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Racial/Ethnic Disparities in Symptom Severity Among Children Hospitalized With Asthma

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Abstract: Asthma is the most common chronic illness among U.S. children as well as a leading cause of hospitalization and functional disability. This cross-sectional study uses 2001 hospitalization data for Pennsylvania to examine disparities among Black, Hispanic, and White children in asthma symptomatology at the time of admission. Compared with Whites, Black children were over twice as likely to have the most severe asthma symptoms, taking into account age, sex, insurance status, income, and rural/urban residence. Increased likelihood of severe clinical condition at admission was also independently associated with Medicaid coverage, with older age at admission, and with urban residence. The relationship between symptom severity at presentation in the emergency department and access to and utilization of appropriate ambulatory care services for children with asthma warrants further investigation.

Key words: Asthma, child, disparity, race, ethnicity.

Asthma is the most common chronic illness among children, affecting 9 million children in the U.S.[1] Childhood asthma is responsible for an estimated 14.5 million missed school days each year,[2] and it is one of the most common causes of hospitalization in childhood.[3] The monetary costs of childhood asthma are staggering, totaling an estimated $2 billion annually in medical care expenditures, lost school days, and lost productivity.[2]

Racial/ethnic disparities related to childhood asthma are of considerable research and policy interest. While one study found no statistically significant differences in childhood asthma prevalence by race/ethnicity,[4] several others have identified increased asthma prevalence among Black[5–9] and Hispanic[5,6] children relative to White children. Socioeconomic factors are thought to contribute to racial/ethnic disparities in asthma prevalence, but there is evidence that this relationship is complex. For example, a recent analysis by Smith and colleagues[9] of data from the National Health Interview Survey revealed that asthma is more prevalent among Black children living in the most deeply impoverished families than among non-Hispanic White children with similar

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family incomes. These prevalence disparities were not seen, however, among children in other income categories.

In addition to prevalence disparities, Black and Hispanic children have been found to experience disproportionately great asthma burden. Disability due to asthma, for example, has been shown to be higher among Black children than among White children.[10] Black and Hispanic children with asthma are known to be at increased risk for hospital admission,[6,11] and hospital admission in turn has been associated with severity of symptoms at presentation to the emergency department.[12] Findings concerning racial/ethnic disparities in severity of asthma symptoms, however, present a mixed picture. Although Black and Hispanic children with asthma tend to have more frequent emergency department use than White children,[8,11,13,14] a recent, comprehensive study noted no difference by race/ethnicity in symptom severity among children with asthma presenting to emergency departments for services.[15] Among adults with asthma, however, Blacks have been found to have lower peak flow rates than Whites at presentation to the emergency department, and to be more likely to have experienced severe or potentially life-threatening episodes.[16]

The objective of the present study was to examine disparities among White, Black, and Hispanic children in asthma symptom severity, assessed at the time of hospitalization for treatment. Because previous research consistently shows that other aspects of asthma burden are disproportionately great among Black and Hispanic children, we hypothesized that these children would also exhibit relatively great symptom severity at hospital admission in comparison with White children. We also hypothesized that sociodemographic factors associated with access to primary care services, including health insurance status, economic resources, and rural/urban residence, would be related to symptom severity at the time of hospitalization.

Methods

Computerized discharge record files for all children aged 0–19 years who were hospitalized in short-term hospitals throughout Pennsylvania in 2001 with a primary diagnosis of asthma (ICD-9 code=493) were analyzed. The source of these hospitalization records was the Pennsylvania Health Care Cost Containment Council.[17] Statewide discharge data are compiled annually on individual acute care hospitalizations, and include demographic information, admission information, discharge status, and insurance coverage. The variables from the discharge data files described next were included as covariates in multivariate analysis. *Age:* Children's age was defined as age in years at the time of hospital admission. *Sex*: Children's sex was included, as reported by parents at admission. *Race/ethnicity:* Children were classified in one of four mutually exclusive racial/ethnic groups: non-Hispanic White, non-Hispanic Black, Hispanic, and other/unknown, based on information provided by parents at admission. *Insurance:* Type of insurance coverage was classified into one of three groups: uninsured at the time of hospitalization; Medicaid or other public insurance coverage; or private insurance coverage.

In addition, socioeconomic data from the 2000 Census were appended to the individual hospitalization records in the data file. The Census variables described next were included in the multivariate analyses. *Family Income:* The median household income of

the residential ZIP code in 2000 was used as a proxy for family income. *Residence:* The ZIP code corresponding to the child's residence was classified as urban or rural based as defined by the Census Bureau, which considers urban areas to have a population density of 500 or more people per square mile.[18]

The dependent variable of interest was condition at hospital admission. Hospitalization records included in the dataset contain a code reflecting the urgency of the patient's condition at admission, as assessed by the admitting physician. All admissions were classified into one of the following three categories:

1. *Emergency*: Indicates that the patient requires immediate medical intervention as a result of severe, life threatening, or potentially disabling conditions
2. *Urgent*: Indicates that the patient requires immediate attention for the care and treatment of a physical or mental disorder
3. *Elective*: Indicates that the patient's condition permits time to schedule the availability of suitable accommodation

For the present analyses, the clinical condition rating was dichotomized into two categories: emergency and non-emergency (i.e., urgent plus elective).

Chi-square test and ANOVA analyses were employed to test whether differences in patients' characteristics by race/ethnicity groups were significant. Multivariate logistic regression was used to model severity of clinical condition at admission as a function of covariates including racial/ethnic group, age, sex, rural/urban residence, health insurance status, and median family income of residential ZIP code.

Results

Among the 8,002 childhood asthma hospitalization records in 2001, 7,726 (96.6%) that included residential ZIP code were included in the analyses. Of these hospitalized children, 3,187 (41.3%) were non-Hispanic White children, 3,323 (43.0%) were non-Hispanic Black children, 113 (1.5%) were Hispanic children, and 1,103 (14.3%) were of an other or an unknown race/ethnicity. Black children tended to be older on average than other children, and Hispanic children tended to be younger (Table 1). Greater numbers of boys than girls were hospitalized in each of the racial/ethnic groups. White children were most likely to have private health insurance, while two-thirds of both Black and Hispanic children were covered by Medicaid or other public insurance. The rate of being uninsured was similar across all groups at 2–3%, which is slightly lower than the rate of 4% seen among Pennsylvania children generally.[19]

Mean family income in the ZIP code of residence can be regarded as a rough indicator of the economic resources available to families, and by this measure Black children are the most disadvantaged, with a mean annual household income of $28,221. Hispanic children are also relatively worse off economically than non-Hispanic White children ($32,331 vs. $42,018 mean annual household income). As for residential location, over 90% of Black and Hispanic children hospitalized for asthma in Pennsylvania in 2001 lived in urban areas, whereas the corresponding proportion of White children was slightly less than half (46%).

Statistically significant differences in the severity of condition at hospital admission

Table 1.

CHARACTERISTICS OF CHILDREN HOSPITALIZED WITH ASTHMA IN PENNSYLVANIA, 2001

	Non-Hispanic White (n=3,187)	Non-Hispanic Black (n=3,323)	Hispanic (n=113)	Other/ unknown (n=1,103)	*p*-value
Age (in years), mean (range)	5.4 (0–19)	6.1 (0–19)	4.4 (0–19)	4.9 (0–19)	<.0001
Sex, n (%)					
Male	1,951 (61%)	2,034 (61%)	63 (56%)	672 (61%)	.7034
Female	1,236 (39%)	1,289 (39%)	50 (44%)	431 (39%)	
Insurance, n (%)[a]					
Uninsured	85 (3%)	85 (3%)	2 (2%)	21 (2%)	<.0001
Medicaid	947 (30%)	2,295 (69%)	74 (65%)	741 (67%)	
Private	2,126 (67%)	928 (28%)	37 (33%)	334 (30%)	
Family income in ZIP code, mean (range)	$42,018 ($14,399–$159,538)	$28,221 ($13,828–$94,228)	$32,331 ($13,828–$93,308)	$30,874 ($13,828–$159,905)	<.0001
Severity, n (%)[b]					
Emergency	1,911 (60%)	2,980 (90%)	72 (64%)	845 (77%)	<.0001
Urgency	1,059 (33%)	239 (7%)	36 (32%)	222 (20%)	
Elective	217 (7%)	91 (3%)	5 (4%)	35 (3%)	
Residence, n (%)					
Rural	1,705 (54%)	149 (5%)	10 (9%)	173 (16%)	<.0001
Urban	1,482 (46%)	3,174 (95%)	103 (91%)	930 (84%)	

[a]51 children had other types of insurance.
[b]Severity rating was missing for 14 children.

are found among children by racial/ethnic group. Among Black children with asthma, 90% presented with clinical findings in the emergency category. In contrast, 60% of White and 64% of Hispanic children were considered to have emergency asthma symptomatology at admission. Of the remaining children, most were classified as having an urgent clinical condition, with very few children considered to be in the elective admission category.

Table 2 displays results from the multivariate logistic regression model predicting admission in the most severe (emergency) clinical condition. The odds of a Black child having severe asthma symptomatology at admission are 2.34 times the odds for White children, after taking covariates into account including age, sex, insurance status, income, and rural/urban residence. In contrast, Hispanic children in this sample have significantly lower odds of severe condition at admission than White children, controlling for the other variables in the model.

The findings in Table 2 also indicate that several of the covariates are significantly associated with severity of clinical condition net of race/ethnicity. The odds of a child with asthma being classified in emergency condition increase by about three percent with each additional year of age. Children with Medicaid or other public coverage are more likely than those with private insurance to have the most severe clinical symptoms at admission. Both race/ethnicity and insurance status can be considered proxies for

Table 2.

RESULTS OF LOGISTIC REGRESSION ANALYSIS PREDICTING EMERGENCY CONDITION AT HOSPITAL ADMISSION

	Regression coefficient	Standard error	*p*-value	Odds ratio	95% Confidence interval
Intercept	−.4556	.1322	.0006		
Age	.0277	.0006	<.0001	1.03	1.02–1.04
Male	−.0213	.0614	.7287	.98	.87–1.10
Insurance					
Medicaid	.2609	.0680	.0001	1.30	1.14–1.48
Uninsured	.0307	.1858	.8689	1.03	.72–1.48
Race and ethnicity					
Black	.8518	.0844	<.0001	2.34	1.99–2.77
Hispanic	−.6740	.2107	.0014	.51	.34–.77
Others and unknown	.0307	.1858	.1992	1.13	.94–1.35
Family income	−5.52E-7	2.40E-6	.8182	1.00	1.00–1.00
Urban	1.5789	.0683	<.0001	4.85	4.24–5.55

Note: Reference categories are private insurance, White race/ethnicity, female sex, and rural residence.

socioeconomic status and, when they are taken into account in the model, the mean family income of the residential ZIP code is not a significant predictor of condition at admission. In contrast, residence in an urban area is strongly associated with poorer clinical condition, with the odds for urban children almost five times those for rural children.

Discussion

Among Pennsylvania children hospitalized with asthma, Black children were found to be significantly more likely than White children to have severe asthma symptoms at admission. This disparity in clinical condition persisted after adjustment for individual characteristics including insurance status as well as aspects of residential context. These findings add to a growing literature indicating that Black children are disproportionately affected by asthma in relation to incidence[6–9] and disease burden.[6,10]

Hispanic children in this population had lower odds of severe symptoms at admission than White children had. Although statistically significant, these results should be interpreted with caution, considering the relatively small number of Hispanic children in the sample (n=113 children, constituting 1.5% of the total sample). The percentage of Hispanics in the dataset appears low relative to their representation in the Pennsylvania population as a whole (4% in the 2000 Census), suggesting that a substantial proportion of Hispanic children may have been misclassified in this dataset.

Controlling for race/ethnicity, an association was found between Medicaid or other public insurance coverage and greater odds of severe asthma symptoms among children, although the mechanisms underlying this relationship cannot be determined from data in the current study. There is evidence from prior research, however, to suggest that therapeutic regimens prescribed for children on Medicaid often do not conform to recommended guidelines. For example, Lieu and colleagues[11] identified widespread underuse of controller medications among Medicaid-insured children with persistent symptoms. Previous research also suggests that Medicaid-enrolled children with asthma receive significantly fewer primary care services. For example, Ortega et al.[20] found that Black children on Medicaid were 90% less likely to have had three or more routine primary care visits for asthma than Black privately insured children.

Residence in a rural area was associated with a markedly reduced risk of having severe asthma symptoms at the time of hospital admission compared with living in urban areas. Asthma prevalence and disease burden have been shown to be similar among rural and urban children,[21] therefore further exploration of geographically-based factors influencing asthma symptom severity is warranted.

Findings in the present study that Black children with asthma present to the emergency department with more severe symptoms than White children suggest a possible difference in prior access to and utilization of ambulatory care. The direction of this difference in primary care receipt, however, is open to competing interpretations. Ferris et al.[22] hypothesize that greater symptom severity among children with asthma in emergency departments should be associated with more optimal primary care receipt, because children with milder symptoms will be managed in primary care settings. Indeed in their study, children enrolled in managed care plans (which generally emphasize

ambulatory preventive care) presented to the emergency department with significantly worse pulmonary index scores than children with other insurance types or no insurance.[22] On the other hand, previous research has shown that Black children receive fewer primary care visits for asthma[11,20] and are less likely to be placed on appropriate anti-inflammatory medications.[11] The present findings might also be consistent with the hypothesis that on average Black children's limited access to ambulatory health care and less optimal medication regimens result in generally poorer disease control and greater symptom severity.

In evaluating our results, several limitations should be considered. Related to the discussion above, data were not available concerning children's access to and utilization of primary care prior to hospital admission, which would be highly informative in interpreting the patterns of results observed. Secondly, asthma symptom severity was determined by an overall rating of the child's condition by the admitting physician. More detailed information, such as the frequency and severity of symptoms in the hours leading up to presentation at the hospital as well as individual physical parameters including respiratory rate and pulmonary function testing would allow a more fine-grained assessment of clinical condition. Another limitation of hospital discharge data is that the ICD-9 diagnosis coding of asthma is subject to some misclassification, since there are wheezing syndromes in childhood that aren't necessarily asthma but may be coded as such. Finally, additional data about the child's residential environment would further inform the analyses, including levels of environmental pollutants and other asthma triggers, proximity to health care providers and facilities, and access to asthma-related educational and supportive programs.

Conclusion

Black children with asthma have disproportionately great odds of experiencing severe asthma symptoms upon presentation to the emergency department compared with White children with asthma; this risk is also independently associated with having Medicaid or other public insurance coverage. The relationship between symptom severity in the emergency department and access and utilization of appropriate ambulatory care services for children with asthma warrants further investigation.

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Notes

1. Bloom B, Dey AN. Summary health statistics for U.S. children: National Health Interview Survey, 2004. Vital Health Stat 10. 2006 Feb;(227):1–85.
2. Wang LY, Zhong Y, Wheeler L. Direct and indirect costs of asthma in school-age children. Prev Chronic Dis. 2005 Jan;2(10):A11.
3. Wood RA. Pediatric asthma. JAMA. 2002 Aug 14;288(6):745–7.

4. Akinbami LJ, LaFleur BJ, Schoendorf KC. Racial and income disparities in childhood asthma in the United States. Ambul Pediatr. 2002 Sep–Oct;2(5):382–7.
5. Lara M, Akinbami L, Flores G, et al. Heterogeneity of childhood asthma among Hispanic children: Puerto Rican children bear a disproportionate burden. Pediatrics. 2006 Jan;117(1):43–53.
6. Akinbami LJ, Schoendorf KC. Trends in childhood asthma: prevalence, health care utilization, and mortality. Pediatrics. 2002 Aug;110(2 Pt 1):315–22.
7. 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 May;117(5):e868–77.
8. Miller JE. The effects of race/ethnicity and income on early childhood asthma prevalence and health care use. Am J Public Health. 2000 Mar;90(3):428–30.
9. Smith LA, Hatcher-Ross JL, Wertheimer R, Kahn RS. Rethinking race/ethnicity, income, and childhood asthma: racial/ethnic disparities concentrated among the very poor. Public Health Rep. 2005 Mar–Apr;120(2):109–16.
10. Newacheck PW, Halfon N. Prevalence, impact, and trends in childhood disability due to asthma. Arch Pediatr Adolesc Med. 2000 Mar;154(3):287–93.
11. Lieu TA, Lozano P, Finkelstein JA, et al. Racial/ethnic variation in asthma status and management practices among children in managed medicaid. Pediatrics. 2002 May;109(5):857–65.
12. Pollack CV Jr, Pollack ES, Baren JM, et al. A prospective multicenter study of patient factors associated with hospital admission from the emergency department among children with acute asthma. Arch Pediatr Adolesc Med. 2002 Sep;156(9):934–40.
13. Joseph CL, Ownby DR, Peterson EL, et al. Racial differences in physiologic parameters related to asthma among middle-class children. Chest. 2000 May;117(5):1336–44.
14. Shields AE, Comstock C, Weiss KB. Variations in asthma care by race/ethnicity among children enrolled in a state Medicaid program. Pediatrics. 2004 Mar;113(3 Pt 1):496–504.
15. Boudreaux ED, Emond SD, Clark S, et al. Acute asthma among adults presenting to the emergency department: the role of race/ethnicity and socioeconomic status. Chest. 2003 Sep;124(3):803–12.
16. El-Ekiaby A, Brianas L, Skowronski ME, et al. Impact of race on the severity of acute episodes of asthma and adrenergic responsiveness. Am J Respir Crit Care Med. 2006 Sep 1;174(5):508–13.
17. Pennsylvania Health Care Cost Containment Council (PHC4). Pennsylvania Inpatient Data, 2001: Data notes. Harrisburg, PA: PHC4, 2001.
18. U.S. Census Bureau. Census 2000 urban and rural classification. Washington, DC: U.S. Census Bureau, 2002 Apr 30. Available at http://www.census.gov/geo/www/ua/ua_2k.html.
19. Pennsylvania Insurance Department. Pennsylvania's Health Insurance Status Survey. Harrisburg, PA: Pennsyvania Insurance Department, 2005 May 9. Available at http://www.ins.state.pa.us/ins/lib/ins/chip_ab/uninsured_study_web2.pdf.
20. Ortega AN, Belanger KD, Paltiel AD, et al. Use of health services by insurance status among children with asthma. Med Care. 2001 Oct;39(10):1065–74.
21. Chrischilles E, Ahrens R, Kuehl A, et al. Asthma prevalence and morbidity among rural Iowa schoolchildren. J Allergy Clin Immunol. 2004 Jan;113(1):66–71.
22. Ferris TG, Crain EF, Oken E, et al. Insurance and quality of care for children with acute asthma. Ambul Pediatr. 2001 Sep–Oct;1(5):267–74.