Microplastics and the Prevention of the Next Environmental Health Hazard

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Abstract

Plastic pollution is a well-known environmental concern through its accumulation in landfills, harm to ocean ecosystems, and deadly effect on wildlife. Microplastics (MPs) are a subset of plastic pollution that has gained attention recently due to novel studies that suggest possible health implications, causing many to wonder if MPs are the asbestos of our generation leading to disease decades down the line. Research on health implications is ongoing and while there are some policies in the US concerning MPs, there is a large gap in regulation compared to other countries. Physicians and medical students should increase their own knowledge on the subject of MPs to become better advocates for their patients and increase public awareness.

Recent studies showing the presence of microplastics in placental tissues revealed the degree to which plastics have polluted not only our environment but also our bodies (Ragusa et al., 2021). This alarming discovery has raised concerns and comparisons to harmful materials such as asbestos and we may soon discover the future health implications of microplastics. Due to its pervasive nature as well as the lack of knowledge of its consequences, it is vital that there be health education and policy to combat human exposure to microplastics and regulate their production.

Microplastics (MPs) are used to describe particles less than 5mm in size either created through the fragmentation of larger plastics or through direct production for commercial uses (Ragusa et al., 2021). With the global production of plastic reaching 320 million tons per year and only increasing, large concentrations of MPs have been found in seafood, drinking water, and in the air (Ragusa et al., 2021).

Although research into the human risk assessment of microplastics have been limited, studies in human cells in culture, as well as rodents and aquatic species, have shown the translocation of MPs <10μm from the gut cavity to the lymphatic and circulatory systems leading to accumulation in various tissues such as liver, kidney, and brain (Vethaak and Legler, 2021). Multiple *in vitro* and *in vivo* rodent studies have shown the particles to cause oxidative stress leading to the secretion of cytokines and inflammatory cell damage (Vethaak and Legler, 2021). Studies in animal models have also shown changes in the gut microbiome

leading to the concern that MPs could serve as a vector for opportunistic pathogens (Lu et al., 2019). There continues to be major knowledge gaps regarding the metabolism and excretion of MPs in humans which can only be alleviated through continued research.

Major sources of MPs include the wear and tear of synthetic products as well as materials production. Common ways in which these toxins enter our environment include the emission of microfibers from textiles during washing and tire breakdown from continuous use (Vethaak and Legler, 2021). There have been some reports of MP-associated interstitial lung disease and increased risk of lung and GI cancers in people working in the textile and flocking industries with extended exposure to MPs (Wieland et al., 2022). The quantity and durability of plastic pollutants makes them difficult to remove from the environment making policy and health education that much more important in preventing the accumulation of MPs.

It is clear that the pervasive nature of MPs has the potential to impact multiple organ systems yet there is not much public knowledge on the subject (Vethaak and Legler, 2021). While textiles and tires are major sources of the pollutant, we encounter MPs daily through drinking water, seafood consumption, and even inhaling airborne particles. As with exposure to other environmental toxins, the first step is to increase awareness. Through counseling and patient education, providers can empower patients to change their habits regarding plastic use, including removing plastic water bottles and single-use plastics for food preparation and storage. Those who have occupational exposure should also be encouraged to use respirator masks and avoid prolonged exposure when possible. Though the extent of negative health implications is still unclear, early education and intervention and may reduce the scale of long-term consequences. However, the most significant change can only come about through health advocacy and collaboration with researchers to encourage health and environmental policies to limit the production and spread of MPs.

Beginning in March 2022 the United Nationals Environmental Assembly began creating an international "Plastic Treaty" to combat plastic pollution by 2024 and the European Chemical Agency has increased regulation on plastics manufacturing since 2017 (Metzler and Simbeck, 2022). However, the last plastic regulation passed in the United States was the Microbead-Free Waters Act of 2015 to address the pollution from microbeads used in cosmetics (Metzler and Simbeck, 2022). In comparison, the US has fallen behind in the regulation and management of MPs and there is room to learn from our European counterparts. Some policies that have been successful in other nations include improvements in wastewater and stormwater runoff management in removing MPs, improving filters on washing machines to capture microfibers released during washing, as well as increased tire and road maintenance to prevent plastic particle release (OECD, 2021). Funding for research

into MPs and their impact on health is essential in increasing our awareness of the threat this toxin presents. Discoveries such as whether the concentration of microplastics correlate to the degree of inflammation and tissue damage can be used to better protect patients. Environmental ads educating the general public would be beneficial in increasing public awareness on the potential adverse effects of MPs.

Comparisons between MPs and asbestos as toxins can be extended to the challenges that may arise while attempting to regulate the material. While the negative health impacts of asbestos exposure were known starting in the early 1900s, the US has been unable to maintain a complete ban on the material (Lemen and Landrigan, 2017). The challenges to regulation include lobbying by the asbestos industry and their ability to manufacture doubt regarding health effects (Lemen and Landrigan, 2017). This further highlights the importance of funding research and increasing public awareness on MPs. There can also be expected resistance from materials manufacturing industries due to the negative financial impacts of regulating the production and spread of MPs. Physician hold a unique position in which they can play an integral role in both public education and promoting regulation through health advocacy.

The recent discoveries in the potential health implications of MPs have made it clear that plastic pollution is not only an environmental concern but a health concern as well. As physicians, we must highlight threats to the health of our patients and work towards creating regulatory change. As with asbestos and harmful microparticles of the past, it is a matter of public health and safety that we proactively work towards decreasing human exposure to MPs.

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