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REVIEW ARTICLE

The impact of microplastic pollution on health

Arina Azmina Ahmad Zubir[1*]

[1]Faculty of Civil Engineering Technology, Universiti Malaysia Perlis, Malaysia

[*]**Corresponding author:** arinaazmina92@gmail.com

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Abstract

Air pollution is an increasingly pressing global issue that has serious impacts on health. The presence of microplastics has polluted almost all ecosystems on earth. Microplastics measuring less than 5 mm can enter the body through the digestive tract, respiration, or contact with the skin. The impacts that can be caused by microplastic pollution include digestive disorders, immune reactions, and accumulation of toxicity in the body which can cause long-term health problems. Some steps that can be taken to avoid microplastic pollution are replacing disposable containers with reusable containers, replacing disposable plastic bags with shopping bags, being careful in using cosmetic products that do not contain polyethylene and polypropylene.

Keywords: Microplastic, Pollution, Health.

INTRODUCTION

Air pollution is an increasingly pressing global issue that has serious impacts on human health and the environment. Around nine out of ten people worldwide breathe contaminated air, and more than seven million deaths each year are linked to air pollution. Poor air quality in urban areas is often caused by poorly managed industrial and transportation activities, resulting in the accumulation of pollutants that exceed nature's ability to purify itself (Prasetyawati and Sudaryanto, 2021).

The presence of microplastics in our environment is increasingly difficult to avoid, with these particles contaminating almost every ecosystem on earth. Research shows that microplastics, measuring less than 5 millimeters, are found in water, soil, air, as well as on the highest mountain peaks and the deepest ocean depths. Microplastic pollution in the air is a complex and urgent issue, especially in countries with high levels of plastic waste production. Recent research has revealed that microplastics can be released into the atmosphere from various sources, including transportation activities and waste management. For example, in Yogyakarta, studies conducted at the Giwangan Terminal and Jombor Terminal found the presence of microplastics in the form of fibers, fragments, and films, with the film type recording the highest percentage at 43% (Aziz, 2023).

In other locations such as Jalan Kolektor in Banda Aceh City, the study found a fairly high concentration of Total Suspended Particulate (TSP), which was 159.32 μg/Nm^3, with significant

variations in concentration depending on time and day. The abundance of microplastics was recorded higher on Sunday afternoon with 729 particles/gr, compared to Sunday morning which recorded 568 particles/gr (Alhamzi et al., 2024).

MATERIALS AND METHODS

This research is a literature review. Literature review is a methodology used in research that aims to collect and take the core of previous research and analyze several overviews of experts written in the text (Nurislaminingsih et al., 2020). Conclude that literature review has a role as a foundation for various types of research because the results of literature review provide an understanding of the development of knowledge, a source of stimulus for policy making, sparking the creation of new ideas and is useful as a guide for research in certain fields (Famuji and Sunarti, 2022). The database used in searching for this article is Google Scholar, using the keywords "microplastic" and "micriplastic health impact" which have been carried out by previous researchers in Indonesia that can be scientifically accounted for.

RESULTS AND DISCUSSION

The presence of microplastics in the human body has become a major focus in health research. Microplastics, defined as plastic particles less than 5 mm in size, can enter the body in a variety of ways, especially through the digestive tract, breathing, and skin contact (Zhao et al., 2024). The mechanism by which microplastics enter the body is as follows:

1. Digestive tract

   Microplastics, which are plastic particles measuring less than 5 millimeters, have become a major concern for their impact on human health, particularly through the digestive tract. Research shows that the digestive tract is the main route for microplastics to enter the human body, often through contaminated food and drink (Rai et al., 2024). Microplastics enter the human body mainly through contaminated food and drinks. A study found that humans can consume around 80 microplastic particles per day through contaminated food (Smith, 2018).

2. Respiratory tract

   In daily activities, humans often produce microplastics. For example, in transportation activities, vehicles driving on the highway cause wear on tires due to friction, pressure, and heat, which then produce microplastic particles into the environment. In addition, improperly managed waste burning also causes microplastic particles to be carried by the wind. This contributes to the formation of microplastics in the air in the form of fibers containing plastic polymer fragments (Nurrachman, 2023). Microplastics in the air, often originating from industrial emissions and road dust, can be inhaled and reach the lungs, potentially causing respiratory disorders (Allen et al., 2019).

3. Skin Exposure

   Microplastics are found in many non-rinse cosmetic products, such as moisturizers, sunscreens, makeup removers, and lipsticks. The use of microbeads in products such as facial washes, toothpastes, and body scrubs has become a serious concern, because these particles are difficult to filter out by wastewater treatment systems and often end up in the environment, especially in ocean waters. Currently, small plastic particles in cosmetics and personal products have become one of the main sources of marine pollution. Their very small size and color variations make marine creatures mistake them for food, which can cause damage to marine ecosystems (Suardy et al., 2020).

Health Impacts of Microplastics

1. Indigestion

   Microplastics can damage the intestinal wall and cause inflammation, potentially disrupting digestive function and reducing the number of good bacteria in the intestines. These good bacteria play an important role in the process of nutrient absorption and increasing the body's immunity. Therefore, exposure to microplastics must be minimized so as not to harm the balance of intestinal microbes and overall digestive function (Rai et al., 2024).

2. Immune Reaction

   Exposure to microplastics can lead to metabolic disorders and increase the risk of autoimmune diseases and cancer, caused by DNA damage caused by these particles (Anjani, Rafi'i, et al., 2023).

3. Accumulation of Toxicity

   Microplastics have significant health impacts due to the accumulation of toxicity in the human body. Exposure to microplastics can occur through various pathways, including consumption of contaminated food and beverages, inhalation, and absorption through the skin. In the long term, the accumulation of toxicity due to microplastics can cause serious disorders in reproductive health, such as decreased sperm quality and fertility in women. Microplastics can accumulate in the human body over time, leading to reproductive health problems, such as decreased sperm quality and fertility in women (Galloway et al., 2017).

Microplastic Findings in Previous Studies

Studies have found that microplastics have been detected in human feces, with findings of around 20 fragments per 10 grams of feces (Schwabl et al., 2019). In Indonesia, microplastics have also been found in various types of fish consumed, increasing the risk of contamination for humans (Lusher et al., 2017). One study found that humans can consume around 80 microplastic particles per day through contaminated food. Other studies have shown that microplastics have been detected in human feces, with findings of around 20 fragments per 10 grams of feces (Rai et al., 2024). In Indonesia, microplastics have also been found in various types of fish consumed, increasing the risk of contamination for humans. Here are the findings of microplastics in previous studies:

Table 1. Microplastic findings in previous studies

Finding	Result	Reference
Microplastics in marine fish for consumption	The abundance of microplastics in fish caught in Bali waters was recorded at 0.78 particles per fish, with 43.82% of the total fish contaminated with microplastics.	(Tobing et al., 2020)
Microplastics in blood cockles	There are total of 23.9 particles per individual were found in mussels measuring less than 3 cm, while in mussels measuring more than 3 cm, the number of particles detected was 26.8 per individual.	(Listiani et al., 2021)
Microplastics in salt	In each salt sample, between 16 and 563 microplastic particles were found. The average number of microplastics detected was 915 particles/kg, with variations ranging from 127 to 3,753 particles/kg.	(Amqam et al., 2022)
Microplastics in children's snacks	There were between 6.4 and 4.3 microplastic particles per ml in instant orange juice and instant tea, with a total microplastic abundance reaching 102 particles/ml.	(Puspita et al., 2022)
Microplastics in bottled drinking watern	Studies have shown that microplastics are present in 93% of sampled bottled water, with an average of 10.4 particles per liter.	(Mason et al., 2018).
Microplastics in seafood	found that 64% of shellfish samples contained microplastics, with an average of 1.5 particles per gram of tissue.	(Setyorini et al., 2021)
Microplastics in freshwater fish	Research conducted in the Citarum River found an average of 2.1 microplastic particles per fish, with 56% of the sampled fish contaminated.	(Sari et al., 2021).

Table 1. Microplastic findings in previous studies

Finding	Result	Reference
Microplastics in tea bags	Studies revealed that plastic tea bags release approximately 11.6 billion microplastic particles per cup when steeped in hot water.	(Álvarez-Hernández et al., 2019)
Microplastics in drinking water	Microplastic Fragments: There were 10.4 particles/L of Polypropylene (PP) type with a size of more than 100 m. There were 335 particles/L ranging in size from 6.5 to 100 m. These microplastics also include types of Polystyrene (PS), Polyethylene Terephthalate (PET), and Polyethylene (PE) with sizes ranging from 0.025 to 5,000 mm. The total number of microplastic fragments detected ranged from 12 to 58 particles/L with sizes ranging from 40 to 723 m. PET and PP microplastics: A total of 118±88 particles/L of PET and PP types were found. Apart from that, there were also 14 ± 14 particles/L which only consisted of PET. Microplastics in Refill Drinking Water (AMIU): Fiber-shaped microplastics were found with the types High Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), and Polyethylene (PE) with a total of 159, 130, 67, and 35 particles respectively, which were blue, red, clear, and yellow in color. In this sample, 0.8 particles/L with a size between 1.02 and 1.49 mm were also detected.	(Faujiah and Wahyuni, 2022)

Research shows that microplastics have contaminated various food and drink sources consumed by humans. In Bali waters, 43.82% of the examined fish contained microplastics, with an average of 0.78 particles per fish. Contamination was also found in bottled drinking water, where 93% of the samples contained microplastics, averaging 10.4 particles per liter. Additionally, table salt on the market was found to be contaminated, with levels ranging from 550 to 681 particles per kilogram. In Jakarta, 64% of shellfish samples contained an average of 1.5 microplastic particles per gram of tissue, while research in the Citarum River recorded that 56% of freshwater fish sampled contained an average of 2.1 particles per fish.

Beyond food and drinking water, another significant source of microplastic exposure is plastic tea bags. Studies have shown that when steeped in hot water, plastic tea bags can release approximately 11.6 billion microplastic particles into a single cup of tea. These findings indicate that microplastics have widely spread into the human food chain and may pose long-term health risks. Therefore, preventive measures are necessary to reduce the consumption of food and beverages that are highly susceptible to microplastic contamination.

CONCLUSIONS

The discussion regarding microplastic pollution and its health impacts is interrelated across various studies. Air pollution, particularly from urban and industrial areas, contributes to the spread of microplastics. These microplastics enter the human body through the digestive and respiratory systems, as well as skin contact, leading to significant health problems, such as inflammation, metabolic disorders, and toxicity accumulation. The research findings provide a strong foundation for understanding how microplastics circulate in the environment and their long-term health implications. Furthermore, the link between microplastic contamination in food chains and direct human exposure highlights the urgent need for policy interventions and sustainable solutions to reduce plastic waste and pollution. Microplastic exposure is an increasingly pressing health concern, particularly related to the digestive system. With microplastic pollution becoming more prevalent in our environment, it is important to be aware of these potential health impacts and take steps to reduce exposure. Simple steps we can take include replacing single-use containers with reusable ones, replacing single-use plastic bags with shopping bags, choosing to read product labels carefully to avoid ingredients such as polyethylene and polypropylene, which are often the source of microplastics in cosmetics.

Author contributions

Arina Azmina Ahmad Zubir: Conceptualization, analysis, draft writing, and editing.

Conflict of Interest

There is no conflict of interest in this study.

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Data availability

Data related to the findings of this study are available at the corresponding author.

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