Chapter 4
Disparity in Access to Care and Its Impact on Diagnosis and Outcomes of Allergic Diseases

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Introduction

Allergic diseases comprise a significant cause of morbidity worldwide and a considerable burden on the health and medical systems [1]. Allergies affect a third of the population and their prevalence is increasing globally [2–4]. However, there are millions of people worldwide who do not have access to care by allergy specialists [2]. Moreover, epinephrine auto-injectors (EAIs), allergen-specific immunotherapy, and new biologic drugs are not available in many parts of the world. Even in affluent populations, there are enormous inequalities in access to allergic care. Health disparities are breaches in the quality of health and health care across racial, ethnic, and socioeconomic groups. Access to health care is strongly associated with socioeconomic features, including income, education, and employment [5–7]. There are even more restrictions for access to health care among racial and ethnic minorities. Ethnic and socioeconomic disparities in access to care in allergy practice are the result of multiple factors working at the individual and community levels. Disparities in access to appropriate medical care could result in different outcomes among specific groups [8, 9]. Much research has been conducted to understand allergic disease disparities considering access to care and its consequences. In this chapter, we will discuss these differential outcomes linked to access to care in multiple allergic diseases including asthma, food allergy, atopic dermatitis, and hymenoptera (stinging insects) allergy.

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Asthma Outcomes

Asthma is a common chronic lung disease affecting more than 8% of the adult and nearly 10% of the pediatric population of the United States [10]. Extensive evidence documents the significant differences in asthma prevalence by age, sex, race/ethnicity, and socioeconomic status (SES) [11–16]. The emergence of disparities in access to care and its health outcomes has been the topic of several studies during the last two decades (Table 4.1).

Table 4.1 Studies evaluating disparities in access to care and its outcomes among asthmatics during the last two decades

Study	Population	No	Outcome measures	Reported findings
Grant et al. [69]	5–34 years NCHS data for mortality 1991–1996	–	Asthma annual mortality rates	Higher standardized mortality ratios were seen for blacks vs whites (3.34 vs 0.65), low vs high educational level (1.51 vs 0.69), and low vs high income (1.46 vs 0.71)
Lieu et al. [37]	Children, the American Academy of Pediatrics (AAP) Children's Health Survey for Asthma	1658	Several asthma outcomes	After adjusting for sociodemographic variables and asthma status, black and Latino children were less likely to be using inhaled anti-inflammatory medication than white children
Cabana et al. [27]	<18 year children with asthma enrolled in a university-based managed care organization 1998–2000	3163	Receiving care from specialist	Compared with Medicaid patients, both non-Medicaid patients with copayment (OR, 2.52; 95% CI, 1.85–4.43) and non-Medicaid patients without any copayment (OR, 3.40; 95% CI, 2.35–4.93) were more likely to receive care from an asthma subspecialist
Boudreaux et al. [47]	Adult asthmatics from Multicenter Airway Research Collaboration (MARC) 1996–1998	1847	ED rates ED management Hospitalization rates	Black and Hispanic asthma patients had a history of more hospitalizations than did whites (ever-hospitalized patients: Black, 66%; Hispanic, 63%; white, 54%; $P < 0.001$; patients hospitalized in the past year: Black, 31%; Hispanic, 33%; white, 25%; $P < 0.05$) and more frequent ED use (median use in past year: Black, three visits; Hispanic, three visits; white, one visit; $P < 0.001$)

Table 4.1 (continued)

Study	Population	No	Outcome measures	Reported findings
Gupta et al. [67]	5–34 years National Hospital Discharge Survey and the US vital statistics system 1980–2002	–	Hospitalizations Mortality	For children, there have been notable increases in asthma B/W differences in hospitalizations and mortality since 1980, whereas for adults, the increase has been smaller
Ferris et al. [32]	National Ambulatory Medical Care Surveys (NAMCS)	3671	ICS usage	Minority patients with asthma were less than half as likely as nonminority patients to have had a steroid MDI prescribed during 1989–1990. By 1995–1996, minority and nonminority patients with asthma were equally likely to have had a steroid MDI prescribed. Although differences between black and white patients resolved, differences between white and Hispanic patients persisted even after adjusting for insurance
Kruse et al. [44]	Children 1–19 years Asthma ED and hospitalization rates in New Jersey 2004 and 2005	37,216	ED rates, ED admissions and hospitalization rates	ED rates among black NH children were 3.4 times higher and almost twice as high among Hispanic children compared to white NH children. Hospitalization rates were 3.3 times higher among black NH children and 1.9 times higher among Hispanic children compared to white NH children. The ED and hospitalization rates were highest among the youngest children (ages 1–4)
Peters et al. [51]	Adults, TENOR 2001–2003	1315	HCU, defined as ED visits and/or hospitalization	Medicaid insurance is not associated with increased HCU in patients with severe asthma once demographic factors have been taken into account but remains modestly associated with poorer asthma control

Table 4.1 (continued)

Study	Population	No	Outcome measures	Reported findings
Stingone and Claudio [20]	5–12 years 2002–2003	5250	Allergy testing	The frequency of a reported allergy diagnosis varied with race/ethnicity, ranging from 14.4% in Mexican American children to 67.9% in white children. Only 54.9% of asthmatic children with an allergy diagnosis reported allergy testing. Children from lower-/middle-income households and children with public forms of health insurance were the least likely to report testing (adjusted ORs, 0.18 and 0.46)
Ginde et al. [43]	Data from the National Hospital Ambulatory Medical Care Survey 1993–2005	6850	ED visits	The overall asthma-related ED visit rate per 1000 US population was highest among the following groups: age <10 years (13), women (7.2), black subjects (19), Hispanic subjects (7.1), and subjects in the Northeast (9.2)
Haselkorn et al. [72]	≥18 years TENOR study 2001–2004	2128	Multiple asthma outcomes in severe-to-treat asthma	Blacks were more likely to have severe asthma and to be treated with 3 or more long-term controllers. Poorer quality of life, more asthma control problems, and higher risk of emergency department visits were observed in blacks compared with whites
Chandra et al. [60]	Children and adults hospitalized with a physician diagnosis of acute asthma at 30 hospitals in 22 US states	1232	Inpatient care and discharge plan	There were no significant racial/ethnic differences in the choice of inpatient medications or length of stay among either children or adults. At hospital discharge, Hispanic children were less likely to receive an asthma action plan (37%) compared to white children (60%) or black children (63%; $P < 0.001$)
Stingone and Claudio [38]	Children A parent-report survey conducted in 26 randomly selected New York City public elementary schools	912	Usage of long-term controller medication	Children of Spanish-speaking parents, African American children, and children with no health insurance were the least likely to use long-term control medication (ORs: 0.51, 0.49, 0.20, respectively)

Table 4.1 (continued)

Study	Population	No	Outcome measures	Reported findings
Gorman and Chu [9]	Adults Behavioral Risk Factor Surveillance System [BRFSS] 2004	133,509	Four measures of asthma-related medical care	Considerable racial/ethnic differences in asthma-related problems and medical care are also present, with Asians doing as well or better than whites, while blacks, Hispanics, and especially Native Americans report more asthma-related problems and medical care use
Roy et al. [49]	Data from the Mississippi Asthma Surveillance System 2003–2005	4242	Asthma hospitalization risk factors	Asthma hospitalization rates were significantly higher among all demographic groups in the rural Delta region compared with the urban Jackson Metropolitan Statistical Area ($P < 0.001$). In both regions, hospitalization rates were higher among blacks and females ($P < 0.001$) Asthma hospitalization rates were highest among children (0–17 years) and older adults (>65 years). In both regions, blacks were more likely to have three or more asthma hospitalizations ($P < 0.001$). Residents of the Delta had higher odds for multiple hospitalizations controlling for race, sex, age, and household income ($P < 0.05$)
Galbraith et al. [35]	Children with persistent asthma	563	ICS prescription	No racial differences in ICS prescription Children with persistent asthma are less likely to receive inhaled steroids if they receive care in community health centers or hospital clinics
Piper et al. [29]	0–17 years National Health Interview Survey (NHIS) 2000	1630	Utilization of health-care services	It was found that black children were highly associated with not visiting a general doctor in the past 12 months (OR 0.47; 95% CI 0.30, 0.75). Uninsured asthmatic children were associated with the risk of not seeing a general doctor in the past 12 months (OR 0.40; 95% CI 0.23, 0.69)

Table 4.1 (continued)

Study	Population	No	Outcome measures	Reported findings
Piper et al. [23]	<18 years National Health Interview Survey 2002–2003	3102	Having an asthma management plan	Whites were significantly more likely than non-Hispanic blacks and Hispanics to have an asthma management plan (OR, 1.66; $P = 0.0031$). In this study, children who reported Children's Health Insurance Program (CHIP) coverage were twice as likely to have an asthma management plan (OR, 2.67; $P = 0.0004$)
Largent et al. [16]	Children 0–14 years living in Orange County 2000–2007	–	ED visits Hospital admissions	Rates of asthma hospital admissions and ED visits were highest among children aged 0–14 years, males, and African Americans and lowest among Asian/Pacific islanders Rates of hospital admissions and ED visits were significantly higher in low-SES groups
Gold et al. [73]	12-year-old asthmatics Asthma Insights and Management (AIM) survey 2009	2493	Asthma control	Having lower annual income was associated with asthma that was classified as partly or uncontrolled. Additionally, subjects/parents who owned their own homes and who were employed had higher rates of well-controlled asthma compared to subjects/parents who did not own their own homes or who were unemployed at the time of the survey. Having a high-school education or less was associated with asthma that was classified as uncontrolled. Finally, not having health insurance was associated with uncontrolled asthma compared to patients who did not have health insurance; similarly, having little or no trouble paying for health-related expenses was associated with well-controlled asthma

Table 4.1 (continued)

Study	Population	No	Outcome measures	Reported findings
Akinbami et al. [66]	0–17 years NCHS data 2001–2010	–	Trends in asthma outcomes: Asthma attack prevalence ED rates Hospitalizations deaths	Analysis with at-risk rates, which account for differences in asthma prevalence, showed that disparities in asthma outcomes remained stable (deaths), decreased (ED visits, hospitalizations), or did not exist (asthma attack prevalence)
Venkat et al. [61]	18–54 years old adults from Multicenter Airway Research Collaboration (MARC) study, 2011–2012	1785	ED care utilization	Non-Hispanic blacks with increased chronic asthma severity were only as likely ($P > 0.05$) as non-Hispanic whites or Hispanics to utilize controller medications or see asthma specialists before ED presentation and to be prescribed recommended inhaled corticosteroids at ED discharge.
Kharat et al. [34]	>4 years asthmatics from Medical Expenditure Panel Survey (MEPS) data 2009	1469	ICS prescription	Hispanic patients aged 18 years or older had 43% lower odds (OR, 0.6; 95% CI, 0.3–0.9) of having a receipt of an ICS prescription compared with non-Hispanic white patients, independent of other factors. There was no significant difference in receipt of an ICS prescription between Hispanic and non-Hispanic white children with asthma (aged 4–17 years)
Mitchell et al. [31]	Children Patient registry data from Baltimore, Maryland 2007–2010	273	Five morbidity outcomes: Hospitalization ICU admission FEV1, FEV1/FVC Asthma control	African American patients had worse asthma morbidity than their white counterparts, including higher rates of ICU admission, worse asthma control, and poorer lung function as indicated by lower FEV_1

Table 4.1 (continued)

Study	Population	No	Outcome measures	Reported findings
Glick et al. [55]	2–18 years US Nationwide Inpatient Sample 2007–2011	97,379	Mortality LOS Total costs	Native American race, older age (13–18 years), and West region were significant independent predictors of mortality. Intubation rate was lower in Hispanic compared with white children ($P = 0.028$). LOS was shorter in Asian compared with white children ($P = 0.022$) but longer in children with public insurance and from low-income areas ($P < 0.001$). Average costs were higher in black, Hispanic, and Asian compared with white children ($P < 0.05$)
Beck et al. [63]	1–16 years Greater Cincinnati Asthma Risk Study cohort	695	Time to asthma-related readmission	African American children were 2.26 times more likely to be readmitted than white children (95% CI, 1.56–3.26). The addition of biologic, environmental, disease management, and access variables resulted in 80% of the readmission disparity being explained
Silber et al. [52]	3–18 years Medicaid Analytic eXtract (MAX) database 2009–2010	11,079 pairs	Revisits, readmissions, LOS, and ICU use	Ten-day revisit rates were 3.8% in black patients versus 4.2% in white patients ($P = 0.12$); 30-day revisit and readmission rates were also not significantly different by race (10.5% in black patients versus 10.8% in white patients; $P = 0.49$). LOS was also similar However, ICU use was higher in black patients than white patients (22.2% versus 17.5%; $P < 0.001$)
Zhang et al. [45]	2–17 years Asthma Call-Back Survey (ACBS) in 2006–2010	5535	ED visits	Minority children with current asthma had higher risks of ED visits compared with white children in 2009 and 2010, e.g., the prevalence ratio (PR) (95% CI) for black children in 2009 was 3.64 (1.79, 7.41)

Table 4.1 (continued)

Study	Population	No	Outcome measures	Reported findings
Franklin et al. [48]	6–17-year-old children with persistent asthma lived in metropolitan Atlanta, Georgia 2016	276	Predictors of ED visit	ED use was disproportionately higher in black (38.7%) vs white (26.1%) children ($P = 0.04$) and children with public (40.4%) vs private (23.4%) insurance ($P = 0.005$), irrespective of race In white children, an ED visit in the previous year and sensitization to dust mites and pets were associated with ED use during the study period. White children were also more likely than black children to report having a cat (27.5% vs 9.5%, $P = 0.001$) or dog (58.2% vs 34.3%, $P < 0.001$) inside the home. However, in black children, the variables associated with ED use during the study period included an ED visit in the previous year, the number of asthma controller medications, FEV1 less than 80% predicted, blood eosinophil count greater than 4%, and mold sensitization
Trent et al. [62]	Random sample of 2–54 years old asthmatics from Multicenter Airway Research Collaboration (MARC) 2011–2012	913	Provision of guideline-concordant asthma care in the hospital and after discharge	NHB children were significantly less likely to receive a written asthma action plan (OR 0.48; 95% CI 0.31–0.76) than NHW children. In contrast, among adults, we found no statistically significant difference in the provision of asthma action plan. Additionally, we found no difference in the provision of a new inhaled corticosteroid prescription or referral to asthma specialist among children or adults

Table 4.1 (continued)

Study	Population	No	Outcome measures	Reported findings
Hughes et al. [50]	6–17 years American Housing Survey 2011	33,201	ED visits	Non-Hispanic black heads of household had a higher odds of having a child diagnosed with asthma in the home in comparison to non-Hispanic white heads of household (OR 1.72, 95%CI 1.50–1.96), and a higher odds of ED visits for asthma (OR 3.02, 95%CI 2.29–3.99)
Trivedi et al. [30]	Study of parent surveys of asthmatic children within the Population-Based Effectiveness in Asthma and Lung Diseases Network 2011	647	Family-provider interactions	Black children had fewer visits in the previous 12 months for asthma than white children: OR 0.63 (95% CI 0.40, 0.99). Additionally, black children were less likely to have a written asthma treatment plan given/reviewed by a provider than their white peers, OR 0.44 (95% CI 0.26, 0.75)
Washington et al. [8]	8–15 years Chicago Initiative to Raise ASTHMA Health Equity (CHIRAH) cohort	544	Several asthma outcomes	African American race and Hispanic/Latino ethnicity were significantly associated with all outcomes when compared to whites. Adjusting for sociodemographic factors resulted in the most significant mediation of racial/ethnic disparities in all outcomes
Guilbert et al. [71]	6–11 years The Epidemiology and Natural History of Asthma: Outcomes and Treatment Regimens (TENOR) 2001–2004	348	Asthma control ED visits Long-term steroid use	Black children had higher geometric mean IgE levels (434.8 vs 136.8 IU/mL; $P < 0.001$), were more likely to have very poorly controlled asthma (72.1% vs 53.4%), use long-term systemic corticosteroids (30.2% vs 9.2%; $P < 0.001$), have poorer quality of life (5.5 vs 6.1; $P < 0.001$), and have an emergency department visit (27.4% vs 7.7%, $P < 0.001$) in the 3 months before month 12. Differences in asthma control and the severity of exacerbations persisted even after accounting for all confounding factors

Table 4.1 (continued)

Study	Population	No	Outcome measures	Reported findings
Zook et al. [46]	2–18-year-old children presented to EDs in the upper Midwest 2011–2012	1755	30-day ED revisits Steroid administration Ordering radiology tests	African American (adjusted OR, 1.78; 95% 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)

B/W, Black/white; *CI*, Confidence interval; *ED*, Emergency department; *HCU*, Health care utilization, *ICS*, Inhaled corticosteroid; *ICU*, Intensive care unit; *LOS*, Length of stay; *MDI*, Metered dose inhaler; *NHB*, non-Hispanic black; *NHW*, non-Hispanic white; *OR*, Odds ratio

Successful asthma management includes proper diagnosis of allergic sensitizations using allergy testing. Allergy testing can be used to tailor allergen avoidance directions and guide some patients to receive immunotherapy [17–19]. These could have beneficial effects on the health outcomes of asthma. However, there is a gap to receive proper allergy diagnosis among different racial and income groups. A study described that Mexican American children, children from lower-/middle-income households, and those with public forms of health insurance were the least likely to report allergy testing [20].

Asthma management plans are an essential component for the long-term treatment of pediatric asthma and beneficial for self-management [21–23]. Having an asthma management plan is also associated with fewer asthmatic episodes [24]. Receipt of specialty care by asthmatic children can affect cost and quality of care and is associated with substantial reductions in asthma emergency department (ED) visits and hospitalizations [25, 26]. Poor and Medicaid-covered children have significantly lower odds of receiving asthma subspecialty care [27, 28].

Racial disparities exist in access to health-care services among asthmatic children. Black children with asthma are seen less frequently by asthma providers and are less likely to have a written asthma treatment plan reviewed than white children with asthma. This can impact the morbidity gap between black and white asthmatic children [29–31]. Moreover, uninsured asthmatic children are less likely to visit a doctor and receive preventive care [23, 29]. Another important factor is whether there are racial disparities related to asthma decision-making during outpatient visits [30]. Inhaled corticosteroids (ICS) are the most efficient controller medications for patients who have persistent asthma [32]. Studies assessing ICS usage among racial minorities have reported conflicting results. Some studies described that black and Hispanic patients are less likely to receive a prescription for ICS [33, 34]. However, other studies did not find a significant racial difference in receiving an ICS prescription [35].The disparity in receipt of ICS prescriptions might also be

attributed to racial differences in health beliefs and fears about steroids [36]. Moreover, younger asthmatics are less likely to receive a prescription for ICS medications [33, 34]. Insured patients have higher odds of having a receipt of an ICS prescription compared with uninsured patients [34, 37, 38].

Poor asthma control is associated with increased ED visits, hospital admissions, and significant medical costs [39]. Asthma-related ED visits present a measure of the asthma burden and morbidity [40]. ED visits add significantly to the financial burden of asthma, costing as much as five times more per visit than outpatient office visits for asthma [41, 42].

There is growing evidence of the presence of racial disparities in ED visits and hospitalization rates among patients with asthma in all age groups with more ED rates and inpatient admissions documented for minority groups [43–46]. ED rates and hospitalizations are higher among black non-Hispanic and Hispanic children compared to white non-Hispanic children [44, 45, 47–50]. Extremes of age are also risk factors for more frequent asthma-related ED rates [43, 44, 49]. Gender disparities reported being different in various studies. ED visits and hospitalizations are more common for females in Mississippi but less common for females living in Orange County [16, 49]. Living in rural and some geographical areas produces a gap in ED rates as well [43, 49]. ED rates and hospital admissions are higher among asthmatics who are not insured or use public insurances than those who have private insurances [16, 48].

Analysis of data from large observational TENOR (The Epidemiology and Natural History of Asthma: Outcomes and Treatment Regimens) study showed that Medicaid insurance is not associated with increased health-care utilization in patients with severe asthma once demographic factors have been taken into account but remains modestly associated with poorer asthma control [51]. Interestingly, in patients with Medicaid, race does not influence revisits, readmissions, or deaths, and blacks are found to have only a small, but significant, difference in ICU use [52].

Some factors may explain the disparities in asthma-related ED visits [45]. Patients with different sociodemographic factors may have variable exposure to environmental risks, such as living in households with poor air quality [53, 54]. The other possible explanation is a disparity in access to health care across race/ethnicity [55, 56].

Even with equal access to health care, the underlying health beliefs, attitudes, and educational level may trigger different health-care usage behaviors among patients and/or caregivers [57, 58].

Background socioeconomic factors also contribute to ED rate disparities. For example, there is an inverse relationship between income levels and ED visits among adults with asthma [12, 59]. Despite declining trends of pediatric asthma ED visits and hospitalizations, these rates are significantly higher in children living in low-SES areas [16].

Despite inequities in ED rates, the quality of care for a patient seen in the ED for asthma and the decision to admit the patient are the same regardless of race/ethnicity [44].

ED admission rates are similar across race/ethnicity groups. However, there are differences in the diagnostic and therapeutic interventions [44, 47, 60, 61]. In the ED setting, children from minority racial/ethnic groups were more likely to receive steroids and less likely to receive radiology tests than white children [46].

Another significant disparity in asthma care is the provision of the discharge plan, provision of a new prescription of an ICS, and referral to an asthma specialist. Non-Hispanic black and Hispanic children are significantly less likely to receive a written asthma action plan than non-Hispanic white children [60, 62]. After asthma-related ED admission, African American children are more likely to be readmitted than white children. However, up to 80% of this disparity is explained by biologic, environmental, disease management, and access to care variables [63, 64].

Adverse asthma outcomes, such as hospitalization and death, are mostly preventable, but rates are higher among some minority children than among white children [65–68].

Racial/ethnic disparities in asthma mortality rates are well described [69, 70]. Black and Native American races are independent risk factors of asthma mortality in different studies [55, 66, 67, 69]. Low SES is also contributing to asthma mortality independent of race [69].

A recent study analyzing US Nationwide Inpatient Samples for 2007–2011 studied factors associated with mortality and morbidity in children hospitalized for asthma [55]. Native American race, older age (13–18 years), and the West region were significant independent predictors of mortality. Hospital length of stay was shorter in Asian compared with white children but longer in children with public insurance and from low-income areas. The average costs were lower in white children compared with other ethnicities.

A large study on national datasets from the National Center for Health Statistics (NCHS) disclosed that population-based rates show stable or increasing racial disparities in asthma outcome. However at-risk rates which account for differences in asthma prevalence show stable mortalities and decreasing ED rates and hospitalizations gaps during recent years [66]. The TENOR study documented worse outcome measures in black patients compared with whites in both children and adults. Black asthmatics were more likely to have very poorly controlled asthma, use long-term systemic corticosteroids/several controllers, and have a more inferior quality of life [71, 72]. Using a large population of US asthma patients, Asthma Insights and Management (AIM) study demonstrated that poorly controlled asthma was strongly associated with indicators of low SES [73].

Differences in asthma-related health outcomes in different racial groups despite accounting for the demographic features and SES substantiate the role of other factors such as physiologic differences and pharmacogenetics [66, 71]. Ancestry seems significantly associated with lung function; African Americans have smaller lung function compared with whites [74]. Moreover, black subjects with asthma have been shown to require higher concentrations of glucocorticoid to suppress the activation of T-lymphocytes, suggesting that black subjects have a racial predisposition to reduced glucocorticoid response [75].

Food Allergy Outcomes

Childhood food allergy (FA) is a significant public health issue resulting in relatively high rates of severe allergic reactions and ED visits [76].

Recent large-scale epidemiologic studies suggest that there may be higher rates of FA in some ethnic/racial groups independent of household income or other atopic comorbidities [77–79].

Several studies examined FA-associated hospital admissions or ED events to assess potential ethnic/racial disparities. These studies demonstrated variable results from no ethnic differences to higher rates of food-induced anaphylaxis in black children [80–84].

Potential racial disparities exist in access to care which may create underdiagnosis/misdiagnosis of a potential FA and may daunt the ability to receive proper care [85]. This could significantly underestimate the rate of FA within certain population segments (Table 4.2).

A large study assessing knowledge about FA among caregivers noted a significant difference in correctly identifying the signs of a reaction, identifying

Table 4.2 Studies evaluating disparities in access to care and its outcomes among patients with food allergy

Study	Population	No	Outcome measures	Reported findings
Hannaway et al. [88]	Students from 3 Massachusetts school districts	21,875	Amount of dispensed EAI among schoolchildren	Males were more likely to be dispensed injectable epinephrine than females (odds ratio [OR], 1.44; $P < 0.02$). Whites were more likely to have been dispensed injectable epinephrine than nonwhites (OR, 4.76; $P < 0.001$)
Soller et al. [90]	Canadian study on the prevalence of FA 2008–2009	105,96	Position of EAI	Individuals with allergy residing in a household where the respondent was married/living with a partner were more likely to have an EAI: Probable group (OR, 3.8; 95% CI, 1.4–9.1) Diagnosed group (OR, 3.6; 95% CI, 1.1–9.4)
Johns and Savage [87]	Data from the 2011–2012 NHIS	26,021	Access to health care and food among subjects with FA	Black respondents with food allergy were significantly more likely to have low food security (OR, 2.15; 95% CI, 1.30–3.53), to have problems paying family medical bills (OR, 1.68; 95% CI, 1.09–2.59), and to have trouble affording prescriptions for the child (OR, 2.40; 95% CI, 1.14–5.05), and Hispanic respondents with food allergy were significantly more likely to have trouble affording follow-up care (OR, 3.02; 95% CI, 1.34–6.81 compared with white respondents with food allergy

Table 4.2 (continued)

Study	Population	No	Outcome measures	Reported findings
Shah et al. [89]	Students from 89 HISD schools 2010–2011 school year	69,310	Presence of EAI in school	When considered simultaneously, both SES ($P < 0.001$) and proficiency of the English language ($P < 0.01$) were found to be independently associated with the number of epinephrine injectors
Szychlinski et al. [91]	Illinois state schools 2012–2013	460 school nurses	School nurses' responses to FA emergencies	Rural schools were least likely to have a written plan or protocol to outline staff procedure in the event of a severe allergic reaction (59.4% of respondents working at rural schools were aware of a written plan or protocol vs 81.7% for suburban vs 71.9% for urban, $P < 0.0019$). Additionally, rural schools were least likely to report undesignated epinephrine policies (35.6% of rural, 47.5% of suburban, and 64.0% of urban schools, $P < 0.005$)
Bilaver et al. [92]	US caregivers with a food allergic child 2011–2012	1643	Economic impacts of FA	Children in the lowest-income stratum incurred 2.5 times the amount of emergency department and hospitalization costs as a result of their food allergy than higher-income children ($1021, SE ± $209, vs $416, SE ± $94; $P < 0.05$). Costs incurred for specialist visits were lower in the lowest-income group ($228, SE ± $21) compared with the highest income group ($311, SE ± $18; $P < 0.01$) as was spending on out-of-pocket medication costs ($117, SE ± $26, lowest income; $366, SE ± $44, highest income; $P < 0.001$)
Mahdavinia et al. [79]	2 FA patient cohorts followed at RUMC and CCHMC	717	Disease phenotype and disparities in health-care utilization	55%, 18%, and 11% of African American, Hispanic, and white children were covered by Medicaid, respectively ($P < 0.00001$). Compared with whites, African American and Hispanic children had a shorter duration of follow-up for FA with an allergy specialist and higher rates of FA-related anaphylaxis and ED visits ($P < 0.01$)

CCHMC, Cincinnati Children's Hospital Medical Center; *CI*, confidence interval; *EAI*, Epinephrine auto-injector; *FA*, Food allergy; *HISD*, Houston Independent School District; *OR*, Odds ratio; *RUMC*, Rush University Medical Center; *SE*, Standard error; *SES*, Socioeconomic status

FA triggers, and recognizing the need for food avoidance in parents of different races [86]. Another national study showed that parents of black children had significantly lower odds of receiving a formal diagnosis of FA by a physician [76].

Recent studies suggest there might be a barrier to accessing health care and food in children with FA, particularly among nonwhite children. Poor access to health care and food might increase morbidity, especially among minority children, by imposing poor nutrition and delayed treatment for allergic reactions.

A US large national survey examined access to health care and food among subjects with FA [87]. Even after adjusting for income and education, black respondents with FA were significantly more likely to report low food security and trouble affording prescriptions, and Hispanic respondents with FA were significantly more likely to report trouble affording follow-up care compared with white respondents.

There is a need to apply strategies to provide better access to outpatient specialist care for all children with FA, especially those from lower income families with lower access to care [85]. Some studies evaluate the possession and usage of EAI as an indicator of access to care for severe FA reactions. It seems that there are socioeconomic, gender, racial, and geographical inequities in access to EAI.

A study of Massachusetts school students showed that white schoolchildren were six times more likely to be dispensed EAIs than all other races [88]. Moreover, males were more likely to be dispensed injectable epinephrine than females.

Another study conducted in the Houston independent school district (HISD) showed both socioeconomic status and proficiency of the English language to be independently associated with the availability of EAIs in schools [89].

A Canadian national study demonstrated that individuals with allergy residing in a household where the respondent was living with a partner were more likely to have EAIs. Furthermore, children and females were more likely to have an EAI [90].

A study conducted in Illinois schools uncovered geographical disparity in the implementation of FA guidelines and access to undesignated epinephrine [91]. Nurses from rural schools reported the least experience with FA reactions and were least likely to recall a written policy for handling of FA emergencies.

Finally, the disparity in health-care utilization depicted as access to insurances and the availability of specialty care endanger children with FA from some minority groups.

Low-income children experience higher costs for ED visits and hospitalization and spend less on specialty care [92]. Compared with whites, African Americans and Hispanic children with a higher rate of Medicaid coverage have a shorter duration of follow-up for FA with a specialist and higher rates of FA-related anaphylaxis and ED visits [79].

Atopic Dermatitis

Atopic dermatitis (AD) is a chronic inflammatory skin condition that classically develops during infancy and early childhood. AD occurs worldwide with different prevalence, showing higher rates in Africa and Oceania, as opposed to India and Northern and Eastern Europe [93].

In the United States, AD prevalence is higher in African American (AA) children compared to European American (EA) children. AA children are three times more likely to be diagnosed with AD during a dermatologist visit; however, they are less likely to seek dermatological care [94, 95]. The association between race/ethnicity and AD persistence is limited and shows conflicting results [96, 97]. Results of a recent American cohort demonstrate that compared with non-Hispanic whites, Hispanics and non-Hispanic blacks with early childhood AD are more likely to have persistent disease into mid-childhood [98].

Considering access to medical care, non-Hispanic black children show low rates of overall health-care use for AD, but more outpatient visits and prescriptions for AD, suggesting a greater disease severity [99].

In the American population, ED visits for dermatological care are more often seen in black and Hispanic patients compared with white patients [100]. Moreover, hospitalization for AD and increased costs are more likely to occur in patients with nonwhite race/ethnicity, a lower income, and public or no insurance [101]. These differences may be due to the higher prevalence of and more severe AD and/or less access to appropriate outpatient care. Unfortunately, there are little data on the efficacy of conventional therapies for AD in nonwhite ethnic groups [102–104].

Less than 60% of AD clinical trials published between 2000 and 2009 included race and ethnicity as baseline information. Only about 10% of studies considered race or ethnicity in the final interpretation [104].

Emerging ethnic groups with different epidemiologic, clinical, and molecular differences have important, but limited therapeutic cues [94]. Topical anti-inflammatory drugs are the mainstay treatment for AD. There is some concern that the use of topical corticosteroids in darker skin types may worsen hypopigmentation; however, hypopigmentation is more likely related to postinflammatory changes than a medication effect [105]. However, topical calcineurin inhibitors showed no difference in treatment outcome among ethnic groups [106, 107].

Pharmacogenetic and pharmacokinetic differences among various populations may affect the optimal dose and side effects of systemic immunomodulators used in AD [105].

Narrowband (NB)-UVB, which is used in severe AD, requires higher doses in more pigmented skin types [108–110], but UVA1,which is an alternative for treating acute AD, does not require dose adjustments between different skin types [111, 112]. Recent Phase III trials of dupilumab (a fully human monoclonal antibody targeting the shared α-subunit of the IL-4 and IL-13 receptors) in moderate-to-

severe AD showed comparable results among white, black, and Asian individuals [113–115]. These new medications are associated with very high cost and need close access to specialty care. Therefore, differential use of them will inevitably impact the outcome and persistence of AD and could be the underlying cause of the observed disparities in outcome of AD. Furthermore, due to its chronicity and fluctuating symptoms, treatment and outcome of AD are closely linked to support and rapport provided by physicians and health-care providers which is another potential factor impacting the outcome of disease that can be impacted by inequity in health care.

Stinging Insect Allergy

Many adults and children experience systemic reactions to Hymenoptera stings each year.

It is recommended that patients with systemic reactions to venom receive an epinephrine auto-injector and be referred to an allergist [116]. A study showed that males were more likely to have been given epinephrine auto-injector for stinging insect allergy than females [88]. Whites were nearly nine times more likely to have been dispensed EAI than nonwhites. Venom immunotherapy (VIT) by an allergist is indicated for confirmed cases of IgE-mediated systemic reactions to Hymenoptera venom [117]. Recent venom shortage due to a manufacturing delay of a leading supplier had an international impact on VIT practice [118, 119]. There is a potential for the emergence of disparities in access to VIT among different groups under this situation; however, no study has addressed it yet.

Conclusion

Access to equal health care is a prominent and unfair contributor to allergic disease disparities. Racial disparities persist in health-care access and quality of care in multiple settings. Low-income and impoverished populations utilize emergency department facilities more frequently for allergy-related needs as they have lower access to outpatient specialty care; however, this is not optimal care, and the problem goes beyond that. Racial inequalities in the use of urgent care were reported to exist even after controlling for accessibility and socioeconomic factors. This differential health-care utilization has resulted in poor outcome across all allergic conditions.

Effectively addressing disparities in allergy care requires a collective effort that includes the full range of public health and health-care systems. Moreover, it calls for the development and implementation of individualized programs intended to educate affected families considering their cultural and socioeconomic setting.

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