



Preventable Asthma Episodes Among Urban/Rural Children and Adolescents: A Comparative Study

Saundra Glover, Ph.D,
University of South Carolina Arnold School of Public Health

Crystal N. Piper, MHA, MPH, Ph.D.
University of North Carolina at Charlotte

Edith Williams, Ph.D.
University of South Carolina Arnold School of Public Health

Kevin Bennett, Ph.D.
University of South Carolina Arnold School of Public Health

Winifred Thompson, Ph.D.
Emory University

Lucy Annang, Ph.D.
University of South Carolina Arnold School of Public Health

Shaniece Charlemagne, MPH
US Virgin Islands Department of Health

Rahnuma Hassan, M.S.
University of South Carolina Arnold School of Public Health

ABSTRACT

Context: Asthma is a chronic respiratory illness that is increasing in prevalence among children in the United States. A limited number of studies have examined the relationship between rurality and the prevalence of asthma in minority children, and those studies found mixed results. The aim of this study is to examine urban/rural locality and its impact on asthma episodes and preventable emergency department visits, and to provide quantitative evidence concerning the relationship between patient characteristics and geographic location. **Methods:** This is a retrospective study and secondary data analysis of the 2000 National Health Interview Survey. Parametric testing using Univariate/Bivariate/Multivariate analysis was performed to examine emergency department utilization for asthma episodes among urban/rural children and adolescents in the United States. **Findings:** Regardless of the geographic location, Black children were more likely to visit the emergency room within the past twelve months (urban area (OR=1.59; 95% CI 0.87, 2.33) – rural area (OR=2.68; 95% CI 1.39, 4.05)). Additionally, children who experienced an asthma episode in the past twelve months were more likely to report not visiting the emergency department (OR=1.93; 95% CI 1.53, 2.44). **Conclusions:** Racial and urban/rural differences exist among children with asthma visits to the emergency department. Asthma prevalence and disparities continue to be a burden in the United States and its deficiencies across geographic locations reflect the health of the US population as a whole.

Key Words: Rural health, asthma, urban health, children, adolescents

INTRODUCTION

Asthma is a chronic respiratory illness that is increasing in prevalence in the United States. From the 1980's through the mid-1990's there has been an overwhelming increase in the hindrance posed by childhood asthma in the United States.¹ Even though there is evidence that pediatric asthma has leveled off, significant problems have continued to persist in the rise in ambulatory care rates for asthma since 2003.² In 2004, 140.1 per 1,000 children ages 5-17 had been diagnosed with asthma in their lifetime.³ In 2005, there were an estimated 6.5 million adolescents diagnosed with asthma in the United States.⁴ Approximately 3.1 million children had an asthma episode or attack in 2006.⁴ Experts have postulated that asthma is linked with several environmental and social factors, but the recent increase in the prevalence is not well understood.⁵

Unfortunately, asthma creates a burden on racial and ethnic minorities and low-income children in particular. It has been proven in multiple studies that asthma prevalence, morbidity, and mortality are present in higher numbers within the Black community.⁶ One study in particular showed that Blacks are two times more likely than Whites to have undiagnosed asthma.⁷ Studies have shown that Black children have a high number of hospitalizations and emergency room visits than their White counterparts.⁷ In 2004, Blacks had hospitalization rates and emergency room rates that were 240% and 350% higher than Whites, respectively.⁴ Researchers attribute this to poorer living conditions, which expose these adolescents to hazardous environments and unhealthy behaviors.⁸

A limited number of studies have examined the relationship between rurality and the prevalence of asthma in minority children, and those that have been conducted yielded mixed results. One study found asthma prevalence in urban communities (16%) greater than rural (12%) among African American children.⁹ Evidence from another study confirmed that in rural areas lower socioeconomic

status and being Black are associated with a higher frequency of asthma for all children.¹⁰ Other study results have also identified urban children were twice as likely as rural children to see an asthma specialist, 2.7 times as likely to receive asthma care in an emergency department, and 1.4 times as likely to receive oral steroids.¹¹ Previous research has shown that risk factors for asthma hospitalizations and mortality include poverty, geographical residence, lack of health insurance coverage, lack of access to primary care, and inadequate follow-up. Other issues contributing to the rise in childhood asthma and hospitalizations are underutilization of anti-inflammatory medications, inadequate access to high quality health care, and differences in diagnosis and treatment across clinical settings and specialties.¹²

The aim of this study is to examine urban/rural locality and its impact on asthma episodes and preventable emergency department visits, and to provide quantitative evidence concerning the relationship between patient characteristics and geographic location. This study will also assess the influence of race and other demographic characteristics on asthmatic episodes and emergency department visits among children with asthma.

METHODS

Study Variables

This study is a retrospective study and secondary data analysis of the 2000 National Health Interview Survey (NHIS), which includes 1,630 children with asthma. The independent variables are age (0-4, 5-17), race (White, Black, Other), gender (male and female), parental income (65,000 and over, \$45,000-\$64,999, \$25,000-\$44,999, \$15,000-\$24,999, \$01-\$14,999), region (Northeast, Midwest, West, South), health status (better, worse, about the same), health insurance coverage (private insurance, Medicaid, CHIP, Tricare, Uninsured) asthma episodes, emergency department utilization (utilizing the ED at least once within the past 12 months), and urban/rural locality. For the purposes of our manuscript, any county that wasn't in a metropolitan area (that is, no city population of 50,000 or more residents) was considered rural.

Data Management

Statistical Analysis Software 8.2 was used to process the data; and to account for the complex multistage sampling design of the NHIS, the data was further analyzed using SAS callable SUDAAN. Categorical variables were used in this study, and if the response to a question included, "Don't Know or Refused" responses were set to missing. Institutional Review Board exemption from the University of South Carolina was granted.

Statistical Data Analysis

Parametric testing using Univariate/Bivariate/Multivariate analysis was performed to examine emergency department utilization for asthma episodes among urban/rural children and adolescents in the United States. The unit of analysis for the evaluation of the hypothesis was urban/rural locality. In preliminary analysis, frequency distributions and univariate statistics were measured to describe the population. The Chi square test statistic was used to test for independence between age, race, gender, parental income, region, health status, asthma episodes, emergency department utilization, delay of care, health insurance coverage, and urban/rural locality. Distribution of variables according to age, race, gender, parental income, region, health status, asthma episodes, emergency department utilization, delay of care, health insurance coverage, and urban/rural locality are presented with p-values and proportions with 95% confidence intervals (CI) and odds ratios (OR).

Bivariate analyses were used to compare urban/rural locality and asthmatic episodes with the independent variables using the Chi Square statistics test. The bivariate statistics provided the first indication of the differences and associations between the variables. Multivariate analysis for the

outcome variable was used to adjust for other demographic factors and dichotomous variables. The estimates produced in this study were weighted to represent the United States population and to adjust for potential survey response bias. For all analyses, statistical significance was set at $p < .05$.

The fitting of the multivariate models was based on empirical and conceptual considerations. Each model was adjusted for race, age, gender, health insurance status, and health care utilization. The partial t-test in each model was considered. The partial t-test was taken into consideration with the presence of other variables in the model. When the partial t-test was significant ($p\text{-value} < \alpha$ value) the null hypothesis was rejected, and it was assumed that the variable was needed in the model, given that the other variables were present. When the partial t-test was not significant ($p\text{-value} > \alpha$ value) it indicated that the variable was not needed in the model, given that the other variables were present. The model was then rerun without the variable that was not significant. The variables that were not significant were removed one at a time to simplify the model. To construct efficient models, a stepwise regression procedure was used to identify demographic predictors for each outcome. In the stepwise regression procedure all variables were considered and then removed if the $p\text{-value} > .05$.

RESULTS

Using SAS, descriptive statistics were obtained from the NHIS data on 0-17 year old children with asthma in the United States. The 2000 original weighted sample population data consisted of approximately 13,376 children, and a subset of the data were used ($N=1,630$) based on affirmative responses to the following question: "Has a doctor or other health professional ever told you that your child has asthma?" There were 1,304 urban children and 326 rural children with asthma. The sociodemographic characteristics of the study population are presented in Table 1. (See Table 1)

In the bivariate analysis using SAS callable SUDAAN, children age 5-17 were more likely to report experiencing an asthma episode in the past twelve months ($p=.0008$). In rural areas, children with asthma were more likely to report more than one emergency room visit in the past twelve months ($p=.0011$). Children in this study that reported their race as "Other" were more likely to reside in an urban area ($p=.0007$). No statistical significance was found in experiencing an asthma episode in the past twelve months and the variables race, urban/rural status, and being uninsured.

Table 2 shows results from the multivariate analysis comparing emergency room visits for children who resided in urban areas were less to those who lived in rural areas. These results show that urban children are 34% less likely to have an ED (Emergency Department) visit in the past twelve months ($p < .0001$). Black urban children are 59% more likely to visit ED in the past 12 months ($OR=1.59$; $p=0.0012$) as compared to other urban racial groups. Black rural children are more than twice as likely to visit the ED when compared to other rural racial groups ($OR=2.68$; $p=0.0035$). Black children were also more likely to visit the emergency room within the past twelve months (urban area- $OR=1.59$; 95% CI 0.87, 2.33; rural area- $OR=2.68$; 95% CI 1.39, 4.05). However, no statistical difference was found between children having an asthma episode in the past twelve months and urban/rural status, race, or health insurance status. (See Table 2)

Table 1. Weighted Percentgae of Sociodemographic Characteristics Among Children With Asthma (n=1,360)

Characteristics	Percentage
Race	
White	67.98%
Black	22.09%
Other	9.94%
Gender	
Male	59.75%
Female	40.25%
Age	
Under 5 years	17.55%
5-17 years	82.45%
Family Income	
\$65,000 and over	28.65%
\$45,000-\$64,999	16.65%
\$25,000-44,999	22.99%
\$15,000-\$24,999	14.06%
\$01-\$14,999	17.65%
Parental Educational Level (High School Graduate/GED Recipient)	
Mom	31.99%
Dad	29.03%
Region of Residence	
Northeast	20.31%
Midwest	20.43%
South	34.79%
West	24.48%
Health Insurance Status	
Private	59.89%
Medicaid	22.65%
CHIP	2.88%
Tricare	3.01%
Uninsured	11.57%
Geographic Locality of Residence	
Urban	80.66%
Rural	19.34%
At Least One Asthma Visit to Emergency Room in Past Twelve Months	
Yes	33.74%
No	66.26%
Reasons for Delay of Health Care Services Utilization	
Could not get through on phone	97.36%
Could not get appointment	94.54%
Long wait at doctor's office	94.48%
Doctor's office not open	96.13%
No transportation	97.18%
Could not afford prescription medication	95.76%
Health Status	
Better	38.25%
Worse	2.64%
About the same	59.10%

Table 2. Asthma Management Status Among Urban/Rural Children

Characteristics	Odds Ratio	95% CI	P Value
Emergency Room visit in Past 12 Months			
Urban	0.66	(0.47, 0.92)	<.0001
Rural	Reference Group		
Emergency Room visit in Past 12 Months			
Black (Urban)	1.59	(0.87, 2.33)	.0012
Other (Urban)	Reference Group		
Emergency Room visit in Past 12 Months			
Black (Rural)	2.68	(1.39, 4.05)	.0035
Other (Rural)	Reference Group		
Asthma Episode Emergency Room Visit			
No	1.93	(1.53, 2.44)	<.0001
Yes	Reference Group		

DISCUSSION

Asthma prevalence and disparities continue to be a burden in the United States and its deficiencies across geographic locations reflect the health of the US population as a whole. The increase in prevalence and noted disparities in asthma remain, for the most part, inexplicable by known risk factors.¹³ The primary objectives of this study were to examine urban/rural locality and its impact on asthma episodes and preventable emergency department visits, and to provide quantitative evidence concerning the relationship between patient characteristics and geographic location. This study also sought to assess the influence of race and other demographic characteristics on asthmatic episodes and emergency department visits among children with asthma. The findings of this study did provide evidence to support the objectives.

Our findings are consistent with other investigations, such as that of Deprez et al. 2002 which found that in rural/low-SES communities there were high rates of emergency department asthma care provided, indicating barriers to accessing primary care services for asthma-related events.¹⁴ The United States has made several significant strides in reducing health disparities, but asthma prevalence/management remains a burden not only on the economy but to the overall health of the nation. Eliminating the existing health disparities that are well-noted is a major public policy goal of the United States.¹⁵ Theory-based interventions to asthma management and self-management plans are exclusively needed for adolescents with asthma, particularly low-income, urban, African American children who may have resource barriers and limited connection with the health care system.¹⁶ In addition, increasing community and school involvement is needed to address the increase in morbidity and mortality associated with asthma.

Further studies are needed to explore the findings illustrated in this study, and to explore what contributes to differences among children in rural and urban areas in preventing asthma episodes and utilizing emergency care. The prevalence and distribution of asthma management plans in rural and urban areas need to be identified and compared. Further studies are also needed to identify the disparities present in urban and rural areas based on race, income, and access to care. Accordingly, policy initiatives should be developed to ensure that all children with asthma be provided with an asthma management plan. In an effort to reduce asthma episodes and enhance self-management practices, primary care and emergency department physicians should be required to provide asthma management plans to children.

REFERENCES

1. Weitzman M, Gortmaker SL, Sobol AM, Perrin JM. Recent trends in the prevalence and severity of childhood asthma. *Journal of the American Medical Association*. 1992;268(19):2673-2677.
2. American Lung Association, Epidemiology and Statistics Unit, Research and Program Services. Trends in Asthma Morbidity and Mortality, November 2007.
3. National Center for Health Statistics. Raw Data from the National Health Interview Survey, US, 1997-2004.
4. Akinbami L. Asthma prevalence, health care use and mortality: United States, 2003-05. National Center for Health Statistics, Office of Analysis and Epidemiology. Hyattsville, MD; 2007.
5. Weiss K, Gergen J, Wagener D. Breathing better or wheezing worse? changing epidemiology of asthma morbidity and mortality. *Annual Review Public Health*. 1993;14:491-513.
6. Claudio L, Stingone J, Godbold J. Prevalence of childhood asthma in urban communities: the impact of ethnicity and income. *Annals of Epidemiology*. 2006;16(5):332-340.
7. Smith LA, Hatcher-Ross JL, Wertheimer, Kahn RS. Rethinking race/ethnicity, income, and childhood asthma: racial/ethnic disparities concentrated among the very poor. *Public Health Reports*. 2005;120(2):109-116.
8. McDaniel M, Paxson C, Waldfogel J. Racial disparities in childhood asthma in the United States: Evidence from the National Health Interview Survey, 1997 to 2003. *Pediatrics*. 2006;117:868-877.
9. von Maffei, J, Beckett WS, Belanger, K, Triche E, Zhang HP, Machung JF, Leaderer BP. Risk factors for asthma prevalence among urban and non-urban African American children. *Journal of Asthma*. 2001;38:555-564.
10. Higgins, P., Wakefield, D., Cloutier, M. Risk factors for asthma and asthma severity in nonurban children in Connecticut. *Chest* 128.6 (Dec 2005): p3846
11. Yawn, B., Mainous, A.m Love, M.m Hueston, D. Do rural and urban children have comparable

asthma care utilization? *Journal of Rural Health*. 2001 Winter;17(1):32-9

12. Ortega AN, Calderon JG. Pediatric asthma among minority populations. *Current Opinion in Pediatrics*. 2000;12(6):579-583.
13. Wright RJ, Subramanian SV. Advancing a multilevel framework for epidemiologic research on asthma disparities. *Chest*. 2007;132:757S-769S.
14. Deprez RD, Asdigian NL, Oliver LC, Anderson N, Caldwell E, Baggott LA. Development of a prototype system for statewide asthma surveillance. *American Journal of Public Health*. 2002;92(12):1946-1951.
15. Lee SS, Mountain J, Koenig BA. The meanings of "race" in the new genomics: implications of health disparities research. *Yale Journal of Health Policy, Law, and Ethics*. 2001;17(44):33-75.
16. Joseph CLM, Peterson E, Havstad S, Johnson CC, Hoerauf S, Stringer S, Gibson-Scipio W, Ownby DR, Elston-Lafata J, Pallonen U, Strecher V. A web-based, tailored asthma management program for urban African-American high school students. *American Journal Respiratory Critical Care*. 2007;175(9):888-895.

Saundra Glover, Ph.D

University of South Carolina Arnold School of Public Health
Institute for Health Disparities

Crystal N. Piper, MHA, MPH, Ph.D.

University of North Carolina at Charlotte
College of Health and Human Services

Edith Williams, Ph.D.

University of South Carolina Arnold School of Public Health
Institute for Health Disparities

Kevin Bennett, Ph.D.

University of South Carolina Arnold School of Public Health

Winifred Thompson, Ph.D.

Emory University
Atlanta, GA 30322

Lucy Annang, PhD

University of South Carolina Arnold School of Public Health

Shaniece Charlemagne, MPH

US Virgin Islands Department of Health

Rahnuma Hassan, MS

University of South Carolina Arnold School of Public Health