Environmental Justice and Kidney Health: Toxic Exposures in Vulnerable Populations

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There is a growing understanding that the health of the physical environment relates directly to the health of its communities and individuals. Exposure to human-made and naturally occurring toxins in the air, water, and soil can lead to tissue accumulation and injury, organ dysfunction, and ultimately contribute to morbidity and mortality. Common environmental pollutants include fine particulate matter (PM) with an aerodynamic diameter of ≤2.5 μm ($PM_{2.5}$), heavy metals (arsenic, cadmium, lead, and mercury), pesticides and herbicides, and perfluorinated alkylated substances (commonly known as forever chemicals). Additionally, transient environmental events such as heat waves, wildfires, and natural disasters—globally increasing in frequency and intensity—are known to have direct effects on human health, as well as contributing to higher exposures to pollutant mixtures (e.g., polluted floodwaters and wildfire smoke) and damage to infrastructure.

Individuals with underlying kidney diseases are especially susceptible to the effects of environmental toxins, presumably from their high underlying comorbidity burden. Of the environmental toxins, $PM_{2.5}$ has been the most widely studied and has been shown to associate with 1) reduced glomerular filtration rate, 2) progressive kidney diseases among the general population and among selected individuals with glomerular disease, and 3) increased hospitalizations and mortality among patients receiving maintenance dialysis. Heavy metals lead to specific types of tubular and interstitial kidney injury, whereas the pesticides, herbicides, and forever chemicals have been postulated to lead to kidney diseases based on the known property of the chemicals, but mechanistic and epidemiological evidence is limited.

The effects of heat, including transient elevations, on kidney injury have been studied primarily in the context of community-acquired acute kidney injury and chronic kidney disease (CKD) of unknown etiology (CKDu) or CKD of nontraditional origin (CKDnt). CKDu or CKDnt often occurs among individuals engaged in intense manual labor in hot environments. A multiagency-sponsored consortium study is underway to investigate the independent and joint effects of heat, toxic pollutant exposures, and medication use on CKDu or CKDnt among outdoor workers (1). Furthermore, recent studies have demonstrated that extreme heat events are associated with increased hospitalizations and mortality for patients receiving in-center hemodialysis (2) and that natural disasters in the Americas have had an immediate impact on the ability of populations on dialysis to receive maintenance dialysis due to closure of dialysis centers, lack of electricity and clean water, and disruptions to the transportation infrastructure (3).

Concurrently, there is growing evidence that the health impacts from the environment are inequitably distributed among populations nationally and internationally according to wealth, race, and ethnicity. In the United States, racially discriminatory practices and policies, such as placement of transportation infrastructure, industrial siting, and redlining, have resulted in racial and ethnic minorities and socially marginalized communities experiencing greater exposure to urban heat and closer residential proximity to diverse sources of air and water pollution. A body of research has demonstrated that socially marginalized communities with Black and Hispanic populations, who are disproportionately impacted by CKD, are exposed to higher concentrations of $PM_{2.5}$, heavy metals (4), and forever chemicals (5) and experience greater urban heat island intensity (6). These environmental exposures do not occur in isolation, resulting in higher rates of exposure to multiple pollutants and adverse health impacts that are further compounded by poverty and a lack of access to resources. Indeed, distance to major roads, a proxy indicator for exposure to traffic-related air pollution as well as community economic status, is associated with low kidney function (7). A recent study in China of short-term air pollution exposure and kidney function among adults reported that the effects of a multipollutant mixture exceeded that of single pollutants (8). Although improvements to air quality have occurred in many industrialized countries, over the last decade, the United States has experienced widening disparities in $PM_{2.5}$ concentrations and greater health impacts among racial and ethnic minority groups (9). Climate change and its associated hazards are likely to deepen existing disparities, resulting from past and present structural racism or colonialism among communities, countries, continents, and hemispheres.

Environmental justice (EJ) emerged from the Civil Rights Movement of the 1960s to confront environmental racism (10). One of its first examples arose in North Carolina. In 1982, the low-income and majority African American community of Shocco Township protested the state's decision to dispose of dirt contaminated with polychlorinated biphenyl in their community. Over time, EJ has evolved to seek the promotion of an equitable distribution of environmental benefits and burdens among all populations, or a fairness concerning the processes and procedures (i.e., policies and enforcement) that lead to the distribution of environmental benefits and burdens.

As we study the impact of environmental toxins among vulnerable populations, it is crucial to examine it through the lens of EJ. Exposure to environmental toxins may be modifiable through individual and collective efforts locally, nationally, and internationally—ultimately leading to a reduction in the burden of kidney diseases. Yet, without using the research to promote equitable policies and enforcement, we are at risk for merely describing and indirectly perpetuating existing disparities. ■

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Dr. Kshirsagar reports receiving royalties from UpToDate. Dr. O'Lenick reports no conflicts of interest.

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