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## Urban Air Pollutants Can Damage IQs before Baby's First Breath

A study in Krakow, Poland, corroborates New York City findings that link children's lower IQ scores with mothers' exposure to compounds created by burning fossil fuels

By Marla Cone, Emily Elert and Environmental Health News

In a sweltering summer in New York City back in 1999, Yolanda Baldwin was eight months pregnant with her first child. She lived near a gas station and across the street from an intersection choked with exhaust-spewing cars and buses. Sometimes the air was so thick with pollution that she could see it, breathe it, smell it, even taste it. And she often wondered what it might be doing to her unborn child.

Now Baldwin and several hundred other mothers whose sons and daughters have been monitored for a decade have an answer: Before children even take their first breath, common air pollutants breathed by their mothers during pregnancy [may reduce their intelligence](#).

A pair of studies involving more than 400 women in two cities has found that 5-year-olds exposed in the womb to above-average levels of polycyclic aromatic hydrocarbons, or PAHs, score lower on IQ tests. The compounds, created by the burning of fossil fuels, are ubiquitous in urban environments.

In African American and Dominican communities of New York City, 249 children are being monitored for the effects of environmental contaminants until the age of 11. And across the Atlantic, in Krakow, Poland, another 214 children are participating in a parallel study.

The findings in Poland, reported this spring, are strikingly similar to New York City's: The children whose mothers had above-average exposure to PAHs scored about four points lower on IQ tests than children whose mothers had below-average exposure.

The difference in IQs is modest, but experts say it is enough to hamper school performance and perhaps lifelong learning. It is about the same deficit linked to low-level exposure to lead, a well-documented cause of reduced IQs in children.

"We think that this is a finding of concern because child [intelligence](#) is one of the predictors of how well a child will do in the academic setting later on," said Frederica Perera, the senior author of the studies and director of [Columbia Center for Children's Environmental Health](#) in New York City.

The pair of studies "adds to a growing literature implicating exposures to environmental toxicants with stunting of children's intellectual abilities and increased risk for attention deficit hyperactivity disorder and conduct disorders," said [Bruce Lanphear](#), professor of children's environmental health at British Columbia's Simon Fraser University. He was not involved in the research.

The link between prenatal exposure to pollutants and cognitive development is a growing area of concern "that's been getting a lot more attention," said [David Bellinger](#), an environmental epidemiologist and professor of neurology at Harvard Medical School.

One strength of the Columbia University research is that the scientists know precisely how much pollution the mothers were exposed to during a brief period of their pregnancy.

Recruited for the study between 1998 and 2006, Baldwin and the other 462 pregnant women in New York City and Krakow carried backpacks for 48 hours that contained equipment for measuring PAHs. Then their children were divided into high and low exposure groups – those above the median and below – and when they reached the age of five, they underwent standardized tests to measure their cognitive skills.

"It's scary and alarming that we can live in a society where these things are happening and they go unnoticed," said Baldwin, now the mother of five children. "I know now that what we do can affect us in the future. The things we eat or breathe in, our

environment, it does affect the children.

In Krakow, most of the compounds come from coal burning for home heating and factories, while in New York City, exhaust from cars, trucks and buses is the major source.

The results in Poland, published in April, bolster the New York City findings, which were published a year ago, because they found the same effect on IQs of children living in different conditions, in different parts of the world.

While the New York City group – from Harlem, the South Bronx and Washington Heights – included only African-American and Dominican women, all the women in Poland were Caucasian.

“We’re confirming a finding in a different population, a different setting, even a different gradient of exposure, and that reinforces the initial finding in New York,” Perera said. “The study provides further evidence that prenatal exposure to air pollution adversely affects children’s cognitive development.”

In Krakow, the women on average were exposed to eight times higher concentrations of PAHs than the women in New York City. (In Krakow, 17.96 nanograms per cubic meter; in New York City, 2.26)

Some experts say the findings raise questions because the IQ losses were similar in the two groups despite the eightfold difference in their average level of exposure.

“It is a striking finding given the many differences in the two cohorts,” said Jennifer Adibi, an epidemiologist at University of California, San Francisco who studies how environmental exposures affect fetal development. “We would want to see this association replicated in other cohorts before we attribute a causal relationship to it.”

Adibi added that many factors are different in New York City and Krakow - such as diet, lifestyle, ethnicity and other contaminants.

“Direct comparison between the two studies, given their differences and the sample sizes, is extremely difficult,” added Negin Martin, a research fellow at the National Institute of Environmental Health Sciences who studies how pollutants affect brain development.

Nevertheless, Martin said it is notable that the studies were consistent; they each found “a measurable and statistically significant decrease in IQ,” she said. When the scientists compared only the 150 women who had similar exposures in the two cities, IQ differences were still found.

The researchers also adjusted their data to consider some factors that could influence a child’s intelligence and skew the results, such as maternal education and [second-hand smoke](#). One possible confounding factor, however, is that the children were not tested for lead exposure when they were toddlers. They were checked only for prenatal exposure, which is normally less of a problem. Accounting for such factors is “a pretty big challenge, and it’s one that Columbia’s group does very well,” said Bellinger, who was not involved in the study.

Researchers have now linked several environmental contaminants to effects on developing brains.

In earlier work, the Columbia University team found lower IQs in children whose pregnant mothers were exposed to high levels of a pesticide, chlorpyrifos, which was widely used in households until it was banned for residential use in 2001. Similar results were reported in children with prenatal exposure to secondhand smoke. And for more than two decades, scientists in the Faroe Islands, in the North Atlantic, have reported reduced IQs in children exposed in the womb to mercury in seafood.

Lanphear said PAHs, lead, mercury, tobacco smoke are systemic poisons that can damage multiple organ systems.

“It is well known that airborne pollutants – a soup of various types of toxicants – are associated with low birth weight, diminished lung function, lung cancer and asthma. So while these studies [of children’s IQ] are novel, the results shouldn’t surprise us,” he said.

Scientists know that many chemicals including PAHs can cross the placenta, but they don’t understand how they [may interfere with a fetus’ developing brain](#).

In the sensitive process of brain development, Bellinger said, there are a lot of things that can go wrong.

“Things are changing very rapidly and they’re supposed to happen in a particular way, in a particular sequence,” he said. “It’s almost like a choreography of events that go into building a brain.” This choreography is made up of hundreds of “performers,” each taking instructions from chemical signals. Pollutants introduce noise to this process, like static over a radio station.

Also, PAHs may affect the fetus’ DNA directly. When a mother breathes in PAHs, those chemicals are changed into byproducts in the bloodstream that can cross the placental boundary and bind directly to a fetus’ DNA, explained Susan Edwards, a graduate

student at the Imperial College in London, and the lead author on the Poland study.

The four-point drop in IQs linked to the air pollutants in New York City and Krakow is fairly subtle; parents and teachers wouldn't notice it because most children would fall within normal ranges.

Nevertheless, "is a three or point IQ-point decrement important? You bet," said Lanphear, whose research has focused on lead exposure and children's neurodevelopment.

He said one recent analysis found that for every dollar invested in reducing lead exposure, society would realize a \$17 to \$220 benefit. "The bulk of the benefit was from increased lifetime earnings by enhancing children's intellectual abilities," he said.

"At some point, we will cease blaming parents and teachers for children's failure to learn or thrive in academics and focus our attention on reducing their exposure to widespread neurotoxicants," Lanphear said.

The good news, Perera said, is that levels of PAHs are declining in New York City. Using data from the women's backpacks, researchers reported that airborne levels dropped by more than 50 percent between 1998 and 2006.

Bellinger said while steps should be taken to reduce children's exposure to pollutants, other factors remain more important for their cognitive development.

"An important point is that while these exposures are associated with health outcomes, they aren't the major determinants. How parents interact with their children, and the kinds of stimulation they provide, explains a lot more," he said.

Living in New York City's Washington Heights, Baldwin, 30, now has five children between the ages of 10 and two. She wore the air-monitoring backpack in 1999 when she was in the third trimester of her pregnancy with her oldest child, Patience.

Like the other children in the group, Patience has been monitored by the team of scientists since she was born. When Baldwin gave birth, a Columbia University researcher was at the hospital to collect the newborn's cord blood for testing. Her daughter had her first IQ test as part of the study when she was two and has undergone an array of other tests since then, including a recent CT scan of her brain.

There is no evidence that the PAHs affected her daughter's IQ. Baldwin said the girl has thrived in school and has no learning problems, although she has moderate asthma. She does not know whether her exposure to PAHs during the pregnancy was classified as high or low.

Baldwin said her role in the study has made her "hyper aware" of the risks of pollutants and pesticides. One of her sons was diagnosed with lead poisoning when he was a toddler; he apparently was exposed from peeling paint.

But she tries not to think about what effects her various exposures during her pregnancies might have had on her children. "I don't like to dwell on something I cannot change," Baldwin said.

Instead, she tries to empower herself. She avoids walking through exhaust, doesn't use pesticides, buys organic foods, shuts her windows to keep air pollution outdoors and uses air filters in her home.

"Maybe this study will potentially change the way we see the environment and treat it in the future," she said. "Individually and in small groups we can invoke change."

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