Role of Financial and Social Hardships in Asthma Racial Disparities

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KEY WORDS

childhood asthma, readmissions, racial disparities, pediatrics

ABBREVIATIONS

CCHMC—Cincinnati Children's Hospital Medical Center
GCARS—Greater Cincinnati Asthma Risks Study
IPW—inverse probability weighting
SES—socioeconomic status

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WHAT'S KNOWN ON THIS SUBJECT: Asthma morbidity disproportionately affects racial minorities and disadvantaged children. Differences in socioeconomic status and genetics have been offered as explanations but an in-depth understanding of differences in hardships may better explain disparities and also help to identify intervention targets.

WHAT THIS STUDY ADDS: Among children admitted for asthma, African Americans were twice as likely to be readmitted as whites. Nearly half the disparity was explained by socioeconomic status and hardships. Community-based interventions targeting hardships may be more feasible given emerging health care payment reform.

abstract

BACKGROUND AND OBJECTIVES: Health care reform offers a new opportunity to address child health disparities. This study sought to characterize racial differences in pediatric asthma readmissions with a focus on the potential explanatory role of hardships that might be addressed in future patient care models.

METHODS: We enrolled 774 children, aged 1 to 16 years, admitted for asthma or bronchodilator-responsive wheezing in a population-based prospective observational cohort. The outcome was time to readmission. Child race, socioeconomic status (measured by lower income and caregiver educational attainment), and hardship (caregivers looking for work, having no one to borrow money from, not owning a car or home, and being single/never married) were recorded. Analyses used Cox proportional hazards.

RESULTS: The cohort was 57% African American, 33% white, and 10% multiracial/other; 19% were readmitted within 12 months. After adjustment for asthma severity classification, African Americans were twice as likely to be readmitted as whites (hazard ratio: 1.98; 95% confidence interval: 1.42 to 2.77). Compared with whites, African American caregivers were significantly more likely to report lower income and educational attainment, difficulty finding work, having no one to borrow money from, not owning a car or home, and being single/never married (all $P \leq .01$). Hardships explained 41% of the observed racial disparity in readmission; jointly, socioeconomic status and hardship explained 49%.

CONCLUSIONS: African American children were twice as likely to be readmitted as white children; hardships explained >40% of this disparity. Additional factors (eg, pollution, tobacco exposure, housing quality) may explain residual disparities. Targeted interventions could help achieve greater child health equity. *Pediatrics* 2014;133:431–439

Racial disparities are widespread and persistent.[1,2] Asthma is the most common chronic physical health condition of childhood, and morbidity disproportionately affects racial minorities.[3–10] Population-based studies that report racial disparities, however, rarely include patient-level details beyond traditional sociodemographic factors.[9] Further characterization of the challenges families face may help identify risks amenable to both clinical and public health interventions that could prevent subsequent morbidity and reduce disparities.[11] Such a focus on prevention could be especially relevant with emerging health care reform in which payment is based on outcomes and coordinated community-based care becomes more feasible.

Asthma-related disparities extend to children of socioeconomic disadvantage.[12,13] Measurement of disadvantage, frequently conceptualized as socioeconomic status (SES), is often crude, failing to capture the varied challenges in patients' lives.[14–16] Failure to fully account for racial variability in disadvantage can lead to prematurely ascribing racial outcome differences to genetic factors,[17–19] missing opportunities for socioeconomic risk identification and mitigation. Given that racial disparities likely operate, at least in part, through socioeconomic disadvantage,[13] a more complete and effective understanding of this relationship is essential.[20–24]

Measures of financial and social hardship, or strain, can highlight challenges families confront in the setting of limited resources.[25,26] African Americans are more likely to experience competing household priorities[14] and hardships, even after adjustment for income and education.[27–29] Personalizing and refining screening to more adequately identify drivers of disparities are increasingly relevant to clinical care in the era of accountable, coordinated care. Adding hardship to patient- and population-level assessments could determine where disparity-reducing investments could be targeted, elevating financial and social screening and interventions to the level of medical tests and treatments.[30,31]

Thus, we first sought to characterize racial differences in time to asthma-related readmission in a population-based pediatric cohort. Second, we aimed to assess the degree to which SES and markers of financial and social hardship explained expected racial disparities in readmissions.

METHODS

Study Design and Population

We analyzed data from a population-based, prospective observational cohort at Cincinnati Children's Hospital Medical Center (CCHMC), a large, urban academic pediatric facility. Data were available for 774 patients, aged 1 to 16 years, enrolled in the Greater Cincinnati Asthma Risk Study (GCARS) cohort between August 11, 2010, and October 20, 2011. GCARS also included children admitted to a nearby satellite inpatient facility beginning November 1, 2010. Because Ohio Hospital Association data indicate that ∼85% of all asthma admissions for children aged 1 to 16 years within our 8-county primary service area occur at CCHMC facilities, the accrued admission sample was considered population-based.[32,33]

Patients were identified by the admitting physician's use of the evidence-based clinical pathway for acute asthma or bronchodilator-responsive wheezing. Children who were removed from the pathway before discharge, who had significant respiratory or cardiovascular comorbidities (eg, cystic fibrosis, congenital heart disease), who resided outside of the 8-county service area, or whose primary caregiver did not understand written or spoken English (∼2% of those otherwise eligible) were excluded. Study recruitment took place, on average, 7 days per week and 12 hours per day. The CCHMC Institutional Review Board approved this study.

During the enrollment period, 1312 patients met inclusion criteria (Fig 1). Of the 1312 eligible, 81 (6.2%) were admitted when research personnel were unavailable. Research personnel were unable to obtain consent for 53 (4.0%) patients who had no parent or guardian available. Fifty-six (4.3%) patients were missed as a result of difficulty completing the consent process because of high patient census or competing patient care priorities. Finally, 346 (26.4%) refused to participate, and 2 withdrew after consent but before completion of any study procedures. Altogether, research personnel enrolled 59.0% of those eligible and 62.9% of those eligible with staff available to recruit.

A 25% subsample of all those enrolled were contacted by telephone ∼12 months after index admission to assess potential loss to follow-up or admission to non-CCHMC sites. The subsample was selected by using block randomization (blocking was used due to the seasonality of asthma morbidity). The 774 enrolled patients were divided into groups of 20 with 5 randomly chosen subjects in each block then selected for follow-up. If staff were unable to complete the call, the subject's current home address was identified by using the electronic medical record and/or public records; 95.9% of those in this subsample were confirmed as having maintained residence in CCHMC's primary service area. Of those reached by telephone (n = 164, 84% of possible participants), none reported an admission to a hospital other than CCHMC during the follow-up period.

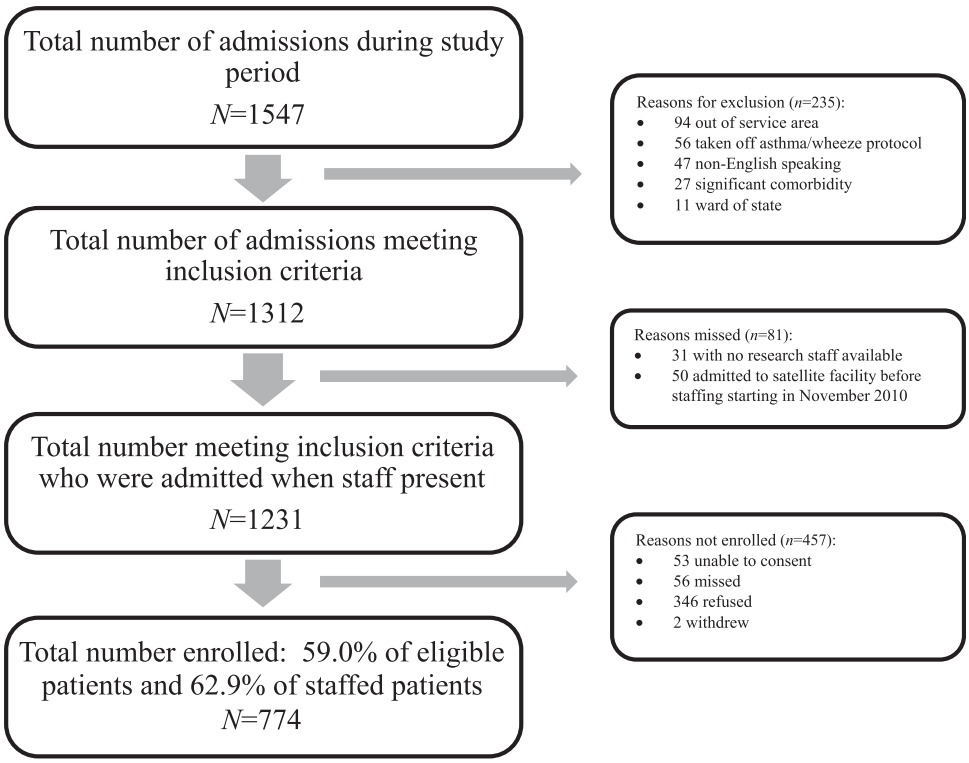

FIGURE 1
Recruitment diagram for patients enrolled in the GCARS between August 2010 and October 2011.

Outcome and Predictors

The primary outcome was asthma-related readmission, assessed as both time to first readmission and any readmission within 12 months. Readmission data were captured by International Classification of Diseases, Ninth Revision, Clinical Modification, classification codes of primary or secondary discharge diagnoses (493.XX or 786.07 for asthma or wheeze, respectively)[34] recorded in hospital billing data. Outcome accuracy was verified by electronic medical record review to ensure that readmissions met the same inclusion and exclusion criteria as index admissions. Time to readmission was calculated as the interval between the discharge date of the index admission and the date of the first readmission for asthma or wheezing. Censoring occurred at the end of the follow-up period (October 2012) for those not readmitted.

We obtained demographic variables, asthma severity classification,[35] and measures of household SES and hardship from a face-to-face survey completed with each patient's caregiver during the index admission. Severity was classified by using survey responses assessing symptoms and control in the 4 weeks preceding the exacerbation; specific therapeutic steps could not be verified. Patient race was defined according to caregiver report. Caregivers could choose ≥1 of the following US Census categories: white/Caucasian, black/African American, Asian/Oriental or Pacific Islander, American Indian or Alaskan Native, or other.[36] Ethnicity was characterized as Hispanic/non-Hispanic. For this study, racial categories were collapsed to African American, white, and multiracial/other. Children identified as Hispanic were included in the multiracial/other category. Given the study aims and small numbers in the multiracial/other category, primary analyses were conducted in African Americans and whites.

SES was measured by using income, adjusted for household size, and primary caregiver educational attainment. Annual household income, household size, and educational attainment were collected as ordinal variables. Annual income per household person was calculated by dividing the midpoint of the reported income category by the number of persons reported to be in the household. Dichotomization of this income variable and educational attainment improved model fit when relationships with readmission were assessed; there were natural breakpoints in observed associations without evidence of dose response. For annual income per household person, dichotomization occurred at $15 000, an approximation of the federal poverty line.[37] Those with incomes of <$15 000 per household person were considered "at risk." Caregivers who had completed high school or had less than a high school education were considered at risk.

Financial and social hardship was characterized by using previously validated questions.[25,38,39] Ten candidate survey questions were included. Financial hardship was assessed via difficulty making ends meet, looking for work but being unable to find it, being unable to pay rent or utilities for financial reasons, having to move in with others for financial reasons, and having had property repossessed. Social hardship was assessed via a household's inability to borrow money during times of need. Those answering "yes" to any of these questions were considered at risk. Wealth was assessed via home and car ownership, with car ownership also allowing for an assessment of transportation access. Those not owning a home or car were considered at risk. Finally, those who were single and never married were conceptualized as having less help with their child's health care and more child care challenges than those in other categories of marital status[40] and were therefore considered at risk.

Statistical Analyses

Bivariate associations compared African American and white children with respect to demographic characteristics, asthma severity classification, SES, and hardship by using χ^2 statistics. Kaplan-Meier curves and log-rank statistics compared African Americans and whites with respect to time to readmission. Bivariate associations between key predictors and time to readmission were assessed by using Cox proportional hazards regression.

To evaluate the extent to which SES and hardship explained the increased risk of readmission in African American children, we focused on variables at least marginally associated ($P < .2$) with both race and time to readmission. We then used inverse probability weighting (IPW) to calculate an African American's risk of readmission should he or she have the same distribution of SES and hardship risks as his or her white counterparts. Similar methods have been previously used to investigate health disparities related to race.[15,41]

By using IPW, we constructed a series of Cox proportional hazards models, adjusted for asthma severity, with the outcome being time to readmission. Model 1 included race as a predictor, model 2 included race and SES variables (income and educational attainment), and model 3 included race and hardship variables that met our significance criteria (looking for work, ability to borrow money, home ownership, car ownership, and marital status). Model 4 included race alongside SES and hardship measures included in models 2 and 3. The extent to which SES and hardship explained the relationship between race and time to readmission was assessed by the percentage change in the parameter estimated for race. This reduction was interpreted as quantification of the degree to which SES and hardship explained the racial disparity in readmission hazard. Bootstrapping was used to obtain confidence intervals (CIs) around this quantification. All analyses used SAS statistical software (version 9.3; SAS Institute, Cary, NC).

RESULTS

A total of 774 children were enrolled in GCARS. Our sample was 57% African American, 33% white, and 64% male with a mean age of 6.2 years (Table 1). A total of 83% reported annual income per household person as <$15 000; 43% of caregivers had a high school education or less. Additionally, 45% of caregivers reported that they were looking but unable to find work, and just 22% of caregivers reported that they owned their home. More than 60% of caregivers were single, having never married. Compared with whites, African American caregivers were significantly more likely to be at risk of each SES and hardship variable: they were more likely to report lower income per household person and educational attainment, difficulty finding work, having no one to borrow money from, not owning a car or home, and being single/never married (all $P \leq .01$).

Compared with enrolled children, those who were eligible but not enrolled did not differ with respect to age, gender, or readmission rate at 12 months. Enrolled children were, however, more likely to be African American and publicly insured. There were no significant differences between children receiving and those not receiving the follow-up phone call.

Overall, 18.6% of enrolled children were readmitted for asthma or bronchodilator-responsive wheezing within 12 months. African Americans were more than twice as likely to be readmitted as whites (23% vs 11%) and had a significantly shorter time to readmission: it took 114 days for 10% of African Americans to be readmitted compared with 234 days for whites ($P < .01$) (Fig 2). Bivariate analyses indicated that time to readmission was marginally associated with both annual income per household person ($P = .1$) and caregiver educational attainment ($P = .17$) (Table 2). For the included hardship variables, time to readmission was at least marginally associated with the caregiver actively looking for work but being unable to find it, having no one to borrow money from in a time of need, not owning a home, not owning a car, and being single/never married (all $P < .1$).

Table 3 shows the analytic approach to identifying the degree to which SES and hardship explained observed racial disparities. After adjustment for asthma severity, model 1 shows that African Americans still had double the hazard of readmission (hazard ratio:

TABLE 1 Demographic, Socioeconomic, and Hardship Characteristics and Distribution by Race for Patients Enrolled in the GCARS Between August 2010 and October 2011

Characteristic	*n*	%	African American (*n* = 441), %[a]	White (*n* = 254), %[a]	Multiracial/Other (*n* = 76), %[a]	*P*[b]
Age						
<4 years	294	38	34	41	53	.14
4–11 years	396	51	55	49	37	
≥12 years	81	11	11	9	11	
Gender						
Male	503	65	63	67	66	.35
Female	271	35	37	33	34	
Asthma severity classification						.03
Mild intermittent	261	34	32	36	38	
Mild persistent	318	41	40	44	45	
Moderate persistent	145	19	22	16	12	
Severe persistent	44	6	7	4	5	
Health insurance						
Public	562	73	89	50	67	<.01
Private	171	22	10	44	28	
Self-pay	27	4	2	7	5	
SES						
Annual household income						
<$15 000	261	34	46	14	30	<.01
$15 000–$29 999	212	28	29	24	29	
$30 000–$44 999	108	14	12	17	17	
$45 000–$59 999	46	6	5	9	3	
$60 000–$89 999	78	10	5	19	9	
≥$90 000	55	8	2	15	12	
Annual income per household person						.16
<$15 000	627	83	91	68	83	
≥$15 000	132	17	9	32	17	
Caregiver educational attainment						
Less than high school graduate	121	16	19	10	16	<.01
High school or GED but not more	204	27	28	27	18	
Some college	220	30	30	23	37	
Two-year college or technical school graduate	83	11	11	10	13	
Four-year college graduate	82	11	7	17	9	
Any postgraduate work	34	5	2	9	5	
Financial and social hardship						
Looking for work, unable to find						
Yes	342	45	55	27	42	<.01
No	426	55	45	72	58	
Unable to borrow money in time of need						
Yes	412	54	58	46	54	<.01
No	358	46	42	54	46	
Owns home						
No	599	78	90	58	75	<.01
Yes	170	22	10	42	25	
Owns car						
No	215	28	39	9	26	<.01
Yes	553	72	61	91	74	
Marital status						
Single, never married	484	63	82	37	39	<.01
Divorced/widowed/separated	77	10	7	13	16	
Married	209	27	11	50	45	

GED, General Educational Development.

[a] Percentages were rounded and thus may add up to more or less than 100.

[b] *P* value compares African American children and white children using χ^2 statistics, and Cochran-Mantel-Haenszel statistics for asthma severity, income, and education.

1.98; 95% CI: 1.42 to 2.77). In model 2, the parameter estimate for race was unchanged after inclusion of the SES variables. In model 3, however, financial and social hardship variables were found to explain 41% of racial differences. When both SES and hardship were included with race in model 4, nearly 49% (95% CI: −2.2% to 111.0%) of race's association with readmission was explained. This reduction nearly met statistical significance, and the adjusted hazard for readmission for African Americans decreased from 1.98 to 1.44.

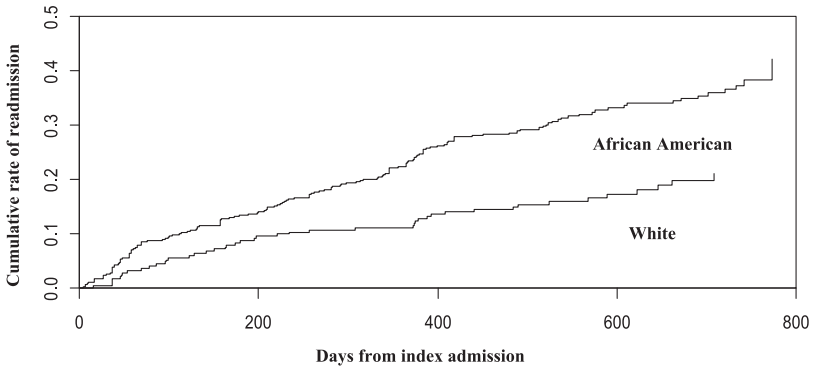

FIGURE 2
Survival curve showing African American–white differences in hospital readmission for patients enrolled in the GCARS between August 2010 and October 2011 and followed through October 2012. Cumulative rates of readmission after index admission were estimated by using a 1–Kaplan-Meier survival curve ($P < .01$, log-rank test).

DISCUSSION

Child health continues to be characterized by pervasive and persistent disparities. Among children admitted for asthma or wheezing, African Americans were twice as likely to be readmitted as whites. We quantified that >40% of the observed disparity could be explained by financial and social hardship. Together with traditional measures of SES, hardships explained almost 50%. Readmission rates are a central focus of health care reform in the United States, and reducing disparities in such outcomes will be critical. Our findings suggest that a more intense patient- and population-level focus on the financial and social hardships that underlie racial disparities may provide 1 path for achieving better outcomes.

TABLE 2 Bivariate Relationships Between Race and Demographic, Socioeconomic, and Hardship Characteristics Using Hazard of Readmission for Patients Enrolled in the GCARS between August 2010 and October 2011 and Followed Through October 2012

	Hazard of Readmission[a]	95% CI
Race		
African American	2.07	1.48 to 2.89
White	Reference	
Asthma severity classification		
Severe persistent	1.83	1.07 to 3.14
Moderate persistent	1.70	1.18 to 2.46
Mild persistent	1.12	0.80 to 1.56
Mild intermittent	Reference	
Annual income per household person		
<$15 000	1.39	0.94 to 2.05
≥1$15 000	Reference	
Caregiver educational attainment		
High school or less	1.21	0.92 to 1.60
More than high school	Reference	
Looking for work, unable to find		
Yes	1.35	1.03 to 1.77
No	Reference	
Unable to borrow money in time of need		
Yes	1.26	0.96 to 1.65
No	Reference	
Owns home		
No	1.59	1.10 to 2.29
Yes	Reference	
Owns car		
No	1.57	1.19 to 2.08
Yes	Reference	
Marital status		
Single, never married	1.69	1.20 to 2.38
Married	Reference	

[a] Outcome was time to hospital readmission with hazard ratios obtained by using unadjusted Cox proportional hazards.

The racial disparities in asthma-related readmissions observed in our population-based cohort align with previous accounts nationally.[3,9] For example, a retrospective analysis in all children admitted for asthma over a 10-year period in St Louis, Missouri, found that African American children were at a 50% greater risk of having multiple admissions.[5] No previous studies, to our knowledge, have analyzed population-based readmission differences by race with the patient-level detail available in this cohort, details that may inform interventions for clinicians and public health officials alike.[42]

In an attempt to more deeply characterize racial disparities, we focused on socioeconomic determinants of health.[13,15,43] To assess the impact of SES, we used caregiver reports of income and educational attainment. Surprisingly, these markers of SES explained none of the observed racial readmission difference. Although some have suggested that such a finding could support

TABLE 3 Association of African American Race With Readmission Accounting for Socioeconomic and Hardship Covariates Using IPW for Patients Enrolled in the GCARS Between August 2010 and October 2011 and Followed Through October 2012

	Race Parameter Estimate	Hazard Ratio (95% CI)	Percentage Reduction in Race Parameter Estimate (95% CI)[a]
Model 1: no SES or strain covariates[b]	0.68	1.98 (1.42 to 2.77)	—
Model 2: SES covariates[c]	0.69	1.99 (1.45 to 2.74)	−0.2 (−23.7 to 24.0)
Model 3: strain covariates[d]	0.42	1.52 (1.13 to 2.04)	40.6 (−5.5 to 94.4)
Model 4: SES and strain covariates[e]	0.37	1.44 (1.07 to 1.96)	48.5 (−2.2 to 111.0)

[a] Parameter estimate obtained by using IPW with Cox proportional hazards regression; 95% CIs obtained by using bootstrapping.
[b] Model 1 includes race alone, adjusted for asthma severity classification.
[c] Model 2 includes race and SES variables (reported income and caregiver educational attainment), adjusted for asthma severity classification.
[d] Model 3 includes race and hardship variables (looking for work but unable to find, need to borrow money, home ownership, car ownership, marital status), adjusted for asthma severity classification.
[e] Model 4 includes race, SES, and hardship variables, adjusted for asthma severity classification.

the genetic basis for disparities,[44] we expect that these measures of SES, taken alone, do not adequately characterize racial differences in socioeconomic adversity experienced day to day and over the life course.[20,45]

Hardship complements SES and provides a more textured characterization of such day-to-day challenges.[1] Each marker of financial and social hardship was chosen given hypothesized relationships with both race and readmission, and the potential for such information to change clinical practice. For example, certain hardships (eg, job-seeking, transportation barriers) may be amenable to intervention, including social services consultation, connections to community resources, or medication home delivery. Other factors (eg, ability to borrow money, marital status, home ownership) may benefit from in-depth screening regarding a family's support structure, barriers to medication adherence, or lower expectations for asthma control.[14]

Alone, these hardship markers explained ∼41% of observed racial readmission differences. Jointly, SES and hardship explained nearly half of the observed disparity. This finding supports the notion that hardship identification could prompt partnerships with individuals and agencies poised to add support to lives characterized by disadvantage.[42] Recent work with social services, public health officials, and legal aid advocates highlights the impact that such interventions can have for individual patients and populations.[36,46–48] Enhanced, scaled partnerships of this sort may be especially relevant as health care reform pushes clinicians to find cost-effective methods for reducing health service utilization.[30] Nationally, identifying where social service and public health expenditures can be augmented may also prove impactful.[31] The increased focus on clinical quality metrics and payment for health outcomes and disparity reduction, not simply for volume of care, would support a broadened approach to these types of health interventions.[49,50]

Additional factors are also likely to affect and explain residual disparities. For example, differential access to care has been linked to both increased risk of readmission and race (African Americans use less ambulatory care and more acute care compared with whites).[9,51] Similarly, previous work has revealed differential adherence to asthma controllers and lower expectations of asthma control among African Americans.[14] Exposures to pollution, tobacco, or substandard housing conditions may also explain persistent differences while presenting opportunities for intervention.

Genes, too, have been postulated to drive racial differences in asthma morbidity.[44] The distribution of asthma-related genes, however, varies by and within race, and a gene's impact often depends on coexistent social and environmental exposures. This fact ought to provoke caution before the personalization of asthma care relies solely on genetic factors or measured biomarkers.[22,52,53] Personalized management of asthma may benefit from complementing genetics with a focus on financial or social hardships that could guide hospital- and community-based resources to those with the most to gain.[54] Additionally, whenever critically appraising conclusions highlighting genes as a basis for health disparities, the issue of residual confounding, of not accurately measuring the underlying variables that affect racial disparities, should be taken into account.[17]

There were limitations to this study. First, asthma admission data were only available for children hospitalized at CCHMC facilities; children may have been admitted elsewhere. Local data indicate, however, that CCHMC cares for ∼85% of all childhood asthma admissions in the 8-county service area.[32] Additionally, none of the 164 patients reached 1 year after index admission reported being admitted elsewhere. Second, our sample was composed primarily of African American and white children, limiting generalizability. Third, there were significant differences with respect to race and insurance between those enrolled and those not enrolled. Given that enrolled children were likely at "higher risk," we expect that this fact, if anything, would bias our findings toward the null. Fourth, wide CIs surrounding our estimates of the percentage of racial disparity explained resulted from loss of

power upon inclusion of additional covariates in the IPW model. Finally, although SES and hardship explained nearly half of observed racial disparities, we are unable to prove that they caused differences in readmission risk to occur.

CONCLUSIONS

In a population-based cohort of children admitted with asthma or bronchodilator-responsive wheezing, African Americans were twice as likely to be readmitted as whites. This disparity was partially explained by financial and social hardship, which added measurably to SES. Highlighting the role of a child's financial and social environment is especially relevant as targeted approaches to risk identification and mitigation are explored. In the future, we will assess potential explanations for residual racial disparities including differential access to care and expectations of care, alongside exposure to air pollution, tobacco smoke, substandard housing conditions (eg, mold, pest infestation), violent crime, and racial discrimination. We also plan to determine how knowledge of such factors could be efficiently translated into testable interventions aimed at improving outcomes and reducing disparities.

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