

# What Are Plastic Fragments Doing in Human Hearts?

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## STORY AT-A-GLANCE

- › Microplastics were detected in heart tissues from 15 people undergoing heart surgery
- › Eight different types of plastic were found in the pericardia – the membrane enclosing the heart – fat in the heart, atrial appendages and other heart tissues
- › Most tissue samples contained tens to thousands of microplastic pieces, which may have been “unexpectedly introduced” during the surgeries
- › Tiny, nanosized plastics may also pass through the blood-brain barrier into the brain
- › It’s believed that most plastic particles enter the human bloodstream after being ingested or inhaled via food, water, air and other sources

Tiny pieces of plastic may be hiding out in an alarming place – the human heart. Microplastics are known to contaminate food and water, the environment and also parts of the human body with direct exposure to the external environment, such as the lungs. However, scientists have now revealed that the contaminants are showing up in “completely enclosed human organs.”<sup>1</sup>

How they found their way into this vulnerable space is another question, but the study, which detected eight types of microplastics in various heart tissues, suggests cardiac surgeries could be partly to blame.<sup>2</sup>

## Microplastics Found in Human Heart Tissues

Microplastics refer to plastic particles less than 5 millimeters wide, which is about the width of a standard pencil eraser. Using a laser direct infrared chemical imaging system and scanning electron microscopy, researchers with Capital Medical University in Beijing, China, examined heart tissues from people undergoing heart surgery. Microplastics were detected in 15 patients, including in the following tissues:<sup>3</sup>

- Six pericardia, the membrane enclosing the heart
- Six epicardial adipose tissues, or fat in the heart
- 11 pericardial adipose tissues, or outer fat accumulation in the heart
- Three myocardia, or muscular heart tissue
- Five left atrial appendages, which are small pouches in the heart's left chamber

In seven additional cases, microplastics were found in pre- and postoperative blood samples. "Nine types of microplastics were also detected in pre- and postoperative blood samples with a maximum diameter of 184  $\mu\text{m}$  [micrometers], and the type and diameter distribution of microplastics in the blood showed alterations following the surgical procedure," the researchers wrote.<sup>4</sup>

In all, eight types of plastic, including polyethylene terephthalate, polyvinyl chloride (PVC) and poly(methyl methacrylate), were detected, in sizes ranging from 20 to 500  $\mu\text{m}$  wide. Most tissue samples contained tens to thousands of microplastic pieces,<sup>5</sup> which the team concluded "cannot be attributed to accidental exposure during surgery, providing direct evidence of microplastics in patients undergoing cardiac surgery."<sup>6</sup>

The plastics may have been "unexpectedly introduced" during the surgeries. The patients' blood samples also contained plastic particles, which decreased in average size but increased in diversity following surgery.<sup>7</sup> A related news release reported:<sup>8</sup>

*"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.”*

## **Plastics May Be in Your Brain, Too**

Media images of plastic pollution often depict plastic bags and soda container rings strangling seabirds and marine life. While this is a legitimate concern, damage from plastics doesn't end there.

The fact that plastics are so durable is part of what makes them so appealing in consumer goods. But once they're used up – often after just one usage – plastics don't biodegrade; they photodegrade, which takes hundreds of years. Researchers estimate a single plastic coffee pod may take up to 500 years, the duration of the Roman Empire.<sup>9</sup>

As they photodegrade, plastics are broken into ever smaller pieces, which only enhances their toxicity. Take the blood-brain barrier (BBB), which is intended to protect the brain from harmful substances. Larger particles can't pass through it, but tiny nano-sized plastics can.

In a mice study, the animals were fed polystyrene microparticles and nanoparticles in drinking water, with sizes of 9.55  $\mu\text{m}$ , 1.14  $\mu\text{m}$  and 0.293  $\mu\text{m}$ . Polystyrene plastics are commonly used in food packaging, including yogurt and takeout containers.<sup>10</sup> The smallest nanosized particles easily passed through the blood-brain barrier, reaching the animals' brains in only two hours.<sup>11</sup>

Cholesterol molecules “enhanced the uptake of these contaminants into the membrane of the BBB.”<sup>12</sup> The Guardian reported, “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.”<sup>13</sup>

Study author Lukas Kenner explained that, once in the brain, “Plastic particles could increase the risk of inflammation, neurological disorders or even neurodegenerative diseases such as Alzheimer's or Parkinson's.”<sup>14</sup> Separate research similarly found that

inhaled polystyrene nanoparticles can reach the brain and deposit there, leading to altered behavior and neurotoxicity.<sup>15</sup>

## **Is Plastic Running Through Your Veins From Birth?**

Researchers in the Netherlands analyzed blood samples from 22 healthy volunteers, revealing plastic particles in 17 – a rate of 77%. They used the term “plastic particles” to describe particles  $\geq 700$  nanometers in dimension, a size that can be absorbed across membranes.<sup>16</sup> The mean concentration of plastic particles in the blood was 1.6  $\mu\text{g}/\text{ml}$ , “showing a first measurement of the mass concentration of the polymeric component of plastic in human blood.”<sup>17</sup>

Some of the blood samples contained up to three different types of plastic; steel syringe needles and glass tubes were used so no plastic would be introduced to the samples.<sup>18</sup> Previous studies have detected micro-sized plastic particles in human feces, providing evidence that such particles travel through the gastrointestinal tract.

Plastic particles have also been found in colectomy specimens from humans as well as in human placental tissue.<sup>19</sup> Even the first stool of a newborn baby, known as meconium, is likely to contain plastic, according to a study published in Environmental Science and Technology Letters, which found there was more polyethylene terephthalate (PET) in the feces of infants than there was in adults.<sup>20</sup>

Infants and children are vulnerable to endocrine-disrupting chemicals as their bodies are still developing. Kurunthachalam Kannan, Ph.D., an environmental health scientist at New York University School of Medicine and researcher of the newborn study, commented:<sup>21</sup>

*“Unfortunately, with the modern lifestyle, babies are exposed to so many different things for which we don't know what kind of effect they can have later in their life. I strongly believe that these chemicals do affect early life stages. That's a vulnerable period.”*

# You May Be Consuming 5 Grams of Plastic a Week

No one knows exactly how much plastic people are exposed to on any given day – or how these 24/7 exposures add up over a lifetime. But in a study by University of Newcastle, Australia, researchers quantified what microplastic exposure may mean for humans, revealing a shocking finding that the average person could be eating about 5 grams of plastic per week – about the amount found in one credit card.<sup>22</sup>

Based on findings from a different WWF International Study, Reuters also created an illustration showing how much plastic a person would consume over time from exposure to food, beverages and dust. According to these estimations, you could be consuming enough plastic to pack a soup spoon every week, enough for a heaping dinner plate every year and as much as the size of a standard lifebuoy every 10 years.<sup>23</sup>

Where's all this plastic coming from? It's believed that most plastic particles enter the human bloodstream after being ingested or inhaled, rather than via absorption through the skin,<sup>24</sup> and there are numerous potential exposure routes, researchers explained in Environment International. This includes:<sup>25</sup>

Air	Water
Food and food packaging	Personal care products, such as PET in lip gloss and polythene in toothpaste
Dental polymers	Fragments of polymeric implants
Polymeric drug delivery nanoparticles	Tattoo ink residues

## Drinking Water Is a Major Source of Plastics

Drinking water is the greatest contributor to plastic ingestion for humans, with the University of Newcastle researchers estimating that the average person consumes 1,769

plastic particles from drinking water weekly, compared to about 11 plastic particles from salt and 182 plastic particles from shellfish.<sup>26</sup>

Plastic particles are found in groundwater, surface water, tap water and bottled water throughout the world. In the U.S., 94.4% of tap water samples contained plastic fibers, as did 82.4% of tap water samples from India and 72.2% of those from Europe.<sup>27</sup>

Switching to bottled water isn't the answer, as people drinking bottled water exclusively may ingest more microplastics than those drinking tap water<sup>28</sup> due to plastic contamination that occurs during the manufacturing process of plastic bottles and caps.

When researchers at the State University of New York tested 259 bottles of 11 popular bottled water brands – including Aquafina, Nestle Pure Life, Evian, Dasani and San Pellegrino – they found, on average, 325 pieces of microplastic per liter.<sup>29,30</sup>

Once in the environment, even as it breaks down plastic doesn't completely vanish. Instead, it turns into tiny plastic particles, commonly referred to as “mermaid tears” or “nurdles,” which act like sponges for toxic chemicals that are then consumed by filter feeders and other marine animals, damaging their bodies.<sup>31</sup>

They're so ubiquitous that nurdles are said to be “the second-largest direct source of microplastic pollution to the ocean by weight.”<sup>32</sup> In addition to the toxic chemicals in the plastics that are transferred to the organism that eats them, the microplastics may also trick the animals into believing they're full, causing them to stop eating and starve to death.<sup>33</sup>

Coral, for instance, overwhelmingly preferred plastic over brine shrimp eggs for its meal in one study, which noted, “Corals preferred microplastic beads and declined subsequent offerings of brine shrimp eggs of the same diameter, suggesting that microplastic ingestion can inhibit food intake.”<sup>34</sup>

## **What Can You Do? Reduce Your Plastic Usage**

Plastic is ubiquitous in modern life, but you can make conscious choices to avoid it as much as possible. To do so, get in the habit of:

Opting for products sold in glass containers rather than plastic whenever possible.

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Looking for plastic-free alternatives to common items such as toys and toothbrushes.

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Choosing reusable over single-use – This includes non-disposable razors, washable feminine hygiene products for women, cloth diapers, glass bottles for your beverages, cloth grocery bags, handkerchiefs instead of paper tissues, and using an old T-shirt or rags in lieu of paper towels.

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Drinking filtered tap water rather than bottled water, and bringing your own refillable glass bottles when going out.

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Buying glass food storage containers rather than plastic ones.

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Bringing your own reusable cloth shopping bags.

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Bringing your own glass dish for leftovers when eating out.

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Skipping plastic cutlery and using your own silverware when buying take-out.

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