

Is The Central Valley's Air Pollution Affecting Our Cells And Genes?

By [Rebecca Plevin](#)

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Here in the Central Valley – in one of the most polluted air basins in the country – we know that poor air is bad for our health. We feel it in our eyes and throat, and when we struggle to breathe.

But what if air pollution is affecting us at a deeper, cellular level?

That's exactly what Dr. Kari Nadeau discovered a few years ago. She's a Stanford School of Medicine professor with an expertise in asthma and allergies.

She noticed that many of her child asthma patients had abnormally low levels of regulatory T-cells, which are crucial to maintaining a healthy immune system.

Then, she noticed something interesting.

"I went back and looked at age, ethnicity and address and, low and behold, the addresses were all in one area of the country," Nadeau recalls.

Fresno, to be exact.

Nadeau then compared the regulatory T-cell function in kids from Fresno – where there's heavy air pollution – with kids from Palo Alto, where there's less air pollution. They focused specifically on exposure to one of the byproducts of combustion. PAH – as it's known by its initials – is a result of gasoline and diesel engines, and burning of wood and tobacco.

The results were surprising.

She found that even kids *without* asthma in Fresno had lower regulatory T-cell levels – meaning, reduced immune system function – than kids in Palo Alto *with* asthma.

The children's immune function was measured by studying a gene, known as FoxP3. In Fresno kids, this gene was also more suppressed than the Palo Alto kids.

That means, she concluded, that exposure to the pollution was possibly causing changes to kids' DNA.

"At the DNA level, there were some changes going on in people who lived in Fresno" - Dr. Kari Nadeau

"This study was all about associations, but it implied, and you could infer that, at the DNA level, there were some changes going on in people who lived in Fresno, and those changes were associated with the level of PAH in the air," Nadeau says.

That finding surprised Dr. Katharine Hammond, a UC Berkeley professor and a longtime air pollution researcher.

"I have to say, my jaw dropped almost to the floor," Hammond says. "I was stunned."

Hammond says that even for a small study, there was a clear and direct link between air pollution and kids' immune systems.

"The more PAH exposure, the worse their T-regulatory cell function was. And then to find out that you could go deeper, to the cellular level, and find that - oh my golly - the air pollution is related to the degree of change in their genes," Hammond says.

Nadeau's results raised more questions for researchers like Hammond. They began to wonder if air pollution's effect on the immune system could lead to other health problems, far beyond asthma.

"It's very clear that air pollution is playing a major role in the health of people in Fresno and the surrounding counties in the Valley but, at the same time, I think we have only begun to understand the full effect of that," Hammond says.

Researchers from Stanford and UC Berkeley – including Nadeau and Hammond – could soon uncover some answers. They've received a major, 5-year grant from the U.S. EPA and NIH to study children's health and air pollution in the Valley. It's one of about a dozen Children's Environmental Health Centers across the country.

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The researchers will study whether exposure to the air pollutant PAH increases the risk of birth defects. Following up on Nadeau's research, they'll also investigate whether the T-regulatory cell and PAH play a role in children's risk of allergic disorders, diabetes and even obesity.

Obesity? Is that because the foul air deters kids from playing outside?

Nope, says Dr. John Balmes. He's a physician at UCSF and UC Berkeley, who's leading the center's research into air pollution and obesity.

Balmes says PAH can injure the lining of the lungs, and cause inflammation, and, “if that airway inflammation is severe enough, it spills over in the circulation and causes systemic inflammation, and we know that systemic inflammation leads to increased risk of diabetes and obesity.”

As part of the study, the UCSF Fresno team will take blood samples, which will be analyzed at Stanford. They will also test kids’ lung function, and measure their height, weight and body fat.

If their hypotheses are correct, the researchers’ work could fundamentally shift the way we view air pollution as a health threat.

Fresno State professor Dr. John Capitman is leading one of the research projects. He says that idea that a polluted environment could not only affect the lungs and heart, but also change people’s underlying genetics and cell formation, is mind-boggling.

The implication of the study, he says, is “we can really show this idea of epigenetic changes – changes in people’s genetic make-up from their exposure to the environment – and those epigenetic changes potentially go on not only through their life, but actually get passed on to children in the second and third generation.”

The Children’s Environmental Health Center has funding through 2018. The researchers expect to have some early results in two to three years.