Racial Residential Segregation and Airborne Toxic Metals

Targeted emissions reductions could reduce these pollution disparities, which likely contribute to health disparities.

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Communities of color are often disproportionately exposed to fine particles in the air called $PM_{2.5}$. But $PM_{2.5}$ is a broad class—defined as particles 2.5 micrometers in diameter or less. $PM_{2.5}$ contains a mix of components, some of which are more toxic than others. Among the most toxic are carcinogenic and neurotoxic metals such as lead and vanadium. Racial disparities in exposure to these specific metals in $PM_{2.5}$ haven't been well understood.

A team of NIH-funded researchers examined $PM_{2.5}$ recorded by EPA monitoring networks at locations across the United States. Led by Drs. John Kodros and John Volckens at Colorado State University, they looked at levels of toxic metals, such as lead, that come mostly from human activities. They also looked at metals, such as iron, that come mostly from natural sources. They compared these measurements with residential segregation in the same locations. Results appeared in Nature Communications on November 1, 2022.

In counties where Black people were highly segregated from White people, total $PM_{2.5}$ levels were twice as high as in well-integrated counties. But levels of human-emitted metals in $PM_{2.5}$ were 4-20 times as high. The mass proportions of metals (the metals' share of total $PM_{2.5}$ mass) followed a similar trend. Mass proportions of the human-generated metals were 3-12 times higher in highly segregated counties than in well-integrated counties. For most metals, these disparities remained stable over the past decade.

These findings suggest that the air pollution in segregated areas is more toxic than in well-integrated areas. "Populations living in racially segregated communities not only breathe more fine particle air pollution," Volckens explains, "they breathe a form of pollution that is much more concentrated in toxic, cancer-causing compounds."

The team also found evidence that targeted regulations can improve these disparities. In 2010, regulations were enacted to limit the sulfur content of fuel used in marine shipping. One effect of these regulations was that the vanadium content of fuel also decreased. Over the next decade, vanadium concentrations in air pollution across the U.S. decreased. The largest decrease, the

research team found, occurred in highly segregated counties. As a result, the racial disparity in vanadium exposure went down by a factor of 1.5.

“The good news is that sweeping environmental cleanups, like the establishment of national clean-fuel standards, not only reduce air pollution nationwide, but also serve to reduce the pollution exposure disparities we see in many segregated communities,” Kodros says.

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