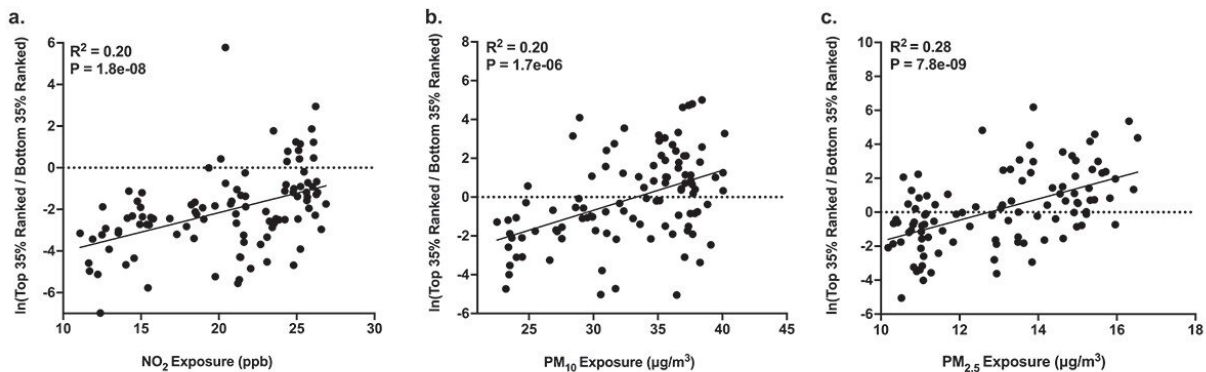


How pollution changes a baby's gut, and why it matters

September 2 2022, by Lisa Marshall



Associations between (a) NO₂, (b) PM₁₀, and (c) PM_{2.5} exposure during the first 6 months of life and differentially ranked log ratios. The differentially ranked log ratios represent the ratio between the top and bottom 35% of sOTUs as ranked based on their association with each pollutant by Songbird (i.e., important taxa). Credit: *Gut Microbes* (2022). DOI: 10.1080/19490976.2022.2105096

Exposure to air pollution in the first six months of life impacts a child's inner world of gut bacteria, or microbiome, in ways that could increase risk of allergies, obesity and diabetes, and even influence brain development, suggests new University of Colorado Boulder research.

The study, published this month in the journal *Gut Microbes*, is the first to show a link between inhaled pollutants—such as those from traffic, wildfires and industry—and changes in infant microbial health during

this critical window of development.

Previous research by the same group found similar results in young adults.

"This study adds to the growing body of literature showing that [air pollution](#) exposure, even during infancy, may alter the [gut microbiome](#), with important implications for growth and development," said senior author Tanya Alderete, assistant professor of Integrative Physiology at CU Boulder.

At birth, an infant hosts little resident bacteria. Over the first two to three years of life, exposure to mother's milk, [solid food](#), antibiotics and other environmental influences shape which microorganisms take hold. Those microbes, and the metabolites, or byproducts, they produce when they break down food or chemicals in the gut, influence a host of bodily systems that shape appetite, insulin sensitivity, immunity, mood and cognition. While many are beneficial, some microbiome compositions have been associated with Crohn's disease, asthma, type 2 diabetes, and other chronic illnesses.

"The microbiome plays a role in nearly every physiological process in the body, and the environment that develops in those first few years of life sticks with you," said first author Maximilian Bailey, who graduated in May with a master's in Integrative Physiology and is now a medical student at Stanford University.

Boosting inflammation

For the study, the researchers obtained fecal samples from 103 healthy, primarily breast-fed Latino infants enrolled in the Southern California Mother's Milk Study and used genetic sequencing to analyze them.

Using their street addresses and data from the U.S. Environmental Protection Agency's Air Quality System, which records hourly data from monitoring systems, they estimated exposure to PM_{2.5} and PM₁₀ (fine inhalable particles from things like factories, wildfires and construction sites) and Nitrogen Dioxide (NO₂), a gas largely emitted from cars.

"Overall, we saw that ambient [air pollution exposure](#) was associated with a more inflammatory gut-microbial profile, which may contribute to a whole host of future adverse health outcomes," said Alderete.

For instance, infants with the highest exposure to PM_{2.5} had 60% less *Phascolarctobacterium*, a beneficial bacterium known to decrease inflammation, support gastrointestinal health and aid in neurodevelopment. Those with the highest exposure to PM₁₀ had 85% more of the microorganism *Dialister*, which is associated with inflammation.

Disadvantaged communities at higher risk

In a previous study, Alderete found that pregnant Latino women exposed to higher levels of air pollution during pregnancy have babies who grow unusually fast in the first month after birth, putting them at risk for obesity and related diseases later in life.

Infants are particularly vulnerable to the health hazards of air pollution because they breathe faster and their gut microbiome is just taking shape.

"This makes early life a critical window where exposure to air pollution may have disproportionately deleterious health effects," they write.

Racial minorities and low-income communities, who tend to work, live and attend school in regions closer to busy highways or factories, are at

even greater risk. One 2018 Environmental Protection Agency study found that communities of color are exposed to as much as 1.5 times more airborne pollutants than their white counterparts.

"Our findings highlight the importance of addressing the impact of pollution on disadvantaged communities and point to additional steps all families can take to protect their health," said Alderete, who hopes her research will influence policymakers to move schools and affordable housing projects away from pollution sources.

The authors caution that more research is needed to determine whether changes in the gut in infancy have lasting impacts, and just what those are. More studies are underway.

Meantime, Alderete advises everyone to take these steps to reduce their exposure to both indoor and outdoor pollutants:

- Avoid walking outdoors in high traffic zones
- Consider a low-cost air-filtration system, particularly for rooms children spend a lot of time in
- If you are cooking, open the windows
- And for new moms, breastfeed for as long as possible

"Breast milk is a fantastic way to develop a [healthy microbiome](#) and may help offset some of the adverse effects from environmental exposures," Alderete said.

More information: Maximilian J. Bailey et al, Postnatal exposure to ambient air pollutants is associated with the composition of the infant gut microbiota at 6-months of age, *Gut Microbes* (2022). [DOI: 10.1080/19490976.2022.2105096](https://doi.org/10.1080/19490976.2022.2105096)

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