

Study finds air pollution affects short-term memory, IQ and brain metabolic ratios

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City smog lowers children's IQ. This is among findings from a recent University of Montana study that found children living in cities with significant air pollution are at an increased risk for detrimental impacts to the brain, including short-term memory loss and lower IQ.

Findings by UM Professor Dr. Lilian Calderón-Garcidueñas, MA, MD, Ph.D., and her team of researchers reveal that children with lifetime exposures to concentrations of [air pollutants](#) above the current U.S. standards, including [fine particulate matter](#), are at an [increased risk](#) for brain inflammation and neurodegenerative changes, including Alzheimer's and Parkinson's diseases.

Calderón-Garcidueñas' findings are detailed in a paper titled "Decreases in Short-Term Memory, IQ and Altered Brain Metabolic Ratios in Urban Apolipoprotein ϵ 4 Children Exposed to Air Pollution," which can be found [online](#).

The study found that clinically healthy children who live in a polluted environment and who also carry a gene - the apolipoprotein ϵ 4 allele, already known to increase a person's risk of developing Alzheimer's disease - demonstrated compromised cognitive responses when compared with children carrying a gene with apolipoprotein ϵ 3 allele.

Metropolitan Mexico City is an example of extreme urban growth and serious environmental pollution, where 8 million children are involuntarily exposed to harmful concentrations of fine particulate

matter in the air every day beginning at conception.

The study matched two groups of children living in Mexico City by multiple variables, including age, gender, socioeconomic status and education, among others. They then compared children carrying the $\epsilon 4$ allele to children carrying the $\epsilon 3$ allele and found that those with the $\epsilon 4$ allele had three significant alterations. They had short-term memory shortfalls, an IQ that while within the normal limits measured 10 points less, and changes in key metabolites in the brain that mirror those of people with Alzheimer's disease.

"The results add to growing data suggesting $\epsilon 4$ carriers could have a higher risk of developing early Alzheimer's disease if they reside in a polluted urban environment," Calderón-Garcidueñas said.

She said the study also raises concerns about important educational issues. Since Mexico City children mostly attend underprovided public schools, children do not build cognitive reserves that serve as a defense to pollution impacts.

"A IQ difference of 10 points will likely have a negative impact on academic and social issues, including bullying and teen delinquency," she said.

The authors argue that sustained exposures to urban air pollution result in cognitive underperformance and metabolic brain changes that could lead to an acceleration of neurodegenerative changes.

Air pollution is a serious public health issue, and exposures to concentrations of air pollutants at or above the current standards have been linked to neuroinflammation and neuropathology. In the U.S. alone, 200 million people live in areas where pollutants such as ozone and fine particulate matter exceed the standards.

There are significant associations between exposures to [particulate matter](#) and increased mortality due to stroke, cardiovascular disease and respiratory events. The problem in children living in megacities like Mexico City is much worse.

"There is an urgent need to have a broader focus on APOE ϵ 4 and air pollution interactions impacting children's brains, and their responses could provide new avenues toward the unprecedented opportunity for Alzheimer's disease prevention," Calderón-Garcidueñas said. "We have a 50-year window of opportunity between the time urban children experience the detrimental effects we are describing here and when they will present with mild cognitive impairment and dementia. We need support for studying the current pediatric clinical and imaging evidence in highly exposed urban [children](#). Our efforts should be aimed to identify and mitigate environmental factors influencing Alzheimer's disease."

Provided by University of Montana

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