

Air quality linked to increased risk of Alzheimer's

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Researchers at the University of California, Davis, have found a link between traffic-related air pollution and an increased risk for age-related dementia, including Alzheimer's disease. Their study, based on rodent models, corroborates previous epidemiological evidence showing this association.

Alzheimer's disease is the most common cause of age-related dementia and the sixth leading cause of death in the United States. More than 5 million Americans currently live with Alzheimer's disease—a number that is expected to triple by 2050 as the population ages. Health care costs for those patients are predicted to grow from \$305 billion in 2020 to \$1.1 trillion by 2050.

UC Davis toxicologist Pamela Lein, senior author of the study recently published in *Environmental Health Perspectives*, said their findings underscore the urgent need to identify factors that contribute to the onset and progression of Alzheimer's to develop effective preventive measures for reducing the individual and societal burden of this disease.

Lein worked with UC Davis atmospheric scientist Anthony Wexler and first author Kelley Patten, while she was a doctoral student in the UC Davis graduate group for pharmacology and toxicology, to develop a novel approach to study the impacts of traffic-related air pollution in real time. Researchers set up a rodent vivarium near a traffic tunnel in Northern California so they could mimic, as closely as possible, what humans might experience from traffic-related air pollution.

"This approach was a creative way to get at the question of what impacts air pollution has on the brain in the absence of confounding factors such as socioeconomic influences, diet, etc.," Lein said. "It's important to know if living close to these roadways poses a significant risk to the human brain as it ages."

Exposure outcomes on the aging brain

The researchers exposed male and female rats for up to 14 months to filtered air or polluted air drawn from the tunnel and delivered it to animals unchanged in real time. The subjects were divided into two groups: wild type rats and those that express Alzheimer's disease risk genes that are relevant to humans.

Testing was conducted in 3-, 6-, 10- and 15-month-old animals using [hyperspectral imaging](#), behavioral testing and neuropathologic measures to quantify the expression of Alzheimer's disease characteristics.

"We saw that traffic-related air pollution accelerated Alzheimer's disease characteristics not only in the animals who express the risk gene (which we anticipated) but also in the wild type rats," Lein said. "We didn't anticipate that. The big, exciting discovery is that traffic-related air pollution is a risk factor for late-onset Alzheimer's disease. This is important because this pollution is everywhere and could explain the increased number of people

impacted by Alzheimer's disease across the world."

What remains unclear is which component of that pollution is predominately responsible for the effects on the brain. There are gases, particulate matter, road dust, tire wear, vibration and noise involved in traffic-related air pollution.

"The next set of studies is to try and tease apart specific components of traffic-related air pollution that drive these Alzheimer's disease traits," Lein said. "Or is it the collective mix that causes the damage?"

Fine particles (PM 2.5) in the polluted air at the study site were below federal regulatory limits, but ultrafine particles, which are not regulated, were detected in the brains of exposed animals.

"The Environmental Protection Agency only regulates down to the PM 2.5 level, but the bulk of this traffic-related air pollution is ultrafine particulate matter," Lein said. "These studies provide incentive to re-evaluate the current regulatory standards and suggest that current ones are not protective of the aging brain."

The study shows traffic-related air pollution can deliver a double whammy, decreasing the time of onset of Alzheimer's disease characteristics and accelerating disease progression. While personal factors can change an individual's risk for Alzheimer's disease (exercise, smoking, diet), people are often poor about sticking to a plan to decrease their risk factors.

"There's a lot of data that shows if you can regulate risk factors through policy at a population level, you have a more significant public health impact than if you try to regulate them at the individual level," Lein said. "If we could make some progress in identifying which component in traffic-related air pollution is causing these effects, then scientists can approach legislators to develop scientifically based regulations. Even if we can delay onset of Alzheimer's [disease](#) by five years, we could potentially save our health care system an enormous amount of money."

This study is one of four published papers to come

out of the research site to date. A prior study, published in *Translational Psychiatry* focused on the developing brain and found a link between traffic-related air pollution and an [increased risk](#) for changes in brain development relevant to neurodevelopmental disorders such as autism.

More information: Kelley T. Patten et al. The Effects of Chronic Exposure to Ambient Traffic-Related Air Pollution on Alzheimer's Disease Phenotypes in Wildtype and Genetically Predisposed Male and Female Rats, *Environmental Health Perspectives* (2021). [DOI: 10.1289/EHP8905](#)

Provided by UC Davis

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