Understanding human health hazards of micro- and nanoplastics: Challenges and Debates

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Human exposure to micro- (MPLs, < 5 mm in size) and nanoplastics (NPLs, < 1 µm in size) can occur through oral inhalation, ingestion, or skin absorption, primarily linked to the use of plastic products or unintentional exposure. MPLs and NPLs have been detected in human fecal samples, placentas, lung tissue, and also blood; however, the potential hazard of MPLs and NPLs remains a subject of debate, given the limited data on human exposure routes, potential risks, fate, and behavior.[1]

Furthermore, the identification, extraction, purification, and quantification of plastic particles in biological matrices pose significant challenges. Environmental plastic particles exhibit polydispersity in size, shape, and composition, with predicted concentrations in the environment being low. Plastics, being carbon-based materials, share similarities with the matrices in which they are dispersed. The inherent hydrophobic and chemically inert properties of plastics, along with the presence of additives or adsorbed chemicals, complicate these tasks further. Additionally, analytical limitations make the characterization of NPLs difficult, which is especially challenging compared to MPLs due to instrument resolution limits. Therefore, a combination of isolation or purification steps and complementary procedures is typically employed for plastic particle characterization, with the caution that some of these procedures can lead to particle degradation and surface damage, a concern that is particularly critical for NPLs.[2]

In our efforts to comprehend the interaction of plastic particles with human cells or tissues, our research group generates test MPLs and NPLs to develop and optimize analytical techniques. [3][4] An overview of the current challenges in this field and a critical discussion about the occurrence in the environment resulting in human impact will be given.

[1] Environ. Sci. Technol. 53 (2019) 1748–1765. https://doi.org/10.1021/acs.est.8b05512.

[2] Chemosphere 293 (2022) 133514. https://doi.org/10.1016/j.chemosphere.2022.133514.

[3] Arch. Toxicol. 94 (2020) 2463–2479. https://doi.org/10.1007/s00204-020-02750-1.

[4] Environ. Sci. Nano 11 (2024) 1000-1011. https://doi.org/10.1039/D3EN00401E.

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