New research underscores pollution's impact on child health

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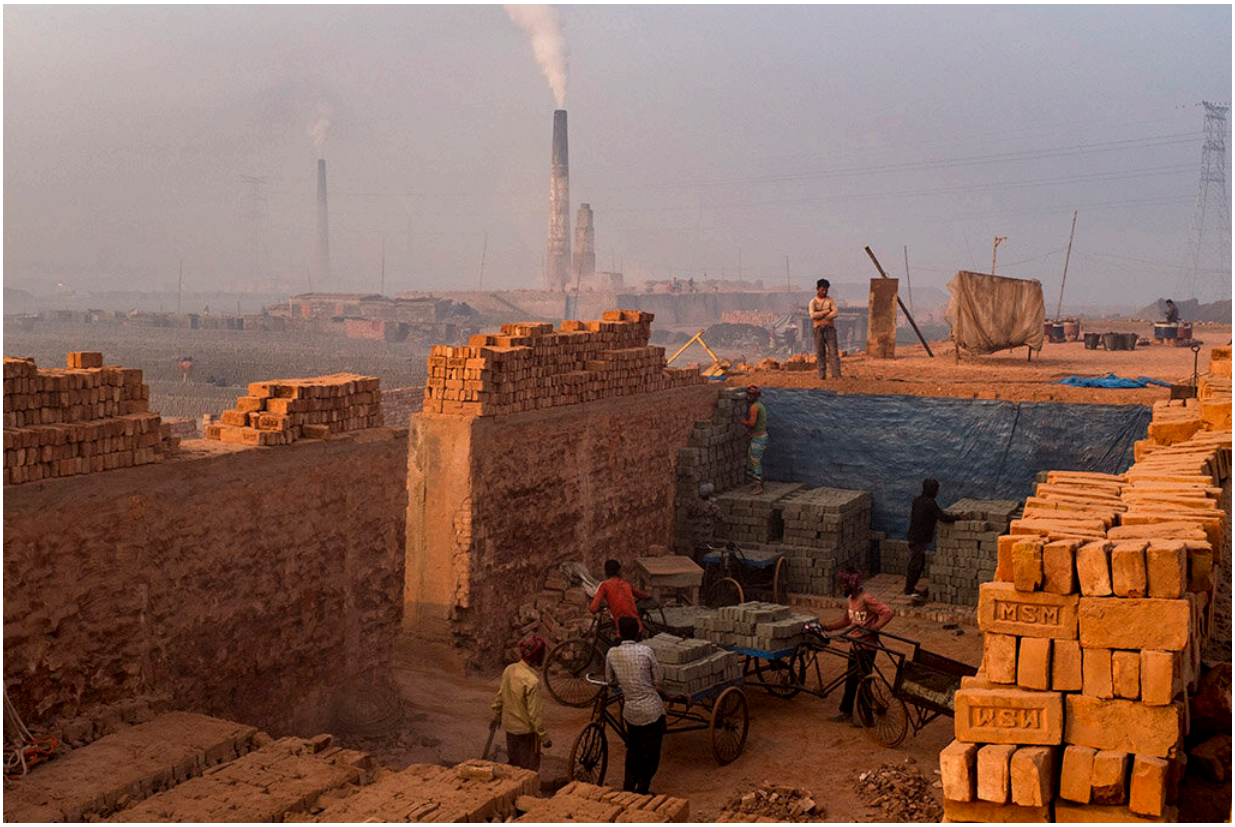

A child looks on as workers remove fired bricks from a kiln in Bangladesh, while smoke billows out of other kilns in the background. Credit: @Navaism

Studies have shown air pollution is a major risk factor for respiratory infection—the leading cause of death among children under five—but

bad air's specific impacts on developing bodies have remained somewhat of a mystery.

A Stanford-led study reveals a link between tiny airborne particles and child health in South Asia, a region beset with air pollution and more than 40 percent of global pneumonia cases. The analysis, published in *Environmental Pollution*, estimates the effect of increased particulate on child pneumonia hospitalizations is about twice as much as previously thought, and indicates a particular industry may play an outsized role in the problem.

The findings could help public health officials and policymakers better target emissions reduction programs to improve child health.

"Everybody wants to protect kids' health," said study lead author Allison Sherris, a postdoctoral research fellow in Earth system science at Stanford's School of Earth, Energy & Environmental Sciences. "Now, we have evidence of a clear health benefit to children from reducing ambient PM2.5 emissions in Dhaka."

For many of the 21 million residents of Dhaka, Bangladesh—the study's focus area—air pollution is an all-too-regular part of life, especially in winter, when coal-burning brick kilns around the city operate. Of special concern is PM2.5, airborne particles 2.5 micrometers wide or smaller. The larger of these particles are about one-thirtieth the width of a human hair, small enough to inhale deep into the lungs.

Once inside the lungs, these particles can cause inflammation and impair the body's ability to fight infection. But particles from different sources can have different shape, size and chemical composition, and it's not clear what specific components of PM2.5 might be most harmful.

Few studies have evaluated the health effects of PM2.5 in infants and

young children, especially in low-income countries where children are more than 60 times as likely to die from air pollution exposure as children in high-income countries, according to the World Bank. Among studies that have, most focused on the indoor environment, where the use of biomass-burning cookstoves has been associated with child respiratory infection.

"Specifying the impact of industry-generated air pollution on child health provides compelling evidence to support interventions to reduce pollution," said study senior author Stephen Luby, a professor of infectious diseases at Stanford University. "This is often more salient to politicians than the marginal contribution of emissions to global climate change."

Sherris, Luby and their colleagues analyzed long-term PM2.5 monitoring data alongside community health surveillance of respiratory infections from the Atomic Energy Centre, Dhaka, and the International Centre for Diarrhoeal Disease Research, Bangladesh. They found pneumonia incidence among children under 5 increased by 3.2 percent for every PM2.5 increase of 10 micrograms per cubic meter of air—a standard measure in air pollution analysis.

The mean PM2.5 level in Dhaka was on average over three times higher than the World Health Organization standard. The association between air pollution and child pneumonia suggests that air pollution is a major contributor to the leading cause of child death in Bangladesh and across South Asia.

That difference equates to more than 200,000 additional child pneumonia cases in Bangladesh each year, and nearly two million additional cases across South Asia. The increase is also approximately double similar prior estimates of pneumonia hospitalizations associated with increased PM2.5 and about 10 times more than such estimates for

outpatient visits.

The difference from previous findings may reflect the young age of the study population—most children in the study were two or younger—the source composition of particulate matter in Dhaka, and the fact that the study included nearly all community infection cases, rather than just focusing on cases that made it to clinics and hospitals.

Prior studies by researchers at the Atomic Energy Centre, Dhaka, found that biomass burning contributed the most to outdoor PM2.5 levels, followed by brick kiln emissions and soil dust. However, on days when brick kilns contributed a heavier than-usual amount of PM2.5 to the mix of bad air, the link between PM2.5 and child pneumonia was stronger.

The findings are among the first evidence that communities and policymakers can point to that suggests a measurable impact of brick kilns on child health. Considering 9 out of 10 people live in areas with air pollution exceeding World Health Organization guidelines, further investigation into whether particles from brick kilns and other sources have different health impacts could inform health and environmental interventions around the world. Luby leads a collaboration among public health experts, industry stakeholders, technology consultants and government agencies to improve the industry. He received funding for related work focused on brick kilns and other industries, funded by the Sustainability Initiative that gave rise to Stanford's new school focused on climate and sustainability.

"We're still only looking at a small slice of the potential health outcomes that might be linked to this kind of air pollution, and we still lack perfect measurements of exposure to it," said Sherris. "The true health burden is likely much greater."

More information: Allison R. Sherris et al, Associations between

ambient fine particulate matter and child respiratory infection: The role of particulate matter source composition in Dhaka, Bangladesh, *Environmental Pollution* (2021). DOI: 10.1016/j.envpol.2021.118073