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Yue Sun
Syracuse University, ysun46@syr.edu

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Syracuse University
Maxwell School of Citizenship & Public Affairs
Center for Policy Research

POLICY BRIEF #8
December 6, 2023

Stronger Regulations on Air Pollution Could Reduce Cardiovascular Disease Mortality Rates

Yue Sun

Cardiovascular disease (CVD) is the leading cause of death in the United States.[1] But there are large disparities in CVD death rates across the country. During 2016-2018, the county-level cardiovascular disease mortality varied from 0 to 646 per 100,000 population.[2] These large geographic disparities can be partially explained by differences in demographic composition (e.g., racial/ethnic composition), economic wellbeing, health care access, and health behaviors (e.g., smoking and excessive drinking).[3] Air pollution also plays an important role in shaping geographic disparities in CVD mortality, as air pollution can increase individuals' risks of contracting and dying from CVD.[4] Air pollutants can become absorbs in human circulation systems, and cause inflammation, damage nervous systems, and trigger poor CVD outcomes.[5]

This brief summarizes findings from my recent study[6] that examined how air pollution was associated with geographic disparities in CVD deaths in 2016-18 and how these associations vary across rural and urban counties. Air pollution is measured by the concentration of fine inhalable particulate matters with diameters of 2.5 μm and smaller (PM 2.5). I calculated age-adjusted cardiovascular disease mortality rates (deaths per 100,000 population) at the county level.

KEY FINDINGS

	Air pollution is a major driver of geographic disparities in cardiovascular disease (CVD) mortality.
	A one standard deviation increase in air pollution in a county was associated with an average of 16.3 more CVD deaths per 100,000 people in 2016-18.
	Stronger regulations on air pollution could reduce CVD mortality, especially in rural counties.
	Enacting the World Health Organization's proposed fine particulate matter standard of 5 μg/m3 or less could have prevented over 300,000 CVD deaths in the U.S. from 2016-18.

Worse Air Pollution is Associated with Higher Rates of CVD Mortality

Figure 1 presents the spatial distribution of outdoor PM 2.5 concentration. PM 2.5 is particle pollution from fine particulates. Outdoor sources of PM 2.5. include motor vehicle exhaust, fires, and burning wood, gas, and other fuels. High concentrations of PM 2.5 are clustered in Ohio, Indianna, Illinois, and some parts of Pennsylvania, California, and the southern U.S. I found that worse air pollution is associated with higher rates of CVD mortality. As of 2016-18, a one standard deviation increase in air pollution was associated with an average increase of 16.3 CVD deaths per 100,000 people in a county. These associations were stronger in rural counties than in urban counties. As of 2016-18, a one standard deviation increase in air pollution was associated with an average increase of 19.1

CVD deaths per 100,000 people in rural counties, compared to 13.0 CVD deaths per 100,000 people in urban counties. Some factors that may explain this are that rural residents are more likely to work outdoors and less likely to use air purifiers. Moreover, rural residents are more likely to lack socioeconomic and health care resources to cope with the adverse effects of air pollution.

Regulations on Air Pollution Could Reduce Geographic Disparities in CVD Mortality

Figure 2 presents the estimated changes in average CVD mortality rates for two counterfactual policy scenarios. In the first scenario, adhering to the Environmental Protection Agency (EPA)'s proposal[7] to limit PM 2.5 concentration to 9 μg/m^3 or lower across all U.S. counties could have resulted in a 0.4% reduction in the average CVD mortality rate for the years 2016-2018. This change could have saved approximately 9,037 lives over this period. In the second scenario, if PM 2.5 concentration had been reduced to 5 μg/m^3 or less, following the World Health Organization (WHO) recommendation,[8] the average CVD mortality rate could have been 12.1% lower than the actual rate, potentially saving about 309,215 lives from 2016-18. Stronger air pollution regulations would be especially beneficial in rural counties. In the first scenario, if the EPA proposed standard was applied, rural counties would have experienced a 0.3% reduction in the average CVD mortality, while urban counties would have seen a 0.4% reduction, potentially saving around 1,458 lives in rural areas and 7,810 lives in urban areas. However, if the stronger WHO proposed standard was applied, the average CVD

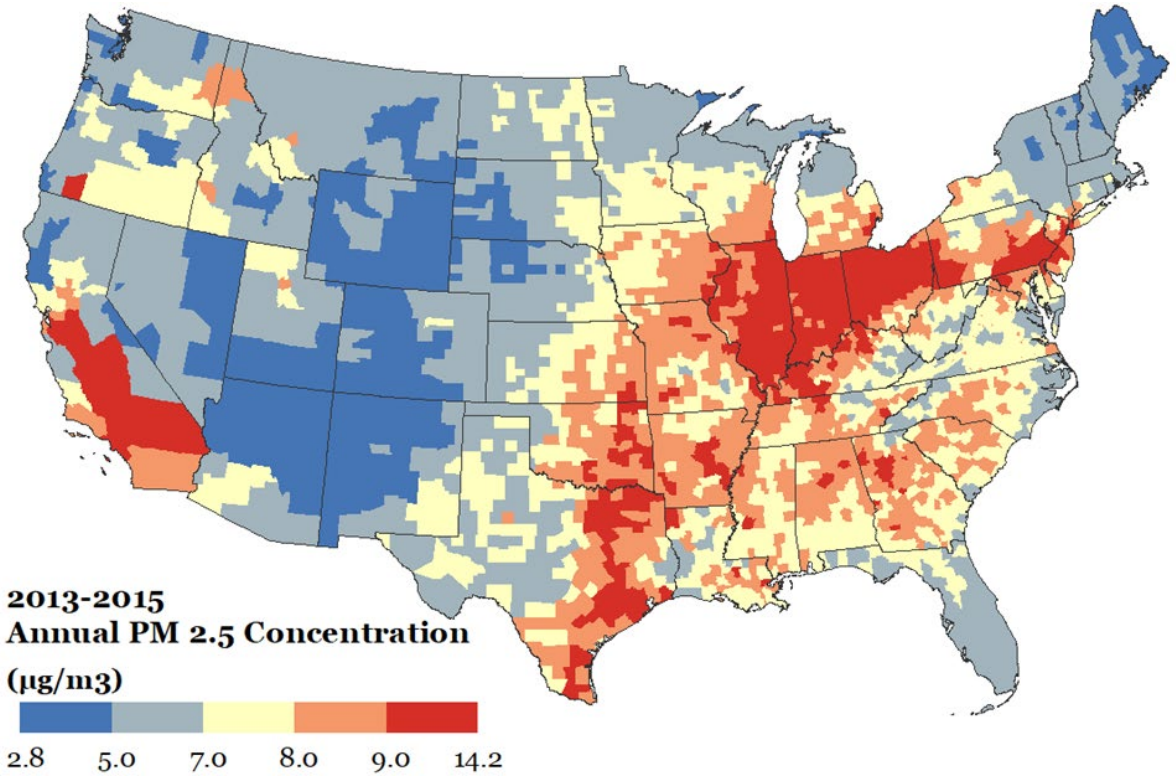

Figure 1: County-Level PM 2.5 Concentration, 2013-15

Data Source: PM 2.5 concentration data as of 2013-2015 are from the Center for Air, Climate, and Energy Solutions.

mortality rates could have been reduced by 12.4% in rural counties and a 11.8% in urban counties. This change could have saved about 59,494 lives in rural areas and 245,147 lives in urban areas from 2016-18.

My estimates suggest that air pollution is an important contributor to geographic disparities in CVD mortality. Curbing air pollution could reduce CVD mortality nationally and geographic disparities in rates. Applying stronger regulations on air pollution would be especially beneficial in rural counties. However, because economic development and pollution are correlated,[9] policymakers must balance trade-offs between economic development, jobs, pollution, and health.

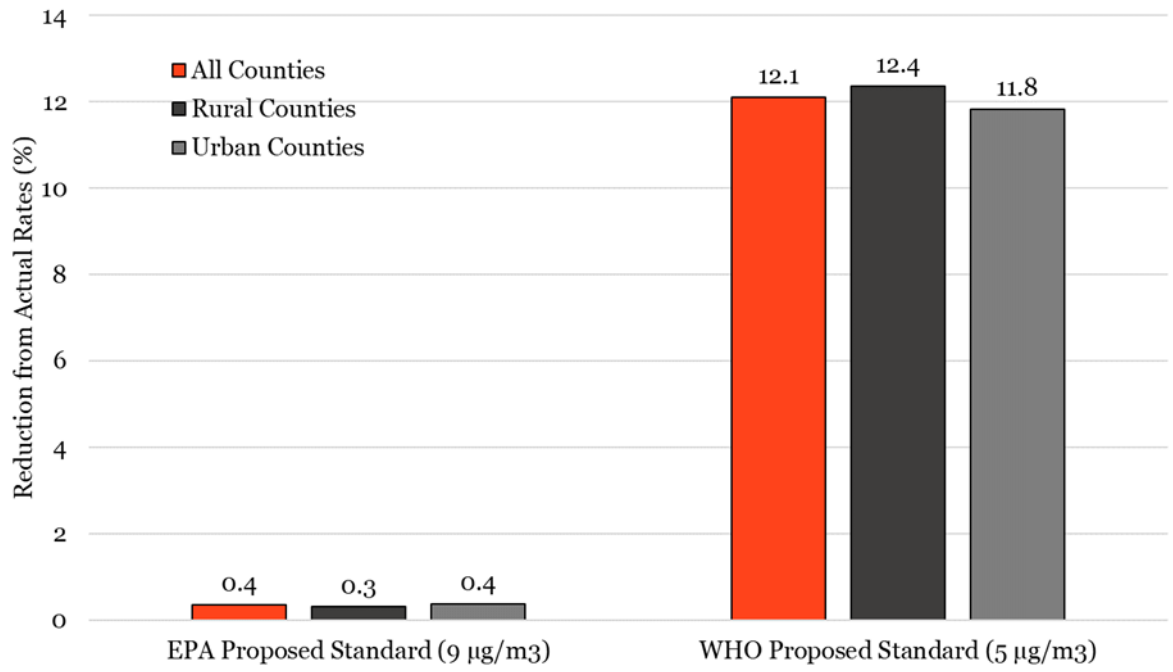

Figure 2: Reductions in Average Cardiovascular Disease Mortality, 2016-18, if the U.S. Had Adopted the Proposed EPA or WHO PM 2.5 Standards
Data Sources: PM 2.5 concentration data as of 2013-2015 are from the Center for Air, Climate, and Energy Solutions. Age-adjusted cardiovascular disease mortality data for 2016-2018 are from the National Vital Statistics System death certificate files. Rural and urban counties are defined by the 2013 Rural-Urban Continuum Codes from Economic Research Service of the U.S. Department of Agriculture. Mortality rates are age adjusted.

Data and Methods

PM 2.5 concentration data as of 2013-2015 are from the Center for Air, Climate, and Energy Solutions. Age-adjusted cardiovascular disease mortality data as of 2016-2018 are from the National Vital Statistics System death certificate files. Metropolitan status is defined by the 2013 Rural-Urban Continuum Codes from the Economic Research Service of the U.S. Department of Agriculture. The unit of analysis is the county. I used spatial error models and spatial regime models to estimate the results. I controlled for the percentage of the population who are non-Hispanic black, percentage of the population who are Hispanic,

median household income, Gross Domestic Product per capita, health insurance coverage rate, physician rate, and the prevalence of smoking and excessive drinking. Full methodological details are available in the published paper.

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About the Author

Yue Sun (ysun46@syr.edu) is a PhD candidate in Sociology, a Graduate Research Associate in the Center for Policy Research, and an Affiliate of the Policy, Place, and Population Health Lab in the Maxwell School at Syracuse University.

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