controlled. Blacks were >2 times as likely as whites to have multiple hospitalizations in the JMSA and 1.7 times as likely in the Delta. Adults age 18 to 44 years in the JMSA and age 45 to 64 years in the Delta had slightly higher odds for multiple hospitalizations than children age 0 to 17 years. This result differs from the asthma hospitalization rates, which were the highest among children age 0 to 17 years in the JMSA and among adults age ≥65 years in the Delta.

In the model 3 analysis, black residents, adults age 18 to 64 years, patients with household income in the lowest 25% of the sample, and residents of the Delta had significantly higher odds of multiple (3 or more) hospitalizations compared with white residents, children age 0 to 17 years, adults age ≥65 years, patients with income in the upper 75% of the sample, and residents of the JMSA (Table VI). Residents of the Delta experience higher odds of multiple hospitalizations, even when controlling for race, sex, age, and household income, indicating that characteristics of the region not included in the regression model potentially account for differences in repeat asthma discharges in the Delta compared with the JMSA.

Poisson regression analysis of the count of repeat asthma hospitalizations among the JMSA and Delta patient sets yielded

TABLE III. Asthma emergency department discharge rates per 10,000 population by selected demographic characteristics, Mississippi, 2003-2005

Characteristics	JMSA ¹	Delta	P value
Race			
White	16.8 (15.9-17.8)	31.0 (28.9-33.0)	<.001
Black	78.1 (76.1-80.1)	89.2 (86.9-91.6)	<.001
Sex			
Male	45.1 (43.5-46.6)	64.4 (62.1-66.8)	<.001
Female	50.3 (48.7-51.9)	75.5 (73.1-78.0)	<.001
Age (years)			
0-17	86.7 (83.8-89.6)	114.9 (110.8-118.9)	<.001
18-44	44.8 (43.1-46.5)	67.2 (64.4-69.9)	<.001
45-64	27.7 (26.0-29.4)	49.3 (46.3-52.3)	<.001
65+	15.5 (13.4-17.4)	31.2 (46.3-52.3)	>.05
Total	48.1 (47.0-49.2)	70.9 (69.2-72.6)	<.001

¹Jackson Metropolitan Statistical Area.

results consistent with logistic regression analysis. Race ($P < .001$), age ($P < .001$), household income ($P < .05$), and region ($P < .001$) were significant predictors of multiple asthma hospitalizations for both regions.

DISCUSSION

This study is the first to delineate the detailed demographic trends of asthma hospitalizations in Mississippi. Findings indicate that residents of the rural Delta have both higher population-based hospital discharge rates and higher odds of multiple asthma hospitalizations than residents of the urban JMSA independent of race, income, age, and sex. Thus, our study is the first of its kind to demonstrate worsened asthma outcomes clearly in rural compared with urban residents with asthma in Mississippi.

In both the urban JMSA and rural Delta regions, asthma hospitalization rates were higher among black residents and female residents. The highest rates were observed among children (0-17 years) and older adults (≥ 65 years). Typical seasonal trends in asthma hospitalizations with an increase from October through December each year and a decrease in hospitalizations during June and July were observed. Year of hospitalization did not affect a patient's probability of repeat hospitalizations.

In a 2006 cross-sectional study of hospital discharge data in Massachusetts, Ash and Brandt⁶ used a logistic regression modeling approach to assess demographic variables contributing to hospital readmissions for asthma and concluded that race, household income, sex, and Medicaid enrollment were significant predictors of readmissions for asthma over a 3-year period. Similarly, other researchers have demonstrated that age and sex predict readmission.¹⁶⁻²⁰

Overall population-based asthma hospitalization rates in our study were substantially higher among all demographic groups in the Delta compared with the JMSA. There is a dearth of hospital discharge data for metropolitan statistical areas from other states; however, this finding differs from results of population-based asthma surveillance in Georgia and New York. In Georgia, the hospital discharge rate (15.9 per 10,000) in Fulton County, which includes Atlanta, is among the highest of all the Georgia regions measured.²¹ Note that this rate is lower than the JMSA rate (18.1 per 10,000). In New York, the hospital discharge rate for New York City (35.4 per 10,000) is higher than both the rate for the

TABLE IV. Asthma outpatient discharge rates per 10,000 population by selected demographic characteristics, Mississippi, 2003-2005

Characteristics	JMSA ¹	Delta	P value
Race			
White	33.4 (32.1-34.8)	21.6 (19.9-23.3)	<.001
Black	109.9 (107.5-112.2)	34.1 (32.7-35.6)	<.001
Sex			
Male	71.9 (70.0-73.8)	26.8 (25.3-28.3)	<.001
Female	76.3 (74.3-78.2)	31.0 (29.4-32.6)	<.001
Age (y)			
0-17	198.9 (194.5-203.3)	56.1 (53.3-59.0)	<.001
18-44	28.4 (27.1-29.8)	17.9 (16.4-19.3)	<.001
45-64	40.6 (38.5-42.7)	25.7 (23.5-27.8)	<.001
65+	26.6 (24.1-29.0)	25.8 (22.7-28.9)	>.05
Total	74.8 (73.5-76.2)	30.5 (29.3-31.6)	<.001

¹Jackson Metropolitan Statistical Area.

rest of the state (12.7 per 10,000) and the JMSA.²² A recent study exploring asthma hospitalizations in Tennessee found that the total number of asthma-related hospitalizations per 100,000 persons per year is 133 in urban central counties (or 13.3 per 10,000, compared with 18.1 per 10,000 in the urban JMSA) and 160 in rural counties (or 16.0 per 10,000, compared with 32.4 per 10,000 in the rural Delta).⁸ When thinking about characteristics of urban environments that may contribute to asthma burden, such as crowding and pollution, it is important to note that the JMSA has a lesser population density than the urban comparison areas mentioned: 186.7 per square mile compared with 671.5 per square mile in Atlanta, 2028.7 per square mile in New York, and 302.3 per square mile in Nashville.¹¹

Black patients were more likely to have 3 or more hospitalizations for asthma, regardless of region. We also determined that residents of the Delta had higher odds of readmission than residents of the JMSA, even when controlling for race, sex, age, and household income. In addition, review of mortality statistics indicates that the age-adjusted mortality rates (per 100,000 population) were 3.3 times and 1.5 times higher for blacks than whites in the JMSA and Delta regions, respectively, from 2003 to 2005 (data not shown). Common factors associated with disparities in hospitalizations include differences in prevalence of disease, access to care, quality of care and treatment, patient education, and personal health beliefs and behaviors. Through selection of a cross-section of patients hospitalized for asthma and analyzing repeat discharges, this study eliminated the likelihood of differences in disease prevalence contributing to the disparities noted, indicating that factors other than disease prevalence drive disparate asthma hospitalizations in the rural Delta region.

The Delta is among the poorest areas in the United States. Concentration of poverty within the region is highest among black residents who do not reside in metropolitan areas,¹² making the region particularly vulnerable to the disproportionate disease burden that parallels nationwide racial and ethnic health disparities. Perry et al²³ examined asthma prevalence in 2 school districts in the Delta region of Arkansas, an impoverished, rural, and medically underserved region of the United States. They found asthma prevalence to be higher than national rates and also found significant uncontrolled asthma in this predominantly black population. Substantial research investigating factors related to asthma hospitalizations among children living in urban areas has been

TABLE V. Adjusted odds ratios (95% confidence intervals) for multiple (≥ 3) asthma hospitalizations by region, Mississippi, 2003-2005

Characteristics	JMSA ¹		Delta	
	1	2	1	2
Regression model				
Race				
White	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Black	2.0 (1.3-3.1)**	2.2 (1.4-3.4)**	1.7 (1.2-2.6)*	1.8 (1.2-2.8)*
Sex				
Male	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Female	1.0 (0.7-1.5)	1.0 (0.7-1.5)	1.2 (0.9-1.7)	1.3 (0.9-1.8)
Age (y)				
0-17	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
18-44	1.9 (1.2-3.1)*	2.0 (1.3-3.1)*	1.9 (1.2-3.0)	1.9 (1.2-3.0)
45-64	1.4 (0.8-2.3)*	1.4 (0.9-2.4)	2.6 (1.7-4.0)*	2.7 (1.7-4.1)*
65+	0.9 (0.5-1.7)*	0.9 (0.5-1.7)	2.2 (1.4-3.6)	2.2 (1.4-3.6)
25th Percentile household income				
<\$25,266 (JMSA)	NA	1.0 (ref)		
>\$25,266 (JMSA)	NA	1.4 (0.9-2.1)		
<\$19,053 (Delta)				1.0 (ref)
>\$19,053 (Delta)				2.4 (1.2-4.6)

* $P < .05$.** $P < .001$.¹Jackson Metropolitan Statistical Area.

conducted, but similar data for rural areas are lacking. Despite the rural nature of the Delta region, some similarities with urban inner city populations exist. Impoverished children from inner cities might be hospitalized for asthma more often than children from the suburbs because of greater morbidity burden, higher incidence of severe asthma episodes, limited access to quality health care, and/or lack of adherence to prescribed therapies or adverse environmental factors. Similar factors should be explored in the context of the black population experiencing asthma in Mississippi, especially in the Delta.

Residents of the Delta had significantly higher asthma ED discharge rates and significantly lower asthma outpatient discharge rates compared with residents of the JMSA, suggesting that the higher probability of 3 or more asthma hospital discharges among residents of the Delta compared with residents of the JMSA may be related to patterns in health care access and use. Residents of the Delta with 3 or more asthma hospital discharges had significantly more ED visits and significantly less outpatient visits compared with residents of the JMSA who had 3 or more asthma hospital discharges during the same period. This may indicate overuse of the ED and underuse of outpatient care as contributing factors to the heightened odds for 3 or more asthma hospital discharges among Delta residents.

In a study by Carr et al,²⁴ asthma hospitalization rates differed 16-fold among certain areas in New York City. Such geographic differences have been ascribed to variation among area-specific physician practice patterns²⁵ or bed supply²⁶ and are often believed to identify opportunities to reduce health care costs by altering practice patterns. For example, cost containment efforts are often based on the assumption that populations with high hospitalization rates have higher numbers of inappropriate admissions. Thus, availability of adequate outpatient asthma care might potentially reduce the number of such inappropriate/preventable admissions. Indeed, in a study by Withy and Davis,²⁷ follow-up office visits are associated with a decrease in ED visit rates; adult rural residents were less likely to receive such follow-up care compared with their urban counterparts for a diagnosis of asthma. The density of primary care providers in the Delta is

TABLE 6. Adjusted odds ratios (95% confidence intervals) for multiple (≥ 3) asthma hospitalizations with region as a covariate, Mississippi, 2003-2005

Regression Model	1	2	3
Race			
White	1.0 (ref)	1.0 (ref)	1.0 (ref)
Black	1.9 (1.4-2.6)**	2.0 (1.5-2.7)**	1.9 (1.4-2.6)**
Sex			
Male	1.0 (ref)	1.0 (ref)	1.0 (ref)
Female	1.2 (0.9-1.5)	1.2 (0.9-1.5)	1.2 (0.9-1.5)
Age (y)			
0-17	1.0 (ref)	1.0 (ref)	1.0 (ref)
18-44	1.9 (1.4-2.7)*	1.9 (1.4-2.7)*	2.0 (1.4-2.7)*
45-64	2.0 (1.4-2.7)*	2.0 (1.4-2.7)*	2.0 (1.4-2.7)*
65+	1.6 (1.1-2.3)	1.6 (1.1-2.3)	1.6 (1.1-2.3)
25th Percentile household income			
<\$21,452	NA	1.0 (ref)	1.0 (ref)
>\$21,452	NA	1.3 (0.9-1.9)	1.5 (1.0-2.2)*
Region			
JMSA	NA	NA	1.0 (ref)
Delta	NA	NA	1.4 (1.1-1.8)*

* $P < .05$.** $P < .001$.

3.3 per 10,000 population, whereas that in the JMSA is 7 per 10,000 population, suggesting that limited access to timely outpatient medical care might help explain higher hospitalization rates in the Delta. However, Mitchell et al¹⁶ and Schaubel et al²⁸ concluded that the number of previous admissions for asthma predicts readmissions for asthma, and that disease severity, not medical treatment, influences the probability of readmission. A study by Minkovitz et al²⁹ also concluded that readmission for asthma among children from low-income families living in urban areas is not associated with prescribed therapies or pediatric care.

Access to quality medical care is influenced by access to health insurance. Recent national increases in health care access and use among children, especially among minorities, has occurred as

a result of the of the State Children's Health Insurance Program.³⁰⁻³² In contrast, Mississippi trends reveal declines in both private and public coverage among children, with an increase in the number of uninsured children in low-income families.³³ Nationwide, >15 million adults without insurance experience chronic health problems, including asthma,³⁴ and the number of uninsured adults is increasing. It is estimated that 24% of the nonelderly rural population lacks insurance in the United States, and of those insured, higher proportions are under public programs.³⁵ Therefore, lack of access to insurance for adults is likely contributing to this disparity.

Beyond insurance, a primary factor associated with quality in asthma management is medication used to treat asthma. In a survey of parents of Medicaid-insured children with asthma, black children had worse asthma status and less use of preventive medication than white children.⁷ In private practice, black children received fewer controller and reliever medications than white children. Likewise, fewer black adults reported care consistent with recommendations for medication use than white adults.^{36,37} Improving the quality of asthma treatment is 1 of 20 priority areas for national action³⁸ and is a critical factor associated with the racial disparity in asthma hospitalizations observed in this study.

One limitation of this study is that MASS does not include data on patient insurance coverage, cost of visit, or comorbidity data. A related study⁶ revealed that payer type and major comorbidities affect readmission to the hospital for asthma. Multiple hospitalizations for asthma in the 2 Mississippi regions evaluated in this study might be affected by payer type and comorbidity factors not included in the regression models. Second, MASS is a nonautomated system made up of voluntary monthly transmission of discharge data from Mississippi hospitals to MSDH. Hospitals located in 18 of Mississippi's 82 counties do not report, including 2 counties (Leake and Scott) bordering the JMSA and 3 counties (Tunica, Quitman, and Tallahatchie) bordering the 11 Mississippi Delta counties included in this study. Hospitalizations among residents of the JMSA and Delta who traveled across county lines to a nonreporting hospital were therefore not included in the study sample; thus, frequency of hospitalizations among JMSA and Delta residents is likely an underestimate attributable to patient travel across county lines to nonreporting hospitals. Despite these limitations, major findings in this study remain consistent with previously published literature and provide valuable insights into the disparities in asthma morbidity in Mississippi.

Multiple strategies that are cost-effective in decreasing asthma symptoms and reducing disparities have been described.³⁹⁻⁴¹ Priorities in research to reduce asthma disparities by the National Heart, Lung, and Blood Institute were published in 2002 and re-emphasized in the 2007 Expert Panel Report.⁴² The ED and outpatient data included in our study supports the hypothesis that the disparate odds for ≥ 3 asthma hospital discharges in the Delta region compared with the JMSA region may be related to differential patterns in patient access to and use of asthma health services in the 2 regions. Residents of the JMSA with ≥ 3 asthma hospital discharges have significantly fewer asthma ED discharges and significantly more asthma outpatient discharges compared with their Delta counterparts. In August 2009, a new outpatient subspecialty asthma clinic began serving the MS Delta region. No such clinics existed in the Delta during the study period; however, 1 such clinic did exist in the JMSA

from 2003 to 2005. Additional research tracking possible changes in asthma outpatient discharges among Delta residents should reveal whether an increase in outpatient services results in a decrease in the odds of the Delta residents having ≥ 3 asthma hospital discharges.

In addition, there is a need for qualitative research to assess hospital policies and practices related to asthma care in the 2 regions. This research should investigate how provision of asthma health services in the 2 regions aligns (or fails to align) with the National Institutes of Health/National Asthma Education and Prevention Program Guidelines for the Diagnosis and Management of Asthma. Research should include assessment of varying asthma referral and prescription policies.

On the basis of the recent trends in asthma hospitalization and mortality, reducing disparities in asthma care should be a national priority for research, health policy, and community action.^{39,42,43} This study demonstrates the need for further research and future programs to reduce racial and regional disparities and to achieve these national goals. Additional investigation is necessary to identify underlying causes of rural and urban disparities in asthma hospitalizations in Mississippi, with particular focus toward environmental, genetic, and health care access factors not analyzed in this study.

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Clinical implications: Significant disparity in asthma morbidity between urban and rural areas remains unexplained by such factors as race or income and necessitates exploration of social, environmental, and other differences among these areas.

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