Environmental Justice and Underserved Communities

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KEYWORDS

• Environmental justice • Toxins • Air pollution • Ingested pollutants

KEY POINTS

- Environmental justice has wide social, economic, and educational implications.
- Air pollution has the highest environmental risk with dangers from gases, organic compounds, and toxic materials.
- Carbon monoxide, nitric oxide, or nitrogen dioxide, sulfur dioxide, and ozone pose higher dangers for the poor.
- Exposure to metals in air pollution (eg, mercury, lead, cadmium, and manganese) can cause cognitive disorders, nervous system diseases, cancers, and mental illness.
- There is currently some controversy about the possible carcinogenic dangers of ingesting pollutants from water, soil, and food (eg, bisphenol A, arsenic).

ENVIRONMENTAL JUSTICE

The idea of environmental justice (EJ) arose in the 1980s, bringing to light the concept that the burdens of environmental exposure should be fairly distributed without undue costs being placed on those with low socioeconomic status (SES). The concept was formally written into US policy by executive order in 1994, with policy creation, implementation, and enforcement tasked to the Interagency Working Group on Environmental Justice under the US Department of Agriculture.

When EJ issues are studied, the location of waste disposal sites, manufacturing facilities, energy plants, highways, airports, and toxic waste sites, are mapped against SES or minority groupings. Most North American, Asian, and African studies have documented higher concentrations of pollutants in underserved or low SES communities.[1] Such disparities have important health implications. For example, the

Disclosure Statement: The authors of this work report no direct financial interest in the subject matter or any material discussed in this article.

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Prim Care Clin Office Pract 44 (2017) 155–170

http://dx.doi.org/10.1016/j.pop.2016.09.016

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prevalence of asthma in some underserved communities in the United States is twice that of the national average (9% of US children have asthma vs 22% in some underserved communities).[2]

EJ issues also have wider social implications due to the interrelatedness of crime, education, poverty, and pollution. For example, a recent air toxin per youth crime mapping study found an association between airborne manganese, mercury, and particulate matter (PM) with higher rates of youth involvement with the juvenile justice system.[3] Although the study methodology could not definitively link exposure to EJ concerns, the implications demand further study. Other studies have noted that mononitrogen oxide (NO_x), ozone, heavy metals, and other pollutants are associated with neurologic deficits, behavioral problems, aggressive behavior, slowed learning, and other cognitive deficits, all important from health, human potential, and social policy perspectives.

ENVIRONMENTAL TOXINS

The Centers for Disease Control and Prevention (CDC) Fourth National Report on Human Exposure to Environmental Chemicals (2009, updated in 2015) includes data on 265 toxins. Exposures may be the result of inhalation (eg, motor vehicle emission, industrial air pollution), ingestion (eg, from tainted foods, ground water), or percutaneous absorption. Compounds, such as pesticides, heavy metals, phenols, fungicides, herbicides, parabens, phthalates, polyaromatic hydrocarbons, volatile organic compounds (VOCs), and tobacco smoke, are included in the analysis. For each chemical in the report, the CDC provides mean blood and urine levels, as well as the 75th, 90th, and 95th percentile levels, so that individuals or groups can be compared with population standards. The best method of detection (blood or urine) for each of the chemicals is also noted and 93 of the compounds have more in-depth biomonitoring data.[4]

The report, however, does not establish what levels may be harmful to an individual's health. These must be obtained from other sources. For example, the CDC provides population comparison levels for arsenic; the Environmental Protection Agency (EPA) monitors and sets the safe levels for air, drinking water, and soil; the Food and Drug Administration (FDA) sets safe food and bottled water levels; and the Occupational Safety and Health Administration (OSHA) is tasked with formulating and monitoring harmful workplace levels. (The EPA, FDA, and OSHA are also tasked with enforcement, so that companies found in violation of guidelines may be fined as set out in their respective policies.)

There are many mechanisms by which toxins may cause injury. Exposures may induce an inhalant allergic response, direct toxic effects on cellular mechanics (eg, lead, arsenic, mercury), endocrine disrupting effects (bisphenol A [BPA], phthalates),[5] direct DNA damage, or may create epigenetic changes (see later discussion). In most cases, free radical formation, oxidative stress, and inflammation[6] are thought to contribute to the injury. Other factors, such as whether the particles are solid, liquid, or gas; electrostatic charge; particle size; site of deposition; and lung response must also be taken into consideration.[7]

The concept of epigenetic change is a relatively recent construct that primary care providers (PCPs) working with underserved populations would do well to keep in mind. This is a growing area of research in which changes in gene expression without alterations in DNA sequence have been shown to contribute to untoward health effects.[8] Briefly, the concept is that environmental, social, physical, nutritional, or chemical stressors can lead to modifications (eg, methylation, acetylation) of the proteins

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