

Alzheimer's

Toxic air pollution particles found in human brains

Detection of 'abundant' magnetite particles raises concerns because of suggested links to Alzheimer's disease

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The new study examined brain tissue from people in the UK and Mexico and found abundant particles of magnetite, an iron oxide. Photograph: Manuel Velasquez/Getty Images

Toxic nanoparticles from air pollution have been discovered in human brains in “abundant” quantities, a newly published study reveals.

The detection of the particles, in brain tissue from 37 people, raises concerns because recent research has suggested [links between these magnetite particles and Alzheimer's disease](#), while air pollution has been shown to [significantly increase](#) the risk of the disease. However, the new work is still a long way from proving that the air pollution particles cause or exacerbate Alzheimer's.

“This is a discovery finding, and now what should start is a whole new examination of this as a potentially very important environmental risk factor for Alzheimer's disease,” said Prof Barbara Maher, at Lancaster University, who led the new research. “Now there is a reason to go on and do the epidemiology and the toxicity testing, because these particles are so prolific and people are exposed to them.”



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Air pollution is a global health crisis that kills [more people than malaria and HIV/Aids](#) combined and it has long been linked to lung and heart disease and strokes. But research is uncovering new impacts on health, including degenerative brain diseases such as Alzheimer's, [mental illness](#) and [reduced intelligence](#).

The new work, [published in the Proceedings of the National Academy of Sciences](#), examined brain tissue from 37 people in Manchester, in the UK, and Mexico, aged between three and 92.

It found abundant particles of magnetite, an iron oxide. “You are talking about millions of magnetite particles per gram of freeze-dried brain tissue - it is extraordinary,” said Maher.

“Magnetite in the brain is not something you want to have because it is particularly toxic there,” she said, explaining that the substance can create reactive oxygen species called free radicals. “Oxidative cell damage is one of the hallmark features of Alzheimer's disease, and this is why the presence of magnetite is so potentially significant, because it is so bioreactive.”

Abnormal accumulation of brain metals is a key feature of Alzheimer's disease and a [recent study](#) showed that magnetite was directly associated with the damage seen in Alzheimer's brains. Magnetite particles are known to form biologically in human brains, but these are small and crystal-shaped, unlike the larger, spherical particles that dominated the samples in the new study.

“Many of the magnetite particles we have found in the brain are very distinctive,” said Maher. “They are very rounded nanospheres, because they were formed as molten droplets of material from combustion sources, such as car exhausts, industrial processes and power stations, anywhere you are burning fuel.”

“They are abundant,” she said. “For every one of [the crystal shaped particles] we saw about 100 of the pollution particles. The thing about magnetite is it is everywhere.” An analysis of roadside air in Lancaster found [200m magnetite particles per cubic metre](#).

Furthermore, said Maher: “We also observed other metal-bearing particles in the brain, such as platinum, cobalt and nickel. Things like platinum are very unlikely to come from a source within the brain. It is a bit of an indicator of a [vehicle] catalytic converter source.”

Other scientists told the Guardian the new work provided strong evidence that most of the magnetite in the brain samples come from air pollution but that the link to Alzheimer's disease remained speculative.

“This is a very intriguing finding and it raises a lot of important questions,” said [Prof Jon Dobson](#), at the University of Florida and not part of the research team. But he said further investigation was needed: “One thing that puzzles me is that the [particle] concentrations are somewhat higher than those previously reported for the human brain. Further studies [are needed] to determine whether this due to regional variations within the brain, the fact that these samples are from subjects who lived in industrial areas, or whether it is possibly due to [lab] contamination.” The researchers said they had gone to great lengths to avoid contamination.

Air pollution was linked to a [significant increase in the risk of Alzheimer's disease](#) by a major study published in 2015, while other research showed [brain damage related to Alzheimer's disease in children](#) and young adults exposed to air pollution. Air pollution has also been [linked to dementia in older men](#) and [women](#).

“We have not demonstrated a causal link between these particles and Alzheimer's disease but when you consider that magnetite has been found in higher concentrations in Alzheimer's brains and you know that magnetite is pernicious in its effect on the brain, then having a direct [air pollution] source of magnetite right up your olfactory bulb and into your frontal cortex is not a great idea,” said Maher.

Prof David Allsop, an Alzheimer's disease expert at Lancaster University and part of the research team, said: “There is [no blood-brain barrier with nasal delivery](#). Once nanoparticles directly enter olfactory areas of the brain through the nose, they can spread to other areas of the brain, [including hippocampus and cerebral cortex](#) - regions affected in Alzheimer's disease.” He said it was worth noting that an [impaired sense of smell is an early indicator of Alzheimer's disease](#).

“Knowledge is power,” Maher said. “So if there's at least a possibility that exposure to traffic pollution is having even worse health impacts than were previously known, then take the steps you can to reduce your dose as far as you can.”

“What this is pointing towards perhaps is there needs to be a major shift in policy and an attempt to reduce the particulate matter burden on human health,” Maher said. “The more you realise the impact this is having, the more urgent and important it is to reduce the concentrations in the atmosphere.”

Dr Clare Walton, research communications manager at the [Alzheimer's Society](#), said: “This study offers convincing evidence that magnetite from air pollution can get into the brain, but it doesn't tell us what effect this has on brain health or conditions such as Alzheimer's disease. Further work in this area is important, but until we have more information people should not be unduly worried. There are more practical ways to lower your chances of developing dementia such as regular exercise, eating a healthy diet and avoiding smoking.”

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