



CENTER for INTERNATIONAL
ENVIRONMENTAL LAW

Breathing Plastic

The Health Impacts of Invisible Plastics in the Air

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As the world's understanding of the plastics crisis grows, new facets of the problem emerge and reveal impacts on human health and the environment. Recent advances in science are allowing scientists to explore how micro- and nanoplastics form a critical piece of the plastic pollution problem. First thought to be mainly a marine pollution issue, over the last decade, scientists have discovered micro- and nanoplastics exist in every environmental compartment — from freshwater to soil and air — and in thousands of species, including humans.¹ But like climate change and hazardous chemicals, most plastics are invisible to the naked human eye, meaning their impact goes relatively unseen.²

Contrary to popular depictions, oceans are not “the final sink”³ for microplastics. These tiny plastic particles can travel worldwide, ending up in urban, rural, and remote areas. They take an even faster transport pathway than oceanic currents: the atmosphere.⁴ Moving through the air, micro- and nanoplastics can cover thousands of kilometers in a matter of days to weeks, creating what could be a “never-ending loop” of plastic transport.⁵ The serious potential

for long-range transport means that micro- and nanoplastics can affect locations and populations vast distances from the sources of plastic pollution, making microplastics “one of the most ubiquitous pollutants released by anthropogenic activities”⁶ and a grave public health issue.⁷ While scientists may not yet know the full scope of the health impacts of micro- and nanoplastics, the cause is undeniably clear: the production and use of plastics.

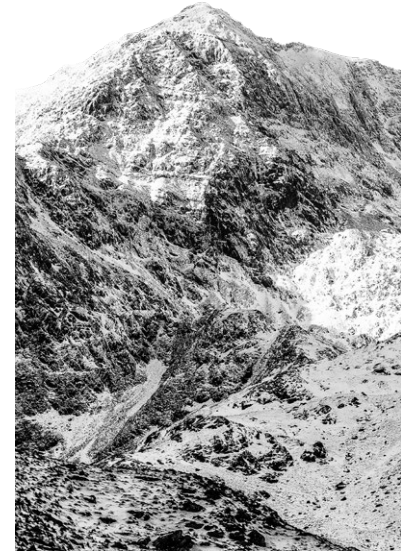
The Problem

Everywhere they look, scientists are finding microplastics.⁸ Often so small that they are invisible to the human eye, these tiny plastic particles are imperceptible as they pass through airways and reach the very bottom of the lungs. Scientists have found that inhalation is a major contributor to human intake of micro- and nanoplastics, and exposure rates — the amount of atmospheric micro- and nanoplastics in an individual's vicinity — can be as high as 5,700 microplastics per cubic meter.⁹ It's estimated that humans can inhale up to 22,000,000 micro- and nanoplastics annually.¹⁰

Microplastic Inhalation over the Average Human Lifetime

If we think of microplastic inhalation as a visual height chart, over the course of these periods of time, the average human inhales the equivalent of...

Height of Snowdon Mountain, Wales
1,019 meters



Height of the Eiffel Tower
363 meters



Height of two giraffes
12.69 meters



Over a year

Over a lifetime (minimum)

Over a lifetime (maximum)

Imagery not drawn to scale.

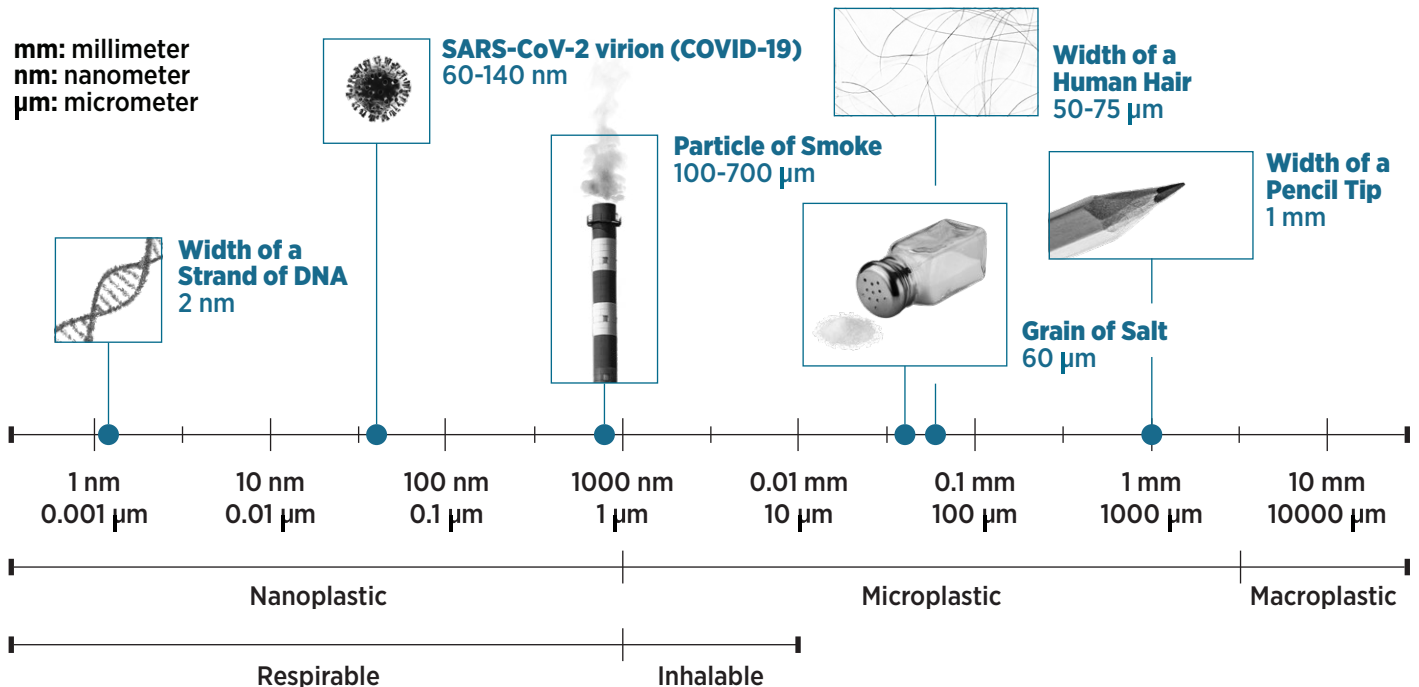
Source: [Data from an investigation by the University of Portsmouth and Good Morning Britain.](#)

To better understand the issue, it is essential to examine the scales used to classify plastic particles. Microplastics are plastic particles less than 5 millimeters (mm) in diameter, about the size of an orange seed.¹¹ Airborne microplastics, however, are much smaller — even a 0.5 mm (500 micrometer (μm)) particle is considered

large. When plastic fragments are below 0.001 mm in size (equivalent to 1 μm or 1,000 nanometers (nm)), they are less than 1/100th of the thickness of a human hair. Particles this small are called nanoplastics and cannot be seen by the naked eye.¹²

The Size of Micro- and Nanoplastics

mm: millimeter
nm: nanometer
 μm : micrometer



Source: [Based on a visual by Deonie and Steve Allen, presented in a webinar hosted by Plastic Pollution Coalition.](#)

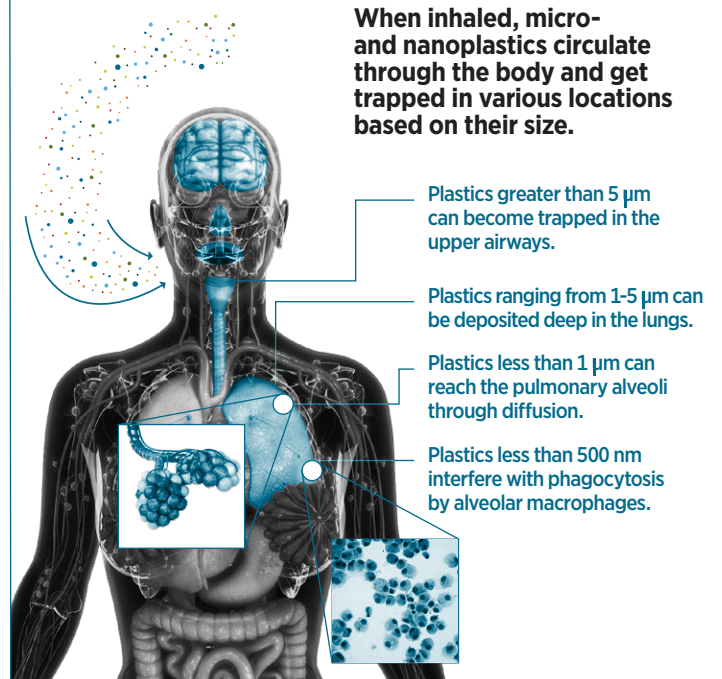
Multiple Sources, Same Origin

Fundamentally, atmospheric microplastics come from human creation and use of plastics. Microplastics fall into categories based on their origin.¹³ Primary microplastics¹⁴ are intentionally produced at microscale for a specific use (such as agrochemicals or pharmaceuticals). In contrast, secondary microplastics result from the mechanical, chemical, and physical fragmentation of larger (macro) plastics, which can include “legacy” plastics disposed of in the environment decades ago. Every stage of the plastics life cycle, from the extraction of feedstocks to production, transport, use, disposal, and remediation, emits both primary and secondary microplastics and other hazardous substances.¹⁵

Moving through Air

Since air is a strong environmental media, the spread and effects of airborne microplastics can remain localized or extend far beyond the point of release. While concentration levels vary, no location remains untouched. Airborne microplastics have been collected worldwide, but especially in the Northern Hemisphere, including France, Iran, China, Japan, Vietnam, Nepal, the United States, Colombia, Saudi Arabia, South Korea, Kuwait, Greece, Romania, Pakistan, and India.¹⁶

Where Microplastics Get Trapped in the Human Body



Source: Based on a visual from a 2021 paper by Alessio Facciola et al., titled “Newly Emerging Airborne Pollutants: Current Knowledge of Health Impact of Micro and Nanoplastics.”

Inside the Body

Exposure to airborne microplastics can occur through inhalation, penetration through skin pores, and ingesting foods that contain them.¹⁷ Microplastics’ reach inside the human body depends on their properties, size, shape, and an individual’s metabolism, susceptibility, and lung anatomy.¹⁸ They can enter the respiratory system through the nose or mouth before being deposited in the upper airways or deep in the lungs.¹⁹ Once there, evidence shows that micro- and nanoplastics can be transferred from the lung epithelial surface to lung tissue,²⁰ potentially to internal organs and the vascular system, and beyond.²¹

A Trojan Horse

The very characteristics of microplastics reveal their potential to be a dangerously potent vector for toxics and pathogens. Microplastics often have large specific surface areas and are predominantly hydrophobic, meaning they repel water. These characteristics make airborne microplastics a “Trojan Horse” capable of hiding and carrying harmful substances inside the animals or humans who inhale, absorb, and ingest them.²² Therefore, knowing what’s inside plastic is as important as knowing what lies on it.²³



Health Impacts

While airborne microplastics research is in its infancy, studies on the inhalation of micro- and nanoparticles of plastics show a series of adverse effects along the respiratory tract and beyond, ranging from irritation to the onset of cancer in cases of chronic exposure.²⁴ These adverse effects include:

- immediate asthma-like reactions;
- inflammatory reactions and fibrotic changes, like chronic bronchitis;
- lung disorders such as extrinsic allergic alveolitis and chronic pneumonia;
- pulmonary emphysema;²⁵
- the development of interstitial lung diseases,²⁶ resulting in coughing, difficulty breathing, and a reduction in lung capacity;²⁷
- oxidative stress and the formation of reactive oxygen species (ROS) and thus the ability to damage cells (cytotoxic effects);²⁸ and
- autoimmune diseases.²⁹



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Human Health Impacts of Exposure to Chemicals in Microplastics

Neurodevelopmental disorders

Attention deficit hyperactivity disorder (ADHD)
Autism
Neurobehavioral deficits
Decreased IQ
Cognitive deficits

Hormonal diseases

Thyroid disease
Thyroid cancer

Cardiovascular disease

Respiratory diseases
Asthma

Male reproductive health impacts

Subfertility
Reduced sperm quality

Female reproductive health impacts

Polycystic ovarian syndrome
Endometriosis
Delayed time to pregnancy
Abnormal Pap smears
Pregnancy-induced hypertension and/or preeclampsia

Metabolic disorders

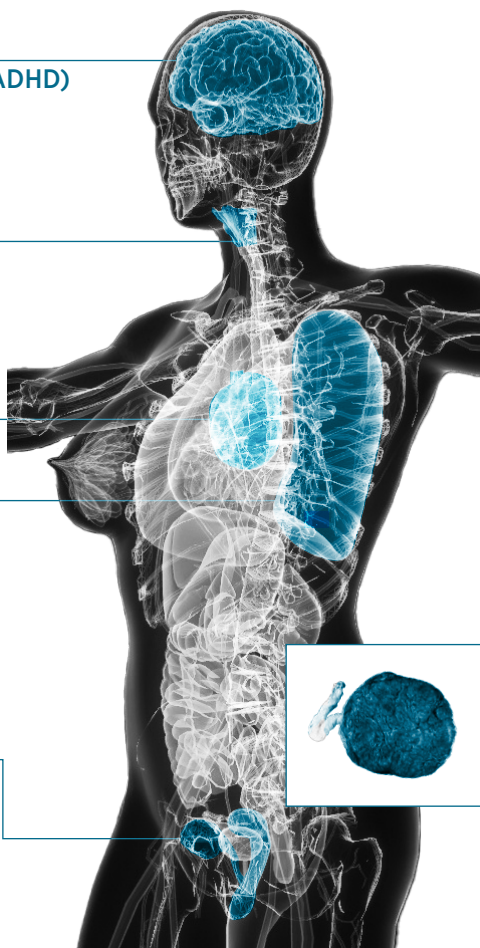
Type 2 diabetes
Excessive childhood weight gain
Increased waist circumference
Serum lipid levels, e.g., total cholesterol and LDL cholesterol

Other health impacts

Decreased antibody response to vaccines
Physical damage
Carcinogen absorption

Pregnancy outcomes

Preterm birth
Lower birth weight
Abnormal genital structure (anogenital distance)
Altered pubertal timing



A Toxic Cocktail

Exposure to airborne microplastics is not happening in a vacuum. Humans are exposed to multiple pollutants and hazardous chemicals daily, including microplastics ingested via other sources, such as food or drink. While research on airborne microplastics is in its infancy, microplastic exposure typically happens alongside other toxic substances.

The Bigger Picture

If no action is taken, the volume of airborne microplastic emissions will follow the expected rise in plastic production, resulting in a greater risk of spreading potentially toxic chemicals. Regulators need to dramatically reduce the production of plastics and phase out hazardous chemicals.

Recommendations

- 1. Consider the combined “cocktail” effect.** Exposure to micro- and nanoplastics is a multi-faceted problem touching on air, water, terrestrial environments, food, and more. Regardless of how exposure occurs, it typically happens alongside other toxics. Humans are exposed to multiple pollutants and hazardous chemical compounds daily, including endocrine disruptors and POPs linked to diabetes,

infertility, and hormone-related cancers. Regulators need to apply the precautionary principle to address the risks of combined exposure. Such an approach should include ensuring access to information on the petrochemical compounds in plastics products and processes (both voluntary and non-intentionally added) for ALL plastic products, not just food-grade plastics.

- 2. Adopt legally binding measures without any further delay.** Self-regulation and voluntary approaches have failed to reduce plastic and microplastic pollution. Banning intentionally added microplastics is the first step. Mandatory regulations will need to reduce the production and release of plastic and its associated compounds and reduce human exposure to plastics, microplastics, and nanoplastics.
- 3. Address the full life cycle of plastics. Airborne micro- and nanoplastics are part of the bigger story of plastics.** Thus, a systemic effort is needed to address the full issue, beginning with the extraction of fossil fuels and associated chemicals used in plastic production. Decision makers should further support action at the global level, supporting ambitious and effective provisions, including strict enforcement measures in the future international legally binding agreement on plastic that will be negotiated before the end of 2024.



Endnotes

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This summary is adapted from an issue brief. Read the full brief at ciel.org/reports/airborne-microplastics-briefing/

