

Further research on impact of microplastics on children's health is essential to protecting future generations

Jongin Lee, MD, PhD^{1,2}, Dong-Wook Lee, MD, PhD³

¹Department of Occupational and Environmental Medicine, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea; ²Centre for Occupational and Environmental Health, Division of Population Health, Health Services Research & Primary Care, The University of Manchester, Manchester, UK; ³Department of Occupational and Environmental Medicine, Inha University Hospital, Incheon, Korea

Key message

- The ecological impacts of microplastics have been documented. It was recently recognized that they can directly or indirectly cause diseases in humans.
- There are few established methods for assessing human exposure to microplastics.
- Standardization of exposure assessments and large-scale epidemiological studies are required to explore the human effects of microplastics.

Modern society has several characteristics that distinguish it from the past. One of the most prominent concerns is the use of plastics. Plastics were first synthesized in the late 1800s and early 1900s, and their use exploded after World War II.¹⁾ Lightweight, cheap, stable, and economical, plastics have become an indispensable part of modern society.

Microplastics are small pieces of plastic typically less than 5 mm in diameter. If the particles are smaller than 100 nm, they are termed nanoplastics. Recent studies have indicated the widespread presence of microplastics in organisms within marine ecosystems.²⁾ Accordingly, concerns about their health risks have continuously emerged. Previous studies supported the hypothesis that these exposures involve multiple toxic mechanisms. One study of microplastic exposure in rats found that the materials accumulated in the liver, kidneys, and intestines and measurably affected several biomarkers.³⁾

These experimental studies predicted that microplastic exposure is an ecological problem and could have direct human effects. Direct evidence of this hypothesis has emerged because microplastics can enter the human body directly through the consumption of food, including seafood and drinking water. Similar to that in other mammals, microplastic exposure can cause a range of toxic

effects in humans.

The study by Leslie et al.⁴⁾ in 2022 was the first to reveal the presence of plastic polymers in human blood and quantify them. An association between the detection of microplastics in thrombectomy specimens and an increased risk of major cardiovascular events was recently reported.⁵⁾ This study is notable because it is the first to show a clear risk of disease directly attributable to microplastics over several years of follow-up. However, it is limited in that the study population was older adults; thus, future studies of such health effects across the life cycle are warranted.

Exposure to microplastics is particularly problematic in infants and children because their metabolic pathways differ from those in adults; moreover, the amount of exposure across their life cycle is expected to increase further for each passing generation. Accordingly, Chia et al.⁶⁾ comprehensively reviewed the health effects of microplastics with a focus on the expected effects in children. Similar perspectives were reviewed previously by other studies.⁷⁾ In that review, the authors identified a large knowledge gap in relation to infant and child exposure to microplastics and noted that very limited studies have focused exclusively on children.

The strength of this review is that it systematically presents the sources of microplastic exposure across the human life cycle. However, in terms of health effects, it still relies on experimental evidence. When translating the paragraphs on health effects in the Results, we noted that almost all of the evidence of health effects (mitochondrial damage, carcinogenicity, liver damage, respiratory system, endocrine system, etc.) cited in the review lacked sufficient epidemiological support.

Risk assessments consist of hazard identification, dose-response assessments, exposure assessments, and risk

Corresponding author: Jongin Lee, MD, PhD. Department of Occupational and Environmental Medicine, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, 222, Banpo-daero, Seocho-gu, Seoul 06591, Korea

✉ Email: leejongin@catholic.ac.kr, <https://orcid.org/0000-0003-4337-8444>

Received: 22 September 2024, Revised: 1 October 2024, Accepted: 1 October 2024

This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.
Copyright © 2025 by The Korean Pediatric Society

Table 1. Examples of suggested research topics based on current knowledge on microplastics

Current knowledge	Research topics that should be conducted further
Widespread increase in the use of plastics	Monitoring and forecasting studies on future use and disposal of plastics Emission pathways of microplastics from different industries Global comparisons of plastic consumption and regulation in different countries
Microplastics in ecosystems	The accumulation of microplastics in ecosystems and soils Pathways by which microplastics move, accumulate and are transferred to living organisms
Microplastics accumulate in human blood and organs	How microplastics are absorbed into the human body In which organs microplastics accumulate over time. What diseases are associated with microplastics and whether they affect the function of specific organs
A variety of toxic mechanisms	Research at the molecular level Specific mechanisms on: cell membranes, inflammatory responses, genetic modifications, etc. Different effects from size, shape and chemical composition of microplastics
Cardiovascular risks of microplastics in adults	Health effects in vulnerable populations such as children, pregnant women, and the elderly Large epidemiological studies Effects of long-term exposure
Exposure pathways	Airborne microplastic particles Relationship between urban air pollution and exposure to microplastics
Accumulation in specific organs	Reproductive system: fertility issues, reproductive function and intergenerational genetic variation. Long-term follow-up studies of generations
Metabolism and immune system in children	Long-term follow-up studies of growth and development Studies in pregnant women and newborns, fetuses
Investigation at a small scale	Differences in exposure levels between population groups Collaborative research at international level Different chemical constituents of plastic products

characterization. The current problem is that quantification methods to investigate the dose-response association and exposure assessments in humans have yet to be established. First, consensus is lacking about which biological samples can represent exposure to microplastics, although many studies have reported their detection in blood and tissues. Second, it is difficult to choose between spectroscopic methods (micro-Fourier infrared spectroscopy and Raman spectroscopy) and pyrolysis mass spectroscopic methods (pyrolysis-gas chromatography-mass spectrometry and thermal extraction desorption-gas chromatography/mass spectrometry) to measure microplastics in samples.

The strength of this review is that it describes the quantification of exposure assessments in detail. It is impossible to conduct a reliable epidemiological study without a reliable exposure assessment. Small research groups can use this as a guide to plan various pilot studies; however, national-level monitoring is required. The Korean National Environmental Health Survey, which has been conducted periodically since 2009, quantitatively assesses markers of exposure to several heavy metals and household chemicals.⁸⁾ The addition of a microplastics-related item to this program could be considered. Examples of suggested research topics based on current knowledge are listed in Table 1; however, further studies are needed to focus on measuring and quantifying microplastics in validated ways and determining which biological sample best represents the accumulated exposure.

As described above, the health effects of microplastics

are expected to increase in the future. Some of the current surges in childhood illnesses compared to the past may be linked to microplastic exposure. Pediatric clinical professionals should be aware that microplastics may have a variety of effects on the human body and play a role in disease surveillance and the exploration of evidence at the frontline of clinical practice.

Footnotes

Conflicts of interest: No potential conflict of interest relevant to this article was reported.

Funding: This study received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ORCID:

Jongin Lee  <https://orcid.org/0000-0003-4337-8444>

Dong-Wook Lee  <https://orcid.org/0000-0002-4023-3269>

References

1. Chalmin P. The history of plastics: from the Capitol to the Tarpeian Rock. *Field Actions Sci Rep* 2019;(Special Issue 19):6-11.
2. Alfaro-Núñez A, Astorga D, Cáceres-Farías L, Bastidas L, Soto Villegas C, Macay K, et al. Microplastic pollution in sea-

- water and marine organisms across the Tropical Eastern Pacific and Galápagos. *Sci Rep* 2021;11:6424.
3. Deng Y, Zhang Y, Lemos B, Ren H. Tissue accumulation of microplastics in mice and biomarker responses suggest widespread health risks of exposure. *Sci Rep* 2017;7:46687.
 4. Leslie HA, van Velzen MJM, Brandsma SH, Vethaak AD, Garcia-Vallejo JJ, Lamoree MH. Discovery and quantification of plastic particle pollution in human blood. *Environ Int* 2022;163:107199.
 5. Marfella R, Prattichizzo F, Sardu C, Fulgenzi G, Graciotti L, Spadoni T, et al. Microplastics and nanoplastics in atherosclerosis and cardiovascular events. *New Engl J Med* 2024;390: 900-10.
 6. Chia RW, Atem NV, Lee JY, Cha J. Microplastic and human health with focus on pediatric well-being: a comprehensive review and call for future studies. *Clin Exp Pediatr* 2025; 68:1-15.
 7. Sripada K, Wierzbicka A, Abass K, Grimalt JO, Erbe A, Röhlén HB, et al. A children's health perspective on nano- and microplastics. *Environ Health Perspect* 2022;130:15001.
 8. Jung SK, Choi W, Kim SY, Hong S, Jeon HL, Joo Y, et al. Profile of environmental chemicals in the Korean Population—results of the Korean National Environmental Health Survey (KoNEHS) Cycle 3, 2015–2017. *Int J Environ Res Public Health* 2022;19:626.

How to cite this article: Lee J, Lee DW. Further research on impact of microplastics on children's health is essential to protecting future generations. *Clin Exp Pediatr* 38;5:359-61.