Racial/Ethnic Variation in Emergency Department Care for Children With Asthma

Heather G. Zook, MA,† Nathaniel R. Payne, MD, MHSA,*‡ Susan E. Puumala, PhD,§|| Katherine M. Ziegler, MPH,§¶ and Anupam B. Kharbanda, MD, MSc#*

Objective: To assess the variation between racial/ethnic groups in emergency department (ED) treatment of asthma for pediatric patients.

Methods: This study was a cross-sectional analysis of pediatric (2–18 years) asthma visits among 6 EDs in the Upper Midwest between June 2011 and May 2012. We used mixed-effects logistic regression to assess the odds of receiving steroids, radiology tests, and returning to the ED within 30 days. We conducted a subanalysis of asthma visits where patients received at least 1 albuterol treatment in the ED.

Results: The sample included 2909 asthma visits by 1755 patients who were discharged home from the ED. After adjusting for demographics, insurance type, and triage score, African American (adjusted odds ratio [aOR], 1.78; 95% confidence interval [CI], 1.40–2.26) and Hispanic (aOR, 1.64; 95% CI, 1.22–2.22) patients had higher odds of receiving steroids compared with whites. African Americans (aOR, 0.58; 95% CI, 0.46–0.74) also had lower odds of radiological testing compared with whites. Asians had the lowest odds of 30-day ED revisits (aOR, 0.26; 95% CI, 0.08–0.84), with no other significant differences detected between racial/ethnic groups. Subgroup analyses of asthma patients who received albuterol revealed similar results, with American Indians showing lower odds of radiological testing as well (aOR, 0.47; 95% CI, 0.22–1.01).

Conclusions: In this study, children from racial/ethnic minority groups had higher odds of steroid administration and lower odds of radiological testing compared with white children. The underlying reasons for these differences are likely multifactorial, including varying levels of disease severity, health literacy, and access to care.

Key Words: asthma, racial differences, steroids, radiological testing

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Asthma is a common diagnosis in the United States, affecting more than 8% of the adult and nearly 10% of the pediatric population.[1] As the most common chronic condition in children,[2] asthma is among the top 5 diagnoses for which children present to the emergency department (ED).[3] Despite the high prevalence and frequent ED presentation of asthma,[1–3] there is wide variation in asthma treatment across EDs.[4,5] The current guidelines for treating asthma recommend administering steroids for all ED visits and reducing radiographs only to cases with suspected cardiopulmonary complications.[6] However, ED steroid administration rates range from 43%[7] to 83%[4] compared with a benchmark goal of approximately 80% utilization.[8] Research suggests that radiography may be unnecessary in asthma treatment[9]; however, compared with a national benchmark goal of approximately 15%,[8] EDs report radiography rates between 29%[8] and 35%[4] for asthma-related visits.

This variation in asthma care is accentuated among racial/ethnic minorities for both adults and children.[10–16] African Americans have the highest asthma prevalence,[10] along with the highest rates of asthma-related ED visits,[11,12] primary care visits,[10] hospital admissions,[12] and mortality.[13] Compared with whites, the rates of asthma hospitalization and mortality for African Americans have increased dramatically over time.[10] Puerto Ricans and American Indians also have high rates of asthma-related ED and urgent care visits.[14,15] A 2002 study found that African American and Hispanic children with asthma received fewer β-agonists compared with white children in primary care and urgent care visits.[16] However, no recent studies have investigated whether differences in asthma care still exist for racial/ethnic minorities, and none have focused on treatment in the ED in particular.

Although not specific to asthma, differences in ED care between whites and racial/ethnic minorities have been reported among pediatric patients for the administration of pain medication[17,18] and in ordering laboratory and radiological tests.[19–21] However, no studies to date have focused on racial/ethnic differences in steroid administration or radiological testing for asthma-related pediatric ED visits. To address these critical issues, we aimed to assess the variation between racial/ethnic groups in ED treatment for asthma patients within a multicenter network of EDs in the Upper Midwest.

METHODS

Study Design and Sample

We conducted a cross-sectional analysis of pediatric patients who presented to 1 of 6 EDs in the Upper Midwest (2 urban pediatric hospitals, 1 urban general hospital, and 3 rural general hospitals). The hospitals previously developed a relationship under a grant received from the National Institute on Minority Health and Health Disparities to better assess the care of American Indian children in the ED setting (Award No.: U54MD008164). This study represents a planned secondary analysis of our cohort. The study was approved by the institutional review boards at all participating hospitals and was granted a waiver of informed consent.

Our overall data set included pediatric visits by patients aged 2 to 18 years who presented to the ED between June 1, 2011, and May 31, 2012. Researchers extracted data from each hospital's electronic medical records and then sent it to a central data collection site where research staff cleaned, deidentified, and merged the data into a single database. We removed duplicate records meeting all of the following criteria: (1) ED visit occurred within a 24-hour

From the *Department of Research and Sponsored Programs, Children's Hospitals and Clinics of Minnesota; †Department of Evaluation, Professional Data Analysts, Inc; ‡Department of Quality and Safety, Children's Hospitals and Clinics of Minnesota, Minneapolis, MN; §Population Health, Sanford Research; ||Department of Pediatrics, Sanford School of Medicine at the University of South Dakota, Sioux Falls, SD; ¶Department of Epidemiology, Colorado School of Public Health, University of Colorado Denver, Aurora, CO; and #Department of Emergency Medicine, Children's Hospitals and Clinics of Minnesota, Minneapolis, MN.

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Reprints: Anupam B. Kharbanda, MD, MSc, Department of Research and Sponsored Programs, Children's Hospitals and Clinics of Minnesota, 2525 Chicago Ave South, Minneapolis, MN 55404 (e-mail: anupam.kharbanda@childrensmn.org).

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period of previous visit and showed an identical triage score, presenting complaint, and diagnosis; (2) neither visit was an elopement; (3) an ED length of stay of 45 minutes or less; and (4) time between visits of 120 minutes or less (Fig. 1). We excluded patients younger than 2 years because of concerns with incorrect asthma diagnosis for that age group (Fig. 1). Patients who died in the hospital or were discharged to a correctional facility were also excluded from our analyses (Fig. 1). After analyzing our data, we discovered that some of the medication information for patients who entered through the ED and were later admitted was incorrectly coded. Therefore, our final sample included only patients who were discharged home from the ED (Fig. 1). For this study, we limited our final analytic sample to patients with a primary diagnosis of asthma (*International Classification of Diseases, Ninth Revision* codes 493.0–493.92). Most (91%) of the asthma visits presented at 2 of the 6 EDs in our sample.

To identify a cohort of asthma patients with "active disease" as opposed to a chronic condition, we conducted a subanalysis of asthma patients who received at least 1 albuterol treatment in the ED (Fig. 1). The administration of albuterol is often used in the ED literature to differentiate between patients who presented for asthma-related complaints and those with asthma who presented for other reasons.[4,8,22–24] Medication data were missing from one of the larger EDs in our sample, so the albuterol subgroup was smaller than we expected. Rather than restricting our sample to those who received albuterol, our primary analysis included all visits ending in an asthma diagnosis so that we had enough patients representing each racial/ethnic group. We used triage score and discharge status (all visits were discharged home) as indicators of symptom severity. Patients from both the overall asthma cohort and the albuterol subgroup presented to the ED with the same top 5 chief complaints: cough, difficulty breathing, asthma, wheezing, and fever.

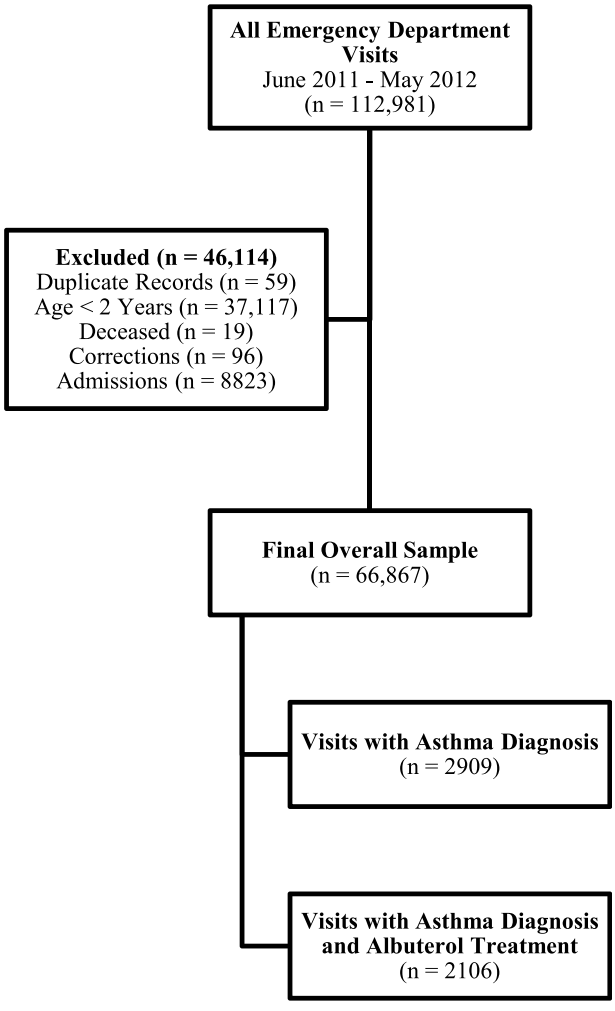

FIGURE 1. Flow diagram of study sample.

Outcome Measures

Our primary outcome measures included steroid administration[6] and the ordering of radiology tests[5,8] among patients with a diagnosis of asthma. We used 30-day ED revisit rates as a marker for poor disease control, which was defined as a patient who presented with asthma and then returned to the ED within 30 days of the index visit.

Statistical Analysis

Demographic, insurance, clinical, and hospital data were electronically extracted from the medical record and used in bivariate and multiple regression analyses. Racial/ethnic group was self-reported at registration. Insurance type was categorized as private, public, or other. Prepaid Medical Assistance plans and self-pay patients were included in the public insurance category. Distance between the patient's residence and the ED was estimated based on the distance from the center of the patient's zip code to the ED at which the patient sought care. We assigned patients the median income for the zip code in which they resided[25] using Truven Health Analytics (Ann Arbor, MI) data. Median incomes were grouped into quartiles and defined as high (76th–100th percentile, $62,322–$103,309), moderately high (51st–75th percentile, $46,392–$62,234), moderately low (26th–50th percentile, $39,901–$46,390), and low (1st–25th percentile, $14,524–$39,845).[25] Patients were assigned to a visit category based on their total number of ED visits (<4 vs ≥4) in the study period.[26,27] To account for illness severity and anticipated ED resource utilization, we included Emergency Severity Index, version 4 (ESI)[28–30] triage scores (ranging from 1 [most acute] to 5 [least acute]), and we combined ESI levels 1 and 2 for analyses because of the low number of visits in ESI level 1. We classified hospital type as either "urban" (city population >100,000) or "rural" (city population <100,000) based on the size of the city it served.

We used χ^2 tests to analyze bivariate associations between treatment outcomes and racial/ethnic groups. To calculate the odds of each treatment outcome, we used mixed-effects logistic regression models (routine "xtmelogit") with the following binary outcome variables: received steroids (yes/no), radiology test ordered (yes/no), and returned to the ED within 30 days (yes/no). The site with missing medication data was excluded from the steroid analyses but included in all other analyses. Covariates were selected based on a hypothesized association with the outcome variables and a significant association in bivariate analyses ($P < 0.05$). We developed a pairwise correlation matrix to identify variables that were highly correlated, and all of the final covariates had correlation coefficients of less than 0.7. We adjusted the steroid and radiology models by racial/ethnic group, age, sex, insurance type, and triage level and included all but sex in the 30-day revisit model because of a nonsignificant relationship between sex and 30-day revisits. In all models, ED visits were clustered within each hospital. Statistical analyses were performed using Stata version 13.1 (Stata Corp, College Station, TX).

RESULTS

Demographics

Our final asthma sample included 2909 ED visits by 1755 patients. Among asthma visits, African Americans, boys, and children between 2 and 5 years old had the highest proportion of ED visits (Table 1). Most asthma visits were made by patients with public insurance, living 5 miles or less from the ED, with a moderately low income level, and with less than 4 ED visits in the study period (Table 1). Asthma visits were most likely to be triaged at ESI level 3, and they occurred more often in an urban than in rural hospital (Table 1). The subgroup of asthma patients who received albuterol reflected a similar distribution in demographic characteristics as the overall asthma cohort, with slightly more albuterol patients receiving high acuity triage scores and presenting at urban hospitals (Table 1).

TABLE 1. ED Demographics

Patient Characteristics	Asthma Sample* (n = 2909)	Albuterol Subgroup† (n = 2106)
Racial/ethnic group		
White	638 (22.5)‡	371 (18.1)
American Indian	118 (4.2)	44 (2.1)
African American	1265 (44.7)	1011 (49.3)
Asian	75 (2.7)	54 (2.6)
Hispanic	413 (14.6)	328 (16.0)
Other	323 (11.4)	244 (11.9)
Age, y		
2–5	1201 (41.3)	843 (40.0)
5–10	1101 (37.9)	818 (38.8)
>10	607 (20.9)	445 (21.1)
Sex		
Female	1135 (39.0)	807 (38.3)
Male	1774 (61.0)	1299 (61.7)
Insurance type		
Private	806 (27.7)	574 (27.3)
Public	2079 (71.5)	1529 (72.7)
Other	21 (0.7)	0 (0.0)
Distance from ED, miles		
≤5	1616 (55.6)	1188 (56.4)
>5	1292 (44.4)	918 (43.6)
Income level§		
High	561 (19.5)	406 (19.4)
Moderately high	619 (21.6)	458 (21.9)
Moderately low	910 (31.7)	675 (32.2)
Low	783 (27.3)	555 (26.5)
No. ED visits		
<4	2170 (74.6)	1560 (74.1)
≥4	739 (25.4)	546 (25.9)
Triage level		
1–2	334 (11.6)	283 (13.5)
3	1356 (46.9)	1024 (48.8)
4	1055 (36.5)	725 (34.5)
5	144 (5.0)	68 (3.2)
Hospital type		
Urban	2732 (93.9)	2074 (98.5)
Rural	177 (6.1)	32 (1.5)

*Visits with a discharge diagnosis of asthma.

†Visits with a discharge diagnosis of asthma and at least 1 albuterol treatment in the ED.

‡Numbers represent n (%) of visits with the row characteristic within the column group.

§Income levels defined as high (76th–100th percentile), moderately high (51st–75th percentile), moderately low (26th–50th percentile), and low (1st–25th percentile) based solely on the sample data.

Steroid Administration

Overall, steroids were administered in 64.4% of asthma visits (Table 2). American Indians, African Americans, Asians, Hispanics, and others had higher rates of steroid administration compared with whites ($P < 0.001$; Table 2). After adjusting for demographics, insurance type, and triage level, children from the African American (adjusted odds ratio [aOR], 1.78; 95% confidence interval [CI], 1.40–2.26; $P < 0.001$), Hispanic (aOR, 1.64; 95% CI, 1.22–2.22; $P \leq 0.001$), and other (aOR, 1.77; 95% CI, 1.29–2.43; $P < 0.001$) racial/ethnic groups had higher odds of steroid administration compared with whites (Table 3). The 5- to 10-year age group had higher odds of steroids compared with those aged 2 to 5 years, and boys had higher odds of steroids compared with girls (Table 3). Patients triaged at ESI levels 3, 4, and 5 had significantly lower odds of receiving steroids compared with those triaged at ESI levels 1 and 2 (Table 3).

Radiological Testing

Radiology tests were ordered for 32.9% of asthma visits in our sample (Table 2). In bivariate analysis, white children were more likely to have a radiology test ordered than children from all other racial/ethnic groups ($P < 0.001$; Table 2). In adjusted analysis, the African American (aOR, 0.58; 95% CI, 0.46–0.74; $P < 0.001$) and other (aOR, 0.60; 95% CI, 0.44–0.81, $P \leq 0.001$) racial/ethnic groups had lower odds of radiological testing compared with white children (Table 4). As may be expected, patients receiving a triage score of 4 or 5 had lower odds of radiological testing compared with those with a triage score of 1 or 2 (Table 4).

Thirty-Day ED Revisits

Fifteen percent of our asthma patients revisited the ED within 30 days of their index asthma visit (Table 2). Asian patients had the lowest proportion of 30-day ED revisits, and whites had a lower proportion of revisits compared with African Americans and Hispanics ($P < 0.01$; Table 2). After adjusting for covariates, Asians (aOR, 0.26; 95% CI, 0.08–0.84; $P < 0.05$) were the only racial/ethnic group with significantly lower odds of 30-day ED revisits than whites, and we observed no other differences between racial/ethnic groups (Table 5). However, children with public insurance had significantly higher odds of 30-day revisits compared with those with private insurance (aOR, 1.70; 95% CI, 1.27–2.27, $P < 0.001$; Table 5).

Albuterol Subgroup

There were 2106 visits (72.4% of asthma sample) with a final diagnosis of asthma that received at least 1 albuterol treatment in the ED. In this subgroup, 79.3% of patients received steroids, 32.6% were ordered a radiology test, and 15.4% revisited the ED within 30 days of their index visit. Subgroup bivariate analyses revealed no significant differences between racial/ethnic groups in steroid administration; however, American Indians (22.7%) and African Americans (27.9%) received lower proportions of radiology tests compared with whites (40.7%; $P < 0.001$). Asians (7.4%) and

TABLE 2. Treatment Outcomes for Asthma Sample*

Racial/Ethnic Group	Steroids†‡, n = 1809 (64.4%)	Radiology Test‡, n = 956 (32.9%)	30-d Revisit§, n = 425 (14.6%)	Total Sample‖, n = 2909 (100.0%)
White	332 (56.4)¶	262 (41.1)	80 (12.5)	638 (22.5)
American Indian	52 (61.9)	39 (33.1)	15 (12.7)	118 (4.2)
African American	856 (67.7)	354 (28.0)	207 (16.4)	1265 (44.7)
Asian	44 (60.3)	28 (37.3)	4 (5.3)	75 (2.7)
Hispanic	265 (64.5)	151 (36.6)	71 (17.2)	413 (14.6)
Other	212 (68.2)	96 (29.7)	37 (11.5)	323 (11.4)

*Visits with a discharge diagnosis of asthma.

†One site was missing steroid data, so it was excluded from this analysis.

‡$P < 0.001$.

§$P < 0.01$.

‖Includes ED visits with an unidentified racial/ethnic group.

¶Numbers represent n (%) of asthma visits in each racial/ethnic group that had the column outcome.

others (10.3%) had lower proportions of 30-day revisits compared with the other racial/ethnic groups (ranging from 13.2% to 18.3%; $P < 0.05$).

In adjusted analysis, African Americans (aOR, 1.50; 95% CI, 1.09–2.07; $P \leq 0.01$) and others (aOR, 1.56; 95% CI, 1.01–2.39; $P \leq 0.05$) had higher odds of steroid administration compared with whites (Table 6). Adjusted analysis also revealed that the American Indian (aOR, 0.47; 95% CI, 0.22–1.01; $P \leq 0.05$), African American (aOR, 0.59; 95% CI, 0.45–0.77; $P < 0.001$), and other (aOR, 0.67; 95% CI, 0.47–0.95, $P \leq 0.05$) racial/ethnic groups had lower odds of radiology tests compared with whites (Table 6). In the albuterol subgroup–adjusted analysis,

TABLE 3. Odds Ratios of Steroid Administration*†

Patient Characteristics	aOR‡	95% CI	P
Racial/ethnic group			
White		Referent	
American Indian	1.66	0.92–2.98	0.09
African American	1.78	1.40–2.26	<0.001
Asian	0.93	0.55–1.57	0.78
Hispanic	1.64	1.22–2.22	0.001
Other	1.77	1.29–2.43	<0.001
Age, y			
2–5		Referent	
5–10	1.28	1.06–1.54	0.01
>10	1.12	0.90–1.40	0.31
Sex			
Female		Referent	
Male	1.27	1.08–1.50	0.005
Insurance type			
Private		Referent	
Public	1.11	0.90–1.36	0.34
Other	0.50	0.04–5.84	0.58
Triage level			
1–2		Referent	
3	0.74	0.55–1.00	0.05
4	0.29	0.22–0.40	<0.001
5	0.14	0.09–0.21	<0.001

*For visits with a discharge diagnosis of asthma.

†One site was missing steroid data, so it was excluded from this analysis.

‡aOR and 95% CI of steroid administration, controlling for racial/ethnic group, age, sex, insurance type, triage level, and clustered by hospital.

TABLE 4. Odds Ratios of Radiology Tests*

Patient Characteristics	aOR†	95% CI	P
Racial/ethnic group			
White		Referent	
American Indian	0.82	0.50–1.35	0.44
African American	0.58	0.46–0.74	<0.001
Asian	0.78	0.47–1.30	0.34
Hispanic	0.89	0.67–1.19	0.44
Other	0.60	0.44–0.81	0.001
Age, y			
2–5		Referent	
5–10	0.89	0.74–1.07	0.21
>10	0.93	0.75–1.15	0.50
Sex			
Female		Referent	
Male	0.95	0.81–1.12	0.54
Insurance type			
Private		Referent	
Public	1.03	0.84–1.25	0.79
Other	1.50	0.55–4.14	0.43
Triage level			
1–2		Referent	
3	1.07	0.82–1.38	0.63
4	0.73	0.56–0.96	0.02
5	0.61	0.39–0.95	0.03

*For visits with a discharge diagnosis of asthma.

†aOR and 95% CI of a radiology test, controlling for racial/ethnic group, age, sex, insurance type, triage level, and clustered by hospital.

TABLE 5. Odds Ratios of 30-Day ED Revisit*

Patient Characteristics	aOR†	95% CI	P
Racial/ethnic group			
White		Referent	
American Indian	0.83	0.45–1.53	0.55
African American	1.05	0.77–1.43	0.77
Asian	0.26	0.08–0.84	0.02
Hispanic	1.08	0.74–1.57	0.70
Other	0.73	0.47–1.12	0.15
Age, y			
2–5		Referent	
5–10	0.85	0.67–1.08	0.18
>10	0.85	0.63–1.13	0.26
Insurance type			
Private		Referent	
Public	1.70	1.27–2.27	<0.001
Other	0.49	0.06–3.75	0.49
Triage level			
1–2		Referent	
3	1.11	0.77–1.60	0.59
4	1.17	0.80–1.69	0.42
5	0.84	0.46–1.55	0.58

*For visits with a discharge diagnosis of asthma.

†aOR and 95% CI of a 30-day ED revisit, controlling for racial/ethnic group, age, insurance type, triage level, and clustered by hospital.

there were no significant differences between whites and the other racial/ethnic groups in 30-day ED revisits (Table 6).

DISCUSSION

In our study, children from minority racial/ethnic groups were more likely to receive steroids and less likely to receive radiology tests than their white counterparts. African Americans, in particular, received more steroids and fewer radiology tests compared with whites in each of our analyses. These findings may indicate poor access to primary care, a lack of asthma management at home,[31–33] or simply that these patients were presenting to the ED with more severe disease. It is possible that some patients received a radiology test at a previous ED visit, and so providers may have chosen not to order a new test after seeing the previous test results in the medical record. On the other hand, our results may also represent a trend toward overtesting white patients in the ED. Recent studies have found higher rates of testing for whites compared with nonwhites in the ED for conditions such as asthma,[5] appendicitis,[20] and chest pain.[34] In our albuterol subgroup, whites underwent 24% more radiological testing than was recommended by national benchmarks (17% for asthma patients receiving albuterol)[8] compared with only 11% more testing for African Americans.

Significant variation exists between EDs in pediatric asthma management across the United States, despite nationally established treatment guidelines.[6] In general, studies report lower rates of steroid administration and higher rates of radiological testing than what is recommended by the guidelines, thereby exposing children to potentially unnecessary testing.[4,7–9] The rate of steroid administration in our albuterol subgroup (79%) was fairly close to the National Asthma Education and Prevention Program recommendations (100%),[6] met national benchmarks (79%),[8] and was similar to the rate from a previous study (83%).[4] Our albuterol subgroup rate of radiological testing reflected that found in one previous report[4] and was lower than the rate in other reports.[22]

Repeat ED visits for asthma have previously been associated with minority racial/ethnic groups.[35,36] The higher rates of steroid administration for African American, Hispanic, and other children in the ED may indicate a lack of adherence to asthma action plans, perhaps because of racial/ethnic differences in parental perceptions of asthma[37] or differing levels of health literacy.[38] Racial/ethnic differences in access to primary care may also impact ED presentation for children with asthma. In a study by Withy and Davis,[39] asthma patients who had an office visit after their initial ED visit were 10% less likely to have a 30-day ED revisit. Furthermore, a recent study by Forester et al[40] found that among children living on military bases, racial/ethnic differences in asthma ED visits, steroid prescriptions, and hospitalizations were eliminated when children had equal access to care.

TABLE 6. Odds Ratios for the Albuterol Subgroup*

	Steroids†, n = 1669 (79.3%)	Radiology Test, n = 687 (32.6%)	30-d Revisit, n = 325 (15.4%)
Racial/Ethnic Group	aOR (95% CI)‡	aOR (95% CI)‡	aOR (95% CI)‡§
White	Referent	Referent	Referent
American Indian	1.84 (0.79–4.32)	0.47 (0.22–1.01)¶	1.07 (0.45–2.51)
African American	1.50 (1.09–2.07)‖	0.59 (0.45–0.77)#	1.01 (0.69–1.47)
Asian	1.16 (0.55–2.47)	0.94 (0.51–1.70)	0.33 (0.10–1.11)
Hispanic	1.35 (0.91–2.00)	0.98 (0.70–1.36)	1.07 (0.69–1.68)
Other	1.56 (1.01–2.39)¶	0.67 (0.47–0.95)¶	0.60 (0.35–1.01)

*Visits with a discharge diagnosis of asthma and at least 1 albuterol treatment in the ED.

†One site was missing steroid data, so it was excluded from this analysis.

‡aOR and 95% CI of each outcome variable in the albuterol subgroup, controlling for racial/ethnic group, age, sex, insurance type, triage level, and clustered by hospital.

§This model did not adjust for sex.

‖$P \leq 0.01$.

¶$P \leq 0.05$.

#$P < 0.001$.

Limitations

Our study is subject to several limitations. First, our data came only from EDs in the Upper Midwest, and results from other regions might differ. However, we did enroll a large, racially diverse sample. A limitation with a chart review design is the possibility that the data were entered incorrectly, so some patients may have mistakenly been coded with an asthma diagnosis and included in our sample. Because of the coding, we were also unable to determine whether the radiology tests were chest x-rays specifically, and we were limited to the potential covariates that were present in the electronic medical record. We had limited ability to determine disease severity, because of the nature of our data and available variables. Although some key variables may have been missing, we were able to analyze more sociodemographic information than what is often available in national databases. Next, medication data were not available for all of the hospitals in our sample, so the number of visits in our albuterol subgroup was relatively small and may not be representative of each racial/ethnic group. Similarly, 1 site had missing racial/ethnic classification for 14.3% of its asthma visits; however, these missing visits made up only 0.3% of the overall asthma cohort. It is possible that patients in our sample received care at an ED outside our network at some point during the study period; however, the EDs in our cohort represent some of the largest providers of pediatric care in their respective areas. Lastly, there was an unequal distribution of visits between the EDs in our study, with 91% of the asthma visits coming from 2 of the 6 sites. However, when we restricted the analysis to only the other 4 sites, the results were reasonably consistent with the overall model.

CONCLUSIONS

In summary, we report racial/ethnic differences in asthma care among pediatric ED patients. Even when controlling for demographic and clinical variables, children from minority racial/ethnic groups were more likely to receive steroids and less likely to receive radiology tests than white children. Whatever the explanation, these differences certainly warrant further investigation to ensure that all children receive proper asthma treatment in the ED.

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REFERENCES

1. Akinbami LJ, Moorman JE, Bailey C, et al. Trends in asthma prevalence, health care use, and mortality in the United States, 2001–2010. *NCHS Data Brief*. 2012:1–8.
2. Child Trends Data Bank. Asthma: indicators on children and youth. 2013. Available at: http://www.childtrends.org/?indicators=asthma. Accessed January 5, 2015.
3. Rasooly IR, Mullins PM, Alpern ER, et al. US emergency department use by children, 2001–2010. *Pediatr Emerg Care*. 2014;30:602–607.
4. Kharbanda AB, Hall M, Shah SS, et al. Variation in resource utilization across a national sample of pediatric emergency departments. *J Pediatr*. 2013;163:230–236.
5. Knapp JF, Simon SD, Sharma V. Variation and trends in ED use of radiographs for asthma, bronchiolitis, and croup in children. *Pediatrics*. 2013;132:245–252.
6. National Asthma Education and Prevention Program. Expert Panel Report 3 (EPR-3): guidelines for the diagnosis and management of asthma—summary report 2007. *J Allergy Clin Immunol*. 2007;120: S94–S138.
7. Kuhlmann S, Mason B, Ahlers-Schmidt CR. A quality improvement project to improve compliance with the Joint Commission Children's Asthma Care-3 measure. *Hosp Pediatr*. 2013;3:45–51.
8. Knapp JF, Hall M, Sharma V. Benchmarks for the emergency department care of children with asthma, bronchiolitis, and croup. *Pediatr Emerg Care*. 2010;26:364–369.
9. Gentile NT, Ufberg J, Barnum M, et al. Guidelines reduce x-ray and blood gas utilization in acute asthma. *Am J Emerg Med*. 2003;21: 451–453.
10. Flores G. Committee on Pediatric Research. Technical report—racial and ethnic disparities in the health and health care of children. *Pediatrics*. 2010; 125:e979–e1020.
11. Akinbami LJ, Moorman JE, Simon AE, et al. Trends in racial disparities for asthma outcomes among children 0 to 17 years, 2001–2010. *J Allergy Clin Immunol*. 2014;134:547–553. e5.
12. Largent J, Nickerson B, Cooper D, et al. Paediatric asthma hospital utilization varies by demographic factors and area socio-economic status. *Public Health*. 2012;126:928–936.
13. Gupta RS, Carrion-Carire V, Weiss KB. The widening black/white gap in asthma hospitalizations and mortality. *J Allergy Clin Immunol*. 2006;117: 351–358.
14. Law HZ, Oraka E, Mannino DM. The role of income in reducing racial and ethnic disparities in emergency room and urgent care center visits for asthma—United States, 2001–2009. *J Asthma*. 2011;48: 405–413.
15. Coffey J, Cloutier M, Meadows-Oliver M, et al. Puerto Rican families' experiences of asthma and use of the emergency department for asthma care. *J Pediatr Health Care*. 2012;26:356–363.
16. Ortega AN, Gergen PJ, Paltiel AD, et al. Impact of site of care, race, and Hispanic ethnicity on medication use for childhood asthma. *Pediatrics*. 2002;109:E1.
17. Johnson TJ, Weaver MD, Borrero S, et al. Association of race and ethnicity with management of abdominal pain in the emergency department. *Pediatrics*. 2013;132:e851–e858.
18. Ortega HW, Vander Velden H, Lin CW, et al. Race, ethnicity, and analgesia provision at discharge among children with long-bone fractures requiring emergency care. *Pediatr Emerg Care*. 2013;29:492–497.
19. Payne NR, Puumala SE. Racial disparities in ordering laboratory and radiology tests for pediatric patients in the emergency department. *Pediatr Emerg Care*. 2013;29:598–606.
20. Levas MN, Dayan PS, Mittal MK, et al. Effect of Hispanic ethnicity and language barriers on appendiceal perforation rates and imaging in children. *J Pediatr*. 2014;164:1286–1291. e2.
21. Goyal MK, Hayes KL, Mollen CJ. Racial disparities in testing for sexually transmitted infections in the emergency department. *Acad Emerg Med*. 2012;19:604–607.
22. Knapp JF, Simon SD, Sharma V. Quality of care for common pediatric respiratory illnesses in United States emergency departments: analysis of 2005 National Hospital Ambulatory Medical Care Survey Data. *Pediatrics*. 2008;122:1165–1170.
23. Wildfire JJ, Gergen PJ, Sorkness CA, et al. Development and validation of the Composite Asthma Severity Index—an outcome measure for use in children and adolescents. *J Allergy Clin Immunol*. 2012;129: 694–701.
24. Gorelick M, Scribano PV, Stevens MW, et al. Predicting need for hospitalization in acute pediatric asthma. *Pediatr Emerg Care*. 2008;24: 735–744.
25. Berkowitz SA, Traore CY, Singer DE, et al. Evaluating area-based socioeconomic status indicators for monitoring disparities within health care systems: results from a primary care network. *Health Serv Res*. 2015;50:398–417.
26. Sun BC, Burstin HR, Brennan TA. Predictors and outcomes of frequent emergency department users. *Acad Emerg Med*. 2003;10: 320–328.

27. Hardie TL, Polek C, Wheeler E, et al. Characterising emergency department high-frequency users in a rural hospital. *Emerg Med J*. 2015;32: 21–25.
28. Gilboy N, Tanabe P, Travers D, et al *Emergency Severity Index (ESI): A Triage Tool for Emergency Department Care, Version 4. Implementation Handbook, 2012 Edition*. Rockville, MD: Agency for Healthcare Research and Quality; 2011.
29. Durani Y, Brecher D, Walmsley D, et al. The Emergency Severity Index Version 4: reliability in pediatric patients. *Pediatr Emerg Care*. 2009;25: 751–753.
30. Tanabe P, Gimbel R, Yarnold PR, et al. The Emergency Severity Index (version 3) 5-level triage system scores predict ED resource consumption. *J Emerg Nurs*. 2004;30:22–29.
31. Crocker D, Brown C, Moolenaar R, et al. Racial and ethnic disparities in asthma medication usage and health-care utilization: data from the National Asthma Survey. *Chest*. 2009;136:1063–1071.
32. McDaniel MK, Waldfogel J. Racial and ethnic differences in the management of childhood asthma in the United States. *J Asthma*. 2012;49: 785–791.
33. Inkelas M, Garro N, McQuaid EL, et al. Race/ethnicity, language, and asthma care: findings from a 4-state survey. *Ann Allergy Asthma Immunol*. 2008;100:120–127.
34. López L, Wilper AP, Cervantes MC, et al. Racial and sex differences in emergency department triage assessment and test ordering for chest pain, 1997–2006. *Acad Emerg Med*. 2010;17: 801–808.
35. Oraka E, Iqbal S, Flanders WD, et al. Racial and ethnic disparities in current asthma and emergency department visits: findings from the National Health Interview Survey, 2001–2010. *J Asthma*. 2013;50: 488–496.
36. Hasegawa K, Tsugawa Y, Brown DF, et al. A population-based study of adults who frequently visit the emergency department for acute asthma. California and Florida, 2009–2010. *Ann Am Thorac Soc*. 2014;11: 158–166.
37. Wu AC, Smith L, Bokhour B, et al. Racial/ethnic variation in parent perceptions of asthma. *Ambul Pediatr*. 2008;8:89–97.
38. Apter AJ, Wan F, Reisine S, et al. The association of health literacy with adherence and outcomes in moderate-severe asthma. *J Allergy Clin Immunol*. 2013;132:321–327.
39. Withy K, Davis J. Followup after an emergency department visit for asthma: urban/rural patterns. *Ethn Dis*. 2008;18:S2-247-51.
40. Forester JP, Ong BA, Fallot A. Can equal access to care eliminate racial disparities in pediatric asthma outcomes? *J Asthma*. 2008;45: 211–214.