New study quantifies disparity among minority communities exposed to traffic-related air pollution across the US

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Credit: Scott Meltzer/public domain

Traffic-related air pollution is a pervasive problem across the United States. Vehicle emissions are highest near major roadways with around

19% of the U.S. population living in the vicinity of a major roadway. In more densely populated states, like California, up to 40% live near a major roadway. Exposure to these pollutants, such as fine particulate matter ($PM_{2.5}$) and nitrogen dioxide (NO_2), a byproduct of burning fossil fuel, can lead to a host of health effects including premature death. Minority communities often live along these corridors and experience disproportionate exposures.

A new study by researchers at the University of North Carolina at Chapel Hill estimates minority communities within 100 meters of a major roadway are exposed to up to 15% more $PM_{2.5}$ and up to 35% more NO_2 than white communities from traffic-related air pollution. The study was published today in *PLOS ONE*.

"This is the first time that a nationwide estimate of health risk due to both $PM_{2.5}$ and NO_2 is made for every census block in the entire nation using a very sophisticated hybrid modeling approach that accounts for model biases. We use this very high-resolution estimate of health risk to quantify exposure inequalities," says Saravanan Arunachalam, corresponding author of the study, and research professor and deputy director at the UNC Institute for the Environment.

Using a novel hybrid data fusion model, the research team was able to generate a more accurate assessment of the health risks of these pollutants compared to previous studies at a census block resolution across the more than 11 million census blocks in the United States. Their model estimates 264,516 premature deaths from $PM_{2.5}$ and 138,550 from NO_2 due to all sources in the U.S.

"Our research confirms that all communities residing within 100 meters of major roads experience elevated levels of $PM_{2.5}$ and NO_2. However, our findings also highlight an important disparity in exposure between white communities and minority communities within this proximity.

Specifically, vulnerable minority communities face a greater burden of pollutants, resulting in a higher risk for adverse health outcomes," says Alejandro Valencia, a co-author and former Ph.D. student in the Department of Environmental Sciences and Engineering at the UNC Gillings School of Global Public Health and former graduate research assistant at the UNC Institute for the Environment.

The hybrid model allowed the research team to assess communities at a high resolution, layered with census and health data, which provided both quantification and visualization of the pervasive and disproportionate exposure of minority communities. They also could see how changes in modeled resolution can contribute to the inequality, providing key insights for developing mitigation strategies.

"Our results reveal that significant exposure inequities can occur within areas as small as a county, or even within a census tract," says co-author Marc Serre, an associate professor in the Department of Environmental Sciences and Engineering in UNC's Gillings School of Global Public Health. "Detecting these small areas, and visualizing their exposure inequities, provides critical new insight to inform and prioritize remediation strategies."

The research team is hopeful this new approach can help in identifying vulnerable populations, quantifying exposure and preventing misclassification of exposures going forward.

"Most of the air pollution related health risk studies focus on $PM_{2.5}$. Our novel analytical approach adds new estimates for NO_2 to the health burden and supports additional motivation to move away from fossil fuel-based combustion sources of air pollution to protect public health," says Arunachalam.

More information: Alejandro Valencia et al, A hyperlocal hybrid data

fusion near-road PM2.5 and NO2 annual risk and environmental justice assessment across the United States, *PLOS ONE* (2023). DOI: 10.1371/journal.pone.0286406