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Yale SCHOOL OF PUBLIC HEALTH
Center on Climate Change and Health

RESEARCH BRIEF

Race-ethnicity and Income Shape U.S. NO2-related Deaths

Non-Hispanic Black populations bear the highest burden in low-income counties. In high-income counties, non-Hispanic Black communities overall face 3 times the NO2-related mortality among non-Hispanic White counterparts, while the most affected race-ethnicity group is location-specific. These disparities are driven by unequal exposures and heightened susceptibility.

BACKGROUND

Nitrogen dioxide (NO2) is a toxic byproduct of fossil fuel combustion from vehicles, power plants, and industrial activities, which may trigger oxidative stress, systemic inflammation, and multi-organ damage through biological pathways that degrade cardiovascular, respiratory, and neurological health. Despite a 30% decline in U.S. ambient NO2 concentrations (from 66.5 to 43.5 parts per billion [ppb]) between 2000-2016, new epidemiological evidence suggests that long-term exposure may elevate mortality risks.

Health burdens may fall disproportionately on marginalized populations, but critical knowledge gaps persist. Prior studies have either evaluated exposure disparities (differences in pollution levels) or susceptibility disparities (variations in response to same-level pollution) in isolation, without integrating both factors. Few have simultaneously considered race-ethnicity and income as intersecting drivers of inequality, and most focus narrowly on all-cause mortality rather than cause-specific burdens that could inform targeted healthcare interventions. Yale Center on Climate Change and Health (YCCCH) researchers address these gaps through a comprehensive analysis of exposure disparities and susceptibility disparities. The latter one is based on 34 million death records, employing quasi-Poisson regression with spatiotemporal controls to quantify how disparities manifest across different diseases and populations.

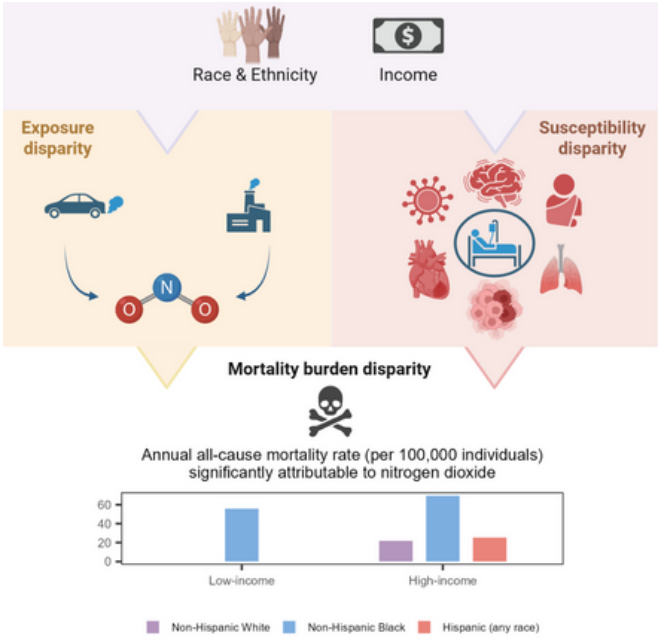

Figure 1: *Race-ethnicity and income drive NO2-related exposure disparities and susceptibility disparities, contributing to mortality burden disparities.*

POINTS FOR POLICYMAKERS

Susceptibility varies sharply by race-ethnicity, income, and cause of death

The mortality impacts of NO2 exposure can last a long time, up to two and a half years. Racial-ethnic minorities had higher risks for most causes of death, with cause- and income-dependent disparity magnitudes. Non-Hispanic Black individuals show elevated risks for NO2-related ischemic heart disease in low-income counties, infections in middle-income counties, and all-cause, non-external causes, hypertensive diseases, and unintentional injuries in high-income counties. Hispanic populations face higher risk for dementia, nervous diseases, and external causes in low-income counties; infections and respiratory diseases in middle-income counties; and external causes in high-income counties.

Non-Hispanic Black populations bear the highest burden, especially in low-income counties

High-income counties show a NO2-attributable all-cause mortality rate of 69.67 deaths/100,000 for non-Hispanic Black people, which is over three times the rate for non-Hispanic White people (21.83/100,000). In low-income counties, non-Hispanic Black people bear an attributable rate of 55.88/100,000, while no significant attributable deaths are observed for non-Hispanic White people and Hispanic people. This disparity stems from compounding disadvantages: higher NO2 exposure levels compared to non-Hispanic White people, combined with heightened susceptibility. Policy responses may prioritize these communities through low-emission zones around residential areas, public insurance expansion, affordable preventive care, and health education programs, and stricter industrial permitting in environmental justice communities.

The most affected race-ethnicity group was location-specific in high-income counties

In high-income counties, the most affected population varies by location, necessitating county-specific analyses. Environmental agencies should utilize NO2 "burden maps" that overlay pollution data, health outcomes, and demographic indices to prioritize enforcement in high-impact zones and subpopulations.

They found higher pollution in high-income counties, with racial-ethnic disparities within income groups. Regarding susceptibility, racial-ethnic minorities had higher risks for most causes of death, with cause- and income-dependent disparity magnitudes. Non-Hispanic Black populations bear the largest overall mortality burden in low-income counties, while in high-income counties, the most affected race-ethnicity group varied by county.

FOR MORE INFORMATION

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This brief is based on **Disparities in NO2-related health burden prevalent across race-ethnicity and income groups in the United States** published in *One Earth*.

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