Rural air pollution may be as hazardous as urban, study finds

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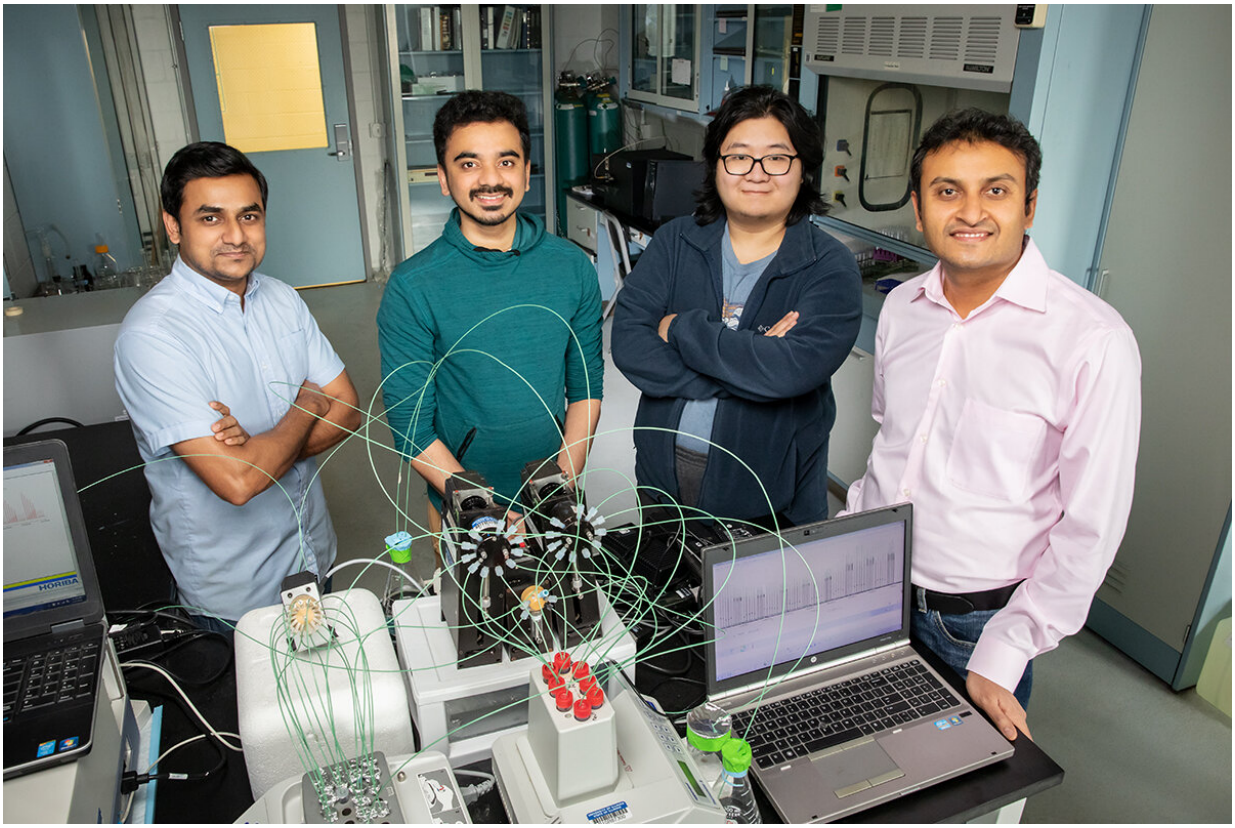

Illinois researchers, from left, Sudheer Salana, Joseph Puthussery, Haoran Yu and professor Vishal Verma recently conducted a comprehensive assessment of the oxidative potential of air pollution in the Midwestern U.S. Credit: L. Brian Stauffer

New research shows that chemical reactivity, seasonality and distribution

of airborne particulate matter are critical metrics when considering air pollution's impact on human health. Current environmental regulations focus on the mass of pollutant particles, and researchers at the University of Illinois Urbana-Champaign are pushing to refocus regulatory efforts on more regional and health-relevant factors.

A new study of air quality in the Midwestern U.S. found that measuring the mass concentration of $PM_{2.5}$—particles that are 2.5 micrometers in diameter or smaller—does not correspond well with current methods for classifying particle toxicity. Additionally, the researchers found that $PM_{2.5}$ exposure may be just as hazardous in rural areas as in urban areas—evidence that challenges a common misconception that air pollution is more toxic in urban areas than in than rural areas, the researchers said.

The findings of the study, led by civil and environmental engineering professor Vishal Verma, are published in the *Journal of Hazardous Materials*.

"The EPA classification of $PM_{2.5}$ accounts for particle diameter and mass, which are characteristics that are easy to measure," Verma said. "However, not all particles that make up $PM_{2.5}$ contribute to health equally."

$PM_{2.5}$ poses a health risk because it can become embedded in lung tissue when inhaled, the researchers said. Although chemically reactive fractions of these particles are known to be toxic, a previous study by Verma's group shows that the exact relationship between $PM_{2.5}$ mass and toxicity is unclear.

"Most air pollution studies have shifted focus from particle mass to a property called cellular oxidative potential," Verma said. "Cellular oxidative potential describes the capability of the particles to generate

reactive, oxygen-based chemicals that can lead to a variety of health problems in the cells of lung tissue."

To examine the influence of oxidative potential more closely, the researchers collected $PM_{2.5}$ samples weekly in the summer and fall of 2018 and in the winter and spring of 2019. They chose three urban localities: Chicago, Indianapolis and St. Louis; a rural location in Bondville, Illinois; and a roadside location adjacent to an interstate highway in Champaign, Illinois.

Using an automated analytical technique developed in a previous study, Verma's team analyzed the sample composition, oxidative potential and mass. The team found that all locations shared similar levels of oxidative potential—but saw a poor correlation between oxidative potential and mass. That suggests that some of the lighter particles that make up $PM_{2.5}$ contribute more to tissue damage than others, the study reports.

"Our rural samples did have less mass than those in the urban settings, but the oxidative potential was equal to samples from urban settings," Verma said. "Additionally, the oxidative potential of the rural samples was higher in the summer than in the winter, suggesting that summertime agricultural activity can produce $PM_{2.5}$ particles that are just as toxic as those from urban settings."

The team hopes this study brings attention to these newly uncovered risks associated with $PM_{2.5}$ in rural areas.

"The current methods used to measure $PM_{2.5}$ oxidative potential are time-consuming and laborious, and we hope that our new methodology, combined with these study findings, makes testing for oxidative potential more appealing to environmental regulators and policymakers," Verma said.

More information: Yixiang Wang et al, Sources of cellular oxidative potential of water-soluble fine ambient particulate matter in the Midwestern United States, *Journal of Hazardous Materials* (2021). DOI: 10.1016/j.jhazmat.2021.127777

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