

# **Communities of color suffer disproportionately higher pollution-related deaths, finds nitrogen dioxide exposure study**

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In the United States, premature death associated with exposure to nitrogen dioxide ( $NO_2$ ) pollution—a toxic gas emitted primarily by burning fossil fuels in cars, trucks and power plants—is more likely to impact people of color compared to the white population, a new Northwestern University study has found.



The study is the first to estimate <u>premature deaths</u> attributed to  $NO_2$  exposure and associated disparities across the contiguous United States.

By combining air pollution concentrations from high-resolution models, relative risks from epidemiological studies and census mortality data, the researchers pinpointed where and who  $NO_2$  pollution affects most.

Ultimately, they found that approximately 171,000 premature deaths per year are linked to  $NO_2$  exposure, and a disproportionate number of those deaths occur in marginalized communities. In predominantly Black census tracts, for example, premature deaths related to  $NO_2$  exposure are 47% higher than the national average, the study authors found.

The study provides further confirmation that historically marginalized communities shoulder disproportionate health burdens related to <u>poor air</u> <u>quality</u>.

The study titled "All-cause  $NO_2$ -attributable mortality burden and associated racial and ethnic disparities in the U.S.," was <u>published today</u> (Nov. 7) in the *Environmental Science & Technology Letters*. Although previous studies have confirmed the unjust burden of  $NO_2$  exposure on marginalized communities, Northwestern's study is the first to estimate the mortality burden (from all natural causes excluding accidental deaths) attributed to  $NO_2$  exposure across the continental United States.

"When looking at who is affected most by  $NO_2$ , we look at not just air pollution exposure, but also susceptibility of the population," said Northwestern's Sara Camilleri, who led the study. "We quantify this by looking at the underlying baseline mortality, which represents susceptibility. In this context, susceptibility could be related to higher occurrences of underlying conditions or lesser access to health care. The Black population, in particular, experiences both high susceptibility and higher  $NO_2$  concentrations."



"Simultaneous advances in epidemiology and air-quality research have allowed us to more confidently quantify the impacts of  $NO_2$  exposure on health outcomes," said Northwestern's Daniel Horton, the study's senior author. "Our results indicate that policies aimed at reducing  $NO_2$ emissions could reduce long-standing environmental injustices and motivate targeted adoption of more stringent standards to protect public health."

Horton is an assistant professor of Earth and planetary sciences at Northwestern's Weinberg College of Arts and Sciences, where he directs the Climate Change Research Group. Camilleri is a postdoctoral scholar in Horton's laboratory.

#### Combining pollution models with census data

Particularly common in high-traffic and industrial areas,  $NO_2$  exposure is linked to a number of health complications, including asthma, respiratory infections and even death. Although the U.S. Environmental Protection Agency has strengthened regulations aimed at reducing  $NO_2$ concentrations, premature deaths associated with exposure remain.

"Over recent decades, we've seen a declining trend in  $NO_2$  emissions," Camilleri said. "But recent <u>epidemiological studies</u> have shown that  $NO_2$  is detrimental to health even at low concentrations. Therefore, low concentrations still have an impact, and disparities in air pollution exposure and associated health impacts still persist across the U.S."

To better understand the most affected populations, Camilleri, Horton and their co-investigators turned to a nationwide land use regression model (LURM) to estimate NO<sub>2</sub> concentrations. The LURM incorporates surface NO<sub>2</sub> observations and remotely sensed satellite observations along with land use and roadway information to predict the concentration of NO<sub>2</sub> pollution.



"Land use regression models estimate pollutant concentrations by associating land use with observed pollutant concentrations," Horton said. "We know that a roadway has higher  $NO_2$  than a park, for example. Surface observations help inform that relationship, and satellite data can further constrain it. These associations allow us to estimate  $NO_2$ concentrations across the contiguous United States."

## **Profound impact on Black communities**

By combining land use, monitor and satellite data, the researchers estimated  $NO_2$  concentrations across areas as small as one kilometer throughout the contiguous United States. Then, to characterize the residents living within these areas, the researchers used population and demographic data from the American Community Survey and <u>mortality</u> <u>rates</u> at the census-tract level derived by Industrial Economics, Inc.

At a national level, the researchers found areas with the largest estimated NO<sub>2</sub>-attributable mortality rates are 29% Black, 18% Hispanic or Latinx, 5% Asian and 45% white. Considering that the racial and ethnic makeup of total U.S. population is 12% Black, 18% Hispanic or Latinx, 5% Asian and 61% white, the disproportionate impact on Black communities is profound.

#### Nationwide urban hotspots

Because internal combustion engine-based transportation is one of the greatest sources of  $NO_2$  emissions, peak concentrations of the pollutant accumulate along highways and major road networks. A large portion of people living close to these hotspots are people of color, who generally have higher-than-average susceptibilities, the authors write.

Filled with dense highways and industrial activity, urban areas



experience the highest rates of  $NO_2$ -related deaths. The larger Detroit area in Michigan, specifically, experiences the highest <u>premature death</u> rate in the country with 1.6 times more  $NO_2$ -attributable mortalities than the U.S. average. The researchers uncovered a similar pattern in the Chicago and New York City metropolitan areas, where mortality rates are 1.3 and 1.4 times higher than the national average.

The disproportionate burden on marginalized communities is amplified in these areas. For example, Black people make up just 21% of the population in the larger Chicago and Detroit metropolitan areas, yet about 60% of the people affected by NO<sub>2</sub>-related mortality in these areas are Black.

## **Exploring potential solutions**

To address the unjust impacts of NO<sub>2</sub> pollution, Camilleri and Horton suggest the adoption of policies that incentivize vehicle electrification and the removal of high-emitting combustion-engine vehicles from roadways. Just last month, their team <u>published</u> a study finding in that electrifying 30% of on-road heavy-duty vehicles could save hundreds of lives per year—largely benefitting disadvantaged communities.

"Based on our previous work, we have shown that shifting to cleaner transportation options can have large implications for reducing inequitable transportation-related health burdens," Camilleri said. "The shift to electric vehicles is definitely one solution that is worth incentivizing from an air quality, public health, climate change and economic perspective."

**More information:** Sara F Camilleri et al, All-Cause NO2-Attributable Mortality Burden and Associated Racial and Ethnic Disparities in the United States, *Environmental Science & Technology Letters* (2023). DOI: 10.1021/acs.estlett.3c00500



#### Provided by Northwestern University

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