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COVID-19, health disparities, and what the allergist-immunologist can do



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The COVID-19 pandemic has laid bare the inequities in health care and has highlighted the need for greater attention to overcoming the structures, systems, and beliefs that contribute to health disparities through inequities in social determinants of health (SDOHs).¹ The SDOHs are the conditions in the environments in which people are born, live, learn, work, play, worship, and age and which influence health, quality of life, outcomes, and risk (Fig 1). Understanding the SDOH context is important for addressing the many COVID-19–related questions that our patients have. These questions range from vaccine-related concerns to understanding COVID-19 risk for people with asthma to understanding and managing risk for people with immune deficiency to environmental controls (ventilation and filtration). We are not fully equipped to engage with patients and their families on these issues without an appreciation of the social needs of the family and how those social needs shape actual risk, risk perception, resources available, and trust. In this review, we will discuss how the COVID-19 pandemic has affected health disparities through the lens of SDOHs.

HEALTH AND HEALTH CARE

The COVID-19 pandemic has devastated the world, with a total of 179,258,465 recorded cases and 3,884,494 deaths globally (as of June 23, 2021).² In the United States, overall COVID-19 case numbers have exceeded 38 million since the start of the pandemic.³ When we look specifically at COVID-19 cases and outcomes among racial and ethnic minority populations, we see that Latinx, Black or African American, and American Indian

or Alaskan Native persons have more than twice the number of hospitalizations and deaths compared with non-Hispanic White persons. The factors that contribute to increased risk of infection include the fact that minority patients are disproportionately represented in essential worker and service positions, with less ability to engage in risk-mitigating behaviors such as working from home or socially distancing.⁴ Crowded housing situations and education and income gaps among minority people are also contributory, and fewer minority people are in positions that afford the ability to take paid leave or to quarantine when ill. In addition to greater risk of hospitalization and death, there are also well-documented COVID-19 vaccine disparities among racial/ethnic groups. According to the US Centers for Disease Control and Prevention, of the 106,155,623 people who have received at least 1 dose of the COVID-19 vaccine and for whom there are race/ethnicity data, only 9.3% are Black, 15.9% are Hispanic/Latino, and 0.3% are American Indian or Alaskan Native persons as compared with 59.2% of non-Hispanic White patients.⁵ In contrast, Black and Latinx people make up 13% and 18% of the US population, respectively. The reasons for these disparities include misinformation, challenges with outreach to the most vulnerable patients, and medical mistrust due to historical and intentional medical atrocities performed against Black persons, such as the Tuskegee experiments, the gynecologic experiments of J. Marion Sims, and countless other examples.

EDUCATION

The COVID-19 pandemic has had a particularly damaging effect on the education of youth, especially children of color. The pandemic has exacerbated well-documented opportunity gaps that put students from low-income families at a disadvantage relative to their better off peers, even if both are attending publicly funded schools. Opportunity gaps are gaps in access to the conditions and resources that enhance learning and development; they include access to food and nutrition, housing, health care and health insurance, and financial relief measures. One of the most critical opportunity gaps is the uneven access to the devices and Internet that are critical for online learning. Whereas wealthier families can afford computers, Internet access, smart phones for family members, equipment for online learning, tutors, and participation in learning pods, these resources typically are less available to children from low- or even middle-income families.⁶

The pandemic has widened the opportunity gaps that disadvantage low-income students. A report by the McKinsey Group estimated that on average, by the end of the 2020-2021 school year, children in grades K to 5 would be 5 to 9 months behind, with students of color being 6 to 12 months behind compared with White children, who would be 4 to 8 months behind.⁷ Children likely lost a year of school, with more lost by students without

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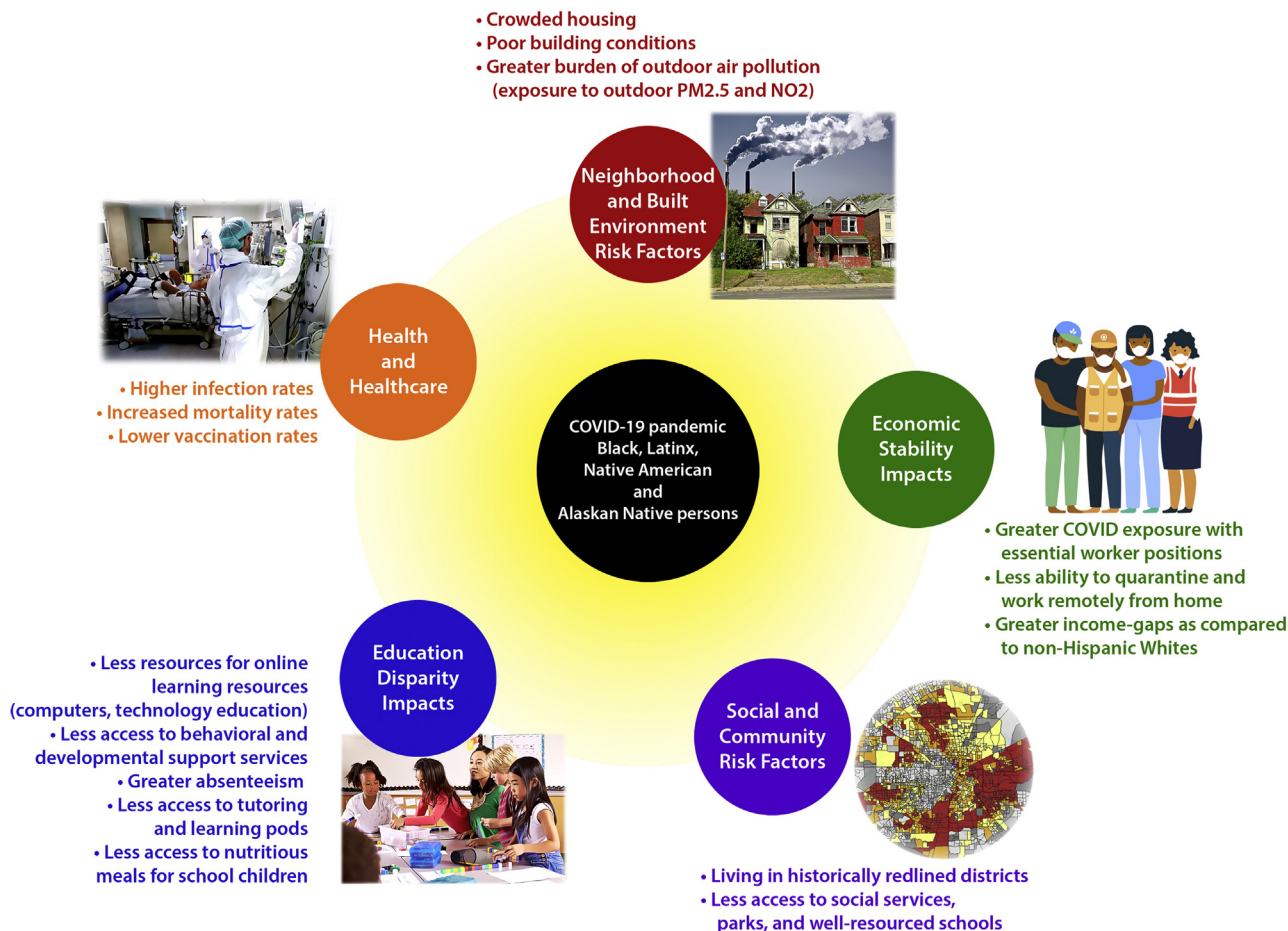


FIG 1. Social determinants of health (SDOHs). SDOHs are social conditions that affect the health and well-being of persons. They can be protective or detrimental to health and some are modifiable. Health disparities refer to modifiable factors that are unequally and unfairly distributed among different population groups. As an example, economic instability leads to poverty and housing instability. Adapted from Healthy People 2030 from the Office of Disease Prevention and Health Promotion, US Department of Health & Human Services, Washington DC.¹

access to summer enrichment, after-school activities, opportunity for personalized instruction, and staffing strategies that reduce class size. Schools provide access to educational, behavioral, and developmental support services, many of which were curtailed during the pandemic. Adequately funded schools also provide school nurses, introduction to the fine arts, and athletic opportunities.

Absenteeism, even with online learning, was reported to be high, particularly among children from lower-income neighborhoods. Teachers had no way of reliably checking on their students. Caregivers tried to assist their children, but many had to leave home for work. Caregivers with limited English proficiency were unable to help their children. Additionally, because inequities are passed down across generations, caregivers also likely experienced lack of resources for their own education, making it difficult to help their children.

THE SOCIAL AND COMMUNITY CONTEXT

The COVID-19 pandemic brought attention to persistent discrimination, racism, and violence directed at Black, Latinx, and Asian people and at immigrants. Redlining is a prime

example of structural racism that disadvantages persons, families, and communities and persists over generations. It recently has attracted renewed attention during the pandemic. Redlining refers to the red color outlining areas of federal government maps of more than 200 metropolitan neighborhoods. These areas were considered too high-risk for mortgage lending. The consequence of redlining was that it flagged Black neighborhoods as too risky for the government to insure with mortgages. The effect still prevails in most US cities, with non-White areas having fewer resources: fewer parks and trees, fewer social services, and underresourced schools, all contributing to pandemic-related disparities. Redlining was a key factor in the development of the highly segregated, socioeconomically deprived neighborhoods that persist today, and these neighborhoods have features that may contribute to COVID disparities such as crowded housing and higher air pollution exposure.

NEIGHBORHOOD AND BUILT ENVIRONMENT

The physical environment, which plays a major role in respiratory disease disparities, has also emerged as an important factor in COVID-19–related disparities. Crowding, measured by

the number of people per room in a housing unit, makes isolating and quarantining difficult, if not impossible, for those known to be infected and those with an exposure, respectively. For those who are infected but unaware and asymptomatic, crowding also increases close contact with others in the home. Not surprisingly, there is now a growing body of literature that has identified crowded housing as a risk factor for COVID-19 incidence. Because crowding is more common among low-income and ethnic minority populations, it is a likely contributor to the racial disparities seen in the pandemic.⁸

As the pandemic has unfolded, the importance of airborne transmission and the use of tools to clean the air, which use ventilation and filtration, has become clear. Ventilation is the process by which air in an indoor space is removed and replaced with cleaner air. Filtration is the process of removing contaminants, such as particles, from the air. Heating, ventilation, and air conditioning (HVAC) systems ventilate and filter the air. Opening windows and/or doors also provides ventilation and portable air cleaners (eg, high-efficiency particulate air purifiers) also provide filtration. Poor building conditions, such as those experienced by racial and ethnic minority populations, include inadequate ventilation and HVAC systems, which can contribute to increased COVID-19 risk. Poor ventilation has been documented in disadvantaged school districts while some wealthier schools have invested in upgrading buildings to optimize ventilation and filtration, furthering the inequity in school structures. There is less research on ventilation and filtration of low-income or subsidized housing, so whether poverty, race, and/or ethnicity increase the risk of living in a home with poor ventilation and filtration is less clear. Although there do not appear to be any studies examining the role of poor ventilation and/or filtration in homes and buildings in racial and ethnic disparities in COVID-19, it is plausible that subpar HVAC systems in schools or other indoor spaces could contribute to these disparities.

Exposure to outdoor air containing particles less than 2.5 μm in size and NO_2 has also been linked to both greater COVID-19 incidence and mortality. Although the published research on the effects of short-term air pollution exposure on COVID-19 risk is less robust, short-term exposures to air containing particles less than 2.5 μm in size, particles less than 10 μm in size, and NO_2 are associated with COVID-19 incidence and mortality.⁹ Long-term exposures may confer risk in that they increase the risk of comorbid conditions, such as cardiovascular disease and chronic obstructive pulmonary disease, which are risk factors for poor COVID-19 outcomes. Short-term exposure may directly act to increase susceptibility to infection or more severe disease by increasing susceptibility of the airways to infection with respiratory pathogens, including SARS-CoV-2. Given that racial and ethnic minority communities bear a higher burden of outdoor air pollution exposure, it is likely that air pollution exposure is a contributor to COVID-19 disparities. Although there are not yet published studies estimating the effect of inequities in air pollution exposure on COVID-19 disparities, there is strong circumstantial evidence that air pollution exposure may be an important contributor.

ECONOMIC STABILITY

Economic stability is a major social determinant of health that drives and perpetuates health disparities, including COVID-19, through a variety of pathways, including housing, nutrition,

stress, access to health care, and so forth. The enormous effects of COVID-19 on housing instability, food insecurity, and unemployment are well documented, and importantly, these effects have been most pronounced among people of color.¹⁰ This profound economic hit and the other contributors to COVID-19 risk in the health care, educational, social context, and physical environment, layer on top of one another, resulting in a piling on of risk factors for COVID-19, so that these risk factors are concentrated among communities of color and thereby amplify COVID-19 disparities.

CONCLUSIONS

According to the US Centers for Disease Control and Prevention's Office of Minority Health & Health Equity, "the future health of the nation will be determined to a large extent by how effectively we work with communities to eliminate health disparities among those populations experiencing disproportionate burden of disease, disability, and death." We need to address the social context, access to education, and health care; ensure a safe, unpolluted physical environment; and equalize opportunities for people of color and end discrimination. We must provide understandable information for those with limited English proficiency, ensure Internet access for all, and provide adequate instruction in use of information technology. We must support, equip, and maintain public resources such as libraries, community health centers, schools, and federally qualified health centers or community centers, where these skills can be taught and learners are safe.

As allergist-immunologists we have unique training that potentially allows us to explain the immunology and science of the disease and the medical interventions. We need to consider and explain to patients how the SDOHs also threaten health and must be addressed. These arguments will be strengthened by increasing the diversity and numbers of our work force and by actively working within our communities to improve the SDOHs. As allergists—clinical immunologists, we and American Academy of Allergy, Asthma & Immunology members have a moral imperative to lobby for the health and welfare of all patients and to help ensure that these needed changes become reality.

REFERENCES

1. Healthy People 2030 framework. Healthy People 2030. Washington, DC: US Department of Health and Human Services. Available at: <https://health.gov/healthypeople/about/healthy-people-2030-framework>. Accessed September 15, 2021.
2. COVID-19 dashboard. Baltimore, Md: Johns Hopkins University of Medicine Coronavirus Resource Center. Available at: <https://coronavirus.jhu.edu/map.html>. Accessed September 15, 2021.
3. Coronavirus in the US: latest map and case count. Updated September 2021. New York, NY: New York Times. Available at: <https://www.nytimes.com/interactive/2021/us/covid-cases.html>. Accessed September 15, 2021.
4. Figueroa JF, Wadhwa RK, Lee D, Yeh RW, Sommers BD. Community-level factors associated with racial and ethnic disparities in COVID-19 rates in Massachusetts. *Health Aff (Millwood)* 2020;39:1984-92.
5. COVID-19 data tracker. Atlanta, Ga: US Centers for Disease Control and Prevention. Available at: <https://covid.cdc.gov/covid-data-tracker/#vaccination-equity>. Accessed July 20, 2021.
6. Kuhfeld M, Soland J, Tarasawa B, Johnson A, Ruzek E, Lewis K. How is covid-19 affecting student learning? Initial findings from fall 2020. Washington, DC: Brookings Institute. December 3, 2020. Available at: <https://www.brookings.edu/blog/brown-center-chalkboard/2020/12/03/how-is-covid-19-affecting-student-learning/>. Accessed July 20, 2021.
7. Dorn E, Hancock B, Sarakatsannis J. COVID-19 and learning loss—disparities grow and students need help. New York, NY: McKinsey & Company. December

8. 2020. Available at:<https://www.mckinsey.com/industries/public-and-social-sector/our-insights/covid-19-and-student-learning-in-the-united-states-the-hurt-could-last-a-lifetime>. Accessed July 10, 2021.
8. Emeruwa UN, Ona S, Shaman JL, Turitz A, Wright JD, Gyamfi-Bannerman C, et al. Associations between built environment, neighborhood socioeconomic status, and SARS-CoV-2 infection among pregnant women in New York City. *JAMA* 2020;324:390-2.
9. Katoto PDMC, Brand AS, Bakan B, Obadia PM, Kuhangana C, Kayembe-Kitenge T, et al. Acute and chronic exposure to air pollution in relation with incidence, prevalence, severity and mortality of COVID-19: a rapid systematic review. *Environ Health* 2021;20:41.
10. Thakur N, Lovinsky-Desir S, Bime C, Wisnivesky J, Celedon JC. The structural and social determinants of the racial/ethnic disparities in the U.S. COVID-19 pandemic. What's our role? *Am J Respir Crit Care Med* 2020;202:943-9.