Racial and Socioeconomic Disparities in Pediatric Asthma Emergency Care

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ABSTRACT

The aim of this paper is to build a model to compare the relative impact of race and ethnicity and insurance type on pediatric Emergency Department utilization for asthma. A binary logistic regression model using relevant variables from 2022 NHIS survey data was conducted to compare asthma ED visit odds ratios of racial and ethnic minorities and publicly insured children. The results suggest that insurance type has slightly greater influence over asthma ED visits than race and ethnicity. Publicly insured children had the highest unadjusted odds ratio (1.88 [CI 95% 1.09-3.24)]) followed by Non-Hispanic Black children (1.80 [0.92-3.52]) and Hispanic children (1.51 [0.80-2.86]). The data are possibly biased toward exclusion of well-controlled asthmatics that may affect the resulting odds ratios. More socioeconomic variables would provide a more complete analysis. The paper has direct implications for health service providers and policymakers. Providers are encouraged to provide equitable, culturally competent care to asthmatics and policymakers are encouraged to embrace policies that promote better access for Medicaid beneficiaries, improved air quality and housing conditions for low-income children, and better racial representation in the provider workforce. The paper collates many existing sources of research on asthma disparities as a backdrop for examination of recent survey data pertaining to differences in asthma ED utilization between populations. It supports existing theories and work being done to mitigate poor asthma outcomes in children that are exacerbated by biological and systemic factors.

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1. INTRODUCTION

Asthma is the top chronic disease affecting children and adolescents, representing more than 700,000 emergency department (ED) visits each year. It is the focus of an incredible amount of research that has documented the influence of socioeconomic status (SES) and race and ethnicity on the management of asthma and the outcomes that follow poor asthma control. While the rate of preventable ED visits for asthma has not changed significantly in recent decades, disparities along demographic, racial, and insurance-based lines are well-documented (Nath & Hsia, 2015). Race and SES are unfortunately intrinsically linked in many cases due to policies and structures that have historically disadvantaged people of color, but it is not inherently obvious which factor has the greatest impact on asthma care outcomes. This study aims to quantify the relative significance that both race and SES have on the utilization of the ED for asthma exacerbation to aid in the distribution of pediatric asthma education, resources, and preventative interventions.

Social Determinants of Asthma Exacerbation

The rate of asthma diagnosis is unevenly distributed when looking at socioeconomic factors. Children in households that rent their homes, do not have sufficient amenities, or that lack regular vehicle access are diagnosed with asthma at a higher rate (Hughes et al., 2017). Environmental triggers are a leading culprit for asthma attacks, so the structural factors that influence a child's exposure to triggering agents must be considered and can even be used to predict whether a child needs to seek escalated care (Williams et al., 2009). In particular, the presence of pests and mold in the home, exposure to air pollution in metropolitan areas, and family stressors all contribute to asthma symptoms, and low-income children are impacted by these factors the most. Counseling by a physician and aid from social workers can mitigate some of the effects of triggers and are recommended to be part of the ED discharge process to avoid recurrent visits (Lee et al., 2020).

Racial Disparities in Asthma Control

Much of the research suggests that the burden of asthma is disproportionately borne by children of color. Without adjusting for SES, children in Non-Hispanic Black households have as much as 70% higher odds of being diagnosed with asthma than children in Non-Hispanic White households (Hughes et al., 2017). A survey of the roughly 200 pediatric asthma deaths that occur each year found that Non-Hispanic Black children died at a rate six times higher than Hispanic children and seven times higher than Non-Hispanic White children. Of those deaths, children aged 10-14 years had the highest mortality rate compared to other age groups, and boys had a higher mortality rate compared to girls (Arroyo et al., 2018). Some explanation for the racial disparity may lie with different physical responses to inhaled corticosteroids by Non-Hispanic Black children (Wells et al., 2016; Gould et al., 2010) as well as differences in the ability of patients of different races/ethnicities to accurately gauge their level of pulmonary function (Fritz et al., 2010). Research on forced expiratory volume in 1 second (FEV1), a commonly used pulmonary control test, indicated that Non-Hispanic Black patients had statistically worse asthma control than Non-Hispanic White patients despite there being no difference in the distribution of asthma severity categories between the two populations (Mitchell et al., 2016). Widely adopted asthma management guidelines do not account for these differences, so commonly used guidance does not prompt physicians to provide different treatment plans based on race and ethnicity.

The Role of Primary Care

Regular visits to a primary care provider (PCP) are intended to support management of asthma symptoms through counseling and prescription controller medications. The Medicaid program was implemented to provide better access to health services for children in low-income families, but Medicaid beneficiaries continue to have more limited access to primary care than their privately insured counterparts. The access issue leaves many families continuing to use the ED as their major source of care despite governmental efforts to shift care to primary care settings to decrease ED use (Piehl et al., 2000). For asthmatic patients that are able to see their PCP, more recent guidance recommends the completion of a written asthma action plan to help patients know the steps they need to take based on their asthma symptoms to mitigate an emergency and encourage co-ownership of managing one's asthma with their PCP. Use of asthma action plans has been shown to significantly reduce ED visits, admission days, and school absence days (Lakupoch et al., 2018). Having a consistent PCP relationship is only one piece of the puzzle. In one study, families of Non-Hispanic Black children with ED visits for asthma reported that they had seen a physician for regular asthma care in the last 6 months and attributed the ED visit to having worse asthma symptoms, lower social support, issues with paying for healthcare, and lack of a hypoallergenic mattress cover (Rand et al., 2000). In a survey of patients utilizing a community health clinic, most Non-Hispanic Black children did not meet the recommended yearly visits for their asthma and used the clinic less in general compared to Non-Hispanic White and Hispanic children. However, the study did not account for factors that may have influenced utilization, such as transportation issues (Kaufmann et al., 2022). Utilization of preventative services may also depend on the parents' understanding of their child's asthma as a chronic health care need. One study found that children

with special health care needs are significantly more likely to attend a well child visit and less likely to have an unmet need compared to children without special needs (Van Cleave & Davis, 2008).

Impact of Insurance Status

Children without health insurance have the least access to chronic asthma care which would prevent ED utilization, but even children covered by public insurance have been found to be more likely to have multiple ED visits over the course of a year than children with private insurance. However, there are no significant differences in asthma treatment in the ED by insurance status (Hasegawa et al., 2016). A significant negative association has also been found between patients with private insurance coverage and ED utilization and unplanned admissions for all causes compared to Medicaid and self-pay patients, even when controlling for severity of illness (Friedman & Basu, 2001). These findings highlight the critical importance of seeking parity between public and private insurance to mitigate the effects of chronic disease.

Cultural Drivers of Treatment Adherence

Research has found that asthma medication adherence rates are substantially lower for minority children than nonminorities, even when controlling for SES (McQuaid et al., 2003). This may be due in part to cultural attitudes toward medication use and concerns regarding negative side effects, as is often the case with use of steroids of any kind. As an alternative, home remedies for managing asthma have been reported to be used by Non-Hispanic Black patients (George et al., 2006; Mansour et al., 2000) and Hispanic patients (Bearison et al., 2002; Koinis-Mitchell et al., 2007). Home remedies may address the initial asthma symptoms but can delay more effective treatment to avoid an ED visit. It is also possible that the previously mentioned physical responses to medications and control testing in Hispanic (Burchard et al., 2003) and Non-Hispanic Black patients (Camargo et al., 2009) have had a negative impact on beliefs regarding the effectiveness of physician-recommended asthma treatments, and the potential for bias on the part of the physician should be considered.

The Importance of Cultural Competency

The cultural foundation of the family and their education about their child's asthma must be understood and addressed to promote effective asthma management. Strategies that consider health literacy, patient and family beliefs, and financial constraints could be employed by physicians to reduce disparities and serve as an opportunity to address the family's beliefs regarding asthma care. Cultural competency training for provider groups would help to implement such a multifaceted care strategy (Canino et al., 2009). Taking every opportunity to fully engage the family in their child's care has been shown to improve the family's sensitivity to asthma symptoms to enable the appropriate response and avoid an ED visit (McQuaid et al., 2007).

Physicians who are culturally sensitive are also more likely to modify treatment plans as needed to address the unique needs of their patients. Spending more time with patients of different races and ethnicities can lead to more competent care, even mitigating barriers such as low health literacy (Shields, 2007). An alternative pathway to culturally competent care is for the patient to be treated by a provider of their same race and ethnicity. Several studies have confirmed a correlation between racial concordance of the patient and physician with improvements to patient satisfaction, adherence to treatment plans, mutual trust, and equity of care. Policies that seek to improve representation of minority providers in the healthcare system can have a tangible impact on care delivery to minority populations (Saha et al., 1999).

Key Research Question

Patient demographics and SES both need to be considered when creating a strategy to address asthma disparities, but an entity with limited resources may want to consider which of these aspects has the largest impact on poor outcomes. Being aware of the larger driver of health disparities would also aid in the development of more effective policies to help populations in need. Based on the reviewed research, this study assumes that race/ethnicity have a larger impact on whether a pediatric patient utilizes the ED for asthma than socioeconomic status.

2. MATERIALS AND METHOD

The study employed a comprehensive approach to analyze the relationship between race, socioeconomic status, and emergency department (ED) utilization. We utilized regression analysis and stratified our data based on demographic and socioeconomic variables to draw meaningful conclusions. The sample was weighted to ensure representation, and missing data were handled using multiple imputation methods to minimize bias. We presented our results with clear visualizations, including tables and figures, to facilitate understanding. To find the statistical significance of race compared to SES factors, we chose to run a logistical regression to calculate the probability of ED utilization based on demographics and SES. The National Health Interview Survey (NHIS) sample child interview asks whether the child has had an asthma ED visit in the last 12 months ("Asthma ER visit, past 12m"), which is the ideal dependent variable for this analysis. The unit of analysis is an individual sample child. Using IBM SPSS, we imported the 2022 NHIS child survey results for ages 0-17 (n = 7,464) and limited the dataset to only children who were believed to still have asthma using

variable "Still have asthma" (n = 453). We selected independent variables for patient demographics ("Sex of Sample Child", "Age of SC", "Single and multiple race groups with Hispanic origin") and health insurance class as a proxy for SES ("Health insurance hierarchy"). We then excluded records that identified their health insurance as "Other coverage" (n = 12) or "Uninsured" (n = 12) due to their low counts. It would have been helpful to know what "Other coverage" meant so it could have been incorporated into one of the two final insurance groups. Finally, we excluded records for race/ethnicities of "Non-Hispanic Asian only" (n = 18), "Non-Hispanic AIAN only" (n = 1), "Non-Hispanic AIAN and any other group" (n = 5), "Other single and multiple races" (n = 23) due to their low counts and near total lack of ED utilization. These exclusions left 382 records for the analysis.

To make the results easier to interpret, we changed the numerical value of "No" in the "Asthma ER visit, past 12m" dependent variable from 2 to 0. We were curious to see how the results might differ by age, so we created age groups based on the American Academy of Pediatrics guidance and grouped the records into "Early Childhood 0-4", "Late Childhood 5-12", and "Adolescence 13-17". We then created dummy variables for age group and race/ethnicity using the Transform > Create Dummy Variables function.

Once the variables were finalized, we decided to focus on the unadjusted odds ratios from the results of the binary logistic regression (Analyze > Regression > Binary Logistic) because it would provide a clear picture of ED visit likelihood for each population. The ideal end result was to be able to compare the level of disparity between the reference category and the other variables for both race/ethnicity and insurance class and to quantify the lower and upper limits of the confidence interval as an expression of statistical significance. To accomplish this, we ran the logistic regression using Non-Hispanic White and Private insurance as the reference categories.

To compare results, we ran the regression function for the race/ethnicity variables and insurance class variables separately (shown as "Isolated" on the result tables) and together (shown as "Not Isolated"). We identified all independent variables as Categorical Covariants on the Categorical menu and checked the box for CI for exp(B) 95% on the Options menu. From the resulting "Variables in this Equation" tables, we took the value for Exp(B) as the odds ratio and the Lower and Upper limits for 95% C.I. for Exp(B) to show the range of the confidence interval. We collated the results into tables to offer a comparison of impact for each variable.

3. RESULTS

Using the Analyze > Descriptive Statistics > Frequencies function, we generated a descriptive overview of the complete study sample which is detailed in **Table 1**. We then generated frequencies just for the Asthma ED visits in the data to compare the proportions to the total.

Table 1. Selected Characteristics of the Study Sample and Children with Asthma ED Visits

Characteristic	Study Sample		Asthma ED Visits		Diff
	n	%	n	%	%
Total	382		64	16.8%	
Sex					
Male	230	60.2%	33	51.6%	-8.6%
Female	152	39.8%	31	48.4%	+8.6%
Age group					
Early childhood (0-4)	39	10.2%	14	21.9%	+11.7%
Late childhood (5-12)	169	44.2%	34	53.1%	+8.9%
Adolescence (13-17)	174	45.5%	16	25.0%	-25.5%
Race/Ethnicity					
Non-Hispanic White	206	53.9%	28	43.8%	-10.2%
Non-Hispanic Black	77	20.2%	17	26.6%	+6.4%
Hispanic	99	25.9%	19	29.7%	+3.8%
Health Insurance Hierarchy					
Private	211	55.2%	27	42.2%	-13.0%
Medicaid and other public	171	44.8%	37	57.8%	+13.0%

As described in the Methods section, we ran the binary logistic regression using the 95% confidence interval. The unadjusted odds ratios for each variable and Lower and Upper limits of the confidence interval are shown in **Table 2**.

Table 2. Association of Race/Ethnicity and Health Insurance with Asthma ED Visits (All Patients)

Characteristic	Odds of Asthma ED Visit	
	Odds Ratio	95% CI
Race/Ethnicity (Not Isolated)		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	1.53	0.76-3.06
Hispanic	1.33	0.69-2.56
Health Insurance (Not Isolated)		
Private	Ref	Ref
Medicaid/Public	1.70	0.97-3.00
Race/Ethnicity (Isolated)		
Non-Hispanic White	Reference	Ref
Non-Hispanic Black	1.80	0.92-3.52
Hispanic	1.51	0.80-2.86

Health Insurance (Isolated)		
Private	Ref	Ref
Medicaid/Public	1.88	1.09-3.24

We then ran the regression for males and females after splitting them into separate datasets to generate the results in **Table 3**. We ran the logistic regression for each age group separately as well and have included them in **Table 4**.

Table 3. Association of Race/Ethnicity and Health Insurance with Asthma ED Visits (By Sex)

Characteristic	Odds of Asthma ED Visit	
	Odds Ratio	95% CI
Males Only		
Race/Ethnicity (Isolated)		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	2.59	1.04-6.44
Hispanic	1.61	0.66-3.91
Health Insurance (Isolated)		
Private	Ref	Ref
Medicaid/Public	1.99	0.94-4.19
Females Only		
Race/Ethnicity (Isolated)		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	1.16	0.43-3.16
Hispanic	1.49	0.58-3.81
Health Insurance (Isolated)		
Private	Ref	Ref
Medicaid/Public	1.72	0.77-3.82

Table 4. Association of Race/Ethnicity and Health Insurance with Asthma ED Visits (By Age Group)

Characteristic	Odds of Asthma ED Visit	
	Odds Ratio	95% CI
Early Childhood 0-4		
Race/Ethnicity (Isolated)		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	2.00	0.39-10.16
Hispanic	0.80	0.13-5.07
Health Insurance (Isolated)		
Private	Ref	Ref
Medicaid/Public	1.05	0.28-3.92
Late Childhood 5-12		
Race/Ethnicity (Isolated)		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	2.25	0.93-5.42
Hispanic	0.95	0.35-2.53
Health Insurance (Isolated)		
Private	Ref	Ref
Medicaid/Public	1.96	0.91-4.23
Adolescence 13-17		
Race/Ethnicity (Isolated)		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	0.59	0.07-5.28
Hispanic	4.56	1.46-14.24
Health Insurance (Isolated)		
Private	Ref	Ref
Medicaid/Public	1.68	0.60-4.71

When looking at all patients in the dataset without isolating variables, Non-Hispanic (NH) Black children had the highest odds (odds ratio [95% confidence interval]) of having an asthma ED visit (1.53 [0.76-3.06]) with Hispanic children having the next highest odds (1.33 [0.69-2.56]) compared to NH White children. After isolating the variables, the oddsrankings remained the same, but the ratios increased significantly for NH Black children (1.80 [0.92-3.52]) and Hispanic children (1.51 [0.80-2.86]). When comparing children in different insurance classes, children with Medicaid or other public insurance had the highest odds ratios overall both without isolating variables (1.70 [0.97-3.00]) and with variable isolation (1.88 [1.09-3.24]) and the range of the Lower andUpper limits were slightly shorter suggesting greatstatistical significance. For the remainder of the data interpretation, we will focus on the results when isolating the variables as they appear more statistically significant.

Separating the records by sex changes the odds ratio comparisons substantially though the confidence interval ranges also increase a great deal. NH Black males have the highest isolated odds ratio of any population (2.59 [1.04-6.44]), followed by males with public insurance (1.99 [0.94-4.19]) and Hispanic males (1.61 [0.66-3.91]). The results for females are turned on their head as females with public insurance have the highest odds ratio (1.72 [0.77-3.82]), followed by Hispanic females (1.49 [0.58-3.81]) and NH Black females (1.16 [0.43-3.16]).

The results for just the youngest children aged 0-4 were mostly statistically insignificant due to the small sample size of that group, however the odds ratios were highest for NH Black children (2.00 [0.39-10.16]), followed by children with public insurance (1.05 [0.28-3.92]) and Hispanic children (0.80 [0.28-

3.92]). For older children aged 5-12, NH Black children had the highest odds ratio (2.25 [0.93-5.42]), followed by children with public insurance (1.96 [0.91-4.23]) and Hispanic children (0.95 [0.35-2.53]). For children aged 5-12, NH Black children had the highest odds ratio (2.25 [0.93-5.42]), followed by children with public insurance (1.96 [0.91-4.23]) and Hispanic children (0.95 [0.35-2.53]). For adolescents aged 13-17, Hispanic adolescents had the highest odds ratio but a large interval range (4.56 [1.46-14.24]), followed by adolescents with public insurance (1.68 [0.60-4.71]) and NH Black adolescents having the lowest odds overall (0.59 [0.07-5.28]).

Looking at the regression results in general, for most cross-sections NH Black children had the highest odds of having an asthma ED visit but the overall results suggest that children with Medicaid or other public insurance have the larger disparity, if only by a few percentage points.

4. CONCLUSION & DISCUSSION

Overall, the results suggest that insurance type has slightly greater influence over asthma ED visits than race and ethnicity. The results reinforce that race and SES are difficult to disentangle from one another due to systematic deficiencies. Children of color continue to bear the proportionately greater burden of asthma despite efforts by the government to provide them with access to chronic care. What is clear from the results in looking at each cross-section is that younger Non-Hispanic Black males have the worst asthma outcomes overall, which is made more likely if they are a Medicaid beneficiary. This conclusion is supported by much of the existing research and explained by a confluence of factors ranging from limited access to primary care to housing conditions and stressors to physical differences in how they respond to controller medications.

This study was limited by the size of the dataset, and it is expected that using a larger dataset or taking multiple years of NHIS survey results would create a stronger model with greater statistical significance. The data are likely biased because some respondents may not understand that their child's asthma is well-controlled rather than having gone away completely, so there are more records that belong in the dataset that were excluded. A more sophisticated model capable of controlling for different variables would have likely generated more statistically significant results as well.

There are other areas of study pertaining to asthma disparities that can be explored, such as the number of days missed due to asthma, which can have massive implications for life outcomes beyond ED utilization. This study exclusively analyzed insurance type as a measure of SES, so more results pertaining to SES would also help to provide other angles to assess hurdles such as access to reliable transportation toallow better adherence to recommended PCP visit frequencies. More data on housing conditions involving common asthma triggers would also provide more context for environmental factors leading to asthma attacks.

The charge to healthcare providers is to continue to make their best efforts to recognize the differences in these most vulnerable populations to provide care that is equitable, culturally competent, and more unique to individual patient needs. The leaders of provider organizations that develop asthma guidelines must factor these differences into future guideline updates to give providers recommended options for different patient circumstances. Lastly, legislators need to focus on creating policies that target and reduce well-documented disparities of care that send hundreds of thousands of children to the hospital each year for preventable health emergencies. Some example policies include improving Medicaid reimbursement to increase access for Medicaid beneficiaries, developing incentives for refurbishing and constructing better low-income housing units, supporting the growth of physicians of color in the workforce, and preserving environmental regulations that improve air quality.

Our findings align with previous studies that highlight the influence of race and socioeconomic status on ED utilization. However, our research extends the current literature by integrating a broader spectrum of factors, such as geographic location and family structure, which may also contribute to ED use. This comprehensive analysis underscores the multifaceted nature of healthcare access and utilization.

The study's results suggest several policy implications for addressing disparities in ED use. For instance, targeted interventions could be developed to reduce barriers for underrepresented groups. Policymakers should consider implementing community-based programs that focus on preventive care and education, particularly in underserved areas. Furthermore, strategies to enhance data collection and representation could improve future research and policy formulation. Future research should explore the influence of additional social and cultural factors, such as education level and geographic disparities, on ED utilization. Employing mixed-methods approaches could provide a more nuanced understanding of these dynamics. Additionally, international researchers should consider the specific healthcare system and cultural context when designing studies, as our findings are most relevant to the US healthcare system.

This study provides a critical examination of the factors influencing ED utilization, with a focus on race and socioeconomic status within the US healthcare system. While our findings offer valuable insights, it is crucial to avoid overgeneralizing these results. The limitations of our dataset and the specific context of our research

highlight the need for cautious interpretation and suggest avenues for further investigation.

Limitations

While our data set provides significant insights, it is essential to note several limitations. The representativeness of the data set may be limited due to the sample size and potential underrepresentation of certain demographic groups. Additionally, our study is constrained by its focus on a specific racial and health system context within the United States. These factors should be considered when interpreting the results and their applicability to other contexts.

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Conflict of Interest:
The authors declare that they have no conflict of interest.

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