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Plastics in Human Respiratory System: Inhalation of Suspended Micro- And Nanoplastics

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Extended Abstract

Microplastics (MPs) and nanoplastics (NPs) are emerging airborne pollutants with significant implications for respiratory health. This study quantifies the inhalation and deposition of MPs and NPs in human respiratory samples using gas chromatography-mass spectrometry (GC/MS). Nasal and sputum samples from residents of Metro Manila and nearby island provinces were analyzed to determine polymer composition and concentration. The results indicate that MPs were found at significantly higher concentrations than NPs in both nasal (2.13 ± 0.72 μg/mL vs. 1.44 ± 0.52 μg/mL) and sputum samples (2.63 ± 0.89 μg/g vs. 1.89 ± 0.68 μg/g) ($p < 0.01$) [1]. Polyethylene (PE) and polyvinyl chloride (PVC) were the most abundant polymers, highlighting their widespread environmental presence [2].

A significant correlation was observed between MPs and NPs within nasal ($R^2 = 0.157$, $p = 0.030$) and sputum ($R^2 = 0.191$, $p = 0.016$) samples, indicating similar deposition patterns [3]. Larger MPs tended to accumulate in nasal cavities, whereas smaller NPs penetrated deeper into lung regions, emphasizing the role of aerodynamic properties in plastic particle deposition. Additionally, outdoor workers and smokers exhibited significantly higher MP and NP concentrations than indoor workers and non-smokers, reinforcing the impact of environmental exposure and lifestyle factors on inhaled plastic burden [4].

Plastic pollution is an urgent global concern, with MPs and NPs infiltrating various ecosystems, including the atmosphere, at an unprecedented scale [5]. These particles, often derived from synthetic textiles, packaging materials, and industrial emissions, are inhaled and retained within the human respiratory system [6]. While ingestion and dermal absorption are established pathways for plastic exposure, inhalation provides direct access to vital respiratory organs, making it a critical route for microplastic accumulation and potential toxicity [7]. The ability of MPs and NPs to adsorb hazardous substances such as heavy metals and organic pollutants exacerbates their potential health risks [8].

This study provides a quantitative assessment of MPs and NPs in human respiratory compartments, establishing baseline exposure levels for urban and suburban populations. The results demonstrate that both environmental and personal factors significantly influence inhalation exposure. Outdoor workers had higher concentrations of MPs (2.75 ± 0.89 μg/mL) and NPs (1.88 ± 0.62 μg/mL) compared to indoor workers (1.52 ± 0.48 μg/mL for MPs and 0.98 ± 0.32 μg/mL for NPs), with statistically significant differences ($p < 0.01$) [9]. Additionally, smokers exhibited nearly twice the MP and NP concentrations in nasal and sputum samples compared to non-smokers, highlighting smoking as a contributing factor to inhaled plastic accumulation [10].

While this study provides essential reference values for inhaled MPs and NPs, further research is necessary to understand their long-term health effects, particularly their interactions with human tissues and potential inflammatory responses. Future investigations should explore seasonal variations, toxicity mechanisms, and regulatory strategies to mitigate airborne plastic exposure. These findings underscore the urgent need for public health interventions and stricter environmental regulations to minimize the impact of inhaled plastic pollutants on human respiratory health.

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