



Health disparities in allergic diseases

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Purpose of review

Healthcare disparities impact prevalence, diagnosis, and management of allergic disease. The purpose of this review is to highlight the most recent evidence of healthcare disparities in allergic conditions to provide healthcare providers with better understanding of the factors contributing to disparities and to provide potential management approaches to address them. This review comes at a time in medicine where it is well documented that disparities exist, but we seek to answer the *Why*, *How* and *What* to do next?

Recent findings

The literature highlights the socioeconomic factors at play including race/ ethnicity, neighborhood, insurance status and income. Management strategies have been implemented with the hopes of mitigating the disparate health outcomes including utilization of school-based health, distribution of educational tools and more inclusive research recruitment.

Summary

The studies included describe the associations between upstream structural and social factors with downstream outcomes and provide ideas that can be recreated at other institutions of how to address them. Focus on research and strategies to mitigate healthcare disparities and improve diverse research participant pools are necessary to improve patient outcomes in the future.

Keywords

allergy, health disparities, research recruitment, social determinants of health, socioeconomic factors, urticaria

Healthcare disparities impact prevalence, diagnosis, and management of allergic disease. Outcomes for allergy patients are directly impacted by these disparities and providers must understand and seek to address the causes for the disparities (Fig. 1). In this review, we discuss the most recent evidence of healthcare disparities in allergic rhinitis, asthma, food allergy, atopic dermatitis, and drug allergy so healthcare providers can better understand and treat disease in allergy patients.

DISPARITIES IN ALLERGIC RHINITIS

Though a common diagnosis affecting one-quarter of the US population, there is a paucity of research on allergic rhinitis morbidity and management in patients with limited English proficiency, from minoritized groups and/or from low-income communities. In a recent study, English-speaking patients were significantly more likely to have been seen by a physician than Spanish-speaking patients [1]. Air quality is also an important factor given exposure to higher levels of air criteria pollutants (carbon monoxide, particulate matter, nitrogen dioxide, sulfur dioxide) impacts asthma control. Children in low-income communities with disproportionately higher exposure to criteria pollutants

experience higher rates of asthma exacerbations [2]. Furthermore, Stern *et al.* [3[•]] reported that minoritized children with allergic rhinitis and asthma had increased odds of missing school and greater odds of hospitalization due to asthma, compared to children without allergic rhinitis.

There are also stark differences in management of allergic rhinitis in these vulnerable communities.

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KEY POINTS

- Disparities exist across the atopic disease spectrum, significantly impacting minoritized patients.
- Common features of healthcare disparities include a correlation of greater allergic disease in populations with lower socioeconomic status and barriers to treatment.
- Lower participation in research and clinical trials has been identified as a contributor to disparities, impairing our understanding of the efficacy of therapies in minoritized populations.
- Effective strategies to address disparities will include mitigation of the barriers to access to care imposed by social determinants of health.

Modi *et al.* [4^{***}] recently published in a population-based database study that significant racial and ethnic disparities in subcutaneous immunotherapy (SCIT) prescriptions for allergic rhinitis were evident after controlling for asthma, atopic dermatitis status, asthma severity, allergic rhinitis type, heart disease diagnosis, or utilization of β -blockers and angiotensin converting enzyme inhibitors (ACEi). Therefore, despite patients of color having higher rates of exposure to air pollutants resulting in more asthma hospitalizations, they are offered less prescriptions for allergic rhinitis and asthma disease-modifying SCIT treatment. These groups are also underrepresented in studies and may have challenges in health literacy, which also further exacerbate their disparities in disease management.

DISPARITIES IN ASTHMA

Understanding the why

Like allergic rhinitis, the disparities that exist in asthma incidence, management and outcomes are the result of a multitude of factors that continue to be the subject of research interest. Many studies have sought to characterize the ethnic disparities that exist regarding asthma incidence and control using genetic testing and -omics techniques. One recent study utilized whole genome sequencing (WGS) to attempt to uncover the potential explanations for how patients of different demographics respond to bronchodilators. While there was no genetic variant identified in Mexican and African-American patients, a bronchodilator response locus for a noncoding RNA was found amongst the Puerto Rican population [5]. Another group also used WGS to uncover nine new variants on African-specific

haplotypes that were associated with severe asthma [6]. In addition to genetic etiologies, the microbiome has also been implicated in asthma development; specifically, *Proteobacteria* is inversely correlated with interleukin (IL)-13, and is associated with shift from Th2 to Th1 immune responses. Using microbiome and transcriptomic analyses of cord blood, a link was identified between low amounts of *Proteobacteria* in cord blood and maternal atopy and increased risk of infant wheezing [7].

The role of socioeconomic status in asthma prevalence

A number of studies have sought to explore the connection between socioeconomic factors and asthma prevalence, with many often reporting that Black and Hispanic children and children from lower income areas have increased risk of developing asthma [8^{***}]. Importantly, Zanobetti *et al.* [8^{***}] noted that the increased rates of asthma persisted for Black and Hispanic patients across various neighborhood socioeconomic statuses (SES). Amongst adolescent athletes, Black individuals make up 65.5% of those with asthma [9]. The aforementioned studies illuminate the role of SES in asthma disparities, which is only supported by another study that found increased odds of an asthma diagnosis amongst adults living in public housing versus home owners [10]. Similarly, survey results obtained during the coronavirus disease 2019 (COVID-19) pandemic uncovered racial and ethnic disparities amongst child-care professionals, such as nannies and daycare workers, with Black, American/Indian Pacific Islander and multiracial workers having higher odds of having asthma than White respondents, whereas Asian respondents had lower odds of asthma than White respondents. The survey also found that nonbinary respondents had higher odds of having asthma than female respondents [11].

What affects asthma exacerbations

Disparities exist not only in the prevalence of asthma, but also in the severity at which different groups are impacted. One study found higher rates of utilization of emergency department (ED) visits and hospitalizations compared to outpatient preventive visits amongst Black children than White children, and amongst children from low- versus high-income neighborhoods [12]. Similarly, hospitalization utilization for a variety of chief complaints including asthma were found to be higher amongst those from lower opportunity neighborhoods (i.e. neighborhoods with worse education, higher poverty and unemployment rates, etc.)

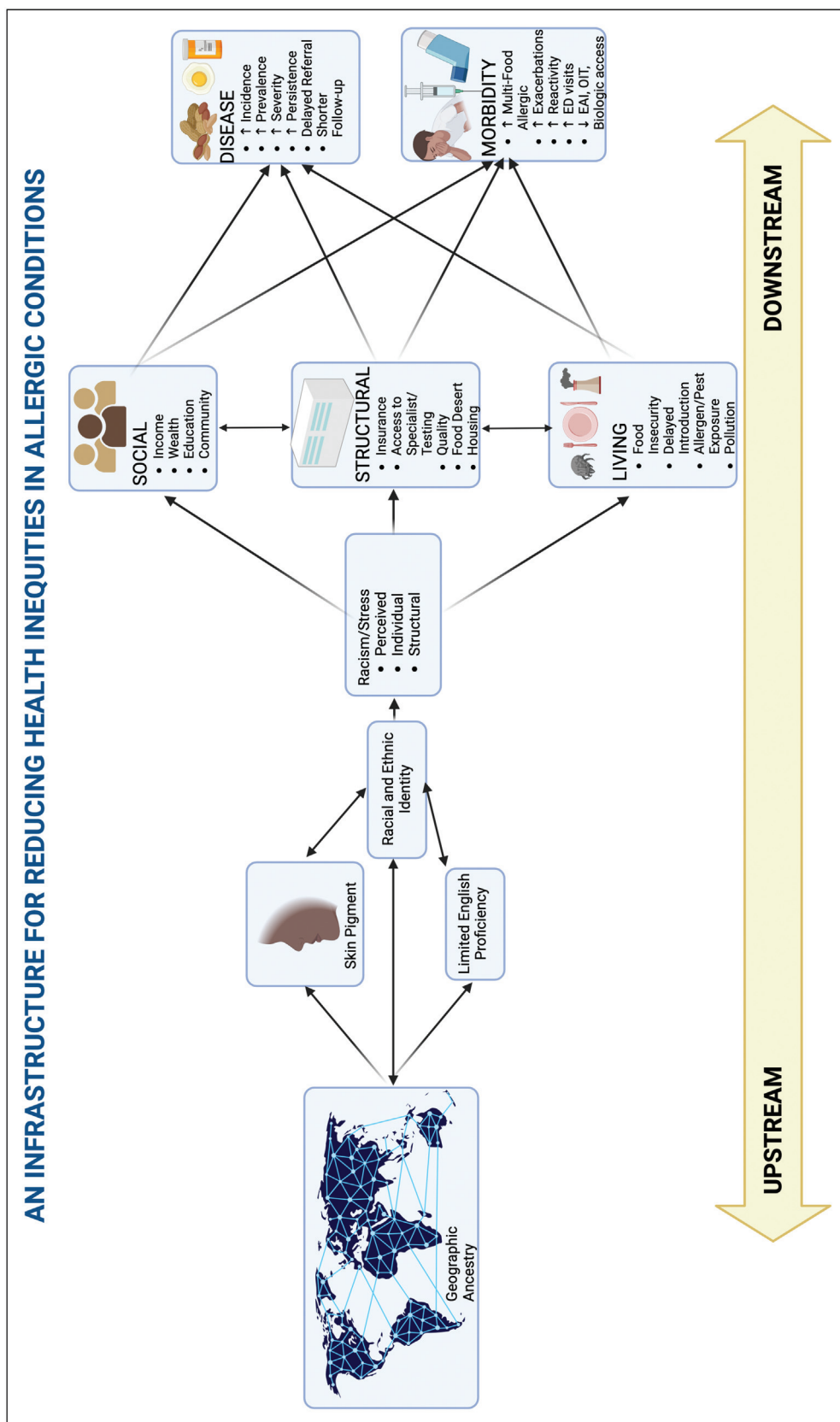


FIGURE 1. An infrastructure for reducing health inequities in Allergic conditions.

regardless of race [13¹¹,14]. Increased rates of asthma-related ED visits amongst Black vs. White patients were found to be mediated by socioeconomic factors, including neighborhood, exposure to air pollutants and allergens and insurance type (i.e. Medicaid versus commercial insurance) [15]. Specifically, one Texas study reported that adult asthma exacerbations were associated with traffic-related pollution, energy drilling activities and decreased greenspace [16]. In addition to the lived space, the learning environment also plays a role in exacerbations. Wu *et al.* [17] found that worse school conditions, defined by variables including ventilation, plumbing and structural integrity, were associated with increased asthma-related hospitalizations, as well as worse school performance in reading and math.

Limited English proficiency can also affect morbidity in asthma. Amongst pediatric patients, males, those between ages 4 and 8, those that were Spanish-speaking and those from low-income backgrounds had increased odds of experiencing asthma-related urgent visits, ED visits or inpatient hospitalizations. Similarly one study found that the Spanish-speaking Hispanic patients were 81% more likely to have an asthma-related ED visit in the past year and asthma-related sleep disturbances in the past month [18¹²].

Management

Contrary to prior studies that have indicated under-prescription of controller medications and less access to biologics for Black patients, a retrospective cohort study of a claims-based database found comparable rates of anti-IL5 agents and higher rates of omalizumab use amongst black patients compared to White patients, but lower rates of anti-IL-5 agents in Hispanic patients [19]. One survey study with over 3000 respondents found that Black children were more likely to have reported receiving an asthma action plan and more likely to have taken a course on asthma management than non-Hispanic white children [20]. Interpreting these findings is difficult, but perhaps they indicate improved efforts to combat the disparities in asthma outcomes.

Regarding management approaches, one study in elementary school-based health centers (SBHC), which typically provide primary care, found that students who utilized SBHCs had significantly less asthma-related ED visits [21¹³]. A study conducted in the UK found a 75% reduction in exacerbations and reduction of maintenance oral corticosteroid dose in 67% of patients that were referred to severe asthma specialists [22]. Another initiative that was trialed included a digital asthma program with sensors on patients' short acting beta-agonist (SABA)

inhalers that provided education and feedback via an app. After using this app, patients relied on SABAs less, with 76% of the patients experiencing more SABA free days [23].

Predictive tools

Asthma medication ratio (AMR) is the ratio of controller medication to total number of asthma medications. One study reported that lower AMR was associated with increased asthma-related ED visits for Hispanic and Black children between ages 5 and 11 in the following 6 and 12 months. However, AMR was not predictive for White and Asian patients [24]. Common asthma prediction tools include Asthma Prediction Index (API) and Pediatric Asthma Risk Score (PARS). Pennington *et al.* [16] found that compared to White participants, PARS was more sensitive and less specific as a predictive tool for Black participants and API was more sensitive as well, suggesting a personalized, tailored approach might improve outcomes in different racial and ethnic populations.

Research recruitment

Health disparities can be mitigated through the inclusion of diverse patient populations in clinical trials. In attempts to diversify research participants, the organization "Black People Like Me" utilized Black clergy, Black doctors and Black patients to organize virtual sessions to discuss opportunities for patient-centered outcomes research and to connect the participants with research opportunities. Pre and posttests demonstrated that participants exhibited growth in knowledge regarding asthma risk, patient-centered outcomes research and research opportunities for patients [25¹⁴]. Another institution used a multipronged approach to recruit research participants more equitably including letters, text messages, phone calls and in-person approaches. The study found that lack of patient access to technology, access to bilingual staff and Spanish language recruitment materials were amongst the several major factors that determined success of enrolment [26].

DISPARITIES IN FOOD ALLERGY

Prevalence

Patients of color have disproportionately high prevalence of food allergy and food-associated anaphylaxis in the US. A recent survey study of ~50 000 households and 110 000 individuals suggested the prevalence of food allergies is highest among Asian,

Hispanic, and non-Hispanic Black individuals at 10.5%, 10.6% and 10.6% compared with non-Hispanic White individuals at 9.5%. Half of non-Hispanic Black individuals reported allergies to multiple foods, which was significantly higher than other races and ethnicities. Hispanic and non-Hispanic Black individuals had the highest rates of severe food allergy reactions and the lowest income. The prevalence of self- or parent-reported food allergies was highest among those earning <\$150 000 per year [27[•]].

Socioeconomic factors and food allergies

A small longitudinal cohort study of individuals with and without asthma from Southeast Michigan and the Detroit metropolitan area [The Study of Asthma Phenotypes and Pharmacogenomic Interactions by Race-Ethnicity (SAPPHIRE)] [28] and a prospective, multicenter cohort study investigating the natural history of pediatric atopy: the Food Allergy Outcomes Related to White and African American Racial Differences (FORWARD) study observed that allergy to seafood, especially shrimp, accounted for the largest difference (13.1% vs. 4.6%; $P = 1.38 \times 10^{-31}$) in food allergies and anaphylaxis among Black participants compared to other races and ethnicities [29]. The SAPPHIRE study found genetic ancestry was not significantly associated with food allergy, suggesting that socioenvironmental factors play a greater role in food allergy disparities, compared to ancestry or ethnicity [28]. The FORWARD study also revealed that socioeconomic factors measured through the area deprivation index (ADI), a validated, multicomponent percentile score was independently associated with asthma and allergic rhinitis in children with food allergy [29]. The ADI is a proxy for local socioeconomic conditions, to characterize neighborhoods based on multiple social determinants of health including income, education, employment, and housing quality, with a high ADI associated with a risk of poor health outcomes [30].

Contributors of increased food allergy in people of color

The significant prevalence of food allergies in people of color may be related to suboptimal implementation of known strategies to prevent the development of food allergy. Some of these strategies include early introduction of allergenic foods, and the inclusion of foods with polyunsaturated fatty acids and avoidance of ultra-processed foods [31]. Current literature from a single-center study suggests both those of White race and with

commercial insurance were more than two times more likely to introduce peanut into the child's diet. In a univariate analysis, African-Americans were more likely to report receipt of education (49.8%) as compared with White respondents (35.6%), but less likely to introduce peanut (20.1%) as compared with White respondents (45.1%) [31]. One of the potential explanations may be the need to incorporate better practices for engagement of people of color in educational efforts, including tailoring educational practices to address barriers and questions of the food allergy community through intentional engagement and messaging. Additional areas identified by the food allergy community of color to increase engagement in research efforts include the inclusion of Black individuals, Indigenous people, and people of color among study staff, the building of opportunities for participant connection and community, and the provision of messaging that appeals to the often invisible burdens unique to food allergy [32].

Inclusion of healthy, unprocessed foods is associated with a lower prevalence of food allergy. A study of 250 pregnant women showed reduced consumption of n-3 polyunsaturated fatty acid (PUFA) and n-6 PUFA were dietary-associated risk factors for allergic illness and were associated with a higher frequency of consuming noncore foods, particularly within the realm of food allergies [33[•],34]. An international population based survey of 3744 children found that those with a "Sweet and savory snacks" dietary pattern had a slightly higher likelihood of developing food allergies compared to those with a lower intake of snacks [35]. This was replicated in another study that showed ultra-processed foods, energy drinks, and convenience food consumption were considerably higher among those with recently diagnosed food allergic patients [33[•],36].

Strategies to mitigate disparities

Strategies to improve the disparities in food allergic disease include recruiting more people of color into clinical trials and medical school, educating health-care providers about diagnosis and treating food allergy in people of color, improving access to safe foods, creating and disseminating culturally appropriate materials for patients, and providing longer appointment times for patients who need them. Research efforts should effectively transition from a research-on to a research-with relationship with individuals and families living with food allergy. Additional health providers of color and engagement of communities of color are needed to minimize the disparities [32,37^{••}].

DISPARITIES IN SKIN DISEASES: ATOPIC DERMATITIS, CHRONIC SPONTANEOUS URTICARIA/ANGIOEDEMA

Atopic dermatitis disparities

People of color are underrepresented in dermatologic atlases and medical curricula, and as a result, education of healthcare representatives in recognizing atopic dermatitis in skin of color is limited. The American College of Allergy Asthma and Immunology recently published an article proposing solutions to address racial disparities in atopic dermatitis and food allergy. They recognized the need for a comprehensive resource to provide examples of atopic dermatitis in skin of color [37[■]]. People of color are also underrepresented in studies of skin disorders in the field of allergy and immunology including atopic dermatitis. In an analysis of 16 clinical trials the authors found that despite high rates of atopic dermatitis in children of color, they represented less than half of participants in clinical trials [38].

Allergists and dermatologists generally make up a small proportion of medical doctors in North America, as well as developing countries [39]. Croce *et al.* [40] found that caregivers believed their child's atopic dermatitis to be under better control when receiving care of a dermatologist. Despite patients of color having more severe atopic dermatitis, access to new therapies and systemic treatments may be limited compared to their White counterparts [41]. Reportedly, out-of-pocket costs for prescription medications in atopic dermatitis are also higher for Black patients, further complicating effective management [42[■]]. Overall, there is a concern that undertreatment of racially minoritized children may be contributing to the differences in atopic dermatitis disease burden that exist [43].

DISPARITIES IN DRUG ALLERGY

Inequities in drug allergy occur from acquisition of a drug allergy label, to allergist referral and diagnostic evaluation, to de-labeling in the medical record after negative testing [44]. There have been conflicting reports of disparities in recent reports which vary based on patient age and level of care.

In pediatrics, there is decreased penicillin allergy (PA) among inpatients with Black race and young age [45[■]]; among outpatients, non-Hispanic Black patients and patients with Medicaid had decreased PA, while male or White children had increased PA [45[■]]. For adults, outpatient PA was associated with female sex and older age, PA was inversely associated with Black or Asian race, yet allergist referral was directly associated with Black race and female sex [46[■]]. Another study by the same group on inpatient

adults showed an increase in PA among Black patients [47[■]].

A number of factors contribute to the described inconsistencies: minoritized patients are prescribed beta-lactam antibiotics less than other patients [48], rashes are the most common symptom of a drug allergic reaction and are more difficult for providers to identify in pigmented skin [49], and there is decreased access to allergist evaluation among certain inpatient populations, particularly veteran facilities and the majority of US hospitals [50,51].

CONCLUSION

Disparities exist across the atopic disease spectrum, significantly impacting minoritized patients. Allergic disease is found more frequently and is more severe in this population. Common features of healthcare disparities include a correlation of greater allergic disease in populations with lower socioeconomic status and barriers to treatment. Lower participation in research and clinical trials has been identified as a contributor to disparities, impairing our understanding of the efficacy of therapies in minoritized populations. Focus on research and strategies to mitigate healthcare disparities and improve diverse research participant pools are necessary to improve patient outcomes in the future.

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Conflicts of interest

There are no conflicts of interest.

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