<http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia>

**Science**

**Evidence builds that dirty air causes Alzheimer’s, dementia**

Air pollution, particularly in major cities such as Los Angeles, California, may promote brain inflammation and disease.

© David McNew/Getty Images

By [Emily Underwood](http://www.sciencemag.org/author/emily-underwood)Jan. 26, 2017 , 9:00 AM

**LOS ANGELES, CALIFORNIA**—In a barbed wire–enclosed parking lot 100 meters downwind of the Route 110 freeway, an aluminum hose sticks out of a white trailer, its nozzle aimed at an overpass. Every minute, the hose sucks up hundreds of liters of air mixed with exhaust from the roughly 300,000 cars and diesel-burning freight trucks that rumble by each day.

Crouched inside the trailer, a young chemical engineer named Arian Saffari lifts the lid off a sooty cylinder attached to the hose, part of a sophisticated filtration system that captures and sorts pollutants by size. Inside is a scientific payload: particles of sulfate, nitrate, ammonium, black carbon, and heavy metal at least 200 times smaller than the width of a human hair.

The particles are too fine for many air pollution sensors to accurately measure, says Saffari, who works in a lab led by Constantinos Sioutas at the University of Southern California (USC) here. Typically smaller than 0.2 µm in diameter, these “ultrafine” particles fall within a broader class of air pollutants commonly referred to as PM2.5 because of their size, 2.5 µm or less. When it comes to toxicity, size matters: The smaller the particles that cells are exposed to, Saffari says, the higher their levels of oxidative stress, marked by the production of chemically reactive molecules such as peroxides, which can damage DNA and other cellular structures.

Bovenkant formulier

Onderkant formulier

Bovenkant formulier

Onderkant formulier

Some of the health risks of inhaling fine and ultrafine particles are well-established, such as asthma, lung cancer, and, most recently, heart disease. But a growing body of evidence suggests that exposure can also harm the brain, accelerating cognitive aging, and may even increase risk of Alzheimer’s disease and other forms of dementia.

The link between air pollution and dementia remains controversial—even its proponents warn that more research is needed to confirm a causal connection and work out just how the particles might enter the brain and make mischief there. But a growing number of epidemiological studies from around the world, new findings from animal models and human brain imaging studies, and increasingly sophisticated techniques for modeling PM2.5 exposures have raised alarms. Indeed, in an 11-year epidemiological study to be published next week in *Translational Psychiatry*, USC researchers will report that living in places with PM2.5 exposures higher than the Environmental Protection Agency’s (EPA’s) standard of 12 µg/m3 nearly doubled dementia risk in older women. If the finding holds up in the general population, air pollution could account for roughly 21% of dementia cases worldwide, says the study’s senior author, epidemiologist Jiu-Chiuan Chen of the Keck School of Medicine at USC.

Deepening the concerns, this month researchers at the University of Toronto in Canada reported in *The* *Lancet* that among 6.6 million people in the province of Ontario, those living within 50 meters of a major road—where levels of fine pollutants are often 10 times higher than just 150 meters away—were 12% more likely to develop dementia than people living more than 200 meters away.

The field is “very, very young,” cautions Michelle Block, a neuroscientist at Indiana University in Indianapolis. Nonetheless, it’s a “hugely exciting time” to study the connections between pollution and the brain, she says. And if real, the air pollution connection would give public health experts a tool for sharply lowering Alzheimer’s risks—a welcome prospect for a disease that is so devastating and that, for now, remains untreatable.

Demented dogs in Mexico Cityin the early 2000s offered the first hints that inhaling polluted air can cause neurodegeneration. Neuroscientist Lilian Calderón-Garcidueñas, now at the University of Montana in Missoula, noticed that aging dogs who lived in particularly polluted areas of the city often became addled, growing disoriented and even losing the ability to recognize their owners. When the dogs died, Calderón-Garcidueñas found that their brains had more extensive extracellular deposits of the protein amyloid b—the same “plaques” associated with Alzheimer’s disease—than dogs in less polluted cities. She went on to find similarly elevated plaque levels in the brains of children and young adults from Mexico City who had died in accidents, as well as signs of inflammation such as hyperactive glia, the brain’s immune cells. Calderón-Garcidueñas’s studies didn’t have rigorous controls, or account for the fact that amyloid b plaques don’t necessarily signal dementia. But later work lent weight to her observations.

Those tubes of fine particles from the 110 freeway have played a key role. In a basement lab at USC, Sioutas and his team aerosolize the pollutants with a hospital nebulizer, then pipe the dirty air into the cages housing lab mice that have been engineered to contain a gene for human amyloid b. Control animals housed in the same room breathe clean, filtered air. After a designated period—220 hours over several weeks, in a recent experiment—the team hands the rodents over to colleagues at USC, who kill the animals and check their brains for signs of neurodegeneration.

Caleb Finch and Todd Morgan, USC neuroscientists who combine studies of aging and the brain, are in charge of the analysis. In mice that breathed the dirty air, they have found, the brain’s microglia release a flood of inflammatory molecules, including tumor necrosis factor a, which is elevated in the brains of people with Alzheimer’s disease and has been linked to memory loss. The pollution-exposed mice also showed other signs of brain damage, the group has reported in several recent papers: more amyloid b than in the control mice and shrunken and atrophied neurites, the cellular processes that extend from neurons toward other cells.

Just how the fine airborne particles might travel from a rodent’s nasal cavity to its brain is a mystery. But a research team led by Günter Oberdörster at the University of Rochester in New York has used traceable, radioactive specks of elemental carbon to demonstrate that inhaled particles smaller than 200 nanometers can get through the delicate tissues lining a rodent’s nasal cavities, travel along neurons, and spread as far as the cerebellum, at the back of the brain, triggering an inflammatory reaction.

To understand what the animal studies might mean for people, however, scientists need to correlate air pollution exposure with human brain scans and with results from rigorous cognitive testing.



A cloudy suspension of smog particles, collected near a Los Angeles, California, freeway, will be turned into an aerosol and piped into tanks holding laboratory mice.

© Spencer Lowell



Scientists let one group of mice breath polluted air for several weeks, while exposing another to clean air. After several weeks, they examine the brains of both groups.

© Spencer Lowell

That’s not easy to do, as long-term, historical data on pollution exposures are scarce in the United States and many other countries, says Kimberly Gray, a program administrator at the National Institute of Environmental Health Sciences (NIEHS) in Durham, North Carolina. But in a September 2016 review of 18 epidemiological studies from Taiwan, Sweden, Germany, China, the United Kingdom, and the United States, all but one showed an association between high exposure to at least one component of air pollution and a sign of dementia. The review, published in *Neurotoxicology*, included a 2012 analysis of 19,000 retired U.S. nurses, which found that the more fine particulates the nurses were exposed to, based on monitoring data near their homes, the faster they declined on cognitive tests. For every additional 10 micrograms per cubic meter of air they breathed, their performance on tests of memory and attention declined as if they had aged by 2 years, says Jennifer Weuve, an epidemiologist at Boston University, who led the analysis.

Imaging studies also suggest that pollution attacks the human brain. In a 2015 analysis of brain MRI scans of people enrolled in the Framingham Heart Study, a long-term cardiovascular study in New England, researchers at Harvard Medical School in Boston found that the closer people had lived to a major roadway—and thus the more PM2.5 they had likely been exposed to—the smaller their cerebral brain volume. The association held up even after adjusting for factors such as education, smoking, diabetes, and cardiovascular disease.

Shortly after that study was published, USC’s Chen reported another example of brain shrinkage: In 1403 elderly women, the total volume of white matter—the insulated nerve fibers that connect different brain regions—decreased by about 6 cubic centimeters for every 3.5-µg/m3 increase in estimated PM2.5 exposure, based on air monitoring data from participants’ residences for 6 to 7 years before the brain scans were taken. Chen’s white matter findings are consistent with studies of cultured neurons, which show that exposure to PM2.5 can cause myelin—the fatty insulation that wraps around neuronal axons—to “peel up at the ends, like a Band-Aid,” Block says.

**Modes of attack**

Pollutant particles might make their way to the brain and damage it directly, or they might attack it from a distance, by triggering the release of inflammatory molecules.



C. Bickel/*Science*

Where the risk is greatestis far from clear. Burning just about anything produces PM2.5: oil and gas, firewood, vegetation. Federal- and state-funded networks of air quality monitors in the United States get turned off and on according to political whim, and are frustratingly uneven. According to the American Lung Association less than a third of U.S. counties have ozone or particle pollution monitors, and coverage is especially sparse in rural areas. Those that exist have only measured PM2.5 since 1997—before that, EPA did not monitor particles smaller than PM10.

Over the past several years, however, new computational models have made it possible to fill in some of the gaps in monitoring data, Gray says. In September 2016, NIEHS and the National Institute on Aging launched several new epidemiological studies that will use such modeling to look at the link between air pollution and brain health. One, based in Seattle, Washington, will estimate participants’ lifetime exposure to PM2.5 pollution and correlate it with the incidence of dementia, says Lianne Sheppard, a biostatistician at the University of Washington in Seattle.

For their study of the Seattle region, Sheppard and her colleagues will take advantage of a model they developed for an earlier study of air pollution and atherosclerosis. Creating it, she says, took “a huge amount of behind-the-scenes work.” First, they compiled more than a decade of air monitoring data on PM2.5 and other pollutants from 600,000 locations across the United States. For each location, they calculated 800 different geographic variables, such as the distance to ports, factories, refineries, residual oil, and roads. Then they fitted their models to the monitoring data using a 25-by-25-meter grid and estimated PM2.5 concentrations in each grid cell.

Building on the model, Sheppard and colleagues will create an even more detailed estimate of past air pollution levels in and around Seattle. To survey dementia in the region, the team will tap the Adult Changes in Thought study, which has monitored 5000 elderly people in the Seattle area for more than 20 years. Although all the participants were cognitively normal when they joined, at age 65 or so, roughly 1000 have since developed dementia, including 859 Alzheimer’s cases. When the participants die and donate their brains to science, as more than 600 already have, pathologists examine their brain tissue for abnormal protein deposits, cerebrovascular damage, and other signs of cellular stress. Combined with genetic studies, Sheppard says, such analyses will allow her group to probe “not just the epidemiology of the relationship between air pollution and cognition, but start drilling down to mechanisms” that explain how airborne pollutants affect the human brain.

I think [air pollution] will turn out to be just the same as tobacco—there’s no safe threshold.

Caleb Finch, University of Southern California

Some peoplemay be more susceptible than others. In the *Translational Psychiatry* study, Chen’s team found that women carrying the Alzheimer’s risk gene *APOE4* faced a disproportionately higher risk from pollution. And recently, Finch has started to examine the overlap—and potential synergy—between PM2.5 and cigarette smoke. The smoke is itself rich in ultrafine particles and can trigger the production of amyloid plaques and neuroinflammation in mouse models. Although smoking was once considered protective against Alzheimer’s, prospective studies have since established tobacco smoke as a major risk factor, he says. In 2014, for example, a report published by the World Health Organization attributed as much as 14% of Alzheimer’s disease worldwide to smoking.

Pollution may take a greater cognitive toll on the poor, in part because they are more likely to live in places with higher PM2.5 exposures, such as near major roadways or ports. Jennifer Ailshire, a USC sociologist, says stresses linked to poverty also could amplify the effects of the toxic particles. In one of her most recent studies, elderly people who rated their neighborhoods as stressful—citing signs of decay and disorder, such as litter and crime—did worse on cognitive tests than people who were exposed to similar pollution levels, but lived in less stressful neighborhoods, she says. “Living in L.A. [Los Angeles], we are all exposed to a lot of pollution, but some of us are fine,” she says. When seeking to reduce the negative health impacts from air pollution, cities “might want to try to focus specifically on reducing pollution in communities particularly vulnerable to these exposures,” she says.

But no one studying the suspected effects of pollutant particles on the brain is eager to do triage. If PM2.5 is guilty as charged, they say, the goal for policymakers worldwide should be to push down levels as far as possible. When all the research is in, Finch says, “I think [air pollution] will turn out to be just the same as tobacco—there’s no safe threshold.”

DOI: 10.1126/science.aal0656



[**Emily Underwood**](http://www.sciencemag.org/author/emily-underwood)

Emily is a contributing correspondent for *Science*, covering neuroscience.

[AERGuru](https://disqus.com/by/aerguru/) • [a day ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3129047865)

The super abundant, deadly and toxic polluting emissions from wood burning stoves has also been confirmed by a Danish report. For instance, the Danish report found that a new, properly operated eco stove emits 25 times more pm2.5 than a 10 year old truck.

From a scientific point of view, wood burning stoves are effectively, unlicensed living room combustion engines that release a toxic soup of poisonous chemicals into the local community.
Please search 'wood burners and pm2.5' to find British medical Journal article which states the super abundant levels of pm2.5 from a single wood stove is equal to 1000 petrol cars travelling 20k km per year.

This is a human rights issue.
Neighbours with non essential wood stoves, recreationally burning wood because it's cozy and nice, have no idea they are actually making pollution victims of their neighbours and damaging their own and their neighbour's short and long term health. Various studies confirm wood burning stoves and their extremely high level of pm2.5 emissions are a danger to young children's brain and lung development, a danger to the elderly, anyone with asthma,
cardiovascular, heart conditions, a danger to pregnant women as pm2.5 can cross the placenta and cause low birth weight and reduce IQ and a myriad of other deadly diseases …. And yet wood stoves carry no health warning, they are not licensed in any way and do not mention the ingredients that are released into the home, local neighbourhood and into the actual bodies of neighbours via the lungs.

When I say ingredients, I mean toxic super carcinogens such as pm2.5, pm10, formaldehyde, dioxins, Furans, PAHs, etc ... an unholy witches brew that should not be released into the home or into any residential area.

Nobody should be allowed to poison their family and neighbours with a wood burning stove. It's a basic human right to breathe clean air and these wood burning 'Smoking Houses' are a menace to the planet's ecosystem. It's a giant, local and community, second hand smoke issue.

Wood burning stoves are creating an unseen and unobserved ecological disaster. No electric cars, no smart cities, no legislation, no diesel engines, no solution to air pollution will be successful without a ban on the use of wood burning stoves. We will never effectively manage air pollution until the the living room chemical combustion engines known as wood burners are banned from urban and residential areas.

Now the science is in, it is an astonishing madness not to immediately, directly address these home pollution devices.

[AERGuru](https://disqus.com/by/aerguru/) • [a day ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3129047865)

The super abundant, deadly and toxic polluting emissions from wood burning stoves has also been confirmed by a Danish report. For instance, the Danish report found that a new, properly operated eco stove emits 25 times more pm2.5 than a 10 year old truck.

From a scientific point of view, wood burning stoves are effectively, unlicensed living room combustion engines that release a toxic soup of poisonous chemicals into the local community.
Please search 'wood burners and pm2.5' to find British medical Journal article which states the super abundant levels of pm2.5 from a single wood stove is equal to 1000 petrol cars travelling 20k km per year.

This is a human rights issue.
Neighbours with non essential wood stoves, recreationally burning wood because it's cozy and nice, have no idea they are actually making pollution victims of their neighbours and damaging their own and their neighbour's short and long term health. Various studies confirm wood burning stoves and their extremely high level of pm2.5 emissions are a danger to young children's brain and lung development, a danger to the elderly, anyone with asthma,
cardiovascular, heart conditions, a danger to pregnant women as pm2.5 can cross the placenta and cause low birth weight and reduce IQ and a myriad of other deadly diseases …. And yet wood stoves carry no health warning, they are not licensed in any way and do not mention the ingredients that are released into the home, local neighbourhood and into the actual bodies of neighbours via the lungs.

When I say ingredients, I mean toxic super carcinogens such as pm2.5, pm10, formaldehyde, dioxins, Furans, PAHs, etc ... an unholy witches brew that should not be released into the home or into any residential area.

Nobody should be allowed to poison their family and neighbours with a wood burning stove. It's a basic human right to breathe clean air and these wood burning 'Smoking Houses' are a menace to the planet's ecosystem. It's a giant, local and community, second hand smoke issue.

Wood burning stoves are creating an unseen and unobserved ecological disaster. No electric cars, no smart cities, no legislation, no diesel engines, no solution to air pollution will be successful without a ban on the use of wood burning stoves. We will never effectively manage air pollution until the the living room chemical combustion engines known as wood burners are banned from urban and residential areas.

Now the science is in, it is an astonishing madness not to immediately, directly address these home pollution devices.

see more

[D. Katz](https://disqus.com/by/d_katz/) [AERGuru](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3129047865) • [14 hours ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3129565272)

It is a human rights issue. The UN and the WHO recognize the Human Right to Health as a basic fundamental human right: “the enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition.”

To quote Doctors and Scientists Against Wood Smoke Pollution,
"A growing body of research clearly demonstrates that people who are routinely exposed to wood smoke pollution where they live, work or go to school face increased risks for serious health outcomes, and even premature death, compared to others who spend their days in neighborhoods with less localized air pollution. When people, especially sick and vulnerable people, are forced to breathe wood smoke they are denied the human right to attain their highest possible standard of health."

[D. Katz](https://disqus.com/by/d_katz/) • [2 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3127618766)

Wood burning is an increasingly large source of particulate pollution. For example, look at what is happening in London now.

I work with a group of scientists and others who are using internet-connected particle sensors to measure localized particulate levels. We are discovering that wood burning contributes a stunning amount of PM2.5. Some neighbors of wood burners are routinely exposed to levels of particulate pollution that are at least as bad as in Beijing, and sometimes worse.

This is an environmental justice issue. Nobody should face a higher risk of dementia, as well as a higher risk of heart attack, stroke, COPD, lung cancer, asthma attack, etc, simply because their neighbors decide to use a wood-burning appliance.

There is a perception that traffic is the largest contributor to pollution levels, but in many communities this is not the case -- wood burning is frequently the largest contributor to community PM2.5 levels, especially during autumn and winter.

[Rainald Koch](https://disqus.com/by/Rainald62/) • [4 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123818210)

"The association held up even after adjusting for factors such as education, smoking, diabetes, and cardiovascular disease."
What about noise? Noise is very different for the two groups (<50 m and >200 m from main roads) and may affect dementia via the quality of sleep.

[CaresAboutHealth](https://disqus.com/by/disqus_qEItVAGBPJ/) [Rainald Koch](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123818210) • [2 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3127749326)

Although living near a road does increase exposure to PM2.5 pollution, there are many other sources. For example, in Sydney, Australia, the NSW EPA's Clean Air Consultation document shows that PM2.5 emissions from residential wood heating are higher than all other sources put together.

Most studies measure PM2.5 exposure from all sources, and have shown that the effects on the brain include increased risk of strokes, small total brain volume and smaller volume of white matter in the brain

In developing countries, children whose mothers cook with wood (as opposed to kerosene) stoves have reduced IQ, memory and poorer social skills in Belize, Kenya, Nepal and American Samoa, and also in Guatemala

Some of this effect might be related to toxic chemicals in woodsmoke known as PAH (polycyclic aromatic hydrocarbons). In developed countries, PAH exposure has been linked to genetic damage in babies, reduced IQ on starting school, with the most recent research showing effects on behavioural problems (anxiety, depression and attention deficit) at age 6-7.

For more information see the Australian Air Quality Group web pages - woodsmoke 3sc net - on health and PAH. Replace the spaces with dots. I can't post the links because this website considers references to scientific studies as spam.

[Kamil Kopij](https://disqus.com/by/true_q/) [Rainald Koch](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123818210) • [2 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3127708403)

Actually you get used to the noise really quickly.

[Craig](https://disqus.com/by/disqus_y49oQGqW2P/) • [3 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3125760730)

Time to replace all vehicles with electric powered ones and to push harder for cheaper solar, wind and tidal electricity production.

[Hai-Ting Chinn](https://disqus.com/by/haitingchinn/) • [4 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123758286)

I recall reading a brief note in a Yale alumni magazine a few years ago that mentioned a rodent study linking air pollution to autism-like symptoms, as well. Is there any new research in this area? Is there evidence that air pollution is a factor in neurological disorders at various stages of life, not just in later-life dementia?

[D. Katz](https://disqus.com/by/d_katz/) [Hai-Ting Chinn](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123758286) • [14 hours ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3129571848)

I know of at least one human study that demonstrated a connection: Autism Spectrum Disorder and Particulate Matter Air Pollution before, during, and after Pregnancy: A Nested Case–Control Analysis within the Nurses’ Health Study II Cohort, Raz et al. It concluded, "Higher maternal exposure to PM2.5 during pregnancy, particularly the third trimester, was associated with greater odds of a child having ASD."

Suades-González, et al, Air Pollution and Neuropsychological Development: A Review of the Latest Evidence concluded, "The public health impact of air pollutants cannot be ignored and the precautionary principle should be applied to protect children." Wood smoke is high in polycyclic aromatic hydrocarbons, which makes it a particularly harmful form of fine particulate pollution. PAHs have been associated with impaired neuropsychological development and a lifelong lowered IQ, among other effects.

I'm sure there are others out there. Those are just the two I know of off the top of my head.

[Ozzie Perch](https://disqus.com/by/ozzieperch/) • [a day ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3128834135)

I didn't read any mention of Asthma...I heard in recent years that cases have increased; wondering if respiratory reactions have some link the the particulate sizes, and mineral vs. chemical origins.

[Wayne Williamson](https://disqus.com/by/waynewilliamson/) • [2 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3126861407)

sounds interesting but they didn't give any stats for the high pollution cities vs low pollution ones...just say'n...

[Tianhao Xu](https://disqus.com/by/tianhaoxu/) • [4 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3124331219)

I WAS EXPOSED IN CHINA FOR MANY YEARS, AD IS WAITING FOR ME IN THE FUTURE, I'm waiting to see if they find the A-beta and Tau pathology in these models to further this research.

[Gayle63](https://disqus.com/by/catalinda8/) • [5 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121531488)

And yet in China, dementia rates are much higher in rural areas than in urban areas. Can this be explained?

[Robert S. Wright](https://disqus.com/by/robert_s_wright/) [Gayle63](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121531488) • [4 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123368321)

The 2007 publication by Mesl et al., "Urban and rural exposure to indoor air pollution from domestic biomass and coal burning across China" in Science of the Total Environment states: "Although indoor air pollution (IAP) from solid fuel use in the households of the developing countries is estimated to be one of the main health risks worldwide, there is little knowledge of the actual exposure experienced by large populations. We have developed a method to estimate exposure to PM10 from IAP for large populations, applied to different demographic groups in China. On a national basis we find that 80%–90% of exposure in the rural population results from IAP. For the urban population the contribution is somewhat lower, about 50%–60%. Average exposure is estimated at 340 μg/m3 (SD 55) in southern cities, and 440 μg/m3 (SD 40) in northern cities. For the rural population we find average exposure to be 750 μg/m3 (SD 100) and 680 μg/m3 (SD 65) in the south and north respectively. Quite surprisingly our results indicate that the heavily polluted northern provinces, largely dependent on coal and believed to have the population with the largest exposure burden, turn out to have medium exposure when IAP is included. We find that the largest exposure burden is in counties relying heavily on biomass, and that there are only small gender differences in exposure."

[MyIdea](https://disqus.com/by/disqus_ld5dVC7Bwn/) [Gayle63](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121531488) • [5 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121575047)

Lol based on what you say above, we might conclude that extreme air pollution is great for your brain's health. Or we might do the more rational thing, and look for additional causes or accelerators of Alz in rural China. Emily has done a great job in this article to point out the many negative health consequences of pollution. She also points out places where the research is not conclusive. I'm thankful for articles like this one. Bravo.

[Gayle63](https://disqus.com/by/catalinda8/) [MyIdea](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121575047) • [5 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121643521)

I'm not disputing the findings of the article. I am genuinely curious why pollution seems to affect people differently, what the difference is in the particulates, etc. I've long wondered if lead emissions from gas had something to do with it. I would like to know more about the possible "additional causes" you mention. I had originally included a link to a study about pollution and dementia in China, but apparently links aren't allowed in this comment section.

[Moderator](https://disqus.com/by/sciencehabit/) Mod [Gayle63](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121643521) • [5 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121690575)

Amount of education has proven to be one of the most protective factors for AD so that may account for some of the rural/urban split. But definitely a good question.

[Gayle63](https://disqus.com/by/catalinda8/) [Moderator](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121690575) • [5 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121736671)

I also found the mention of cigarette smoking interesting. The decline of smoking has resulted in reductions in cancer and heart disease, so that could be a factor in dementia numbers as well. It seems clear there won't be just one cause, of course, but this is one more piece of the puzzle.

[Shuqi Gao](https://disqus.com/by/shuqigao/) [Gayle63](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121736671) • [4 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3124038491)

It might also be that in rural areas there are other sources of pollution that contribute to dementia progression. Water pollution is a big problem in China and is much more prevalent in rural areas. Pollution in water such as industrial runoff can be much more detrimental.

[Gayle63](https://disqus.com/by/catalinda8/) [Shuqi Gao](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3124038491) • [4 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3124072629)

Would that be true of the UK and US also, though? I agree water pollution is a factor. It's too bad AD wasn't identified until 1901. It would be interesting it compare pre- and post-Industrial Revolution numbers.

[MyIdea](https://disqus.com/by/disqus_ld5dVC7Bwn/) [Gayle63](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121643521) • [5 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121747810)

Then my humble apologies if I misread the tone of your comment. There are certainly a lot of interesting possible causes or accelerators of Alz. Environment, diet, behavior, and genes all seem to play an important role.

[Gayle63](https://disqus.com/by/catalinda8/) [MyIdea](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121747810) • [5 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121772118)

No worries, it's easy to hear different tones, especially when it seems like most comments are snarky, lol. :) Yes, I agree, all those things are factors. From what I've read, they all seem to point primarily to inflammation. We really need more funding for research...

[captainhurt](https://disqus.com/by/captainhurt/) [Gayle63](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121531488) • [4 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123433917)

RURAL: coal (and other) burning INSIDE THE HOUSE for heat, cooking.
very bad.
RURAL: poor consumption of essential vitamins/minerals.

[Charles Miller](https://disqus.com/by/disqus_d8Iz4ZnrOW/) [captainhurt](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123433917) • [2 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3127283425)

Indoor air quality is typically worse than outdoor air in both amount and potency of contaminants.

[Robert S. Wright](https://disqus.com/by/robert_s_wright/) [Gayle63](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121531488) • [4 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123333007)

The 2012 publication by Mainali et al., "Analyzing cooking fuel and stove choices in China till 2030", in Journal of Renewable and Sustainable Energy states: "Many people in China still burn low grade solid fuels in traditional stoves to meet their cooking and heating energy demands. This results in significant pollution, affecting the health of especially women and children who are exposed most. The mode of energy consumption and types of stoves in use may change with increasing prosperity. Product specific and socio-economic parameters also influence these choices. We analyze cooking fuel and stove choices in China. Choices are modeled to depend on standard economic variables such as income, technology costs, and fuel prices, along with some variables unique to the developing country setting such as inconvenience costs. Our analysis shows that 24% of the rural and 17% of the urban population will still depend on solid fuels in 2030 under a business as usual scenario. Various policy scenarios that can accelerate transition to modern fuels by 2030 are also analyzed in this paper and their costs, energy, emissions and health impacts assessed."

[Gayle63](https://disqus.com/by/catalinda8/) [Robert S. Wright](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123333007) • [4 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123756516)

It's interesting that even in the UK and US, however, AD rates seem to be higher in rural areas. Perhaps the common denominator is pesticides?

[D. Katz](https://disqus.com/by/d_katz/) [Gayle63](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123756516) • [14 hours ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3129574445)

Or pollution from wood burning. Rural areas can have even worse pollution than urban ones, especially during the colder months, from all the wood stoves, fireplaces, and wood boilers.

[Gayle63](https://disqus.com/by/catalinda8/) [Robert S. Wright](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123333007) • [4 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123365816)

Thank you, that's great info!

[AERGuru](https://disqus.com/by/aerguru/) [Gayle63](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121531488) • [20 hours ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3129180106)

Yes, higher rates of dementia in rural areas can be explained by domestic wood burning for heating and cooking

[AlanFSmith](https://disqus.com/by/AlanFSmith/) [AERGuru](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3129180106) • [3 hours ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3130567945)

I can not comment re China but I note that in Europe and Britain, because of wood and coal burning in rural areas they can be as polluted or more so than cities.

[sadhayam](https://disqus.com/by/sadhayam/) [Gayle63](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121531488) • [4 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123563461)

Can you provide any evidence by way of source material or links to articles?

[Gayle63](https://disqus.com/by/catalinda8/) [sadhayam](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123563461) • [4 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3123685860)

Unfortunately, this site won't allow posting of links, but if you go to the journal of the Alzheimer's Association, aandjournal(dot)net, then search for: The prevalence of dementia in urban and rural areas of China, you can read that study. There is also an article about urban vs. rural rates of AD in the UK at www(dot)nhs(dot)uk - search for: Growing up in the countryside 'doubles Alzheimer's Risk.'

[Po](https://disqus.com/by/disqus_mFsE1mzTG2/) [Gayle63](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3121531488) • [5 days ago](http://www.sciencemag.org/news/2017/01/brain-pollution-evidence-builds-dirty-air-causes-alzheimer-s-dementia#comment-3122336022)

Air pollution in rural areas may very likely be more serious than in urban areas, due to the industrial pollution, less so the traffic.