

Effect of pollution on allergy/immunology



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Of all the recognized medical specialties in the United States, allergists and immunologists have most regularly paid attention to environmental factors that affect disease and incorporated environmental control as an important part of disease management. Traditionally, allergy/immunology has focused on indoor environmental controls, primarily for reduction of allergen exposure but also to decrease other airway irritants, most notably secondhand tobacco smoke. More recently, however, research by our specialty and others has shown that outdoor air pollutants, most significantly ozone and particulate matter, are associated clearly with increased asthma morbidity, with increased medication use, emergency and acute care visits, and hospitalizations.^{1,2}

Research by members of the allergy/immunology community has shown that pollutants augment immediate and late-phase responses to allergens. Research also indicates that pollutants contribute to development of disease, with tobacco smoke and diesel exhaust particles augmenting primary sensitization to antigens, leading to an IgE response. Epidemiologic studies also demonstrate that exposure to ambient air pollutants contributes to increased hospitalizations, decreased lung growth, and development of disease. Our science clearly shows that air pollutants, even at levels less than the current National Ambient Air Quality Standards for ozone and particulate matter, contribute to asthma morbidity.^{1,2}

To address the environmental effects on disease, our community has engaged in a number of research endeavors to address indoor environmental controls in homes and schools, as well as individualized pollution avoidance strategies and potential interventions that subjects can take to decrease the effect of pollutants on their health. All of this research is important and urgently needed. However, recent observations show clearly that a more holistic approach that involves clinicians, researchers, engineers, sociologists, and policymakers is needed to address a broader effect of environmental exposures on disease.^{3,4}

Data from our own National Allergen Bureau has proved critical in demonstrating the effect of changing climatic conditions on allergen levels in North America. In the northern latitudes of the United States, annual pollen exposures begin earlier, last longer, and result in greater amounts of pathogenic allergen production than ever before.⁵ Other studies show that plant-based

pathologic antigens are produced more vigorously with experimental exposures to carbon dioxide and ozone. These are some allergy/immunology-specific observations that indicate a broader effect of adverse environmental conditions.⁵⁻⁷

On a worldwide level, environmental pollution has an even greater effect on human health. The Lancet Commission on pollution and health report published in October 2017 examined data from the 2015 Global Burden of Diseases.⁸ As noted in the report, it is estimated that 9,000,000 persons per year die as a result of air, water, and soil pollution. This is more than the deaths caused by HIV/AIDS, tuberculosis, and malaria combined (Fig 1).⁸ It is also 15 times greater than deaths associated with war and violence. Death caused by air pollution (ambient and household air pollution) accounts for more than 6,000,000 deaths per year. These deaths are due to chronic obstructive pulmonary disease, lung cancer, ischemic heart disease, stroke, and all cardiovascular deaths, with chronic obstructive pulmonary disease being the leading cause (Fig 2).⁸ Ambient and household air pollution (caused by biomass use) is also associated with increased occurrence of bronchitis and pneumonia. It is important to note that the majority of pollution-related disease is associated with lower socioeconomic status. Thus this is not only a worldwide health issue but also a health equity issue.⁸

Of note, most of these disease processes are within either our clinical (asthma, airway disease, and infection) or research (immune response and inflammation) domains. The field of allergy and immunology is poised to bring environmental awareness to clinical practice. This includes ensuring that appropriate medications are being used, reducing use of tobacco and biomass fuel use indoors, and patient education regarding the effect of ambient pollutants on disease outcomes.

However, it is also incumbent on our specialty to participate in policy and regulatory discourse.

The most significant effects on the diseases we treat derive from policy and regulatory actions that reduce pollution. A prime example of this in the United States is removal of lead from gasoline. This was directly related to decreased blood lead levels and improvement in diseases associated with lead exposure.⁸ Another example can be found in Southern California. In studies undertaken by researchers at the University of Southern California, it has been shown that there has been a significant reduction in ambient air pollutants in this region over the past 20 years. Pollutant exposure had been associated with decreased lung volume and increased episodes of acute asthma and bronchitis. However, with decreased levels of ambient air pollutants, both of these outcomes have improved remarkably.^{9,10}

Going forward, it is clear that exposure to pollutants, even at levels less than current air quality standards, is associated with respiratory, cardiovascular, and, more recently, neurocognitive disease and even osteoporosis. There are policy decisions that could reduce these outcomes further. Decreased use of fossil fuels, understanding the relationship between living near heavily traveled roads, and addressing the use of indoor biomass use

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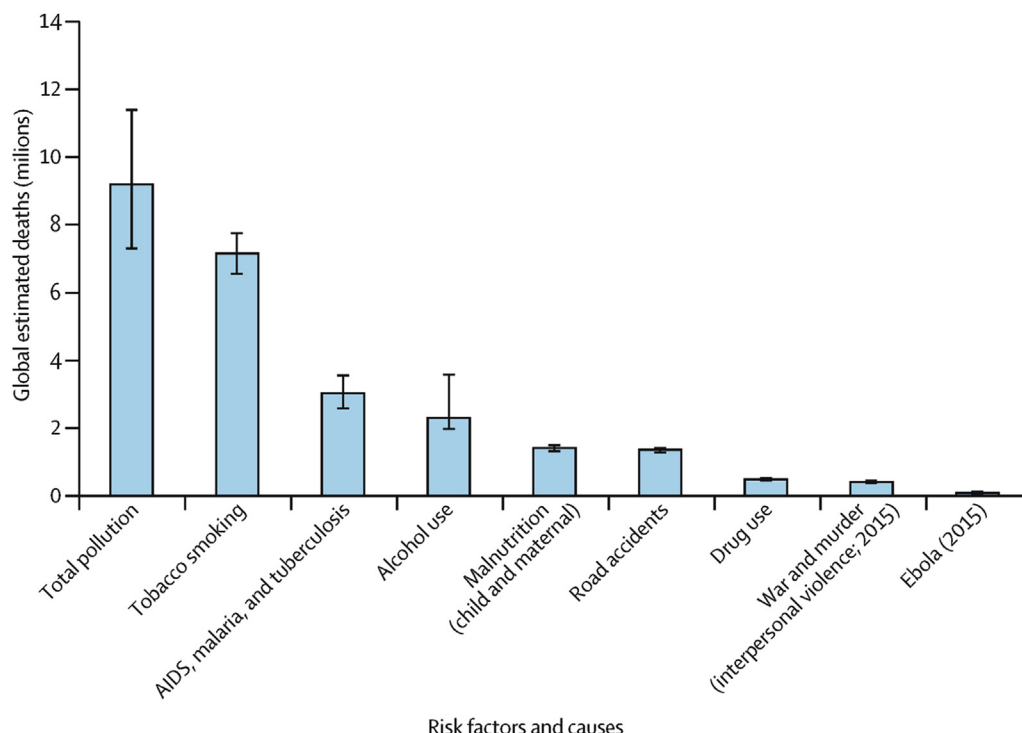


FIG 1. Global estimated deaths by major risk factor and cause, 2015, using data from the GBD Study, 2016.⁸ Used with permission.

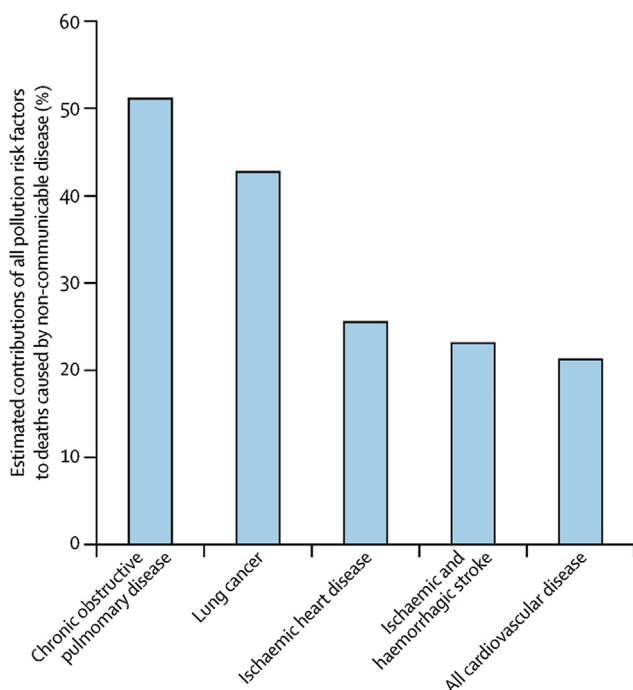


FIG 2. Estimated contributions of all pollution risk factors to deaths caused by noncommunicable diseases, 2015, using data from the GBD Study, 2016.⁸ Used with permission.

are all actions we as allergy/immunology practitioners can undertake. The solutions to pollution and the effect it has on climate and human health are complex and multifactorial. Partnership with communities, regulators, health care systems,

business leaders, and government at all levels will be important. This is a challenge our specialty is very able to address.

In this spirit the *Journal of Allergy and Clinical Immunology*, the *Journal of Allergy and Clinical Immunology: In Practice*, and the annual meeting are focused on environmental effects on allergic disease. I look forward to the meeting and to our specialty playing a leading role in this crucial public health issue.

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