Micro- and Nanoplastics in Human Tissues: A Systematic Review of Distribution and Biological Effects

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Abstract

Background: Microplastics (MPs, <5 mm) and nanoplastics (NPs, <1000 nm) are emerging contaminants increasingly detected in the human body. Their small size, persistence, and chemical heterogeneity enable them to cross biological barriers, raising concerns about systemic accumulation and potential health effects.

Methods: A systematic review was conducted in accordance with the PRISMA 2020 guidelines. PubMed and Scopus were searched for studies published between January 2020 and December 2025. Searches were initially performed on March 1, 2025, and updated on January 31, 2026. Eligible studies reported detection or quantification of MPs or NPs in human tissues or biological fluids from clinical, surgical, or post-mortem contexts. Extracted data included biological matrices, polymer types, particle characteristics, concentrations, and reported biological effects. Risk of bias was assessed using the Newcastle–Ottawa Scale and QUADAS-

2. The review was registered on the Open Science Framework (DOI: 10.17605/OSF.IO/5VWJK).

Results: Out of 1,660 records, 42 studies met the inclusion criteria. MPs and NPs were identified in multiple human matrices, including lungs, liver, blood, placenta, breast milk, semen, urine, cerebrospinal fluid, and vascular tissues. The most frequently detected polymers were polyethylene, polypropylene, polystyrene, and polyethylene terephthalate. Concentrations varied widely across studies and matrices. Reported biological effects were primarily linked to oxidative stress and inflammatory responses, with emerging evidence indicating endocrine disruption and alterations in gene expression. Overall, the risk of bias was low, although concerns regarding contamination control and methodological heterogeneity were noted.

Conclusions: Micro- and nanoplastics are detectable in human tissues, confirming systemic exposure. While current evidence indicates potential involvement in key biological pathways, causal relationships and dose–response effects remain unclear. Standardized analytical methods and longitudinal biomonitoring studies are needed to better assess human health risks.