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A Silent Injustice: Air Pollution as a Contributing Factor of COVID-19 Health Disparities

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Abstract

COVID-19, the disease caused by SARS-CoV-2 has had a disproportionate impact on Black communities throughout the United States. This paper suggests that air pollution may be a factor for why Black individuals experience markedly poorer health outcomes after contracting COVID-19. It establishes that not only are Black Americans exposed to disproportionate amounts of air pollution, but also that many air pollution-related ailments are the exact ones that have been clinically proven to make COVID-19 more fatal. As the United States discusses what a “new normal” entails for healthcare practice and public health policy, this paper makes the case for why air pollution and the danger it presents to Black Americans should play a greater role in those discussions.

In late December, 2019, a cluster of pneumonia cases of unknown origin were identified in Wuhan, the capital city of China’s Hubei province.¹ By early January, researchers had identified the virus causing these cases as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). In the weeks to follow, the World Health Organization declared coronavirus disease 2019 (COVID-19), the disease caused by SARS-CoV-2, a global “public health emergency of international concern.”² Since then, the COVID-19 crisis has transformed life for billions of individuals worldwide.

Despite being touted as a “great equalizer” in the earliest stages of the pandemic, coronavirus has been shown to disproportionately affect the health and well-being of Black communities.³ Across the nation, Black Americans are shouldering disproportionately high rates of infection and mortality. In New York City, Black patients comprise 28% of all fatalities despite only making up 22% of the city population.³ Black Chicagoans, who make up 30% of the city population,

account for 50% of COVID-19 cases and 70% of COVID-19-related deaths. These ratios are even more dramatic in Michigan, where 33% of cases and 40% of deaths have occurred in the Black community, which makes up only 14% of the state population.³ The fact that Black Americans are at both higher risk of contracting COVID-19 and suffering worse outcomes stems from longstanding disparities in access to health care, safe working conditions, and healthful environments.³ In light of these disparities, researchers have investigated whether or not living in a healthful environment can have an impact on COVID-19 outcomes. Several have found links between air pollutants such as nitrogen dioxide and increased mortality among patients with COVID-19.⁴ This paper builds upon that hypothesis, suggesting that increased exposure to air pollution may be a contributing factor for why Black Americans experience markedly poorer health outcomes when battling coronavirus. It must be noted that these epidemiological studies only establish an association between higher levels of air

pollution and COVID-19-related mortality, not a direct causation. Nevertheless, the alarmingly high death rate among Black Americans highlights the importance of further examining the potential role of air pollution in the genesis of COVID-19 disparities.

Air pollution is broadly categorized into ambient (outdoor) and household (indoor) air pollution.⁵ This paper focuses exclusively on the former, which is comprised of particulate matter (PM), gaseous pollutants, and traffic-related air pollution (TRAP).⁵ Particulate matter is classified as coarse (PM₁₀), fine (PM_{2.5}), or ultrafine (PM_{0.1}), with corresponding diameters of 2.5-10 μ m, 2.5-0.1 μ m, and <0.1 μ m, respectively. PM₁₀, which has a diameter of about one-fifth the width of a single strand of hair, deposits mainly in the head and upper respiratory tract.⁵ PM_{2.5} and PM_{0.1} penetrate more deeply, depositing in small airways of the lungs and the alveoli, microscopic air sacs within the lungs.⁵ The most notable gaseous pollutants include ozone (O₃), carbon monoxide (CO), and sulfur dioxide (SO₂).⁶ O₃ can either occur naturally or come about as a result of reactions between nitrogen oxides and chemicals emitted due to human activities. CO is produced by burning fossil fuels, particularly coal or wood, and SO₂ is emitted primarily as a result of fuel consumption and industrial processes.⁶ Finally, TRAP is a mixture of polycyclic aromatic hydrocarbons and diesel-exhaust particles.⁵ This mixture consists of small particulates derived from combustion (such as elemental carbon), non-combustion sources (such as road dust, tire wear, and break wear) and gaseous emissions (such as nitrogen oxide).⁵

“Nevertheless, the alarmingly high death rate among Black Americans highlights the importance of further examining the potential role of air pollution in the genesis of COVID-19 disparities.”

Not all populations bear the burden of air pollution equally. In 2011, Marie Lynn Miranda and her colleagues at the Duke University School of the Environment conducted a study that measured the degree to which the Clean Air Act had been successful in promoting better air quality for both advantaged and disadvantaged areas in the United States. What they found was that non-Hispanic Blacks were more likely to live in counties with the worst air quality and greater levels of PM_{2.5} and O₃.⁷ This finding aligns with a 2019 report by the EPA which states that nonwhite and particularly Black populations face higher risk of particulate air pollution.⁸ Most recently, a study conducted across eight cities in California showed that diesel exhaust and particle emissions increased directly with the proportion non-Hispanic black, Hispanic, and impoverished individuals living in an area.⁹ The authors hypothesize that historical redlining policies may contribute to the high levels of air pollution in Black communities.⁹ These policies have denied wealth-generating opportunities to communities of color, which in turn has inhibited them from investing in the health and quality of their own neighborhoods. Additionally, the 1940s and 50s saw many highways constructed in areas with greater populations of Black Americans.⁹ Black communities were often less empowered to resist the construction of these highways, which became major sources of diesel emissions and TRAP.⁹ Unfortunately, these policies do not exist in a vacuum. Years later, historically redlined census tracts have significantly higher rates of emergency department visits due to asthma.⁹ In this way, decades-old discriminatory practices continue concentrate air

pollution in Black communities and impair the overall health of those living there.

In the context of our current pandemic, the danger of Black Americans facing greater exposure to air pollution is that air pollutants are associated with many of exact conditions that make COVID-19 more deadly. Air pollutants enter the body through the respiratory tract, which can affect the onset and morbidity of respiratory ailments such as asthma, chronic obstructive pulmonary disorder (COPD), and acute respiratory distress syndrome (ARDS).¹⁰⁻¹² COPD, which is characterized by an overactive inflammatory response in the airways and lungs, can be exacerbated by PM and gaseous pollutants.¹¹ Long-term exposure to PM has been shown to reduce the already-impaired pulmonary function of COPD patients.¹¹ ARDS, a common syndrome characterized by lung inflammation and acute respiratory failure, is believed to be associated with long-term exposure to ozone.¹² Asthma, which is common among both children and adults, is characterized by airway obstruction, chronic airway inflammation, and airway remodeling.¹⁰ It can be aggravated by both ozone and PM_{0.1}, especially in sensitive populations and those who experience higher levels of exposure to air pollutants.^{10,12}

Beyond the airway and lungs, air pollution can also exact a toll on the cardiovascular and circulatory systems. Vascular dysfunction, which has adverse health effects ranging from coronary artery disease to cardiovascular disease, is associated with exposure to TRAP.¹³ PM, in particular, has been shown to cause excessive constriction of blood vessels.¹³ PM has also been linked to hypertension.¹³ Multiple reports have demonstrated that those who live in regions with higher levels of air pollution have an increased prevalence and incidence of hypertension.¹³ Several experts even suggest that longer-term exposures may play a role in the development of chronic hypertension.¹³ These findings build upon those of researchers who discovered an association between PM_{2.5} and incident hypertension among Black women living in California.¹⁴

Interestingly, this report also established a link between PM_{2.5} and diabetes.¹⁴ The associations between hypertension, diabetes, and pollution were strongest for TRAP.¹⁴

The CDC names asthma, chronic lung disease, hypertension, heart conditions, obesity and diabetes as several of the comorbidities that can lead to greater mortality in COVID-19 patients.¹⁵ Given the relatively recent onset of the coronavirus pandemic, many of the specific mechanisms by which certain comorbidities exacerbate COVID-19 symptoms have yet to be fully understood. However, it is clear that different comorbidities have different degrees of lethality. For example, those with pre-existing hypertension, diabetes, or cardiovascular disease are 2.29, 2.47, and 2.93 times more likely to develop severe COVID-19.¹⁶ The risk is even greater among patients with pre-existing cerebrovascular disease or COPD. These individuals are 3.89 and 5.97 times more likely to develop severe COVID-19, respectively.¹⁶ Lethality aside, these comorbidities are omnipresent. New York has seen the largest volume of coronavirus patients in the United States, many of whom present with one or more comorbidities. Among a sample of 5,700 COVID-19 patients admitted to 12 hospitals in NYC, Long Island, and Westchester County, hypertension, obesity, and diabetes were present in 56.5%, 41.7%, and 33.8% of patients, respectively.¹⁷ These results were replicated in a New York state-wide study which found 86.2% of COVID-19 deaths to involve at least one comorbidity, and 55.4% to involve hypertension.¹⁸ This final statistic is particularly concerning considering the 45% prevalence of high blood pressure in the overall adult population.¹⁸

There are, without a doubt, limitations of both this report and the resources it draws upon. The first is that methods to gauge the concentrations of different air pollutants are often imperfect. For example, there are more air pollution monitors in urban settings, which are characterized by larger populations of Black Americans, than there are in rural areas, which are characterized by larger populations of older, non-Hispanic

White Americans.⁷ The unequal distribution of air pollution monitors could, in turn, artificially deflate the concentrations of air pollution in rural settings. This bias may be partially mitigated by choosing to study populations in cities such as Los Angeles which contain, on average, a uniformly high number of air pollution monitors.¹⁴ However, fully addressing this bias would require more monitors to collect more accurate data on air pollution concentrations. A second argument against the hypothesis presented in this report is that there are multiple behavioral and environmental factors beyond air pollution that influence the development of comorbidities. This is undoubtedly true. However, the epidemiological studies referenced in this paper each account for confounding in their respective analyses.¹⁰⁻¹⁴ In other words, the influence of coinciding environmental and behavioral factors is accounted for when determining the overall influence of air pollution on comorbidity development. Finally, limited race-stratified data on COVID-19 incidence, hospitalizations, and mortality may present an incomplete picture of how people from different race categories have actually been affected by the ongoing pandemic.³ Unfortunately, this limitation has affected all COVID-19-related work. For months, researchers and politicians alike have called for more transparent COVID-19 race data with the hope that, as this data becomes more widely available, the United States may direct time and resources to those who have been most severely affected.³

The coronavirus pandemic has laid bare the need to implement policies and practices that improve the health and well-being of our most at-risk populations. Initiatives geared towards providing greater access to healthful resources and creating cleaner, healthier environments may represent a step in the right direction. In the context of air pollution, perhaps the clearest path towards creating a healthier environment would be to enforce policies that reduce the emission of harmful pollutants. While such policies would require nuanced solutions involving stakeholders from both within and beyond the world

of public health, they could nevertheless prove incredibly effective.¹⁹ For example, China's Air Pollution Prevention and Control Action Plan (APPCAP) presents different scenarios for controlling PM_{2.5} emissions.¹⁹ The most conservative scenario projects a 4.4% reduction in premature births. For a more short-term solution, public health officials could work with policy-makers to enforce stricter emissions guidelines in regions with higher rates of SARS-CoV-2 transmission or larger populations of at-risk individuals. This would have the added benefit of mitigating stress on America's already overburdened health care system. Finally, public health experts and clinicians could collaborate to generate entry points into the healthcare system that exist outside of the hospital. Urgent care centers, walk-in clinics at pharmacy chains, and health services at Costco have already expanded access to health care professionals and resources to a greater number of citizens.²⁰ Continuing to build upon the existing telehealth infrastructure may also afford more people the opportunity to meet with primary care physicians and specialists.²⁰ While making health care more accessible will not directly mitigate air pollution and its effects on health, it may indirectly help patients become more aware of these effects and manage them.

The healthcare system has evolved rapidly in the past several months.²⁰ This has presented the United States with a unique opportunity to make improvements in areas where the health care system has historically fallen short. Over the course of the pandemic, researchers have voiced the need to devote greater time and resources towards addressing how air pollution affects public health.⁴ This topic has often taken a back seat in the greater public discourse. However, if government and public health officials are to foster a higher standard of care and healthful living among the individuals who have been most severely impacted by coronavirus, the adverse health effects of air pollution must be considered. To disregard their potential role in the genesis of COVID-19 outcomes disparities would be

to disregard yet another opportunity to improve the health of our most at-risk populations.

ENDNOTES

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