CORONAVIRUS

How air pollution may influence the course of pandemics

Jeremy Jackson, Deputy Editor, *Science Advances*; Center for Biodiversity and Conservation and Department of Paleontology, American Museum of Natural History, New York, NY 10024, USA. Email: jjackson@amnh.org

Kip Hodges, Deputy Editor, *Science Advances*; Foundation Professor, School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85287, USA. Email: kip.hodges@aaas.org

The COVID-19 pandemic is causing devastating mortality, with the highest rates of intensive care unit hospitalization and morbidity among older adults, men, and those with certain preexisting conditions, most notably cardiopulmonary diseases, obesity, and diabetes. In addition, a host of interrelated socioeconomic factors—including race, ethnicity, occupation, and poverty—increase the risks of COVID-19 infection for people of color, health care professionals, and other essential workers. These factors are, in turn, influenced by conditions of the human environment including chronic levels of air pollution, most notably fine particulate matter ($PM_{2.5}$) that is a well-established risk factor for death from cardiovascular and pulmonary obstructive diseases. This raises the question of whether long-term exposure to higher levels of $PM_{2.5}$ increases the severity of COVID-19 and, if so, what measures might be taken to ameliorate those risks. This is the challenge addressed by Wu *et al.* in a new contribution to a developing series of papers for *Science Advances* that is dedicated to the study of pandemics from an environmental perspective.

The ideal way to address questions about how $PM_{2.5}$ pollution might influence the course of the pandemic would involve the study of detailed health datasets for very large numbers of people from all walks of life and locations. In this way, the potential effects of $PM_{2.5}$ pollution might be evaluated in the context of other details about each individual's life history and conditions. That approach is the gold standard of rigorous environmental epidemiology. A great example is a paper published earlier this year by Wu *et al.* (*Sci. Adv.* 2020; 6: eaba5692) that examined U.S. Medicare data for 68.5 million enrollees over 16 years and established that even very small decreases in $PM_{2.5}$ pollution can result in a significant decrease in elderly mortality. Moreover, recent studies have shown that even short-term exposure to $PM_{2.5}$ pollution increases risks of acute lower respiratory infections and hospitalizations for influenza (*1*, *2*).

The amount of time required for rigorous, extensive studies, however, conflicts with the swift nature of the COVID-19 pandemic. Addressing the potential impact of air pollution on COVID-19 mortality requires a more nimble approach to environmental policy decision-making.

One alternative is to search for correlations that suggest—rather than prove—causality, make the results of such studies publicly available, and then consider as a society whether or not actions should be taken out of an abundance of caution. This is the approach taken by Wu *et al.* in their newly published research in the November 6 issue of *Science Advances*. Their methods involved using ecological regression to search for correlations between area-specific, COVID-19–related death counts (compiled by Johns Hopkins University for more than 3000 U.S. counties) and well-established $PM_{2.5}$ pollution levels for each county. The results show that higher values of exposure to $PM_{2.5}$ are positively correlated with higher county-level mortality after taking into account over 20 potentially confounding factors. Most notably, they conclude that an increase of just 1 $\mu g/m^3$ in the long-term average of pollution is associated with a significant 11% increase in a county's rate of mortality.

There are strong policy implications for these results. COVID-19, zoonotic influenza, and other potentially severe emerging zoonotic diseases are and will remain long-term threats to our species. Rapidly emerging datasets suggest that these threats are likely to be exacerbated by air pollution, even at the levels currently attained in the United States despite conscientious efforts to improve air quality. While incomplete and not yet fully vetted by the broader scientific community, pathfinding studies such as that of Wu *et al.* set the stage for more traditional environmental epidemiology research.

–Jeremy Jackson and Kip Hodges

REFERENCES

1. B. D. Horne, E. A. Joy, M. G. Hofmann, P. H. Gesteland, J. B. Cannon, J. S. Lefler, D. P. Blagev, E. K. Korgenski, N. Torosyan, G. I. Hansen, D. Kartchner, C. A. Pope III, Short-term elevation of fine particulate matter air pollution and acute lower respiratory infection. *Am. J. Respir. Crit. Care Med.* **198**, 759–766 (2018).
2. D. P. Croft, W. Zhang, S. Lin, S. W. Thurston, P. K. Hopke, E. van Wijngaarden, S. Squizzato, M. Masiol, M. J. Utell, D. Q. Rich, Associations between source-specific particulate matter and respiratory infections in New York State adults. *Environ. Sci. Technol.* **54**, 975–984 (2020).

10.1126/sciadv.abf1897

Citation: J. Jackson, K. Hodges, How air pollution may influence the course of pandemics. *Sci. Adv.* **6**, eabf1897 (2020).

How air pollution may influence the course of pandemics

Jeremy Jackson and Kip Hodges

Sci Adv **6** (45), eabf1897.
DOI: 10.1126/sciadv.abf1897