

Microplastics and Phthalate Co-Exposure Synergistically Disrupt Thyroid Hormone Homeostasis Through Enhanced Gut Barrier Permeability and Systemic Inflammation

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Abstract

Environmental exposure to microplastics (MPs) and phthalates is ubiquitous, yet their combined endocrine effects are unexplored. We demonstrate that polystyrene microplastics (5 μm) and di(2-ethylhexyl) phthalate (DEHP) synergistically impair thyroid hormone synthesis and metabolism in murine models. Co-exposure disrupted intestinal tight junction proteins (occludin, claudin-1), increasing gut permeability and systemic lipopolysaccharide (LPS) translocation. TLR4-NF κ B-mediated inflammation suppressed iodothyronine deiodinase activity and thyroid transcription factor expression. Fecal microbiota transplantation from exposed donors recapitulated thyroid dysfunction in recipient germ-free mice. These findings establish the gut-thyroid axis as a critical mediator of environmental endocrine disruption.

Keywords: microplastics, phthalates, thyroid hormone, gut barrier, environmental endocrinology, gut-thyroid axis



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