ScienceDirect

Journal of Hazardous Materials

Volume 403, 5 February 2021, 123799

Human exposure to microplastics: A study in Iran

Sajjad Abbasi [a], Andrew Turner [b]

Show more

https://doi.org/10.1016/j.jhazmat.2020.123799

Get rights and content

Highlights

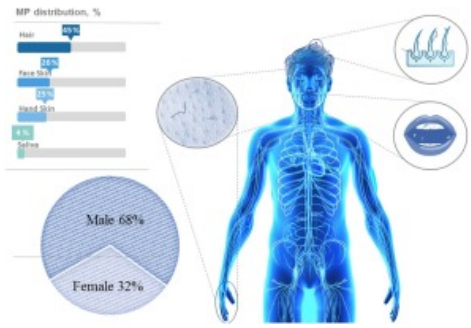
- Microplastic (MP) exposure to adult humans has been quantitatively assessed.
- MPs were retrieved from hand-face skin, head hair and saliva of individuals (n = 2000).
- Over 16,000 MPs were recorded, with head hair returning the most and saliva the least.
- Polyethylene-PET and polypropylene fibres of < 100 μm were the most abundant type of MP.
- The study serves as a starting point for understanding and modeling human MP exposure.

Abstract

Exposure of microplastics (MPs) to a cohort of adults of various demographics from different regions of Iran has been quantitatively assessed. Specifically, MPs were retrieved from filtered washes of the hand and face skin, head hair and saliva of individuals (n = 2000) after an exposure period of 24 h and were counted and, in a selected number of cases, characterised for shape-form and size microscopically. A total of over 16,000 MPs were recorded in the study, with head hair returning the most samples (> 7000, or, on average, >3.5 MPs per individual per day), saliva returning the least samples (about 650, or on average 0.33 MPs per individual), and MPs about twice as high in males than females. The number of MPs was similar amongst residents of different urbanised regions, albeit with evidence of greater quantities captured in more humid settings, and was considerably lower in residents of a remote and sparsely populated area. Polyethylene-polyethylene terephthalate and polypropylene fibres of < 100 μm in length, likely derived

from clothing and soft furnishings in the indoor setting and a wider range of sources in the exterior environment, were the most abundant type of MP in all body receptors. Daily sampling of receptors from six participants over a seven-day period revealed that, despite these broad trends, both inter- and intra-individual exposure was highly heterogeneous. Although the present study has demonstrated the ubiquity of MP exposure, the resulting impacts on human health are unknown.

Graphical abstract



Download : Download high-res image (213KB)

Download : Download full-size image

Introduction

Microplastics (MPs) have received considerable attention over the past two decades because of their presence in a wide variety of environments, including rivers and lakes, groundwater, the ocean, soils, the atmosphere and the household (Dris et al., 2017; Chae and An, 2018; Boucher et al., 2019; Kane and Clare, 2019; Panno et al., 2019). Ubiquitous contamination by MPs results from the wide use of plastics in society and industry, and the persistence and ready transport of primary and secondary particles of sub-mm dimensions (Rezaei et al., 2019; Waldschläger et al., 2020).

Amongst the greatest concerns of MPs is human exposure and any consequent adverse impacts on human health. Exposure may result from a variety of pathways but most attention has been paid to consumption of food and drink contaminated by MPs in the environment or during storage (Iniguez et al., 2017; Li et al., 2018; Welle and Franz, 2018) and the inhalation of fugitive atmospheric particles (Prata, 2018; Abbasi et al., 2019). Here, estimates of the quantities and types of MP that are taken in are based on measurements in dietary components, like shellfish, salt and water, and in interior and exterior air (Cox et al., 2019; Zhang et al., 2020). An alternative means of evaluating exposure, however, and one that could probe the influences of demographics, working practices and climate, for example, would be to measure MPs in human body receptors, like hair and skin. These receptors can act as passive samplers that capture MPs from multiple sources and different pathways over a specific timeframe as individuals go about their daily activities.

In the present study, human cohorts of males and females from different regions of Iran have been tested for MP exposure by counting particles associated with or accumulated by various receptors (head hair, hands, faces and saliva). The size and shape distributions of MPs amongst participants and receptors have also been determined microscopically and the polymeric makeup of selected samples established by Raman spectroscopy.

Section snippets

Study area and sample cohort

In the current study, four contrasting regions in Iran were considered (see Fig. 1); namely, the continental cities of Tehran and Shiraz, the coastal port of Bushehr and the remote, agricultural village of Ghazghan. Population and climatic data for each region are given in Table 1.

Occupants of several thousand households were contacted and after sufficient positive responses were received, research teams were deployed in each region. A total of 8000 samples from head hair, hand skin, face skin…

MP abundance and distribution

Table 2 summarises the distribution of MPs counted according to region, sex and body receptor in terms of both numbers and percentages (note that no MPs were observed in the various control filters). Thus, amongst the cohort of 2000 participants and 8000 samples, a total of over 16,000 MPs were counted according to the criteria above. Overall, MPs were most frequently observed in hair samples (> 7000, or, on average, >3.5 MPs per individual per day) and were least abundant in saliva (about 650, …

Discussion

The findings of the present study are perhaps not surprising given the ubiquity of MPs in the indoor and exterior environments and in commodities that are widely used or worn. Nevertheless, the results are significant in demonstrating both the nature and heterogeneity of human exposure to MPs from different routes.

Regarding the indoor setting, common sources of synthetic microfibrous particles include soft furnishings and items of clothing, with a recent study showing that the release of fibres …

Conclusions

This study has shown that the exposure of MPs to humans is ubiquitous but heterogeneous in both space and time, with the skin, mouth and head hair all acting as important passive receptors. The majority of MPs are fine (< 100 μm) fibres constructed of polyethylene-polyethylene terephthalate and polypropylene that appear to be derived from both textiles (clothing and furnishings) and a range of sources in the interior and exterior environments. Other MPs include a diversity of regularly-shaped…

CRediT authorship contribution statement

Sajjad Abbasi: Funding acquisition, Project administration, Methodology, Conceptualization, Investigation, Writing - original draft, Writing - review & editing. **Andrew Turner:** Conceptualization, Investigation, Writing - original draft, Writing - review & editing.…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

Acknowledgments

We are grateful to the following individuals for assistance with the co-ordination and undertaking of MP sampling: Reza Negarandeh, Mohammad Din, Ashkan Nikoo, Amin Rostami, Ehsan Mohammadi, Ali Asadi, Hamed Jabari, Habib Bagheri, Hasan Hosseinzehi, Sasan Jalili, Morteza Hedatati, Reza Pahlavanlu and Shahin Motahar. The study was funded by the SAMA Company.…

Recommended articles

References (30)

S. Abbasi *et al.*
Distribution and potential health impacts of microplastics and microrubbers in air and street dusts from Asaluyeh County, Iran
Environ. Pollut. (2019)

J. Boucher *et al.*
(Micro) plastic fluxes and stocks in Lake Geneva basin
Trends Analyt. Chem. (2019)

Y. Chae *et al.*
Current research trends on plastic pollution and ecological impacts on the soil ecosystem: a review
Environ. Pollut. (2018)

P.K. Cheung *et al.*
Characterisation of plastic microbeads in facial scrubs and their estimated emissions in mainland China
Water Res. (2017)

R. Dris *et al.*
A first overview of textile fibers, including microplastics, in indoor and outdoor environments
Environ. Pollut. (2017)

J. Gasperi *et al.*
Microplastics in air: are we breathing it in?
Curr. Opin. Environ. Sci. Health (2018)

J.N. Li *et al.*
Microplastics in mussels sampled from coastal waters and supermarkets in the United Kingdom
Environ. Pollut. (2018)

K. Liu *et al.*
Source and potential risk assessment of suspended atmospheric microplastics in Shanghai
Sci. Total Environ. (2019)

J.C. Prata

Airborne microplastics: consequences to human health?
Environ. Pollut. (2018)

S.M. Praveena *et al.*
Exploration of microplastics from personal care and cosmetic products and its estimated emissions to marine environment: an evidence from Malaysia
Mar. Pollut. Bull. (2018)

View more references

Cited by (110)

Vertebrate response to microplastics, nanoplastics and co-exposed contaminants: Assessing accumulation, toxicity, behaviour, physiology, and molecular changes
2024, Toxicology Letters

Show abstract

ROS-dependent degeneration of human neurons induced by environmentally relevant levels of micro- and nanoplastics of diverse shapes and forms
2024, Journal of Hazardous Materials

Show abstract

Neurotoxicities induced by micro/nanoplastics: A review focusing on the risks of neurological diseases
2024, Journal of Hazardous Materials

Show abstract

A comprehensive assessment of macro and microplastics from Rivers Ganga and Yamuna: Unveiling the seasonal, spatial and risk factors
2024, Journal of Hazardous Materials

Show abstract

Microplastics in drinking water: A review on methods, occurrence, sources, and potential risks assessment
2024, Environmental Pollution

Show abstract

Toxicological Research on Nano and Microplastics in Environmental Pollution: Current Advances and Future Directions
2024, Aquatic Toxicology

Show abstract

View all citing articles on Scopus

View full text