FOOD & WATER WATCH

Tiny Particles, Big Problems: Microplastics in Our Drinking Water

Fossil fuel-backed plastic production is polluting our environment and our drinking water with tiny plastic particles. Research suggests that micro- and nanoplastics are widespread and pervasive in our environment, our waters, and our bodies, and they pose significant risks to human health. It is time for the U.S. Environmental Protection Agency (EPA) to mandate that public water systems test our drinking water for this plastic contamination, so that we can better understand this threat and make strides toward protecting public health.

What Are Micro- and Nanoplastics?

Microplastics are plastic fragments or particles less than 5 millimeters in diameter.[1] Nanoplastics are even tinier at less than 1,000 nanometers[2] (which is about 100 times smaller than the width of a human hair).[3] Primary micro- or nanoplastics are intentionally produced and added to products (such as microbeads in body scrubs) or are used in fields of medicine (such as nanosensors and imaging). Secondary micro- and nanoplastics form when plastic waste degrades.[4] Two main sources include tire wear and the laundering of synthetic fibers.[5] Secondary micro- and nanoplastics can also originate from plastics or plastic-coated cookware found in your home.[6]

Because of their size, abundance, and ability to stick to biological components, micro- and nanoplastics are carriers for pollutants and toxins,[7] while being easily ingested or inhaled by all kinds of life.[8] Scientists estimate that we ingest about a credit card's worth of microplastic every week,[9] and that we even breathe in microplastics.[10]

Microplastics Can Be Mega Harmful

Thousands of toxic chemicals are added to plastics during manufacturing, and they can be released when the plastic degrades. Some have the potential to bioaccumulate, or to concentrate in the body over time.[11] Micro- and nanoplastics can be coated in these toxic chemicals and can even adsorb (take up and hold onto) additional toxins, effectively doubling-down on the harmful effects.[12] Some of these toxins and pollutants include phthalates and bisphenol A (BPA), polychlorinated biphenyls (PCBs), heavy metals, flame retardants,[13] pesticides, and antibiotics.[14]

Microplastics are also great carriers for compounds like per- and polyfluoroalkyl substances (PFAS),[15] which have their own concerning health effects linked to issues such as diabetes and cancer.[16] Microplastics are able to adsorb PFAS, increase its concentration over time, and increase its resistance to environmental degradation.[17] Emerging research suggests that an organism's

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exposure to PFAS and microplastics combined can result in greater health effects than if exposed to either alone.[18]

Once ingested, microplastics can accumulate in cells, tissues, and organs, causing damage to cell walls, inducing allergic responses, and causing early cell death.[19] Exposure to micro- or nanoplastics is linked to liver damage,[20] different forms of cancer,[21] reproductive harm,[22] and an increased combined risk that includes heart attacks and strokes.[23] Nanoplastics in particular have been found to migrate into crucial organs such as the brain.[24]

Research has documented these particles throughout our bodies,[25] yet there is still much we do not know about their harmful effects.[26]

Microplastics Are Everywhere, Including in Our Drinking Water

Globally, we produce over 300 million tons of plastic waste each year, much of which reaches our oceans.[27] Once in marine waters, it degrades and transforms as a result of exposure to ultraviolet radiation, waves, and microorganisms.[28] Microplastics harm marine life because they resemble the food sources of many organisms and adsorb toxic pollutants.[29] Microplastics have been documented in every ocean basin on the planet, as well as in fresh water, rain water, and drinking water.[30]

Drinking water is one of the main, and most alarming, ways that people can ingest microplastics.[31] Studies have confirmed that microplastics occur in tap water worldwide, including in the U.S.[32] One study estimated that consuming only tap water adds around 4,000 microplastic particles annually into our bodies,[33] which the author believes is an underestimate.[34] Another study, conducted in 2017, took 159 global water samples – 33 of which were tap water samples from major U.S. cities such as Buffalo, Chicago, Los Angeles, New York City, and Washington, D.C. – and found that the U.S. had the highest concentration of microplastics in its tap water.[35] Currently, drinking water treatment plants are not able to remove 100 percent of microplastics.[36]

Bottled water is not an alternative, since most bottled water contains tap water, and drinking from single-use plastic bottles can actually increase the amount of microplastics you can ingest by around 680 percent.[37] Research suggests that bottled water could be one of the main ways we ingest microplastics.[38]

With Microplastics, What We See Is Not All We Can Know

Current understanding of the ubiquitous nature of micro- and nanoplastics and their harmful effects is likely the tip of the iceberg. The tiny size of these plastics – in addition to the lack of defined analytical techniques or databases that would help shed light on their physiochemistry and varied plastic compositions – creates a diverse problem that is difficult to comprehend.[39] This is largely because the U.S., among other governments, lacks proper studies, initiative, and regulation aimed at understanding the full enormity of the issue.[40]

However, while there is need for improvement,[41] we have various detection and analytical methods to begin identifying and characterizing these particles in water.[42] What is missing is a regulatory

move from the EPA to start monitoring microplastics in drinking water. Until we are able to dedicate more regulatory effort and attention toward this crisis, we are going to be left fighting in the dark.

Plastic Pollution Is an Environmental Injustice

Plastic pollution poses greater harm to marginalized groups than to others, according to the United Nations Environment Programme. Where there is plastic, there will inevitably be microplastics. Low-income, rural, and Indigenous groups can be disproportionately affected by microplastic pollution due to their high exposure rates and fish-heavy diets.[43] Island and coastal communities can also fall into this category, particularly as ocean currents and wind patterns redistribute plastics onto shorelines.[44]

Even if marginalized groups could avoid microplastic exposure and the health burdens it brings, they would still be left at the mercy of plastic's toxic lifecycle. Plastic production and incineration facilities are often located near low-income communities where residents are constantly exposed to toxic pollution through the air, water, and soil – leading to the creation of "cancer alleys."[45]

Conclusion

Micro- and nanoplastics are a pervasive public health risk that currently evades regulation, and drinking water is a primary exposure route. Today's science suggests that what we know is just the beginning. To take the first meaningful step in tackling this problem, the EPA must mandate public water systems to test for these tiny plastic particles. Ultimately, we need to cut these microplastics off at their source by moving off of fossil-fueled plastics altogether.

Endnotes

1 U.S. Environmental Protection Agency. "Microplastics research." Available at https://www.epa.gov/water-research/microplastics-research. Accessed May 2023 and on file with Food & Water Watch (FWW); Ateia, Mohamed et al. "Emerging investigator series microplastic sources, fate, toxicity, detection, and interactions with micropollutants in aquatic ecosystems — a review of reviews." *Environmental Science: Processes & Impacts.* Vol. 24, Iss. 2. February 2023 at 3.

2 Ziani, Khaled et al. "Microplastics: A real global threat for environment and food safety: A state of the art review." *Nutrients.* Vol. 15, No. 617. January 2023 at 2.

3 U.S. National Nanotechnology Initiative. "Size of nanoscale." Available at https://www.nano.gov/nanotech-101/what/nano-size. Accessed August 2024 and on file with FWW.

4 Bashir, Saidu M. et al. "Personal care and cosmetic products as a potential source of environmental contamination by microplastics in a densely populated Asian city." *Frontiers in Marine Science.* Vol. 8, No. 683482. June 2021 at 2; Franklin Rey, Savannah. "Microplastic pollution on island beaches, Oahu, Hawai'i." *PLOS ONE.* Vol. 16, No. 2. February 2021 at 1; Hanpeng, Lai et al. "Nanoplastics and human health: Hazard identification and biointerface." *Nanomaterials.* Vol. 12, No. 1298. April 2022 at 1 to 2.

5 Hanpeng (2022) at 2; Vasselinko, Ekaterina et al. "Domestic laundry and microfiber pollution: Exploring fiber shedding from consumer apparel textiles." *PLOS ONE.* Vol. 16, No. 7. July 2021 at abstract and 1; Ateia et al. (2023) at 3 to 4.

6 Cole, Matthew et al. "Microplastic and PTFE contamination of food from cookware." *Science of the Total Environment.* Vol. 929, No. 172577. April 2024 at abstract and 6.

7 Nguyen, Thu et al. "Sinking of microbial-associate microplastics in natural waters." *PLOS ONE.* Vol. 15, No. 2. February 2020 at 1 to 2 and 15; He, Li et al. "Research on the non-point source pollution of microplastics." *Frontiers in Chemistry.* Vol. 10. July 2022 at 1.

8 Yu, Hong et al. "Microplastics as an emerging environmental pollutant in agricultural soils: Effects on ecosystems and human health." *Frontiers in Environmental Science.* Vol. 10, No. 855292. March 2022 at 1 to 2; United Nations Environment Programme (UNEP). "Neglected: Environmental Justice Impacts of Marine Litter and Plastic Production." April 2021 at 21.

9 Berry, Sarah. "We consume a credit card worth of plastic each week. What is it doing to our health?" *Sydney Morning Herald.* April 1, 2023; Lazarus, David. "Column: You do know that, in most cases, bottled water is just tap water?" *Los Angeles Times.* September 28, 2021.

10 Vianello, Alivse et al. "Simulating human exposure to indoor airborne microplastics using Breathing Thermal Manikin." *Scientific Reports*. Vol. 9, No. 8670. June 2019 at abstract.

11 Wiesinger, Helene et al. "Deep dive into plastic monomers, additives, and processing aids." *Environmental Science & Technology*. Vol. 51. June 2021 at abstract.

12 Yu et al. (2022) at 2 and 5.

13 Campanale, Claudia et al. "A detailed review study on potential effects of microplastics and additives of concern on human health." *International Journal of Environmental Research & Public Health.* Vol. 17, No. 1212. February 2020 at 4, 5, and 15.

14 Peña, Aránzazu et al. "Interactions of microplastics with pesticides in soils and their ecotoxicological implications." *Agronomy.* Vol. 13, No. 701. February 2023 at 6; Du, Jia et al. "Ecotoxicological effects of microplastics combined with antibiotics in the aquatic environment: Recent developments and prospects." *Environmental Toxicology and Chemistry.* Vol. 43, No. 9. June 2024 at 1951.

15 Parashar, Neha et al. "Microplastics as carriers of per- and polyfluoroalkyl substances (PFAS) in aquatic environment: Interactions and ecotoxicological effects." *Water Emerging Contaminants & Nanoplastics.* Vol. 2, No. 15. August 2023 at 2.

16 Roth, Katherine and Michael Petriello. "Exposure to per- and polyfluoroalkyl substances (PFAS) and type 2 diabetes risk." *Frontiers in Endocrinology*. Vol. 13. August 2022 at abstract; 88 Fed. Reg. 18639. March 29, 2023.

17 Parashar et al. (2023) at 8 and 13.

18 Rainieri, Sandra et al. "Combined effects of microplastics and chemical contaminants on the organ toxicity of zebrafish (*Danio rerio)*." *Environmental Research.* Vol. 162. January 2018 at 137 to 139, 141, and 142; Kang, Peiying et al. "The unheeded inherent connections and overlap between microplastics and poly- and perfluoroalkyl substances: A comprehensive review." *Science of the Total Environment.* Vol. 878, No. 163028. June 2023 at abstract and 3.

19 Amobonye, Ayodeji et al. "Environmental impacts of microplastics and nanoplastics: A current overview. *Frontiers in Microbiology.* Vol. 12, No. 768297. December 2021 at 13 to 13; Carrington, Damian. "Microplastics cause damage to human cells, study shows." *Guardian.* December 8, 2021.

20 Chiang, Chun-Cheng et al. "Impact of microplastics and nanoplastics on liver health: Current understanding and future research directions." *World Journal of Gastroenterology.* Vol. 30, Iss. 9. March 2020 at 1012, 1013, and 1014.

21 Bhuyan, Md. Simul. "Effects of microplastics on fish and in human health." *Frontiers in Environmental Science.* Vol. 10, No. 827289. March 2022 at 6 and 8; Park, Jun et al. "Polypropylene microplastics promote metastatic features in human breast cancer." *Scientific Reports.* Vol. 13, No. 6252. April 2023 at abstract; Cetin, Meltem et al. "Higher number of microplastics in tumoral colon tissues from patients with colorectal adenocarcinoma." *Environmental Chemistry Letters.* Vol. 21. February 2023 at abstract; Bonanomi, Marcella et al. "Polystyrene micro and nano-particles induce metabolic rewiring in normal human colon cells: A risk factor for human health." *Chemosphere.* Vol. 303, No. 134947. May 2022 at abstract.

22 Ateia et al. (2023) at 10 to 11; Dubey, Itishree et al. "Developmental and reproductive toxic effects of exposure to microplastics: A review of associated signaling pathways." *Frontiers in Toxicology.* Vol. 4, No. 901798. August 2022 at 2 and 4 to 6.

23 Marfella, Raffaele et al. "Microplastics and nanoplastics in atheromas and cardiovascular events." *New England Journal of Medicine.* Vol. 390, No. 10. March 2024 at abstract.

24 Kopatz, Verena et al. "Micro- and nanoplastics breach the blood-brain barrier (BBB): Biomolecular corona's role revealed." *Nanomaterials*. Vol. 13, No. 1404. April 2023 at abstract.

25 Leslie, Heather A. et al. "Discovery and quantification of plastic particle pollution in human blood." *Environment International.* Vol. 163, No. 107199. March 2022 at abstract; Zimmermann, Lisa. "Microplastics detected in human testis and semen." *Food Packaging Forum.* March 31, 2023; Ragusa, Antonio et al. "Raman microspectroscopy detection and characterisation of microplastics in human breastmilk." *Polymers.* Vol. 14, No. 2700. June 2022 at abstract; Ragusa, Antonio et al. "Plasticenta: First evidence of microplastics in human placenta." *Environment International.* Vol. 146, No. 106274. December 2020 at abstract.

26 Osaka, Shannon. "With microplastics, scientists are in a race against time." *Washington Post*. March 11, 2024.

27 Ateia et al. (2023) at 3 to 4 ; Vasselinko (2021) at abstract.

28 Ateia et al. (2023) at 6 to 8.

29 Bhuyan (2022) at 2 to 4; Maes, Thomas et al. "You are what you eat, microplastics in Porbeagle sharks from the Northeast Atlantic: Method development and analysis in spiral valve content and tissue." *Frontiers in Marine Science.* Vol. 7, No. 273. May 2020 at 2 and 8.

30 Baldwin, Austin K. et al. "Microplastics in Lake Mead National Recreation Area, USA: Occurrence and biological uptake." *PLOS ONE.* Vol. 15, No. 5. May 2020 at 2 and 12; Gambino, Isabella et al. "Occurrence of microplastics in tap and bottled water: Current knowledge." *International Journal of Environmental Research and Public Health.* Vol. 19, No. 5283. April 2022 at abstract; Wetherbee, Gregory et al. U.S. Geological Survey. "It's Raining Plastic." 2019 at 1.

31 Gambino (2022) at 4; Brancaleone, Eleonora et al. "Microplastic in drinking water: A pilot study." *Microplastics.* Vol. 3, Iss. 1. January 2024 at 32.

32 Udovicki, Bozidar et al. "Microplastics in food: Scoping review on health effects, occurrence, and human exposure." *International Journal of Food Contamination.* Vol. 9, No. 7. July 2022 at 9.

33 Cox, Kieran D. et al. "Human consumption of microplastics." *Environmental Science & Technology.* Vol. 53, Iss. 12. June 2019 at abstract.

34 Ziani (2023) at 3.

35 Kosuth, Mary et al. "Anthropogenic contamination of tap water, beer, and sea salt." *PLOS ONE*. Vol. 13, No. 4. April 2018 at 3 and 7 to 8.

36 Acarer, Seren. "Abundance and characteristics of microplastics in drinking water treatment plants, distributions systems, water from refill kiosks, tap waters and bottled waters." *Science of the Total Environment.* Vol. 884, No. 163866. August 2023 at 2.

37 Danopoulos, Evangelos et al. "Microplastic contamination of drinking water: A systemic review." *PLOS ONE.* Vol. 5, No. 7. July 2020 at abstract; Cox (2019) at abstract.

38 Berry (2023).

39 Lamichhane, G. et al. "Microplastics in environment: Global concern, challenges, and controlling measures." *International Journal of Environmental Science and Technology.* Vol. 20. May 2022 at 4684 and 4685.

40 Usman, Sunusi et al. "The burden of microplastics pollution and contending policies and regulations." *International Journal of Environmental Research and Public Health.* Vol. 19, No. 6773. June 2022 at abstract, 2, 6, 9, and 12.

41 Koelmans, Albert et al. "Microplastics in freshwaters and drinking water: Critical review and assessment of data quality." *Water Research*. Vol. 155. May 2019 at abstract; Blevins, Morgan G. et al. "Field-portable microplastic sensing in aqueous environments: A perspective on emerging techniques." *Sensors*. Vol. 21, No. 3532. May 2021 at 22.

42 Huang, Zike et al. "Analytical methods for microplastics in the environment: A review." *Environmental Chemistry Letters.* Vol. 21. September 2023 at 387 and 395; Ziani (2023) at 10.

43 UNEP (2021) at 36; Dharssi, Alia. "Newsletter: Plastic pollution is a social justice issue." *Discourse.* February 2018; Provencher, Jennifer F. et al. "Future monitoring of litter and microplastics in the Arctic — challenges, opportunities, and strategies." *Arctic Science.* Vol. 9. November 2022 at 216.

44 Franklin Rey (2021) at 2 and 8; Charlton, Karen E. "Fish, food security and health in Pacific Island countries and territories: A systematic literature review." *BMC Public Health.* Vol. 16, No. 285. March 2016 at abstract.

45 UNEP (2021) at 24 and 28.