



## MICRO PLASTICS- ENVIRONMENT

**NEWS: Microplastics block blood flow in brain in mice**

### WHAT'S IN THE NEWS?

#### Introduction to Microplastics

- **Definition of Microplastics:** Microplastics are small plastic fragments or particles that measure less than **5 millimeters in diameter**, making them so tiny that they can enter and interact with living organisms' cells and tissues.
- **Detection in Human Body:** Research has shown that microplastics are not limited to external environments but have been found in several **internal parts of the human body**, including the lungs (affecting breathing), testicles (potentially impacting reproduction), bone marrow (a key part of blood production), and even blood itself.
- **Health Concerns:** A new study has found that these microplastics could potentially **block blood flow in the brain**, at least in mice, which poses concerns for humans due to the possibility of similar physiological mechanisms.

#### About the Study

- **Study Title:** The study, titled "*Microplastics in the bloodstream can induce cerebral thrombosis by causing cell obstruction and lead to neurobehavioral abnormalities*", focuses on how microplastics in the blood can affect the brain.
- **Published in Science Advances:** It was published in *Science Advances*, a reputable scientific journal that focuses on cutting-edge research.
- **Recent Research:** The study was released **last week**, making its findings a current and significant contribution to understanding microplastic pollution's biological impacts.

#### Methodology

##### a. Animal Model Used

- **Why Mice Were Used:** Mice, commonly used in biomedical research, were selected as test subjects due to their biological similarity to humans in areas like blood flow and immune response.

##### b. Material Used

- **Fluorescent Polystyrene:** Researchers used **tiny fluorescent polystyrene particles**, a widely used plastic in everyday items such as **appliances, packaging, and toys**. The fluorescence made it easier to track these particles under a microscope.

##### c. Procedure



1. **Feeding Polystyrene to Mice:** The mice were fed **microplastics** in controlled amounts to simulate realistic exposure.
2. **Observation Through Microscope:** A **specialised microscope** was used to track the flow and accumulation of microplastics in their bloodstream and brain.
3. **Surgical Implantation:** Researchers surgically implanted a **transparent window in the mice's skulls**. This window allowed direct observation of blood flow and cellular interactions in the brain cortex, a crucial region for many bodily functions.

## What are Microplastics?

### ▪ About:

- They are defined as **plastics less than five millimetres** in diameter. It can be harmful to our ocean and aquatic life.
- Under the influence of **solar UV radiation**, wind, currents, and other natural factors, plastic fragments into small particles, termed microplastics (particles smaller than 5 mm) or **nanoplastics** (particles smaller than 100 nm).

### ▪ Classification:

- **Primary Microplastics:** They are tiny particles designed for **commercial use** and microfibers shed from clothing and other textiles.
  - E.g., microbeads found in personal care products, plastic pellets, and plastic fibres.
- **Secondary Microplastics:** They are formed from the **breakdown of larger plastics**, such as water bottles.
  - Exposure to environmental factors, primarily solar radiation and ocean waves, is the cause of this breakdown.

### ▪ Applications of Microplastics:

- **Medical and Pharmaceutical Uses:** Used in **targeted drug delivery** due to the capacity to absorb and release chemicals effectively.
- **Industrial Applications:** Used in **air-blasting technology** for cleaning machinery and in the production of synthetic textiles.
- **Cosmetics and Personal Care Products:** Used as **exfoliating agents** in facial scrubs, toothpaste, and other personal care products.

## What are the Current Developments Regarding Microplastics?

- **Microplastics in Testicular Tissues:** The study reported mean total microplastic levels of 122.63  $\mu\text{g/g}$  in dogs and 328.44  $\mu\text{g/g}$  in humans, with polyethylene (PE) being the dominant



polymer. This discovery raises concerns about the potential impact on human reproductive health, including **declining sperm counts**.

- **Global Plastic Overshoot Day (POD):** In 2024, **POD** is projected to occur on 5th September, marking the point when plastic waste generation exceeds the world's capacity to manage it.
  - **By the end of 2024, 217 countries are expected to release over 3 million tonnes of microplastics into waterways**, with China and India being the top contributors.
- **Microplastics in Drinking Water:** A critical review assessed the quality of 50 studies on microplastics in drinking water and freshwater sources.
  - It highlighted the **need for standardised sampling** and analysis methods, as **only four studies met all the quality criteria**.
- **Microplastic contamination in Ashtamudi Lake:** A study highlights significant microplastic pollution in **Ashtamudi Lake, a Ramsar wetland**, revealing microplastics in fish, shellfish, sediment, and water.
  - Hazardous **heavy metals** like molybdenum, iron, and barium were found in microplastics, posing risks to aquatic organisms and humans who consume contaminated fish and shellfish.

## Key Findings

### a. Microplastics in Immune Cells

- **Ingestion by Immune Cells:** Within **three hours** of consuming the microplastics, researchers found that certain immune cells, like **neutrophils** (which help fight infections) and **phagocytes** (which engulf harmful particles), had absorbed the plastic fragments.
- **Trapping in Blood Vessels:** Once the immune cells ingested the microplastics, they became **trapped in narrow blood vessels**, particularly in the cortex, a vital region of the brain responsible for higher-order functions like decision-making and perception.

### b. Blood Flow Blockages

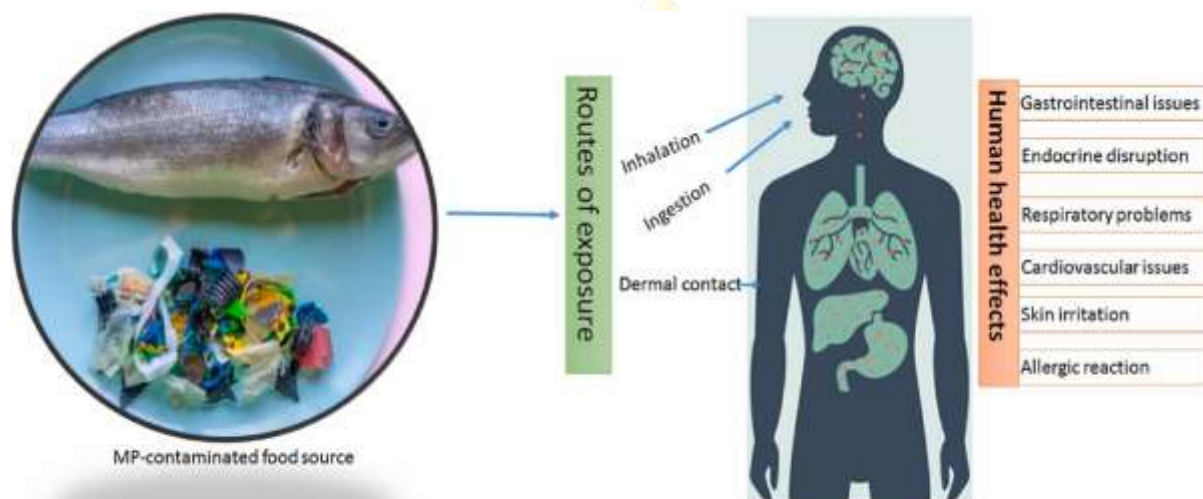
- **Clot-Like Effects:** The trapped immune cells caused **obstructions in blood flow** that resembled blood clots. These blockages reduced oxygen and nutrient supply to parts of the brain.
- **Mixed Outcomes:**
  - **Temporary Blockages:** Some blockages naturally cleared over time as blood flow resumed.
  - **Persistent Blockages:** Other blockages lasted for **several days**, leading to more sustained damage.



- **Impact on Mobility:** Mice affected by persistent blockages experienced **reduced mobility**, which suggests an impact on motor function and behavior.

## c. Broader Impacts on Organs

- **Unpublished Observations:** The research team also noted similar blockages in other organs like the **heart** and **liver**, though these results are yet to be formally published. This implies microplastics may have widespread effects beyond the brain.



## Broader Implications

### a. Potential Human Impact

- **Possible Similar Effects in Humans:** While the study focused on mice, the findings raise concerns about whether microplastics could cause similar blockages and impairments in the **human brain** or other organs.

### b. Evidence of Microplastics in Humans

- **Microplastics in Human Blood:** A study published in *Environment International* in 2022 confirmed that **microplastics exist in human blood**, highlighting widespread exposure.
- **Annual Consumption of Microplastics:**
  - Humans are estimated to **consume or inhale between 78,000 and 211,000 microplastic particles each year**. This estimate comes from research by the **World Economic Forum**, reflecting microplastic infiltration into food, water, and air.

## Regulations Related to Microplastics

- **Global:**
  - **United Nations Environment Assembly (UNEA) Resolutions:**



- The UNEA resolution mandated the development of an **international legally binding instrument** on plastic pollution, including in the marine environment.
- The resolution led to the establishment of the **Intergovernmental Negotiating Committee (INC)** to draft the treaty, to complete negotiations by the end of 2024
- **United Nations Environment Programme (UNEP) Plastics Treaty:**
  - The UNEP is working on an international legally binding instrument to address plastic pollution, including microplastics.
- **New Zealand's Waste Minimisation (Microbeads) Regulations:** New Zealand has **banned** the sale and manufacture of wash-off products containing plastic microbeads since 2017.
- **India:**
  - **Ban on Single-Use Plastics**
  - **India Plastics Pact**
  - **Plastic Waste Management Rules, 2016**
  - **Plastic Waste Management (Amendment) Rules 2018**
  - **Plastic Waste Management (Amendment) Rules, 2024**

## Conclusion

- **Serious Health Risks:** This study highlights the **significant health risks** posed by microplastic exposure, particularly related to **brain function, blood flow, and organ damage**.
- **Need for Further Research:** Additional research is required to:
  - Determine whether microplastics can have similar effects in **humans**.
  - Explore the long-term consequences of microplastic **accumulation** in the body.
  - Investigate possible measures to **mitigate exposure** and its health impacts.

**Source:** <https://indianexpress.com/article/explained/explained-sci-tech/microplastics-block-blood-mice-9802470/>