

Microplastics May Be Harming Your Body and Brain

Analysis by [Dr. Joseph Mercola](#)

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STORY AT-A-GLANCE

- › Discarded plastic – both large and microscopic – circles the globe, choking our oceans and polluting our food supply, ultimately finding their way into your body where they can accumulate over time
- › Scientists have detected microplastic in all kinds of human tissues, including the placenta, lungs, spleen, liver, kidney, heart, brain and stool. In 2022, Dutch scientists also confirmed the presence of microplastics in meat and milk, as well as the blood of both farm animals and humans
- › Austrian researchers found plastic microparticles migrate into the brains of mice within two hours of drinking water contaminated with microplastic. Once in the brain, these plastic microparticles can increase the risk of inflammation, neurological disorders or neurodegenerative diseases such as Alzheimer's. Other recent research found it can trigger behavioral changes akin to dementia in as little as three weeks
- › Microplastics are toxic to cells. Research shows microplastic particles enter cells within 24 hours of exposure and primarily accumulate around the nucleus of the cell. As levels of microplastics and exposure time increase, cell viability significantly decreases
- › Chinese scientists discovered microplastics in the heart tissue of 15 patients undergoing cardiovascular surgery, and some of this plastic appears to be introduced during the surgery itself

We live in a throwaway society. The next time you're in a grocery store, take a look around you and note the number of items packaged in plastic. The problem is, many of

these petroleum-based plastics will last forever. So we have products for short-term consumption packaged in materials that survive for centuries, endangering wildlife and human health alike all the while.

Discarded plastic – both large and microscopic – circles the globe, choking our oceans and polluting our food supply, ultimately finding their way into your body where they can accumulate over time. In recent years, scientists have detected microplastic in all kinds of human tissues, including the placenta,¹ **lungs**, spleen, liver, kidney, heart, brain² and **stool**.

In 2022, Dutch scientists also confirmed the presence of microplastics in meat and milk, as well as the **blood** of both farm animals and humans.^{3,4} In all, nearly 80% of meat and dairy products tested contained microplastics. Shockingly, it was revealed that many feed producers will use expired food products in their processing – with the plastic packaging left on!

Microplastic Rapidly Enters Your Brain

In May 2023, The Guardian reported⁵ on Austrian research,^{6,7} which found plastic microparticles migrated into the brains of mice within two hours of drinking water contaminated with microplastic.

"Using computer models to track the dispersion of the plastics, researchers found that nanoplastic particles – which are under 0.001 millimeters and invisible to the naked eye – were able to travel into the mice's brains via a previously unknown biological 'transport mechanism,'" The Guardian wrote.

"Essentially, these tiny plastics are absorbed into cholesterol molecules on the brain membrane surface. Thus stowed away in their little lipid packages, they cross the blood-brain-barrier – a wall of blood vessels and tissue that functions to protect the brain from toxins and other harmful substances."

Once in the brain, these plastic microparticles "could increase the risk of inflammation, neurological disorders or even neurodegenerative diseases such as Alzheimer's or

Parkinson's," the researchers warned, and these concerns were recently echoed by scientists at the University of Rhode Island.

Microplastics Trigger Dementia-Like Behavioral Changes

The research, published in the August 2023 issue of the International Journal of Molecular Sciences,⁸ showed that microplastics extensively infiltrate the body, including the brain, and can trigger behavioral changes akin to dementia in as little as three weeks.

Here, young and old mice (4-month-olds and 21-month-olds) were exposed to varying levels of microplastics in their drinking water for three weeks. During behavioral testing at the end of the three weeks, many of the animals were found to exhibit dementia-like behavior.

The changes were more pronounced in older animals, which the researchers theorized might be due to "age-related dysfunction exasperating the effects of the PS-MPs [polystyrene microplastics] on behavioral performance." Lead researcher Jaime Ross called the finding "striking," because "These were not high doses of microplastics." As reported by the New York Post:⁹

"After dissecting the animals, the researchers found the particles had started to accumulate in every organ, including the brain and in bodily waste.

Because the microplastics were ingested by mouth, it was expected they would be found in the gastrointestinal tract, liver and kidneys – but their expansion to other tissues was shocking.

'The detection of microplastics in tissues such as the heart and lungs, however, suggests that the microplastics are going beyond the digestive system and likely undergoing systemic circulation,' Ross explained.

'The brain blood barrier is supposed to be very difficult to permeate. It is a protective mechanism against viruses and bacteria, yet these particles were

able to get in there. It was actually deep in the brain tissue.'

The experts noted that the microplastics' penetration of brain tissue may lead to a decrease in glial fibrillary acidic protein [GFAP], which supports cell processes in the brain.

'A decrease in GFAP has been associated with early stages of some neurodegenerative diseases, including mouse models of Alzheimer's disease, as well as depression,' Ross shared. 'We were very surprised to see that the microplastics could induce altered GFAP signaling.'"

Microplastics May Speed Onset of Neurodegenerative Disease

As explained in the paper,¹⁰ GFAP is found in mature astrocytes (cells found in your brain and spinal cord), and is involved in cellular processes such as autophagy, neurotransmitter uptake and astrocyte development. GFAP is commonly used as a marker for neuroinflammation.

Oddly enough, GFAP levels were slightly lower in the mice that had been exposed to microplastics, compared to controls, which is atypical if inflammation is part of the problem.

However, the authors pointed out that previous studies have found that "GFAP expression might decrease in early stages of certain diseases, such as Alzheimer's disease, or in younger patients with disorders such as Major Depressive Disorder."

Such studies suggest that "early pathology/early onset of disease may be characterized by astrocyte atrophy (as opposed to astrocyte hypertrophy later on), which may result in decreased GFAP expression."

Microplastics Are Cytotoxic and Boost Inflammation

The International Journal of Molecular Sciences paper¹¹ also concluded that microplastics are cytotoxic, which means they're **toxic to cells**. The microplastic particles were found to enter cells within 24 hours of exposure, and primarily accumulated around the nucleus of the cell. And, as levels of microplastics and exposure time increased, cell viability significantly decreased.

They also found alterations in immune markers. For example, expression of tumor necrosis factor (TNF-a), an inflammatory cytokine, was two-fold higher in the livers of exposed mice, compared to unexposed controls.

Weathered Plastic Triggers More Severe Inflammatory Response

In another recent experiment, researchers looked at the impact of weathered microplastics on human brain cells, compared to brand-new plastic, showing microplastic that has been degraded by environmental exposure causes a more severe inflammatory response. As explained by Science Alert:¹²

"While previous research¹³ has tested the effects newly minted plastics have on our brain cells, DGIST [Daegu Gyeongbuk Institute of Science and Technology] biologist Hee-Yeon Kim and colleagues challenged them with weathered particles instead.

They took a close look at how our brains' immune cells, microglia, respond to weathered polystyrene-derived microplastics compared with similarly-sized 'virgin' ones.

Feeding weathered microplastics to mice for seven days increased levels of inflammatory particles in their blood. They also experienced increased cell death in their brains. So the researchers then compared weathered polystyrene bits in human microglia grown in the lab ...

Kim and colleagues found the weathered microplastics affected proteins involved in breaking down sugars into energy, increasing their expression in the microglial cells 10 to 15 times more than in cells belonging to control groups.

They also increased the concentrations of proteins involved in brain cell death by a factor of 5.

The team suspects this may be to do with the changes microplastics encounter once exposed to sunlight. Polystyrene absorbs UV waves, causing the plastic to become more brittle and prone to fragmentation. Kim and team found weathered polystyrene had increased surface area and altered chemical bonds; two properties that that affect their reactivity.

This all amounts to an increased inflammatory response by brain cells – far more severe than what was produced by unweathered microplastics tested at equivalent doses.

'We have, for the first time, identified that plastic leaked into the environment undergoes an accelerated weathering process, transforming into secondary microplastics that can serve as neurotoxic substances, leading to increased inflammation and cell death in the brain,' explains [DGIST biologist Sung-Kyun] Choi."

This could have important implications for human health, considering a significant portion of the microplastic we consume is through food. Plastic trash in the oceans degrade into microplastic through photosynthesis (exposure to the sun), and those bits are then consumed by fish that end up on our dinner plates.

Microplastics Accumulate in Your Blood and Heart

Chinese scientists also recently discovered microplastics in the heart tissue of 15 patients undergoing cardiovascular surgery.¹⁴ As reported in a press release:¹⁵

"... in a pilot study of people who underwent heart surgery, researchers in ACS' Environmental Science & Technology report that they have found microplastics in many heart tissues. They also report evidence suggesting that microplastics were unexpectedly introduced during the procedures ...

[The] researchers collected heart tissue samples from 15 people during cardiac surgeries, as well as pre- and post-operation blood specimens from half of the participants.

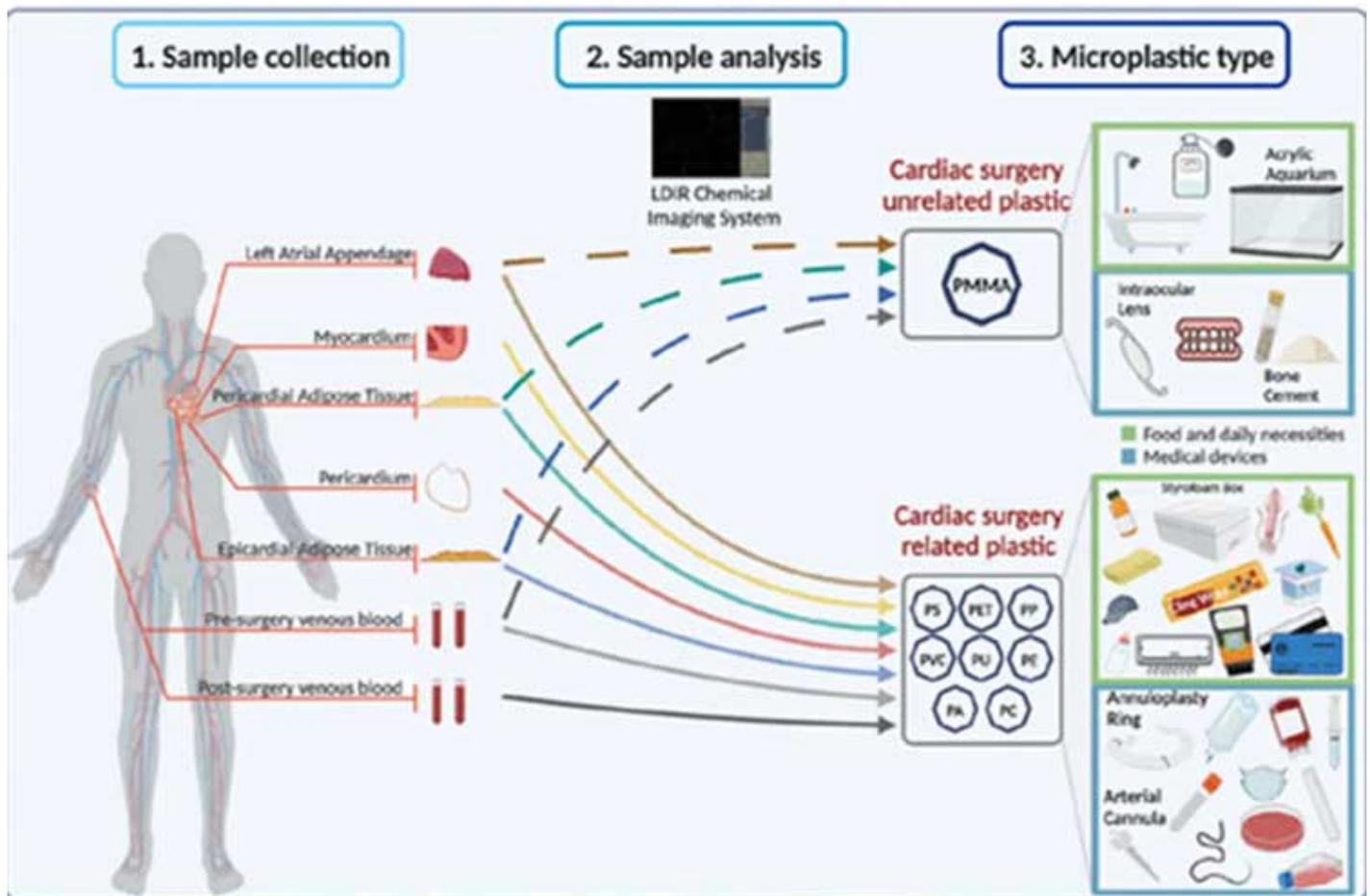
Then the team analyzed the samples with laser direct infrared imaging and identified 20 to 500 micrometer-wide particles made from eight types of plastic, including polyethylene terephthalate, polyvinyl chloride and poly(methyl methacrylate).

This technique detected tens to thousands of individual microplastic pieces in most tissue samples, though the amounts and materials varied between participants. All of the blood samples also contained plastic particles, but after surgery their average size decreased, and the particles came from more diverse types of plastics.

Although the study had a small number of participants, the researchers say they have provided preliminary evidence that various microplastics can accumulate and persist in the heart and its innermost tissues.

They add that the findings show how invasive medical procedures are an overlooked route of microplastics exposure, providing direct access to the bloodstream and internal tissues."

The following graphic showing where the various plastic particles were found, and their potential sources, was published by the New York Post, August 12, 2023.¹⁶ While this study did not theorize about plastic's contribution to heart disease, considering its impact on inflammation and cell viability, it's certainly feasible that it could be a contributing factor.



Plastic Exposure Adds Up

In late 2020, research by the World Wildlife Federation International estimated that the average person consumes about 5 grams of plastic every week, which is about the weight of a credit card.¹⁷

“ In the average lifetime, a person will consume about 40 pounds of microplastic. While much of this will pass through you, some will remain and accumulate in your organs. ”

Over time, that really adds up. According to the WWF's calculations,¹⁸ each month, you consume about 21 grams, or the equivalent of one Lego brick. In a year's time, you've consumed 250 grams, or the size of a full dinner plate's-worth of plastic.

In 10 years, you've ingested some 5.5 pounds, and in the average lifetime, a person will consume about 40 pounds. While much of this will pass through and be eliminated through your stool, some will remain and accumulate in your organs.

How to Lower Your Microplastic Exposure

Considering much of the microplastic in your body comes from food and water, it would be wise to use a high-quality water filtration system for your home, and opt for organic grass fed and grass finished meats whenever possible.

Avoid any meats or animal products from livestock (or farmed fish) that have been fed feed pellets, as these can contain microplastic from food packaging that have been processed in. Also, try to reduce your plastic consumption and generation of plastic trash in general.

For example, use reusable shopping bags when buying groceries, use your own coffee mug when getting coffee to go, skip the plastic wrap on your dry cleaning, and use a fabric shower curtain instead of a plastic one. This will reduce the amount of plastic ending up in landfills and the ocean.

Bring drinking water from home in glass water bottles instead of buying bottled water, and store foods in glassware or mason jars instead of plastic bags. You can also take your own leftover container to restaurants. Strategies such as these will help to reduce the amount of plastic that can migrate into your food. Definitely never microwave food in plastic containers.

These are just a handful of examples. Plastic is all around us and can be extremely difficult to avoid. But if you start looking around, you may find many areas of your life where you can eliminate the use of plastic and replace it with something inert that won't harm the environment and your health.

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