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Assessing the impact of microplastics on aquatic life and the subsequent cascading effects on human health

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Abstract
Microplastics are tiny pieces of plastic, all smaller than five millimetres, that are causing serious damage to our environment and health. They are created in several ways: bigger plastic items breaking down, clothing fibres shedding, and the use of microbeads in soaps and lotions. As these particles wash into our rivers and oceans, they become a major hazard for wildlife. Marine animals often mistake them for food, leading to severe health consequences like internal injuries, reproductive troubles, and changes in natural behaviour. To make matters worse, these plastics can soak up harmful chemicals and carry dangerous germs, spreading pollution throughout the water supply.

Keywords: Marine, plastics, aquatic, hazardous, freshwater, accumulation

Introduction

The 1900s marked a transformative era for the plastics sector, fuelling a surge in the manufacturing of everything from everyday domestic objects to intricate vehicle parts. Today, the world is grappling with the devastating ecological fallout from this rapid industrial expansion. A toxic mixture of inadequate disposal infrastructure, a lack of public knowledge, and widespread negligence has led to planetary contamination on a massive scale. These synthetic materials have moved beyond mere surface clutter; they have infiltrated forests, landscapes, and the deepest reaches of our oceans, directly endangering the health of both humans and wildlife.

A critical component of this crisis is the presence of microplastics tiny fragments measuring under 5 millimetres. These materials are generally grouped into two categories based on how they enter the environment. Primary microplastics are intentionally created as small, functional units, such as the industrial pellets often called "nurdles" used to manufacture larger plastic goods. While these pellets are shipped worldwide for production, frequent spills during transit or factory processing led to their direct escape into the environment, where they wreak havoc on aquatic life.

Conversely, secondary microplastics emerge as the byproduct of larger plastic refuse—such as discarded bags, bottles, and various wrappings breaking down over time due to wear and exposure. These particles appear in diverse shapes, including fibres, beads, and jagged slivers. Whether through the air, the soil, or our water systems, these secondary pollutants continue to permeate and degrade the global environment.

Microplastics originate from a wide array of sources, including the fragmentation of macro-plastic debris (Khan *et al*., 2020 [7]; Du *et al*., 2021), the shedding of synthetic fibres through laundry cycles (Li *et al*., 2023) [9], and the use of manufactured microbeads in cosmetic or hygiene products (Xiang *et al*., 2022) [16]. Furthermore, environmental weathering processes continuously fracture larger plastic debris into increasingly minute particles (Kutralam *et al*., 2023; Emenike, 2022) [5, 9]. Due to the widespread reliance on plastic materials, these pollutants have become pervasive across terrestrial, aquatic, and atmospheric systems (Yang *et al*., 2021; Yusuf *et al*., 2022; Brein *et al*., 2023) [10, 17, 18].

Although originally identified as a strictly marine ecological threat, microplastics have successfully entered the global food web, making human exposure unavoidable. This shift has prompted significant anxiety regarding their physiological consequences. Researchers have confirmed the presence of these particles in various human biological samples, including faeces (Luqman *et al*., 2021; Schwabl *et al*., 2019) [11, 13], oral fluids (Huang *et al*., 2022) [6], and placental tissue (Ragusa *et al*., 2021) [12], fuelling concerns about long-term bioaccumulation and toxicity. While the specific pathways through which these particles affect human health remain a subject of active study, it is well-established that microplastics infiltrate the human body through inhalation, ingestion, and skin interaction.

The widespread habit of discarding plastic waste into aquatic environments fuelled by a lack of accountability has significantly exacerbated the challenge of oceanic pollution. Consequently, the proliferation of microplastics within marine systems has emerged as a critical international crisis. This study aims to investigate the origins of these pollutants, analyze their destructive influence on marine biodiversity, and evaluate the resulting implications for human well-being."

Types of Microplastics

Microplastics are categorized into two main types: primary and secondary (Verma *et al*., 2023) [15].

Primary microplastics: are small plastic particles directly released into the environment. These include minute fragments manufactured for industrial purposes (such as those found in cosmetics) and microfibers shed from fabrics, fishing nets, and garments.

Secondary microplastics: in contrast, are formed from the decomposition of larger plastic items, such as water bottles.

They are produced when polymers break down due to environmental weathering.

Microplastics on Fish and other Aquatic Animals

Due to their minute size and propensity for ingestion, microplastics pose diverse threats to fish and other aquatic species. The severity and nature of these impacts are highly influenced by the animal species, the quantity and type of microplastics consumed, and the duration of exposure. Below, we explore some of the primary negative consequences attributed to microplastics on aquatic life.

Ingestion and Toxicity

Microplastics pose significant physiological and toxicological risks to aquatic life upon ingestion. Research indicates that these particles can induce structural degradation in essential organs, including the brain, liver, gills, and digestive tract (Zolotova *et al*., 2022) [19]. Furthermore, microplastic exposure is linked to systemic physiological impairment, manifesting in metabolic dysregulation, diminished reproductive success, and disrupted behavioural patterns, alongside adverse outcomes such as inhibited growth, oxidative stress, and decreased appetite.

Reduced Feeding Activity

The consumption of microplastics severely hinders the dietary intake of marine organisms, which in turn compromises their developmental progress and longevity. This occurs primarily through internal blockages; as non-biodegradable particles occupy gastric space, they displace essential nutrients and disrupt regular consumption habits. Additionally, high concentrations of these pollutants can trigger shifts in ethological patterns; species might shun contaminated habitats or experience a diminished stimulus to hunt for actual prey.

Microplastics Effects on Human Health

The presence of synthetic chemical additives in plastics, combined with the toxic substances carried by microplastics, poses a serious danger to human well-being (Kumar *et al*., 2020) [7]. These pollutants permeate our environment through wastewater and drainage systems, while simultaneously appearing in everyday items like cosmetics, household detergents, and fabrics. Research links microplastic ingestion to several severe health issues, including obesity, cardiovascular ailments, and breast cancer. Beyond the toxic nature of the chemicals themselves, the physical presence of microplastics within the body serves as a persistent irritant (Campanale *et al*., 2020) [7]. Exposure to these particles often triggers oxidative stress, creating an imbalance where reactive oxygen species (ROS) overwhelm the body's natural defense systems, leading to cellular and tissue degradation. Furthermore, microplastics can trigger erratic immune responses, ranging from allergic hypersensitivity to overall system failure (Campanale *et al*., 2020) [3]. Consequently, those affected may experience a spectrum of detrimental health outcomes, such as neurotoxicity, cytotoxicity, systemic inflammation, and the unwanted migration of plastic debris into vital organs (Bhuyan, 2022) [1].

Microplastics are also frequent drivers of chronic inflammation, a primary factor in the development of autoimmune disorders, diabetes, and heart disease. Additionally, they function as endocrine-disrupting agents, wreaking havoc on hormonal balance. Long-term contact with these plastic particulates is specifically known to interfere with the body's ability to maintain healthy thyroid function (Ullah *et al*., 2023) [14].

Conclusion

Research into how microplastics impact human physiology highlights the critical need to confront this pervasive ecological crisis. These tiny synthetic fragments infiltrate the food web via marine life, eventually reaching human consumers who eat tainted seafood. Evidence suggests that these particles trigger serious biological issues, such as systemic inflammation, oxidative stress, and various toxicological responses. Although experts are still uncovering the long-term consequences of such exposure, the current findings necessitate immediate, collaborative action from government officials, corporate leaders, and the general public to reduce contact with these pollutants and curb their broader health and environmental impact.

References

1. Bhuyan MS. Effects of microplastics on fish and human health. Frontiers in Environmental Science,2022:10:827289, 250.
2. Brien SO, Rauert C, Ribeiro F, Okoffo ED, Burrows SD, Brien JWO, *et al*. There's something in the air: a review of sources, prevalence and behaviour of microplastics in the atmosphere, Sci. Total Environ.2023:874:162193.
3. Campanale C, Massarelli C, Savino I, Locaputo V, Uricchio VF, *et al*. A detailed review study on potential effects of microplastics and additives of concern on human health. International journal of environmental research and public health,2020:17(4):1212.
4. Du J, Zhou Q, Li H, Xu S, Wang C, Fu L, *et al*. Environmental distribution, transport and ecotoxicity of microplastics: a review, J. Appl. Toxicol.,2021:41(1):52–64.
5. Emenike EC, Adeniyi AG, Omuku PE, Okwu KC, Iwuozor KO. Recent advances in nano-adsorbents for the sequestration of copper from water, J. Water Proc. Eng.,2022:47:102715.
6. Huang S, Huang X, Bi Q, Guo X, Yu Q, Zeng Z, *et al*. Detection and analysis of microplastics in human sputum, Environ. Sci. Technol.,2022:56(4):2476–2486.
7. Khan MT, Cheng YL, Hafeez S, Tsang YF, Yang J, Nawab A. Microplastics in wastewater, in: T. Rocha-Santos, M. Costa, C. Mouneyrac (Eds.), Handbook of Microplastics in the Environment, Springer International Publishing, Cham, 2020, 1–33,
8. Kumar S, Rajesh M, Rajesh KM, Suyani NK, Rasheeq Ahamed A, Pratiksha KS. Impact of microplastics on aquatic organisms and human health: A review. International Journal of Environmental Sciences & Natural Resources,2020:26(2):59-64.
9. Kutralam Muniasamy G, Shruti V, Guevara FP, Roy PD. Microplastic diagnostics in humans: "The 3Ps" Progress, problems, and prospects, Sci. Total Environ.,2023:856:159164.
10. Li Y, Lu Q, Xing Y, Liu K, Ling W, Yang L, *et al*. Review of research on migration, distribution, biological effects, and analytical methods of microfibers in the environment, Sci. Total Environ.,2023:855:158922.

11. Luqman A, Nugrahapraja H, Wahyuono RA, Islami I, Haekal MH, Fardiansyah Y, *et al*. Microplastic contamination in human stools, foods, and drinking water associated with Indonesian coastal population, Environments,2021:8(12):138.
12. Ragusa A, Svelato A, Santacroce C, Catalano P, Notarstefano V, Carnevali O, *et al*. Plasticenta: first evidence of microplastics in human placenta, Environ. Int,2021:146:106274.
13. Schwabl P, SK¨oppel P, K¨onigshofer P, Bucsics T, Trauner M, Reiberger T, *et al*. Detection of various microplastics in human stool: a prospective case series, Ann. Intern. Med.,2019:171(7):453–457.
14. Ullah S, Ahmad S, Guo X, Ullah S, Nabi G, Wanghe K. A review of the endocrine disrupting effects of micro- and nanoplastics and their associated chemicals in mammals. Frontiers in Endocrinology,2023:13:1084236.
15. Verma DK, Maurya NK, Inwati P, Harinkhede H. Impact of Microplastics and Their Prevention in Aquatic Ecosystem. Biotica Research Today.,2023:5(4):305-307.
16. Xiang Y, Jiang L, Zhou Y, Luo Z, Zhi D, Yang J, *et al*. Microplastics and environmental pollutants: key interaction and toxicology in aquatic and soil environments, J. Hazard Mater.,2022:422:126843.
17. Yang L, Zhang Y, Kang S, Wang Z, Wu C. Microplastics in soil: a review on methods, occurrence, sources, and potential risk, Sci. Total Environ.,2021:780:146546.
18. Yusuf A, Sodiq A, Giwa A, Eke J, Pikuda O, Eniola JO, *et al*. Updated review on microplastics in water, their occurrence, detection, measurement, environmental pollution, and the need for regulatory standards, Environ. Pollut.,2022:292:118421.
19. Zolotova N, Kosyreva A, Dzhalilova D, Fokichev N, Makarova O. Harmful effects of the microplastic pollution on animal health: A literature review. Peer J,2022:10:135-139.