Effects of Microplastics On Lung Airways

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- Deposition in lung airways
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Introduction

Microplastics, defined as plastic particles smaller than 5 mm, have become a pervasive environmental contaminant, infiltrating ecosystems, food sources, and even the human body. Microplastics are a major global issue due to their toxicity and pose a major risk on human health. These tiny particles are found everywhere, including in drinking water, salt, seafood, and even the atmosphere. Individuals may unknowingly consume anywhere from a few tens to millions of microplastic particles every day, and in severe cases, the amount of microplastics consumed in a year can be equivalent to the weight of a small card.

Sources of Human exposure

- *Cosmetics*: Every year, around 3800 tons of microplastics are introduced into the environment solely from the daily use of cosmetics in continental Europe [32]. It is challenging to estimate how much microplastics are released from cosmetics in other countries or the world as a whole, but it is undoubtedly a substantial amount. Sometimes, a single cosmetic product contains synthetic or plastic polymers, which can make up to nearly 90 % of its ingredients. Usage of such cosmetics cause for the microplastics to contaminate the body.
- *Ingestion via eating/drinking:* Recent laboratory-based investigations have confirmed the widespread presence of microplastics in various environmental media, including air, food, and drinking water, as well as within human tissues, excretions, and the bloodstream. This has underscored the imperative need for accurately identifying and quantifying the occurrence of microplastics in the gastrointestinal system alongside other human tissues and internal systems.
- *Ingestion via breathing:* The degree of human exposure to microparticles suspended in the atmosphere is generally dependent on their size. Microparticles are usually divided into four categories: those larger than 10 μm, those smaller than 10μm, those smaller than 2.5μm, and ultrafine particles smaller than 0.1μm. Upon inhalation, particles larger than 10μm typically collide with the upper airways, whereas particles smaller than 10μm can enter the bronchioles, and particles *smaller than 2.5μm and ultrafine particles can even penetrate the alveoli.*

Microplastics' effects on lung

According to a study using human biomonitoring, there was proof of plastic in the lung tissue, indicating that microplastics from the air can deposit and build up in

the lungs. Moreover, extended exposure to microplastics can result in respiratory illnesses such as asthma and pneumoconiosis. Moreover, fibrous particles that come from synthetic clothing are present everywhere and it's possible to inhale some of them. After entering the respiratory system, the majority of these particles are likely to be caught by the fluid lining the lungs. Nevertheless, certain particles may manage to bypass the lung's natural clearance mechanisms. According to Zhang et al it is widely accepted that inhalation is the primary route for the uptake of microparticles, as compared to other methods of exposure. It is suggested that as a result of microplastic's diminutive dimensions, humans have the potential to inhale airborne microplastics directly.

Microplastic deposition in lung airways

Islam et al demonstrated microplastic deposition in lung airways. Notably, cylindrical microplastics with diameters of 2.56 and 5.56μm exhibit higher deposition, while 1.6μm cylindrical particles show lower rates at a flow rate of 7.5l/min. Spherical and tetrahedral microplastics display identical deposition rates at this flow rate. Despite this, the overall deposition efficiency at 7.5l/min exceeds that of 30l/min for all microplastic sizes. This discrepancy is attributed to the extended residence time at lower flow rates, influencing the passage of microplastics through the upper airway region. Factors like gravitational sedimentation and Brownian diffusion play vital roles, with Brownian diffusion being more pronounced at lower flow rates but diminishing as flow rates increase.

Preventions/control

Given the widespread presence of microplastics in the environment, completely eliminating exposure is unrealistic. A more practical approach is to reduce the most significant sources of microplastics intake.

- Switching from bottled water to tap water to 4,000 particles per year, making it an impactful intervention
- Stopping the practice of heating food in plastic could be one of the most effective ways to reduce microplastic consumption. Tea bags are often plastic, and a study found that despite being labeled food grade released a total of 16 μm of micro and nanoplastics (2.4 million micron-sized particles 1–150 μm and 14.7 billion submicron plastic particles <1 μm)
- Highly processed foods, like chicken nuggets, contained 30 times more microplastics per gram than chicken breasts, highlighting the impact of industrial processing, which often uses plastics at some point
- Inhalation is another substantial source of exposure, with up to 62000 particles in male adults per year. A High-Efficiency Particulate Air (HEPA) filter removes up to 99.97% of airborne particles as small as 0.3 μm, which includes a significant amount of airborne microplastics, though data on whether this translates to meaningful changes in absorption and outcomes humans is lacking .

References

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