ScienceDirect

Science of The Total Environment

Volume 767, 1 May 2021, 144345

You are what you eat: Microplastics in the feces of young men living in Beijing

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https://doi.org/10.1016/j.scitotenv.2020.144345

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Highlights

- Microplastics have been found in human feces.
- The highest proportion of microplastic components was polypropylene.
- Sources of water intake may one of the influencing factors on the content of microplastics in the human gastrointestinal tract.
- More attention should be paid to the widespread existence of microplastics and its health effects.

Abstract

Purpose

Microplastics have been widely detected in the environment and marine organisms. However, few studies have investigated the presence of microplastics in humans. This preliminary study identified and quantified the microplastic content in human feces.

Methods

A total of 26 young male students aged 18–25 years were recruited from Beijing, China. A self-administered 7-day 24-h fluid intake record was used to document fluid intake, and food intake was recorded for 3 days. Feces were collected by participants using a sterile fecal collector. Microplastics in the remaining fecal residues were measured and identified using fourier transform infrared micro-spectroscopy.

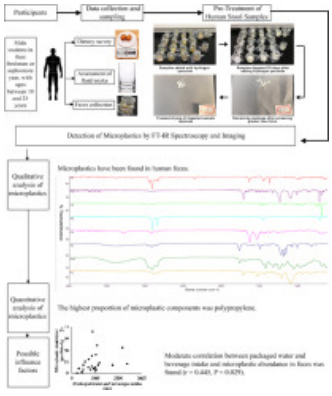
Results

Eventually, twenty-four participants completed the study. The fecal samples of 23 (95.8%) participants tested positive for microplastics. In these 23 samples, the abundance of microplastics varied from 1 particle/g to 36 particles/g (size 20 to 800μm). The summed mass of all microplastic particles per participant ranged from 0.01 to 14.6mg. Qualitative analysis of the microplastics indicated the presence of one to eight types of microplastics in each sample, with polypropylene (PP) being the most abundant; it was found in 95.8% of fecal samples. We examined associations between water intake habits and the abundance of microplastics in their feces. A moderate correlation was observed between packaged water and beverage intake and microplastic abundance in feces (r = 0.445, P = 0.029).

Conclusion

Various types of microplastics were detected in human feces, with PP being found in the highest proportion. There may be an association between water intake habits and microplastic abundance in feces.

Graphical abstract



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Introduction

Plastics are widely used in various industries and are also widely used in daily lives. However, the tradeoff for this convenience is the wide dissemination of plastic in the environment. Microplastics, a type of pollutant, are plastic particles and textile fibers less than 5mm in diameter (Fischer, 2016). The main sources of microplastics are small particles discharged directly into the environment and debris produced by the degradation of plastic waste (Mccormick et al., 2016; Weinstein et al., 2016). Plastic consumer products, such as toothpaste additives, abrasive ingredients in bath gel, cosmetics, and cleaning products, are all potential sources of microplastics (Hoellein and Mccormick, 2015; Wang et al., 2017). In addition, the packaging of food and water is a significant source of microplastics such as polyethylene and polystyrene (Ma et al., 2019; Momen Doust et al., 2017). The current research results showed that microplastics have been found in almost all marine environments in the world, including Italy, Canada, Brazil, China and other countries, even in Arctic oceans (Ajith et al., 2020; Morgana et al., 2018). Microplastics have also been detected in lakes in the world, such as the Great Lakes in North America and Garda in Italy, in freshwater lakes or rivers in many European countries, and in urban lakes in Wuhan, China (Wagner et al., 2014). In addition, microplastics have been detected in soil and air. Moreover, microplastics have even entered human's food system and have been detected in various foods, such as beer, salt, honey, seafood, tap water, bottled water and so on (Ali Karami et al., 2017; Madeleine et al., 2018; Mary et al., 2018; Ossmann et al., 2018; Sherri et al., 2018).

Marine organisms may ingest microplastics from the environment, but these materials cannot be digested. Some studies have been demonstrated that microplastics could be detected in the gastrointestinal tract of marine animals (Baalkhuyur et al., 2018; De Sa et al., 2018; Savoca et al., 2019). In addition to marine animals, microplastics have also been found in the intestines and livers of other organisms, such as mice. In an animal experiment, the results showed that the presence of microplastics was found in the intestinal tract of mice when exposed to 1000μg/L microplastics, and could significantly reduce the secretion of intestinal mucus and destroy the barrier function of intestinal tract (Jin et al., 2019).

In human, microplastics may also enter the body through the process of food digestion, absorption and metabolism through digestive system, inhalation through respiratory system and some other possible ways. Some studies have been reported that microplastics could be found in human lung tissue (EbereVerla and Wirnkor, 2019; Pauly et al., 1998; Prata, 2017). The risk of microplastics exposure from food intake are also high. In a study, the concentration of microplastics within various types of food and beverages were identified based on a literature review and the annual microplastics consumption of human was estimated according to their recommended intake on the American diet (Cox et al., 2019). It was reported that the annual microplastics consumption ranged from 39,000 to 52,000 particles when approximately 15% of Americans' caloric intake was evaluated (Cox et al., 2019). An additional 90,000 microplastics were ingested in annually if people had the recommended amount of adequate water intake through only bottled water, and additional 4000 microplastics for those who only had tap water (Cox et al., 2019). Despite the wide spread existence in various kind of food, the burden of microplastics in human gastrointestinal tract due to food ingestion was less explored. The results of a pilot study with eight participants from eight countries revealed that there were 20 microplastic particles per 10g feces in humans (Schwabl et al., 2019). However, beyond that, no further study has been reported on the issue. More studies should be conducted to explore the possibility of detecting microplastics in the human body and related health impacts.

The objectives of this preliminary study are to determine the presence of microplastics in human excrement and to quantitatively and qualitatively analyze the content and types of microplastics in the human body.

Section snippets

Participant recruitment

Male students in their freshmen or sophomore year, with ages between 18 and 25years, were selected for this preliminary study from Beijing Sport University in China. Of the selected students, those with habitual high alcohol consumption (>20g/day) and tobacco use, as well as those that were ailing from diseases (such as gastrointestinal diseases, non-communicable chronic diseases, communicable diseases, or any others) were excluded. Finally, a total of 26 young healthy male students were…

Characteristics of the participants

Of the 26 young men, 24 completed the study, for a follow-up completeness of 92.3%. The average age of the participants was 20.5years, their average height 180.0cm, and their average weight 71.3kg. The daily fluid consumption

of the participants was as follows: the total fluid intake, 1675 (1355, 1975) mL; packaged water and beverages, 928 (674, 1088) mL; tap water, 444 (373, 729) mL; milk and dairy products, 63 (38, 226) mL; beer, 0 (0, 46) mL; and others, 90 (7, 256) mL. According to the…

Discussion

There have some studies who focus on the possible ingestion of microplasitic through food intake in human (Cox et al., 2019; Danopoulos et al., 2020), but the burden of microplastic in gastrointestinal tract and the existence of microplastic in human body were less investigated. This preliminary study qualitatively and quantitatively analyzed the presence of microplastics in human feces. Eight types of microplastics were detected. The top three predominant microplastics were PP, PET, and PS. In …

Conclusion

The microplastics were detected in human feces in the studied Chinese population. More studies should analyze the microplastics exposure from water and food intake, and the environment. The existence of microplastics in human body and their related metabolic pathway should also be further studied.…

Clinical trial registration

Chinese clinical trial registry. Identifier: ChiCTR1900025710. Registry name “Study on the behavior of drinking water and micro plastics in the feces of sports people in university”.…

Availability of data and material

The datasets used during the current study are available from the corresponding author on reasonable request.…

Funding

There is no funding source for this study.…

CRediT authorship contribution statement

Conceptualization, Na Zhang and Guan Sheng Ma; Data curation, Jian Fen Zhang; Formal analysis, Na Zhang; Investigation, Na Zhang and Yi Bin Li; Methodology, Na Zhang and Guan Sheng Ma; Project administration, Na Zhang and Yi Bin Li; Supervision, Na Zhang and Guan Sheng Ma; Writing – original draft, Na Zhang, Yi Bin Li and Jian F Zhang; Writing – review & editing, Guan Sheng Ma. All authors were involved in the manuscript revision and have approved this final version.…

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.…

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