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Insights Into the Environmental Health Burden of Childhood Asthma

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Asthma is a serious chronic, inflammatory respiratory disease characterized by recurrent breathlessness coughing, chest tightness, shortness of breath, and wheezing.[1] Asthma is one of the leading chronic childhood diseases affecting approximately 6.3 million or 8.4% of children under the age of 18 years in the United States[2–4] and the third leading cause of hospitalizations among children under the age of 15 years. Parents and caregivers that have a child with asthma are often confronted with a myriad of problems, including unexpected emergency department (ED) and unscheduled physician office visits, missed school days and work absenteeism, daytime fatigue, reduced activity levels, emotional, and economic challenges.[2,5,6]

Despite improvements in medication and treatment, the prevalence of asthma continues to increase worldwide, especially in children and young adults.[7] In 2001, one in 14 persons were reported to have physician-diagnosed asthma in the United States compared with one in 12 in 2009.[4] This increase may be partially due to underreporting and/or underdiagnosis, which may also lead to undertreatment. In addition to the emotional pain and suffering of asthma, the annual estimated financial cost burden of pediatric asthma from health care expenditures in the United States are estimated at 27 billion dollars.[8]

The asthma burden in America is unevenly distributed within the population with race/ethnicity and socioeconomic status playing a major role.[9] Poor, black, and Hispanic children living in households with incomes less than the federal poverty level are at twice the risk of asthma, have higher ED visits and hospitalization rates, and experience more deaths compared with white children.[10,11] The reasons for these disparities and higher prevalence rates are complex but scientists agree that the differences cannot be attributed to genetics alone.[12,13]

The root cause of asthma and continued increasing rates have been at the crux of research for decades. Several studies have pointed to children living in urban environments are more susceptible to asthma; however, the nature of this relationship is not well established.[14] Other studies and theories suggest

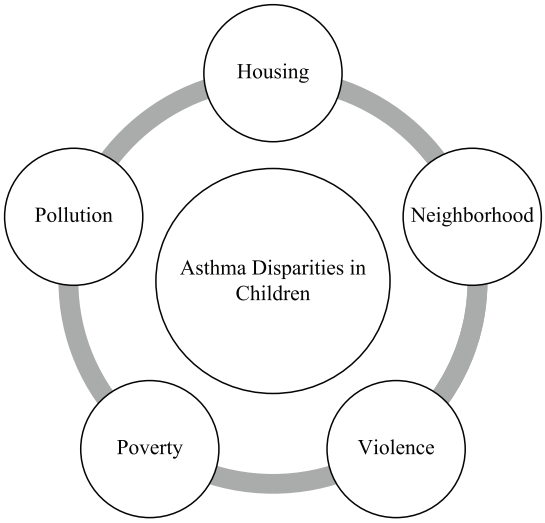

Figure 1. Environmental factors associated with the social determinants of health that influence childhood asthma.

that contributing risk factors of asthma include lack of early childhood exposure to infectious agents,[15] air pollution, microbial environment,[16] biodiversity,[17] and increased westernization (eg, diet, smoking).[18] However, none of these concepts have established causality.

Experts agree that asthma is multifactorial and likely the complex interplay between genetics and environment. However, until a cure has been recognized, health care providers (HCPs) must continue to follow national guidelines that focus on treatment, management, and control of symptoms for their patients with asthma.[13] One of the key recommendations from the guidelines that presents challenges for HCPs, is asking low-income children to avoid environmental "triggers" that can lead to an asthma attack. As further described below, the racial, ethnic and low socioeconomic health disparities found in asthma, confounded by factors such as, living in poor-quality neighborhoods and housing, stressors (eg, violence) and exposures from

environmental pollutants, provide synergistic opportunities for increased respiratory symptoms and asthma exacerbations[19–22] (Figure 1).

Poverty

Children living in poverty often face increased environmental exposures and other factors including being more likely to encounter family turmoil, violence; consuming more polluted air, water, noise; and living in lower quality homes that can threaten health and well-being.

Air Pollution

Low-income children with asthma face increased environmental respiratory exposures from ambient air quality exposure to ozone, particulate matter, sulfur dioxide, and nitrogen oxides.[23] Outdoor air pollution studies often cite traffic-related air pollution in urban areas associated with asthma development, exacerbations, and morbidity.[24]

Segregated Neighborhoods

Where a person lives can have an impact on asthma. A study by Alexander and Currie[25] clearly described the importance of residential segregation and neighborhoods in explaining racial asthma health disparities.

Violence

Low-income urban children with asthma who experienced community violence and violence exposure are more likely to report asthma symptoms but less likely to seek care for asthma.[26,27]

Substandard Housing

In North America, poor-quality ambient indoor air pollutants from poorly maintained heating and ventilation systems inside children's homes and schools have been cited as a leading contributor to asthma exacerbations.[28] Many common asthma allergen triggers can be found in poor-quality indoor environments, including secondhand tobacco and other smoke, dust mites, molds, cockroaches and other pests, pets, nitrogen dioxide (from gas appliances, burning of kerosene or wood, car and equipment emissions, other particulates, etc), chemical irritants (cleaners, paints, adhesives, pesticides, cosmetics, air fresheners, etc), and other gases and particles from wood-burning smoke.[28,29]

Summary

Clinical research is highly important for evaluating genetics and mechanisms that contribute to asthma.[30] However, the multifactorial nature of asthma requires HCPs and public health practitioners to work in parallel with researchers by going outside of the clinical setting to consider social determinants that contribute to asthma health disparities.[11] Practices for asthma management and guidelines emphasize and underscore that education for partnerships in asthma care and control of environmental factors for controlling asthma. Over the past few years, partnering agencies at the national level, including the US Environmental Protection Agency and Department of Health and Human Services, have been seeking input on cost-effective programs that include reimbursement by insurers to encourage addressing health disparities.[5] However, more collaboration among HCP agencies and actions at local levels are needed to address asthma disparities in children and to move this issue forward.

In conclusion, avoidance and/or control of environmental triggers are an important preventative measure that should always be considered with a child that has asthma.[31] Examining the social determinants of health and how environmental exposures influence asthma are critical to our understanding and improving chronic disease management for asthma. To better address the asthma burden at the population level, we must improve diagnostics and patient care and step from treatment to prevention.[32] By going outside of the traditional clinic setting, and looking at socioeconomic factors and where people live, we can better identify and address environmental exposures of children with asthma.

Author Contributions

TK and GDK conceived and designed the experiments, wrote the first draft of the manuscript, contributed to the writing of the manuscript, agree with manuscript results and conclusions, jointly developed the structure and arguments for the paper, made critical revisions and approved final version, and reviewed and approved the final manuscript.

Disclosures and Ethics

As a requirement of publication, authors have provided to the publisher signed confirmation of compliance with legal and ethical obligations including but not limited to the following: authorship and contributor ship, conflicts of interest, privacy and confidentiality, and (where applicable) protection of human and animal research subjects. The authors have read and confirmed their agreement with the ICMJE authorship and conflict of interest criteria. The authors have also confirmed that this article is unique and not under consideration or published in any other publication, and that they have permission from rights holders to reproduce any copyrighted material. The external blind peer reviewers report no conflicts of interest.

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