

The impacts of air pollution on the immune system

By Robin Arnette

As a pediatric immunologist and NIEHS grantee, Kari Nadeau, M.D., Ph.D., knows that environmental exposures may have serious effects on human health. That's why she teamed up with researchers from several universities in California, as well as NIEHS and the U.S. Environmental Protection Agency, to form the [Children's Health and Air Pollution Study – San Joaquin Valley](#)

(<http://chaps.berkeley.edu/index.html>)

. The study aims to understand and reduce the risks of air pollution exposure to children living in California's San Joaquin Valley.

Nadeau

(<https://med.stanford.edu/profiles/kari-nadeau>)

is associate professor of Pediatrics – Allergy and Immunology at Stanford University School of Medicine. She talked about the study, collaborations, and scientific insights that have resulted, during a Dec. 16 NIEHS Distinguished Lecture, "How Pollution Exposure Leads to Immune Dysfunction: The Role of Epigenetics and Multiplex Immunophenotyping Studies." Gwen Collman, Ph.D., NIEHS Division of Extramural Research and Training director, served as seminar host.

Environmental exposures and disease outcomes

One of the things that prompted Nadeau to examine the effects of pollution on children was a World Health Organization report she read as a young pediatrician. According to the report, more than 33 percent of diseases in children age 5 and younger result from environmental exposures. With most risk factors related to air and water pollution, pesticides, and contaminants in the diet, Nadeau knew the immune system was playing a critical role.

"Both the innate and adaptive immune systems are sensitive to these detrimental environmental exposures and can tell us a lot about how our body reacts to toxicants," Nadeau said.

Nadeau studies regulatory T cells – cells that modulate the immune system – to form hypotheses about the link between the immune system and asthma. Though her group focuses on asthma, pollution may worsen defects in a person's immune system, resulting in diseases such as endocrine disorders, allergic reactions, cancer, cardiovascular disease, and autoimmune disease.

NIEHS advice spurs new research connection

Nadeau, who specializes in molecular immunology, had been looking for ways to test her hypotheses. She decided to call NIEHS and was advised to collaborate with Ira Tager, M.D., professor of epidemiology at the University of California, Berkeley. For several years, Tager had been studying children with asthma and allergies in Fresno and the surrounding San Joaquin Valley, one of the most polluted areas of the country, with fine particulate matter in air exceeding the federal annual standard by more than 40 percent.

Tager and Nadeau worked together to develop four cohorts of healthy and asthmatic children at both Stanford and Berkeley. They collected blood from 367 children and measured surrounding particulate matter, air pollutants, polycyclic aromatic hydrocarbons, volatile organic compounds, smoke, and allergens.



"With the Children's Environmental Health Centers, we're working to educate the community about what the science is telling us, and how it may help the community and help shape public health policy," Nadeau said. (Photo courtesy of Steve McCaw)



"Since Kari has been a grantee of the institute for some time, I'm familiar with the proposals she has submitted," Collman said. "I thought it would be great to hear her talk about the work we currently fund." (Photo courtesy of Steve McCaw)

The study found a 3-fold increase in a special set of cells, called ILC2-like cells, in children with high exposure to air pollution. The findings are the first to show that ILC2-like cells are associated with high pollution exposure in humans.

Donald Cook, Ph.D., head of the NIEHS Immunogenetics Group noted innovative aspects of the work. "Their research used a new technology called time-of-flight mass cytometry, which allowed a large number of different antibodies to be used simultaneously," he said "This work definitely pushes the field of immunology further along."

Linked Video

[Watch Nadeau discuss her insights into biomarkers for the success of clinical immune therapy, in an interview with the editor of the Journal of Allergy and Clinical Immunology, which published a 2014 paper on these findings. \(8:33\)](#)

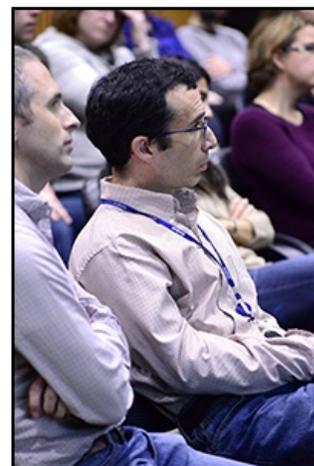
Heavy metals in water

Nadeau also discussed her role in the New Hampshire Birth Cohort Study, which examines the impact of environmental factors on pregnancy and child health. Many residents of New Hampshire use privately owned wells, which often contain high levels of arsenic. Nadeau worked with Margaret Karagas, Ph.D., of Dartmouth College to evaluate arsenic and cadmium exposure in area pregnant mothers and their children.

Looking back on her involvement in these studies, Nadeau said her training was an asset. "I wanted to approach the problem as a clinician scientist, as a translational researcher, and as an immunologist," she said. "It's great that we can be cross-trained in immunology, as well as other fields."



Cook's research group uses genetic approaches to understand the molecular and cellular mechanisms that lead to responses to inhaled allergens. (Photo courtesy of Steve McCaw)



Michael Fessler, M.D., deputy chief of the NIEHS Immunity, Inflammation, and Disease Laboratory, and head of the Clinical Investigation of Host Defense Group, was particularly interested in Nadeau's findings related to the innate immune response. (Photo courtesy of Steve McCaw)

The Environmental Factor is produced monthly by the [National Institute of Environmental Health Sciences \(NIEHS\)](http://www.niehs.nih.gov/) (<http://www.niehs.nih.gov/>)

, Office of Communications and Public Liaison. The content is not copyrighted, and it can be reprinted without permission. If you use parts of Environmental Factor in your publication, we ask that you provide us with a copy for our records. We welcome your [comments and suggestions](#). (bruskec@niehs.nih.gov)

This page URL: NIEHS website: <http://www.niehs.nih.gov/>
Email the Web Manager at webmanager@niehs.nih.gov