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Clarifying the absence of evidence regarding human health risks to microplastic particles in drinking-water: High quality robust data wanted

In a recently published article, Leslie and Depledge (2020) raise concerns regarding statements on the risk that microplastic particles represent to human health and which have been attributed to reports published by both the Science Academies' Group, Science Advice for Policy (SAPEA) (part of the European Commission's Science Advice Mechanism) and the World Health Organization (WHO) (SAPEA, 2019; WHO, 2019). Leslie and Depledge (2020), for instance, suggest that WHO (2019) conclude that there is 'no evidence to indicate a human health concern.' This statement, taken out of context from the WHO report (WHO, 2019), is then used to imply that the WHO conclude there is 'no risk' related to the exposure of microplastic particles (Leslie and Depledge, 2020). While, Leslie and Depledge (2020) highlight the importance of debate and systematic assessment of claims related to the assessment of risk, observations that we agree are important to highlight, there are a number of points raised in the article that require clarification.

Specifically and most importantly, the WHO report (WHO, 2019) does not conclude that microplastics are safe. The report (WHO, 2019), however, does acknowledge that there are significant uncertainties related to the quality and breadth of available data pertaining to human exposure to microplastics in drinking-water and that our knowledge regarding both exposure and toxicological effects require the acquisition of more robust 'evidence'. In an effort to help strengthen the quality and robustness of data needed to better inform human health risk assessment, the WHO report (WHO, 2019) identifies several research priorities, which are further supported by an evaluation and guidance towards improving the characterization and quantification of microplastic particles in drinking-water (Koelmans et al., 2019).

The suggestion by Leslie and Depledge (2020) "…that it is clearly perilous to believe that the absence of evidence of risk translates into evidence for the absence of risk", raises an important issue that policy makers must continuously address when considering policy decisions. To address the associated uncertainties in relation to the actual and potential risks attributed to exposure to microplastic particles there exists the following dilemma, which we perceive represents a source of frustration, not only to the research community as expressed by Leslie and Depledge (2020) but also to risk assessors, managers and decision makers:

- The 'evidence' we have is not always the 'evidence' we want.
- The 'evidence' we want is not always the 'evidence' we need.
- The 'evidence' we need is not always the 'evidence' we can obtain.
- The 'evidence' we can obtain costs more than we want to pay.

Consequently, to obtain the appropriate 'evidence' associated with high-quality data and address the uncertainties requires resource, i.e. money, people, time. Furthermore, the suggestion that simply because the available 'evidence' is insufficient to demonstrate a risk to human health, is not the same to concluding that there is an absence of risk (Wardman et al., 2020). The fundamental basis of risk pertains to an assessment of probabilities, such as the probability of an adverse effect resulting from a probability associated with a potential exposure. From a probabilistic perspective, therefore, there always exists the probability of a risk – there is never a complete absence of risk – however, characterizing and quantifying the associated probabilities is often challenging and complex. The objective of scientific research in helping to inform the assessment of risk is to test various hypotheses and to develop a weight-of-evidence that either supports or rejects the null hypothesis (Wardman et al., 2020). In the instance of human health effects associated with exposure to microplastic particles in drinking-water, the evaluation of the current state-of-the science implies low probability of risk, although the report notes that the available information is insufficient to draw firm conclusions (WHO, 2019). Therefore a key message of the WHO report (WHO, 2019) is that there are significant uncertainties related to the available data and that our knowledge regarding both exposure and toxicological effects require the acquisition of high quality robust 'evidence'. In other words high quality robust data are needed and wanted to progress a meaningful assessment of human health risk

How to best address the uncertainties and relative quality of the data, however, should consider the reality that we live in a world of limited resources. Consequently, opportunities to advise and prioritize resources to help reduce key uncertainties are important to optimize, with the organization, development and publication of the WHO report (WHO, 2019) aimed at supporting the prioritization of research efforts. As noted by Leslie and Depledge (2020), 'stakeholders including scientists should thoughtfully and systematically scrutinize all claims, policy justifications and political angles in the debate. Multiple hypotheses and viewpoints abound and so they should until new data and better knowledge emerge.' We entirely agree with this perspective and the WHO report (Leslie and Depledge, 2020) included efforts to address these very challenges – by including expert scientists from varying fields of expertise and perspectives in both the development and review of the report. Consequently, the conclusions and recommendations for future research were identified based on consensus from scientific experts from varying perspectives.

It thus follows that based on the assessment of the available data, which imply that exposure concentrations do not currently represent significant risks to humans or the environment (SAPEA, 2019; WHO, 2019) it would be inappropriate to suggest that drinking-water suppliers and regulators expend scarce resources to routinely monitor microplastics, particularly when those resources could be directed towards

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monitoring critical water quality parameters, of known public health significance, especially in low-income settings. The WHO report (WHO, 2019), however, does emphasize the importance of putting in place and optimizing drinking-water and wastewater treatment systems, which are designed to remove particulates (and other contaminants including microbial pathogens) and therefore the implementation of these treatment systems will reduce plastic particle concentrations (WHO, 2019). Encouraging the optimization of drinking-water and wastewater treatment systems represents a key priority identified in the WHO report (WHO, 2019), a suggestion that is further augmented by a number of research recommendations. The WHO report (WHO, 2019), for instance, concludes that 'to better assess human health risks and inform management actions, a number of research gaps need to be filled.' Specific examples identified include:

- The need to better understand microplastics occurrence throughout the water supply chain, using quality-assured methods to determine the numbers, sizes, composition and sources of microplastics and to better characterize the effectiveness of water treatment.
- The development and application of quality-assured toxicological data on the most common forms of plastic particles relevant to human health risk assessment.
- Improved understanding of the uptake and fate of both micro- and nano-plastic (<1 μm) following ingestion.
- More robust data on exposure to both micro- and nano-plastic (<1 μm) from all exposure pathways, including inhalation, food and beverages and an overall better assessment of exposure to microplastics from the broader environment.

Leslie and Depledge (2020) additionally note that the ability of microplastics to be chemical and pathogen vectors needs to be seriously considered. The WHO report (WHO, 2019) does indeed seriously address each of these issues in two sections of the report. One section on– "Possible human health risks associated with microplastics in drinking-water: particles and chemicals" and a second on "Possible human health risks associated with microplastics in drinking-water: biofilms". The WHO report (WHO, 2019) indicates low concern for human health, which based on a conservative approach, inter alia, to assess the potential for microplastics to act as vectors of chemicals. Statements that are further augmented with an acknowledgement that uncertainties in the exposure assessment represent important knowledge gaps that need to be considered. Consequently, the research needs identified in the WHO report (WHO, 2019) are perceived as important contributions towards directing future research activities, effectively and efficiently.

Overall, the WHO, in its drinking water report, is strongly supportive of efforts that will help to reduce plastic pollution, which represents a central message of its press release that accompanied the report and statements on the WHO website. As noted in the WHO report, reducing sources of plastic pollution and of microplastics are win-win – these actions are better for the environment, for personal well-being, and as such it is a no-regrets intervention. The report also indicates that mitigating releases of plastic pollution and microplastics are key to helping to reduce human exposure. Activities of the WHO continuously take into account new science and recommendations from the 2019 report (WHO, 2019) can be revised as new scientific understanding advances our understanding. Future research should ideally be targeted at priorities identified based on consensus from scientific experts from varying perspectives, such as from SAPEA (2019) and WHO (2019). Given WHO identified several research priorities in its 2019 report (WHO, 2019), it is not clear how this report should result in inaction by policy makers and researchers, as indicated by the Leslie and Depledge (2020) article. WHO is currently reviewing the state-of-science on the potential human health impacts of microplastics from the wider environment. This report will include an updated analysis on drinking-water, incorporating evidence emerging post the WHO 2019 report (WHO, 2019), and will continue to engage scientists from varying perspectives.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Koelmans, A.A., Mohamed Nor, N.H., Hermsen, E., Kooi, M., Mintenig, S.M., De France, J., 2019. Microplastics in freshwaters and drinking water: Critical review and assessment of data quality. Water Res. 155, 410–422. https://doi.org/10.1016/j.watres.2019.02.054.

Leslie, H.A., Depledge, M.H., 2020. Where is the evidence that human exposure to microplastics is safe? Environ. Int. 142, 105807. https://doi.org/10.1016/j.envint.2020.105807.

SAPEA. Science Advice for Policy by European Academies, 2019. A Scientific Perspective on Microplastics in Nature and Society. SAPEA, Berlin https://doi.org/10.26356/microplastics.

Wardman, T., Koelmans, A.A., Whyte, J., Pahl, S., 2020. Communication the absence of evidence for microplastics risk: Balancing sensation and reflection. Environ. Int. https://doi.org/10.1016/j.envint.2020.106116 (in press).

WHO, 2019. Microplastics in Drinking-water. WHO, Geneva, Switzerland.

T. Gouin[a,*], D. Cunliffe[b], J. De France[c], J. Fawell[d], P. Jarvis[d], A. A. Koelmans[e], P. Marsden[f], E.E. Testai[g], M. Asami[h], R. Bevan[i], R. Carrier[j], J. Cotruvo[k], A. Eckhardt[l], C.N. Ong[m]

[a] *TG Environmental Research, Sharnbrook, Bedfordshire, UK*

[b] *Department for Health and Wellbeing, Adelaide, South Australia, Australia*

[c] *Water, Sanitation, Hygiene and Health, Department of Environment, Climate Change and Health, World Health Organization, Geneva, Switzerland*

[d] *Cranfield Water Science Institute, Cranfield University, Cranfield, Bedfordshire MK43 0AL, UK*

[e] *Aquatic Ecology and Water Quality Management Group, Wageningen University, P.O. Box 15 47, 6700 DD Wageningen, the Netherlands*

[f] *Drinking Water Inspectorate, London SW1P 3JR, UK*

[g] *Istituto Superiore di Sanità- Environment and Health Dept, Viale Regina Elena 299, 00161 Rome, Italy*

[h] *Department of Environmental Health, National Institute of Public Health, 2-3-6 Minami, Wako, Saitama 351-0197, Japan*

[i] *IEH Consulting Ltd., Nottingham, UK*

[j] *Health Canada, Ottawa, Canada*

[k] *Joseph Cotruvo & Associates, LLC, Washington, D.C, United States*

[l] *German Environment Agency, Bad Elster, Germany*

[m] *School of Public Health, National University of Singapore, Singapore*

[*] Corresponding author at: TG Environmental Research, 18 Wellpond Close, Sharnbrook MK44 1PL, UK.
E-mail address: todd.gouin@environresearch.com (T. Gouin).