Two new studies explore how pollution affects the brain

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A pair of recently published USC studies add to our growing understanding of how fine particle pollution—the tiny, inhalable pollutants from cars and power plants—impacts our brains.

The first study, published in *Environment International*, found that these fine particles—known as PM2.5—may alter the size of a child's developing brain, which may ultimately increase the risk for cognitive and emotional problems later in adolescence.

"At this young age, the neurons in children's brains are expanding and pruning at an incredible rate. As your brain develops, it wants to create efficient pathways," said lead author Megan Herting, an assistant professor at the Keck School of Medicine of USC. "If these pathways are altered by PM2.5 exposure, and different parts of the brain are maturing and making connections at different rates, that might set you up for individual differences later on."

USC, located in what the American Lung Association frequently cites as the most polluted city in the nation, is home to a robust air pollution research program. Findings from its studies have led to changes in state and federal guidelines to improve air quality standards. One of its cornerstones is the USC Children's Health Study, one of the largest and most detailed studies of the long-term effects of air pollution.

Herting's team used MRI scans from nearly 11,000 children aged nine and 10 from 21 cities across the United States and matched each scan with yearly pollution data for each child's residence. This is the first study of its kind to show that, even at relatively low levels, current PM2.5 exposure may be an important environmental factor that influences patterns of brain development in American children.

When they compared highly exposed kids with those who had less exposure to PM2.5, they saw differences. For example, areas associated with emotion were larger in highly exposed kids, while other areas associated with cognitive functioning were smaller.

Herting plans to follow the progress of the children, who are part of the

ABCD Study, the largest long-term study of brain health and child development in the United States.

Eating fish could help protect women's brains against fine particle pollution

The second study, published in *Neurology*, found that omega-3 fatty acids from consuming fish may protect against PM 2.5-associated brain shrinkage in older women.

Previous USC research showed that women in their 70s and 80s who were exposed to higher levels of air pollution experienced greater declines in memory and more Alzheimer's-like brain atrophy than their counterparts who breathed cleaner air.

For this study, researchers looked at the brain MRIs of 1,315 women aged 65 to 80 and blood test results to determine levels of healthy omega-3 fatty acids in their blood.

"We found that women with higher blood levels of omega-3s had larger volumes of white matter in their brains. Women living in locations with higher PM2.5 tended to have smaller white matter in their brains, but such damage that may be caused by PM2.5 was greatly reduced in women with high blood levels of omega-3 fatty acids," said corresponding author Jiu-Chiuan Chen, an associate professor at the Keck School of Medicine of USC.

The brain's white matter, in contrast to gray matter, makes up most of the volume of the brain. It is the vast, intertwining system of neural connections that unites different regions of the brain that perform various mental operations. White matter loss may be an early marker of Alzheimer's disease.

More information: Dora Cserbik et al. Fine particulate matter exposure during childhood relates to hemispheric-specific differences in brain structure, *Environment International* (2020). DOI: 10.1016/j.envint.2020.105933

Cheng Chen et al. Erythrocyte omega-3 index, ambient fine particle exposure and brain aging, *Neurology* (2020). DOI: 10.1212/WNL.0000000000010074

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