Tiny shards of plastic are increasingly infiltrating our brains, study says

Story by Sandee LaMotte, CNN • 5d • 7 min read

Human brain samples collected at autopsy in early 2024 contained more tiny shards of plastic than samples collected eight years prior, according to a preprint posted online in May. A preprint is a study which has not yet been peer-reviewed and published in a journal.

"The concentrations we saw in the brain tissue of normal individuals, who had an average age of around 45 or 50 years old, were 4,800 micrograms per gram, or 0.5% by weight," said lead study author Matthew Campen, a regents' professor of pharmaceutical sciences at the University of New Mexico in Albuquerque.

"Compared to autopsy brain samples from 2016, that's about 50% higher," Campen said. "That would mean that our brains today are 99.5% brain and the rest is plastic."

That increase, however, only shows exposure and does not provide information about brain damage, said Phoebe Stapleton, an

associate professor of pharmacology and toxicology at Rutgers University in Piscataway, New Jersey, who was not involved in the preprint.

"It is unclear if, in life, these particles are fluid, entering and leaving the brain, or if they collect in neurological tissues and promote disease," she said in an email. "Further research is needed to understand how the particles may be interacting with the cells and if this has a toxicological consequence."

The brain samples contained 7 to 30 times more tiny shards of plastic than samples from the cadavers' kidneys and liver, according to the preprint.

"Studies have found these plastics in the human heart, the great blood vessels, the lungs, the liver, the testes, the gastrointestinal tract and the placenta," said pediatrician and biology professor Dr. Philip Landrigan, director of the Program for Global Public Health and the Common Good and the Global Observatory on Planetary Health at Boston College.

"It's important not to scare the hell out of people, because the science in this space is still evolving, and nobody in the year 2024 is going to live without plastic," said Landrigan, who was not involved with the preprint.

"I say to people, 'Listen, there are some plastics that you can't escape. You're not going to get a cell phone or a computer that doesn't contain plastic.' But do try to minimize your exposure to the plastic that you can avoid, such as plastic bags and bottles."

The American Chemistry Council, an industry association, told CNN that while "some studies on microplastics have recently garnered headlines, just last month the FDA noted, 'Current scientific evidence does not demonstrate that levels of microplastics or nanoplastics detected in foods pose a risk to human health.'

"Research underway not only helps address current data gaps in our understanding of exposure to microplastics but it also aims to develop improved tools to measure the toxicity of microplastics to humans, said Kimberly Wise White, the council's vice president of regulatory and scientific affairs.

"This work is important given the unvalidated methods often applied by researchers which can lead to unreliable or misleading outcomes,

the complex nature of microplastics, and the many variables that can affect human health," she said.

Nanoplastics 'hijack' their way into the brain

For the study, researchers examined brain, kidney and liver tissues from 92 people who underwent a forensic autopsy to verify cause of death in both 2016 and 2024. Brain tissue samples were gathered from the frontal cortex, the area of the brain associated with thinking and reasoning, and which is most affected by frontotemporal dementia (FTD) and later stages of Alzheimer's disease.

"Based on our observations, we think the brain is pulling in the very smallest nanostructures, like 100 to 200 nanometers in length, whereas some of the larger particles that are a micrometer to five micrometers go into the liver and kidneys," Campen said.

Microplastics are fragments that can range from less than 0.2 inch (5 millimeters) or about the size of a pencil eraser, to 1 nanometer. A strand of human hair is about 80,000 nanometers wide, according to the US Environmental Protection Agency. Anything smaller is a nanoplastic that must be measured in billionths of a meter.

Nanoplastics are the most worrisome plastics for human health, experts say, because the minuscule pieces can take up residence inside individual cells.

"Somehow these nanoplastics hijack their way through the body and get to the brain, crossing the blood-brain barrier," Campen said. "Plastics love fats, or lipids, so one theory is that plastics are hijacking their way with the fats we eat which are then delivered to the organs that really like lipids — the brain is top among those."

The human brain is about 60% fat by weight, far more than any other organ. Essential fatty acids, such as omega 3s, are key to the strength and performance of the brain's cells. Since the human body can't produce essential fatty acids on its own, they must come from food or supplements.

Diet is the main route of exposure for micro- and nanoplastics, said Landrigan, who is the lead author of a March 2023 report from the Minderoo – Monaco Commission on Plastics and Human Health, a global consortium of scientists, health-care workers and policy analysts charged with following plastics from creation to final product.

In that report, the consortium determined plastics are associated with harms to human health at every single stage of the plastic lifecycle.

"Some microplastics are also airborne," Landrigan said. "For example, when people are driving down the highway and their tires are abrading on the surface of the highway, a certain amount of microplastic particles are thrown into the air.

"If you live near the coast, some of the microplastic particles that are in the ocean get kicked into the air through wave action," he said.

"So ingestion is probably the dominant route, but inhalation is also an important route."

Plastics with ties to cancer

Polyethylene, which is used in plastic bags, films and bottles and is not biodegradable, was the predominant type of plastic found in tissue samples. It was found in greater quantities in the brain than in the liver or kidney, according to the preprint.

Polyethylene was also the predominant type of polymer found in human and dog testicles, according to an August 2024 study by Campen and his team.

The production of various forms of polyethylene, such as polyethylene terephthalate (PET) plastics, are the biggest contributor to the release of the solvent 1,4-dioxane into the environment, according to industry data collected by Defend our Health, an environmental advocacy group.

The US National Toxicity Program and the International Agency for Research on Cancer considers 1,4-dioxane to be possibly carcinogenic to humans. In 2023, the EPA released a draft report saying that the solvent poses an "unreasonable risk of injury to health" for plastics workers and community residents whose drinking water has been polluted by discharges from PET plastics factories.

"The biggest question is, 'OK, what are these particles doing to us?' Honestly there's a lot we still don't know," Landrigan said. "What we do know with real certainty is that these microplastic particles are like Trojan horses — they carry with them all the thousands of chemicals that are in plastics and some are very bad actors."

By invading individual cells and tissues in major organs, nanoplastics can potentially interrupt cellular processes and deposit endocrine-disrupting chemicals such as bisphenols, phthalates, flame retardants, heavy metals and per- and polyfluorinated substances, or PFAS.

Endocrine disruptors interfere with the human reproductive system, leading to genital and reproductive malformations as well as female infertility and a decline in sperm count, according to the Endocrine Society.

"We have some pretty good indications that microplastics and nanoplastics cause harm, even though we are a long way from knowing the full extent of that harm," Landrigan said. "I would say we have enough information here that we need to start taking protective action."

Microplastics can sometimes be seen with the naked eye. Nanoplastics cannot. - Svetlozar Hristov/iStockphoto/Getty Images

Learn to use less plastic

There are many steps individuals can take to reduce their exposure to plastics and their plastic footprint, experts say.

"It's hard to avoid foods wrapped in plastic film but be sure to take the food out of the plastic wrapping before you cook it or put it in the microwave," Landrigan said. "When you heat plastic, that accelerates the movement of the microplastics out of the wrapping into the food.

Invest in a zippered fabric bag and ask the dry cleaner to return your clothes in that instead of those thin sheets of plastic, suggested the Natural Resources Defense Council, an environmental advocacy group. Bring a travel mug to the local coffee store for takeout and silverware to the office to cut back on plastic cups and utensils.

"Don't use plastic bags when you go shopping. Use a cloth bag or a paper bag or a recycle bag. Try to avoid plastic water bottles, if you can possibly do so," Landrigan said.

A March 2024 study found 1 liter of bottled water — the equivalent of two standard-size bottled waters typically purchased by consumers — contained an average of 240,000 plastic particles from seven types of plastics. Some 90% of those were nanoplastics.

"Use a metal or glass drinking cup instead of a plastic cup. Store your food in glass containers instead of in plastic ones," Landrigan said. "Work in your local community to ban plastic bags, as many communities around the United States have now done. There is a lot you can do."

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