

# Childhood lead exposure leads to structural changes in middle-aged brains

November 17 2020

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More than three decades after they were found to have elevated blood

lead levels as children, a group of middle-aged adults were found to have some small but significant changes in brain structure that corresponded to their dose of lead exposure in early life.

MRI scans at age 45 revealed some small but significant changes in the brains of the people who had higher lead exposures measured at age 11.

For each 5 micrograms per deciliter more lead they carried as children, the study participants lost an average of 2 IQ points by age 45. They also had slightly more than 1 square centimeter less cortical surface area and 0.1 cubic centimeter less volume in the hippocampus, which plays a role in memory, learning and emotions.

Participants with the highest [childhood](#) lead exposures also demonstrated structural deficits in the integrity of their brains' white matter, which is responsible for communication between [brain regions](#).

The research participants themselves reported no loss of cognitive abilities, but people close to them said otherwise, noting that they tended to display small everyday problems with memory and attention, such as getting distracted or misplacing items.

"We find that there are deficits and differences in the overall structure of the [brain](#) that are apparent decades after exposure," said Duke University doctoral candidate Aaron Reuben, who is a co-first author on the study, which appears Nov. 17 in the *Journal of the American Medical Association*. "And that's important because it helps us understand that people don't seem to recover fully from childhood lead exposure and may, in fact, experience greater problems over time."

"All of our brain measures were selected based on previous associations with age-related decline and cognition," said Duke doctoral candidate Maxwell Elliott, co-first author of the study. "Cortical surface area has

one of the strongest relationships with cognitive functioning."

The findings come from a long-term study of more than 1,000 people born in the same town in New Zealand in 1972 and 1973 who have been studied nearly continuously since. For this study, the researchers had childhood lead exposure data for 564 of the study participants, who grew up during the peak era of leaded gasoline, which ran from the late-1960's to the late-1980s. As was true across the developed world during that time, almost all of the study participants were exposed to higher lead levels than are permitted today.

"Our findings involve gross features of how your brain looks as a whole," explained Terrie Moffitt, the Nannerl O. Keohane distinguished professor of psychology & neuroscience at Duke and senior author on the paper. "Our research started by looking at these features of the brain because scientists don't really know a whole lot about childhood lead exposure and the brain later in life."

But the differences are there. Elliott said they may reflect long-term consequences of lead exposure, since the cortical surface area, hippocampal volume and [white matter](#) structure all grow during childhood and peak in early adulthood.

More differences may emerge as these people age, Reuben said.

It's probably too soon to tell with this well-studied group of middle-aged New Zealanders, but what Reuben would eventually like to understand is whether individuals exposed to lead in childhood may be at greater risk for degenerative disease as they enter older age.

Animal studies have shown that early exposure to lead may lead to brain changes that contribute to degeneration, such as different gene expression patterns and poorer vascular health. But this hasn't been

shown yet in humans, Reuben said.

**More information:** "Association of Childhood Lead Exposure with MRI Measurements of Structural Brain Integrity in Midlife," Aaron Reuben, Maxwell Elliott, Wickliffe C. Abraham, Jonathan Broadbent, Renate Houts, David Ireland, Annchen Knodt, Richie Poulton, Sandhya Ramrakha, Ahmad Hariri, Avshalom Caspi and Terrie E. Moffitt. *JAMA*, Nov. 17, 2020 [DOI: 10.1001/jama.2020.19998](https://doi.org/10.1001/jama.2020.19998)

Provided by Duke University School of Nursing

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