frontiers | Frontiers in Water

TYPE Editorial
PUBLISHED 07 December 2022
DOI 10.3389/frwa.2022.1101313

Check for updates

OPEN ACCESS

EDITED AND REVIEWED BY
Tissa H. Illangasekare,
Colorado School of Mines,
United States

*CORRESPONDENCE
Rafael Trevisan
rtrevisa@ifremer.fr

SPECIALTY SECTION
This article was submitted to Water and Human Health, a section of the journal Frontiers in Water

RECEIVED 17 November 2022
ACCEPTED 25 November 2022
PUBLISHED 07 December 2022

CITATION
Trevisan R, Brander SM and Coffin S (2022) Editorial: Microplastics in water and potential impacts on human health. *Front. Water* 4:1101313. doi: 10.3389/frwa.2022.1101313

Editorial: Microplastics in water and potential impacts on human health

Rafael Trevisan[1]*, Susanne M. Brander[2] and Scott Coffin[3]

[1]UMR6539 Laboratoire des Sciences de L'environnement Marin (LEMAR), Plouzané, France, [2]Department of Fisheries, Wildlife, and Conservation Sciences, Coastal Oregon Marine Experiment Station, Oregon State University, Newport, OR, United States, [3]California State Water Resources Control Board, Sacramento, CA, United States

KEYWORDS

plastic pollution, microplastics, nanoplastics, human health, drinking water, sources of contamination, toxicity

Editorial on the Research Topic
Microplastics in water and potential impacts on human health

As millions of tons of plastic waste enter our oceans and freshwater ecosystems each year, we are presently facing unprecedented quantities of plastic particles in our food, water, and environment. Such particles, which may range in size from the milimeter to the nanometer, can contaminate our water supplies and build up in the food web, leaching harmful compounds and concentrating and carrying chemicals and microorganisms. Examples of these plastic particles with a dimension of <5 mm include microplastics. Their effects on human bodies are mostly uncertain, although they have the potential to cause physical, chemical, and microbiological toxicity, which may result in oxidative stress, cellular damage, inflammatory and immunological responses, neurotoxic, and even metabolic abnormalities. Considered one of the final sinks for plastic waste, water bodies receive significant amounts of microplastics every year, endangering water quality and human health. The challenges for comprehensive risk assessments are numerous, but more than ever, research on microplastics is crucial to characterize the potential hazard of small plastics to human health. The papers in this *Microplastics in Water and Potential Impacts on Human Health* collection were written by plastic pollution experts in an attempt to provide and integrate scientific facts for risk assessment, policy making, and mitigation measures.

Microplastic contamination of drinking water sources will be a serious concern in the coming decades. Many key rivers and lakes across the globe have been identified as contaminated by microplastics, raising concerns about the efficacy of the filtering systems used in our drinking water treatment facilities. Negrete Velasco et al. recreated the filtering methods utilized by the city of Geneva to offer potable water to 500,000 people using a pilot-scale drinking water treatment facility. By combining ultrafiltration and FT-IR techniques with the analysis of representative volumes of raw or treated water, they found an efficacy as high as 96–97% in the water treatment processes in removing microplastics and synthetic fibers ranging from 63 to 1,000 µm. Barbier et al. investigated

French drinking water treatment plants in the Paris region and found that particle removal efficiency in conventional treatment is as high as 99% against 25–5,000 μm microplastics, though the addition of nanofiltration processes can further increase this efficiency, especially for very small particles. They also discovered contamination of drinking water throughout the distribution network, a matter of great concern. Both studies indicate a high rate of success for the removal of plastic fragments and fibers from our drinking water; however, it is still necessary to determine whether this efficacy holds for the removal of particles on the micrometer or nanometer scale.

While characterizing treatment efficacies for microplastics in drinking water is a key component to managing exposure, understanding how microplastics harm humans and the concentrations at which unacceptable risks occur is vital for risk managers. Immunological responses to ingested foreign particles are known to cause adverse impacts on human health and alter the functioning of the immune system. These adverse effects may result from the inability of macrophages to degrade engulfed particles which results in the secretion of inflammatory cytokines. Beijer et al. investigated the relationship between particle properties and immunotoxicological effects of microplastics using a cell-based assay specifically designed for measuring particle toxicity. By using environmentally-weathered microplastics collected from ocean and land, they provide more meaningful data than if they used un-realistic virgin microplastic particles–which have commonly been used in mammalian toxicity experiments. Macrophages secreted inflammatory cytokines (IL-1β, IL-8, TNF-α) in a dose-dependent manner following exposure to microplastic particles. Multivariate analysis revealed that particle size was a driving factor for toxicity, although polyethylene terephthalate was significantly more toxic than other polymers tested. While this study shines light on a poorly research hazard trait of microplastics, additional research is needed to understand impacts on humans.

Like other persistent contaminants, MPs are of potential concern to human health when ingested or otherwise internalized by fishes that are consumed as seafood. Additionally, exposure to MPs does not occur in isolation, thus fishes containing microplastics likely also contain other contaminants. A study by Pittura et al. characterized these co-exposures by analyzing fishes sampled from lakes in Central Italy. They sought to better understand the bioavailability of co-occurring pollutants in freshwater ecosystems, with a focus on fish (*Rutilus rutilus, Anguilla Anguilla, Carassus auratus*) and invertebrate species (*Procambarus clarkia*) consumed by humans. One of the two lakes which is historically more polluted, Piediluco, contained more organisms that had MPs in their digestive tracts, with a dominance of polyester fibers, and a higher number of samples with elevated PBDEs and HBCDs. Interestingly even though MPs were detected in the majority of fishes, no MPs were found in filets. Recommendations included the further study of the influence of MPs on bioaccumulation in edible tissues and the continued use of these species as bioindicators.

Concerns about micro and nanoplastic contamination in drinking water have been expressed worldwide, although little is known about the levels at which they are present and how this may vary globally. Using MP exposure levels estimated from the literature, Szule et al., exposed female adult mice to polystyrene nanoplastic spheres (20, 200 nm) *via* drinking water for 25.5 h. While mice displayed no outward signs of toxicity or gross histopathological response, immunohistochemistry approaches detected markers of inflammation in the small intestine, and sequestration of particles in liver endosomes. The microbiome also appeared to be altered after just one day of exposure, with decreased bacterial diversity following exposure to both NP sizes. Results indicate a potential risk of exposure to NPs in drinking water, warranting further investigation using different polymer types and morphologies, especially considering that exposure in humans would be chronic and occur over a lifetime. Early enteric and hepatic responses to ingestion of polystyrene nanospheres from water in C57BL/6 mice.

These articles discuss topics such as the origin of microplastics, methods to eliminate them, and their hazardous nature to humans. Their contributions to the subject of microplastics will promote the development of this multidisciplinary and dynamic field of study.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Funding

This work was funded by National Science Foundation Growing Convergence Research Big Idea, award number 1935028 (to SB).

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note