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MICROPLASTIC POLLUTION IN HUMAN BLOOD CHALLENGES THE EXTRAMURAL RESEARCH OF CUTTING-EDGE MODERN ARENA

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ABSTRACT

Microplastic pollution has been detected in human blood for the first time, with scientists finding the tiny particles in almost 80% of the people tested. The discovery shows the particles can travel around the body and may lodge in organs. The impact on health is as yet unknown. But researchers are concerned as microplastics cause damage to human cells in the laboratory and air pollution particles are already known to enter the body and cause millions of early deaths a year. Huge amounts of plastic waste are dumped in the environment and microplastics now contaminate the entire planet, from the summit of Mount Everest to the deepest oceans. People were already known to consume the tiny particles via food and water as well as breathing them in, and they have been found in the faeces of babies and adults. The scientists analysed blood samples from 22 anonymous donors, all healthy adults and found plastic particles in 17. Half the samples contained PET plastic, which is commonly used in drinks bottles, while a third contained polystyrene, used for packaging food and other products. A quarter of the blood samples contained polyethylene, from which plastic carrier bags are made and the plastics are leaching from those bags and enters into blood to produce health manifestations.

KEYWORDS: Polyethylene, Polypropylene, Polyvinyl chloride, Polystyrene, Bisphenol-A, Polymethylmethacrylate, Polyethylene terephthalate, attention deficit hyperactivity disorder and Autism.

OVERVIEW

Plastics are everywhere. Plastics are a wide range of synthetic or semi-synthetic materials that use polymers as a main ingredient. Their plasticity makes it possible for plastics to be moulded, extruded or pressed into solid objects of various shapes. This adaptability, plus a wide range of other properties, such as being lightweight, durable, flexible, and inexpensive to produce, has led to its widespread use. Plastics typically are made through human industrial systems. Plastic is the most prevalent type of marine debris found in our ocean and Great Lakes. Plastic debris can come in all shapes and sizes, but those that are less than five millimeters in length (or about the size of a sesame seed) are called “microplastics.” Most modern plastics are derived from fossil fuel-based chemicals like natural gas or petroleum; however, recent industrial methods use variants made from renewable materials, such as corn or cotton derivatives. Although, in theory, much of it can be recycled, a lot of it ends up in landfills, or worse, in watercourses and marine ecosystems. Many people are too familiar with distressing images of turtles and dolphins trapped in plastic bags or fishing nets. But there is a less visible effect — microplastics, tiny plastic particles formed when plastics break down and during commercial product manufacturing. Several studies have found evidence of plastics in the human body. One revelation came after scientists detected plastic additives such as bisphenol A (BPA) and phthalates. Microplastics are specks of plastic. By definition, they are less than 5mm in any dimension, but many are invisible to the naked eye. There are two types of microplastics: primary microplastics and secondary microplastics. The former are the particles used in some cosmetics, and the latter comes from the breakdown products of larger plastic items. Much concern about microplastics has previously focused on their effect on the marine environment, as they are found in oceans worldwide. Many marine organisms, such as fish and shellfish, have been found to contain microplastics.[1]

For this study, the researchers looked for particles that could be absorbed across membranes in the human body. They filtered the blood to collect any plastic particles between 700 nanometers(nm) and 500,000nm. To avoid any plastic contamination, the researchers used glass fiber filters. Trusted Source in human urine. Researchers have also found microplastics in human faces. However, until now, no published study has directly examined. Trusted Source the effect of these tiny plastic specks on human health.[2]

Half-life of polymer plastics is 58 years (bottles) to 1200 years (pipes). A new biological plastic (L) shows obvious biodegradation compared to polyethylene (R). Polyethylene gave an estimated half-life of 48-years in the Marine Degradation studies, while the PHA bioplastic indicated a half-life of only 11-months. The researchers suggest several ways the plastics may have entered the bloodstream — via air, food, water, personal care products such as toothpaste and lip gloss, dental polymers, and tattoo ink residues. Based on DOC production, the half-life of the microplastics ranged from 0.26 years for EPS to 86 years for PE, suggesting sunlight is a major removal term for buoyant oceanic microplastics. Indeed, a plastic ocean of those substances might be in our future. To get from new polyethylene terephthalate plastic bottles in ocean waters to those little microplastics can take anywhere between 450 and 1,000 years.[3]

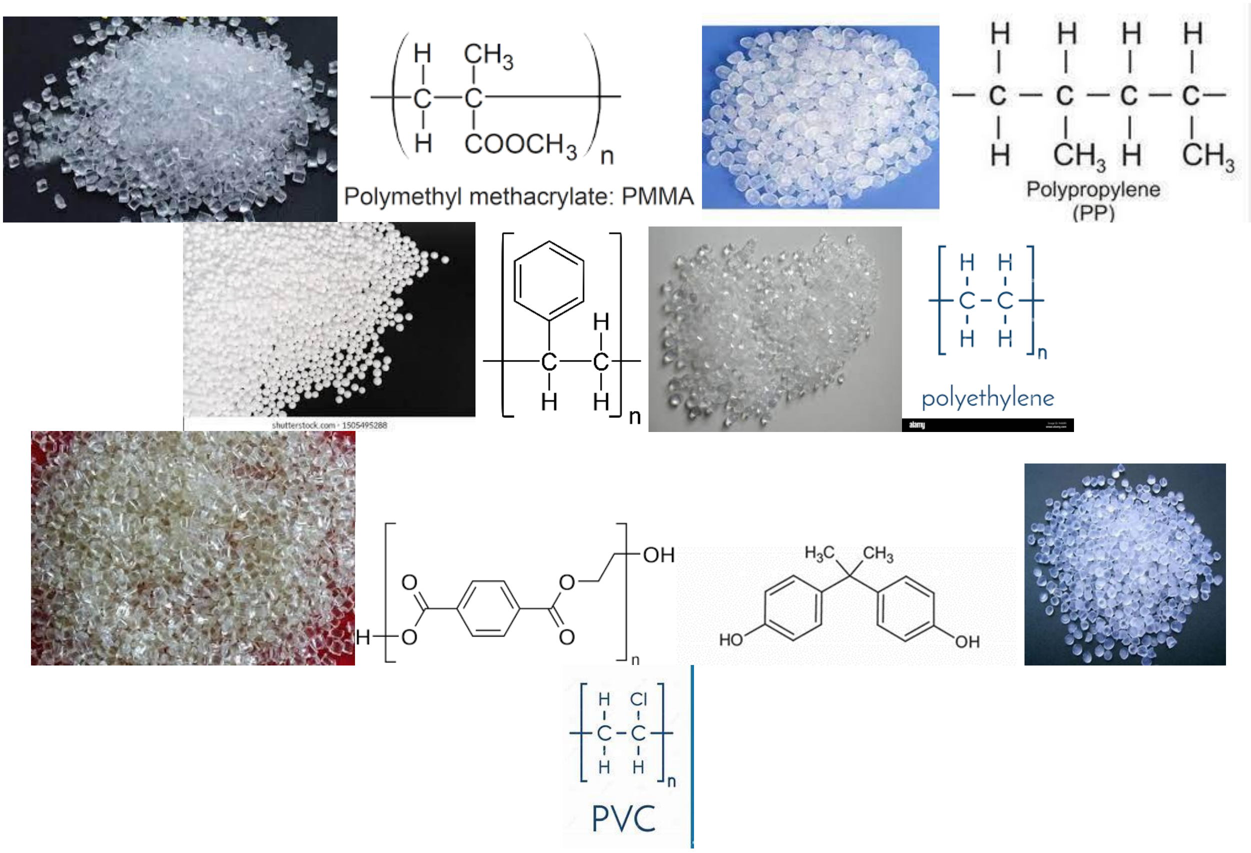


Figure-1: Polymers as microplastics.

The researchers looked for six common plastics
Poly (methyl methylacrylate) (PMMA), used in dentistry and other medical applications
Polymerized styrene (PS), used for lightweight packaging
Polyethylene (PE), the most widely used plastic, used for carrier bags, among many other things
Polyethylene terephthalate (PET), widely used in textiles and food and drink containers
Polyvinyl chloride (PVC) used in pipes, gloves

Microplastics cause damage to human cells in the laboratory at the levels known to be eaten by people via their food, a study has found. The harm included cell death and allergic reactions and the research is the first to show this happens at levels relevant to human exposure. Microplastics can carry a range of contaminants such as trace metals and some potentially harmful organic chemicals. These chemicals can leach from the plastic surface once in the body, increasing the potential for toxic effects. Microplastics can have carcinogenic properties, meaning they potentially cause cancer. Microplastics Can Kill Human Cells at Concentrations Found in the Environment, Scientists Say. There is currently no evidence that the small numbers of microplastics found in wild and farmed aquatic organisms have negative effects on these populations. Some people are concerned about human exposure to

microplastics and whether they have an impact on our health. The study said the microplastics could have entered the body by many routes: via air, water or food, but also in products such as particular toothpastes, lip glosses and tattoo ink. "It is scientifically plausible that plastic particles may be transported to organs via the bloodstream," the study added. Plastic products contain chemical additives. A number of these chemicals have been associated with serious health problems such as hormone-related cancers, infertility and neurodevelopment disorders like ADHD [Attention deficit hyperactivity disorder] and autism. So, here are 3 reasons why you should worry about microplastics in 2020: Microplastics may contains harmful chemicals: They might have an average of 4–7% of chemicals and additives, which include plasticizers, flame retardants and antimicrobial agents that might leach into food, water, and body tissues. Stahlhut says that it appears that the amount of BPA [bisphenol-A] in the body drops relatively rapidly from four to nine hours after exposure, but then levels out. "After the nine hours or so," he says, "it stops doing what it's supposed to and the decline goes flat." How do microplastics affect humans and the environment? There are three ways that plastics can impact health. First, the toxic additives used to make plastic (such as phthalates, bisphenols, and flame retardants) can leach out of plastics and into food and drinks and even our bodies. Microplastics cause damage to human cells in the laboratory at the levels known to be eaten by people via their food, a study has found. The harm included cell death and allergic reactions and the research is the first to show this happens at levels relevant to human exposure. Microplastics, or tiny plastic particles, are ubiquitous pollutants found almost everywhere on earth. Scientists have detected microplastics near the peak of Mount Everest, in the Mariana Trench and even in baby poop.[4-8]
Don't microwave food in plastic.
Drink (filtered) tap water.
Cut out takeaway cups.
Avoid extra-harmful plastics (3,6,7).
Change your laundry routine.
Use plastic-free cosmetics and microbead-free beauty products.
Limit seafood consumption.

Microplastics are fragments of any type of plastic less than 5 mm (0.20 in) in length, according to the U.S. National Oceanic and Atmospheric Administration (NOAA) and the European Chemicals Agency. They cause pollution by entering natural ecosystems from a variety of sources, including cosmetics, clothing, food packaging, and industrial processes. The term macroplastics is used to differentiate microplastics from larger plastic waste, such as plastic bottles. Two classifications of microplastics are currently recognized. Primary microplastics include any plastic fragments or particles that are already 5.0 mm in size or less before entering the environment. These include microfibers from clothing, microbeads, and plastic pellets (also known as nurdles). Secondary microplastics arise from the degradation (breakdown) of larger plastic products through natural weathering processes after entering the environment. Such sources of secondary microplastics include water and soda bottles, fishing nets, plastic bags, microwave containers, tea bags and tire wear. Both types are recognized to persist in the environment at high levels, particularly in aquatic and marine ecosystems, where they cause water pollution. 35% of all ocean microplastics come from textiles/clothing, primarily due to the erosion of polyester, acrylic, or nylon-based clothing, often during the washing process. However, microplastics also accumulate in the air and terrestrial ecosystems.[9]

Because plastics degrade slowly (often over hundreds to thousands of years), microplastics have a high probability of ingestion, incorporation into, and accumulation in the bodies and tissues of many organisms. The toxic chemicals that come from both the ocean and runoff can also bio-magnify up the food chain. In terrestrial ecosystems, microplastics have been demonstrated to reduce the viability of soil ecosystems and reduce weight of earthworms. The cycle and movement of microplastics in the environment are not fully known, but research is currently underway to investigate the phenomenon. Deep layer ocean sediment surveys in China (2020) show the presence of plastics in deposition layers far older than the invention of plastics, leading to suspected underestimation of microplastics in surface sample ocean surveys. Microplastics have also been found in the high mountains, at great distances from their source.[10]

The term "microplastics" was introduced in 2004 by Professor Richard Thompson, a marine biologist at the University of Plymouth in the United Kingdom.

Figure-2: Prof Richard Thompson [marine biologist].

Microplastics are common in our world today. In 2014, it was estimated that there are between 15 and 51 trillion individual pieces of microplastic in the world's oceans, which was estimated to weigh between 93,000 and 236,000 metric tons.[11]

Primary microplastics: Polyethylene based micro-spherules in toothpaste
a) Artificial turf football field with ground tire rubber (GTR) used for cushioning. b) Microplastics from the same field, washed away by rain, found in nature close to a stream.

Primary microplastics are small pieces of plastic that are purposefully manufactured. They are usually used in facial cleansers and cosmetics, or in air blasting technology. In some cases, their use in medicine as vectors for drugs was reported. Microplastic "scrubbers", used in exfoliating hand cleansers and facial scrubs, have replaced traditionally used natural ingredients, including ground almond shells, oatmeal, and pumice. Primary microplastics have also been produced for use in air blasting technology. This process involves blasting acrylic, melamine, or polyester microplastic scrubbers at machinery, engines, and boat hulls to remove rust and paint. As these scrubbers are used repeatedly until they diminish in size and their cutting power is lost, they often become contaminated with heavy metals such as cadmium, chromium, and lead. Although many companies have committed to reducing the production of microbeads, there are still many bioplastic microbeads that also have a long degradation life cycle similar to normal plastic. Primary microplastics which enter the environment directly, are tiny particles designed for commercial use, as well as microfibers shed from clothing and other textiles, such as fishing nets. Examples of primary microplastics include microbeads found in personal care products, plastic pellets used in industrial manufacturing, and plastic fibres used in synthetic textiles.[12]

Secondary microplastics: Secondary plastics are small pieces of plastic derived from the breakdown of larger plastic debris, both at sea and on land. Over time, a culmination of physical, biological, and chemphotodegradation, including photo-oxidation caused by sunlight exposure, can reduce the structural integrity of plastic debris to a size that is eventually undetectable to the naked eye. This process of breaking down large plastic material into much smaller pieces is known as fragmentation. It is considered that microplastics might further degrade to be smaller in size, although the smallest microplastic reportedly detected in the oceans at present is 1.6 micrometres (6.3×10^{-5} in) in diameter. The prevalence of microplastics with uneven shapes suggests that fragmentation is a key source. Secondary microplastics form from the breakdown of larger plastics such as water bottles. This typically happens when larger plastics undergo weathering, through exposure to conditions like wave action, wind abrasion, and ultraviolet radiation from sunlight.[13]

Other sources: as a by-product/dust emission during wear and tear

There are countless sources of both primary and secondary microplastics. Microplastic fibers enter the environment from the washing of synthetic clothing. Tires, composed partly of synthetic styrene-butadiene rubber, will erode into tiny plastic and rubber particles as they are used. Furthermore, 2.0-5.0 mm plastic pellets, used to create other plastic products, often[quantify] enter ecosystems due to spillages and other accidents. A Norwegian Environment Agency review report about microplastics published in early 2015 states it would be beneficial to classify these sources as primary, as long as microplastics from these sources are added from human society since the "start of the pipe", and their emissions are inherently a result of human material and product use and not secondary defragmentation in the nature.[14]

Nanoplastics: Depending on the definition used, nanoplastics are less than 1 μm (i.e. 1000 nm) or less than 100 nm in size. Speculations over nanoplastics in the environment range from it being a temporary by-product during the fragmentation of microplastics to it being an invisible environmental threat at potentially high and continuously rising concentrations. The presence of nanoplastics in the North Atlantic Subtropical Gyre has been confirmed and recent developments in Raman spectroscopy coupled with optical tweezers (Raman Tweezers) as well as nano-fourier-transform infrared spectroscopy (nano-FTIR) or atomic force infrared (AFM-IR) are promising answers in the near future regarding the nanoplastic quantity in the environment. Nanoplastics are thought to be a risk to environmental and human health. Due to their small size, nanoplastics can cross cellular membranes and affect the functioning of cells. Nanoplastics are lipophilic and models show that polyethylene nanoplastics can be incorporated into the hydrophobic core of lipid bilayers. Nanoplastics are also shown to cross the epithelial membrane of fish accumulating in various organs including the gall bladder, pancreas, and the brain. Little is known on adverse health effects of nanoplastics in organisms including humans. In zebrafish, polystyrene nanoplastics can induce a stress response pathway altering glucose and cortisol levels, which is potentially tied to behavioural changes in stress phases. In Daphnia, polystyrene nanoplastic can be ingested by the freshwater cladoceran Daphnia pulex and affect its growth and reproduction as well as induce stress defense, including the ROS production and MAPK-HIF-1/NF-κB-mediated antioxidant system. Examples of primary microplastics include microbeads found in personal care products, plastic pellets (or nurdles) used in industrial manufacturing, and plastic fibres used in synthetic textiles (e.g., nylon).[15]

Apples had one of the highest microplastic counts in fruit, with an average of 195,500 plastic particles per gram, while pears averaged around 189,500 plastic particles per gram. Broccoli and carrots were shown to be the most contaminated vegetables, averaging more than 100,000 plastic particles per gram. Apples and carrots have the highest levels of microplastic particles. However, microplastics appeared in other crops such as pears, broccoli, lettuce, potatoes, radishes, and turnips. Contamination in fruit and vegetables is thought to occur when plants suck water that contains microplastics up through their roots. At this rate of consumption, in a decade, we could be eating 2.5kg (5.5 lb) in plastic, the equivalent of over two sizeable pieces of plastic pipe. And over a lifetime, we consume about 20kg (44 lb) of microplastic. Microplastics confirmed by SEM and Raman spectra. Microplastics particles (a–e) are generated by patting packing foam (PS), (f–j) by scissoring a drinking-water bottle (PET), (k–o) by manually tearing a plastic cup (PP) and (p–t) by knife-cutting a plastic bag (PE). Primary microplastics are small pieces of plastic that are purposefully manufactured. They are usually used in facial cleansers and cosmetics, or in air blasting technology. In some cases, their use in medicine as vectors for drugs was reported. Seven major sources of primary microplastics are identified and evaluated in this report: Tyres, Synthetic Textiles, Marine Coatings, Road Markings, Personal Care Products, Plastic Pellets and City Dust. Plastic debris can come in all shapes and sizes, but those that are less than five millimeters in length (or about the size of a sesame seed) are called "microplastics." Microbeads are tiny pieces of polyethylene plastic added to health and beauty products, such as some cleansers and toothpastes.[16]

Reduce Your Use of Single-Use Plastics.
Support Legislation to Curb Plastic Production and Waste.
Recycle Properly.
Participate In (or Organize) a Beach or River Clean-up.
Avoid Products Containing Microbeads.

Plants do not absorb microplastics between 1-150 microns in size even though small dye molecules can be absorbed by roots. If ingested, microplastics can block the gastrointestinal tracts of organisms, or trick them into thinking they don't need to eat, leading to starvation. Many toxic chemicals can also adhere to the surface of plastic and, if ingested, contaminated microplastics could expose organisms to high concentrations of toxins." However, microplastics do accumulate on the tips of roots, which could bode well for future cleanup of contaminated environments, but not well for root crops, like carrots. The results show that XPS microplastics (MP-XPS) contaminate food products at a level ranging from 4.0 to 18.7 MP-XPS/kg of packaged meat. Analysis shows that these microplastics are likely to come from the XPS trays. These particles are difficult to remove by mere rinsing and are probably cooked before being consumed. However, this study demonstrated that microplastics were able to make their way through the blood brain barrier with just one week of exposure. Many microplastics are small enough to be inhaled straight into your lungs. Like other foreign objects, microplastics can be harmful when they get into your airways. They can cause swelling and damage to your windpipe and to the tissue of your lungs, making you feel mild chest pain or shortness of breath.[17,18]

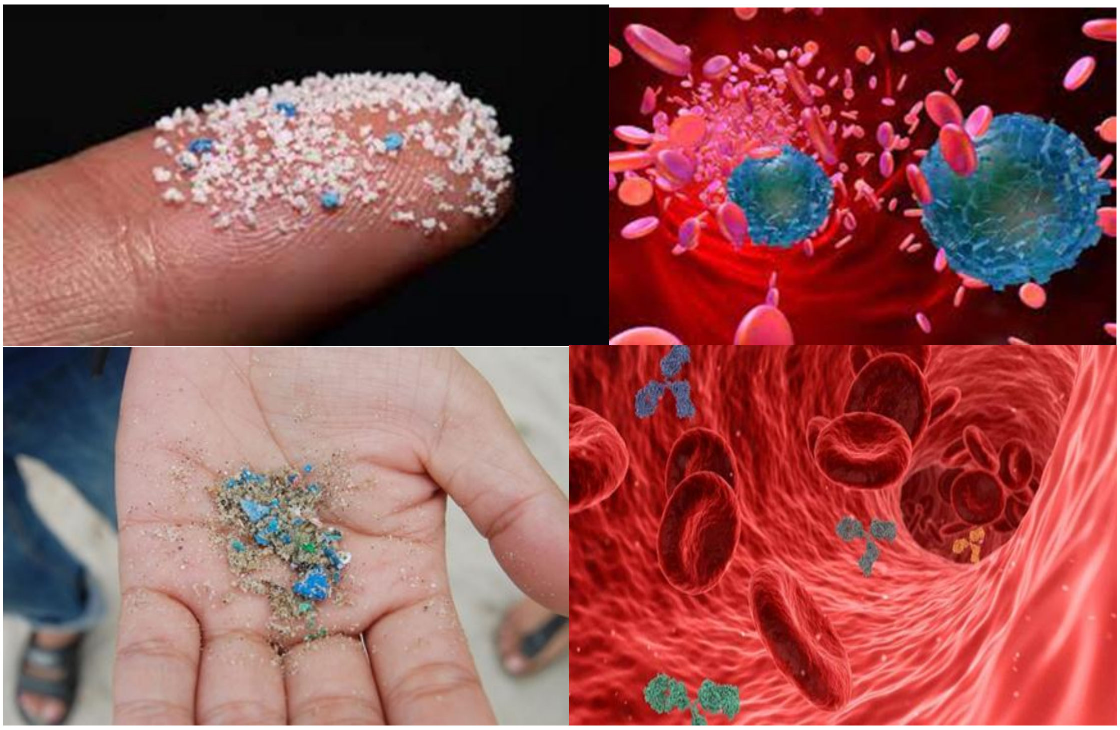


Figure-3: Microplastics in blood.

Microscopic bits of plastic have most likely taken up residence in all of the major filtering organs in your body, a new lab study suggests. Researchers found evidence of plastic contamination in tissue samples taken from the lungs, liver, spleen and kidneys of donated human cadavers. The floating solids are separated from the denser undigested mineral components using a density separator. The floating plastic debris is collected in the density separator using a custom 0.3-mm filter, air-dried, and plastic material is removed and weighed to determine the microplastics concentration.

Another recent piece of scientific research found a potential link between high concentrations of microplastics in the faeces of test subjects and the prevalence of inflammatory bowel disease (IBD).[18]
Washing synthetic garments is the biggest source of microplastic pollution!
“Plastic breaks Up into microplastics (or microfibers) creating micro pollution.
Microplastics are small pieces of plastics, less than 2-5mm long.
Approximately, 60% of the clothing industry today comprises synthetic material.

To summarize, there are 7 types of plastic exist in our current modern days
1 – Polyethylene Terephthalate (PET or PETE or Polyester)
2 – High-Density Polyethylene (HDPE)
3 – Polyvinyl Chloride (PVC)
4 – Low-Density Polyethylene (LDPE)
5 – Polypropylene (PP)
6 – Polystyrene (PS)
7 – Other.

CASE STUDY

Microplastics found in human blood for the first time, Scientists have discovered microplastics in human for the first time, Dutch scientists found 17 of 22 volunteers, or 77%, had "quantifiable" microplastics in their blood. The discovery shows the particles can travel around the body and may lodge in organs. The impact on health is as yet unknown. But researchers are concerned as microplastics cause damage to human cells in the laboratory and air pollution particles are already known to enter the body and cause millions of early deaths a year. Huge amounts of plastic waste are dumped in the environment and microplastics now contaminate the entire planet, from the summit of Mount Everest to the deepest oceans. People were already known to consume the tiny particles via food and water as well as breathing them in, and they have been found in the faeces of babies and adults. The scientists analysed blood samples from 22 anonymous donors, all healthy adults and found plastic particles in 17. Half the samples contained PET plastic, which is commonly used in drinks bottles, while a third contained polystyrene, used for packaging food and other products. A quarter of the blood samples contained polyethylene, from which plastic carrier bags are made and the plastics are leaching from those bags and enters into blood to produce health manifestations. Plastics are a wide range of synthetic or semi-synthetic materials that use polymers as a main ingredient.

Figure-4: Christian Friedrich Schönbein & Hermann Staudinger.

Plastic was discovered by famous German chemist Christian Schonbein [Christian Friedrich Schönbein HFRSE (18 October 1799 – 29 August 1868) was a German-Swiss chemist who is best known for inventing the fuel cell] in 1846. Plastics were actually discovered accidentally. Christian was experimenting in his kitchen and by accident, he spilt a mixture of nitric acid and sulfuric acid. To mop that solution (a mixture of nitric and sulfuric acid) he took a cloth and after moping he kept it over the stove. After some time, the cloth disappeared and from their plastic got its name. The word, plastic, was derived from the word ‘Plastikos’ meaning ‘to mould’ in Greek. Fossil fuels have compounds containing hydrogen and carbon (hydrocarbon) which act as building blocks for long polymer molecules. These building blocks are known as monomers, they link together to form long carbon chains called polymers. Their plasticity makes it possible for plastics to be moulded, extruded or pressed into solid objects of various shapes. This adaptability, plus a wide range of other properties, such as being lightweight, durable, flexible, and inexpensive to produce, has led to its widespread use. Plastics typically are made through human industrial systems. Most modern plastics are derived from fossil fuel-based chemicals like natural gas or petroleum. **We use plastics for all kinds of purposes and when we're done with it, we throw it away. Some of the plastic waste ends up being recycled, but**

another part ends up in a big heap - or worse, in the environment. The plastic soup in seas and rivers is a major environmental problem. Wageningen University & Research measures the number of plastics in oceans and rivers, traces its origin and assesses its impact on nature. The world's first fully synthetic plastic was Bakelite, invented in New York in 1907, by Leo Baekeland, who coined the term "plastics". Polyoxybenzylmethylenglycolanhydride, better known as Bakelite was the first plastic made from synthetic components. It is a thermosetting phenol formaldehyde resin, formed from a condensation reaction of phenol with formaldehyde. It was developed by the Belgian chemist Leo Baekeland in Yonkers, New York, in 1907. Bakelite was patented on December 7, 1909.

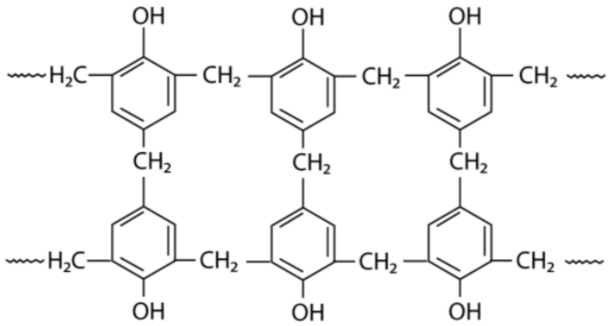


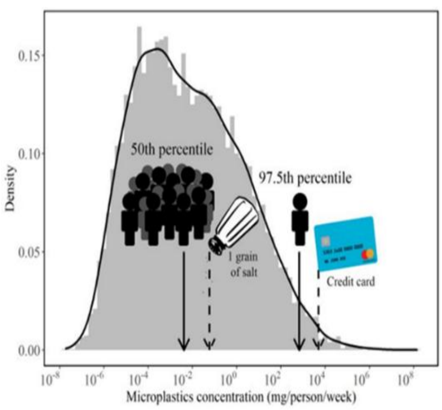
Figure-5: Bakelite.

Dozens of different types of plastics are produced today, such as polyethylene, which is widely used in product packaging, and polyvinyl chloride (PVC), used in construction and pipes because of its strength and durability. Many chemists have contributed to the materials science of plastics, including Nobel laureate Hermann Staudinger, who has been called "the father of polymer chemistry" and Herman Mark, known as "the father of polymer physics". Plastic debris can come in all shapes and sizes, but those that are less than five millimeters in length (or about the size of a sesame seed) are called "microplastics." Microplastics are tiny plastic particles, less than 5 mm (0.2 inch) in length, that occur in the environment as a consequence of plastic pollution. The term 'microplastics' was introduced in the mid-2000s. Microplastics are present in a variety of products, from cosmetics to synthetic clothing to plastic bags and bottles. The term microplastics is used to differentiate microplastics from larger plastic waste, such as plastic bottles. Microplastics and Nano plastics are tiny plastic particles that may end up in the environment. Microplastics are microscopic in size: 50 µm - 5 mm (0.05-5mm). Nano plastics are 1,000 times smaller than an algal cell. The tiny pieces of mostly invisible plastic have already been found almost everywhere else on Earth, from the deepest oceans to the highest mountains as well as in the air, soil and food chain. Half of the blood samples showed traces of PET plastic, widely used to make drink bottles, while more than a third had polystyrene, used for disposable food containers and many other products. "The study said the microplastics could have entered the body by many routes: via air, water or food, but also in products such as particular toothpastes, lip glosses and tattoo ink. "It is scientifically plausible that plastic particles may be transported to organs via the bloodstream," the study added. Mr. Vethaak also said there could be other kinds of microplastics in blood his study did not pick up — for example, it could not detect particles larger than the diameter of the needle used to take the sample.

Figure-6: Microplastics found in sea food and drinking water.

The study was funded by the Netherlands Organization for Health Research and Development as well as Common Seas, a UK-based group aimed at reducing plastic Pollution. Alice Horton, anthropogenic contaminants scientist at Britain's National Oceanography Centre, said the study "unequivocally" proved there was microplastics in blood. Every year, several million tons of plastic litter course through rivers and out to the oceans, where they are gradually broken down into smaller fragments through the motion of waves and the ultraviolet light of the sun. Marine organisms such as fish, crabs and prawns consume these microplastics by misidentification as food. Humans consume this seafood which leads to several health complications. Microplastics are tiny plastic particles that can end up in the environment and the human body. It is not yet clear how harmful microplastic particles are to human health, but researchers from Wageningen University & Research calculated that we ingest about 0.0041 mg microplastics particles a week (less than a grain of salt) and 12.3 mg in a lifetime. Their new calculation method means a big step forward in predicting the health risks of microplastics and the corresponding uncertainties. Microplastics are found in all kinds of products, such as clothing and cosmetics, or are created when plastic breaks or shreds. Because the environment barely breaks down plastic particles, they often last and may end up in our drinking water and food among other things. People are exposed to microplastics throughout their lives. Microplastic particles in the environment and in our food and drinking water are extremely diverse and complex. This makes it difficult to determine the risks to humans and the environment. Researchers of Wageningen University & Research now provide the first mathematical framework to assess the risks of these particles. Worldwide, microplastic debris has been found in the oceans, soils, surface waters and in our food. Emissions are expected to increase by orders of magnitude in the coming years. Fragmentation leads to smaller and smaller particles, which eventually reach the submicron scale. At these very small dimensions, plastic particles can pose unforeseen risks. They are also so incredibly complex that until now there was no method to determine the risks of these small particles for humans and the environment. **The researchers used a new way to describe the microplastics. "We have not divided the plastics into fixed categories, but have classified them on a continuous scale. Just like temperature is measured in Celsius and not described as hot, warm, lukewarm or cold." This unified approach makes it possible to precisely quantify an uncertainty, that previous models did not include. Another new feature is that the model calculates how many toxic substances you ingest with the plastic. They found that in the most extreme scenario, a person receives up to 20% more lead through microplastics than without. The researchers calculated the consumption of microplastics for both children and adults. They show that the majority of the world population takes in 0.0041 mg of microplastics per week, based on 20% of an average human diet. For a small minority of 1 in 20 people, this can be as high as 676 mg of microplastics per week, depending on eating habits and concentrations of microplastics found in food products. The study predicts that the accumulated amount of microplastics an average human consumes over a lifetime is 12.3 mg. A small fraction (41 ng) of this is absorbed in the body.**

Health risks: There is a loud call in the scientific community to improve the quality of research into microplastics and the even smaller Nano plastics. Also concerns in society are high. "There is still a lot unclear about the risks of microplastics to human health," says Professor Bart Koelmans and leader of the Wageningen research team. "With this model, we are breaking new grounds. We are showing for the first time that it is possible to describe the exposure to the plastic particles, their build-up in the body and the toxic substances. With all the information about the source, plastic diversity, kinetics, and chemical properties in place. Most importantly, we also quantify the uncertainty of the model. We are in the process of further refining the model to also describe, for example, the distribution of microplastics between organs, and to cover the full diet. With this, we are taking a big step towards predicting health risks".



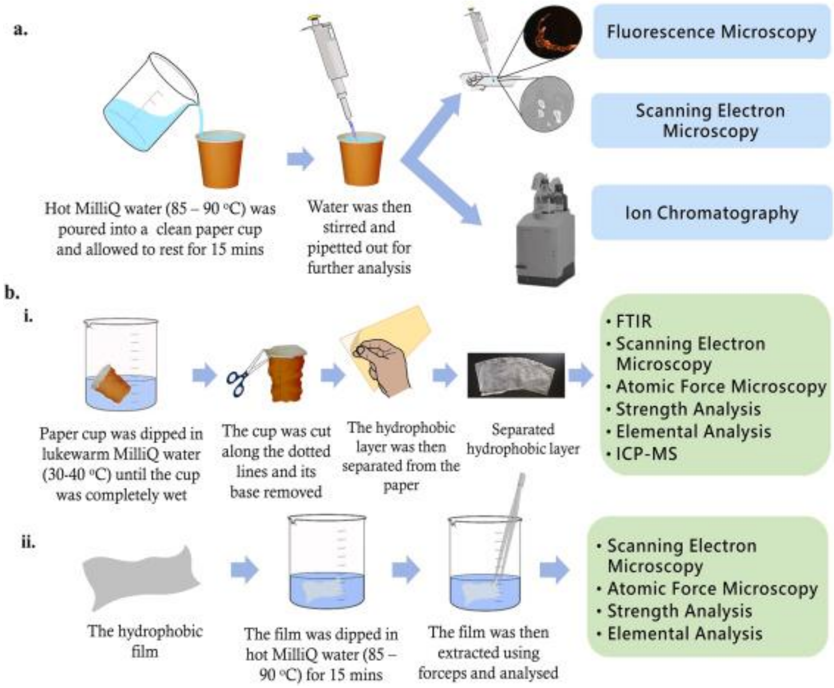


Figure-7: Microplastic source.

A person drinking three cups of tea in disposable paper cups will end up ingesting 75,000 tiny microplastic particles. Disposable paper cups are not safe for drinking tea and a person drinking three cups of tea in them will end up ingesting 75,000 tiny microplastic particles, a study by the Indian Institute of Technology (IIT) Kharagpur, has found. According to Sudha Goel, Associate Professor at IIT Kharagpur, who led the research, disposable paper cups are a popular choice for consuming beverages. Research has confirmed contamination of the hot liquid served in paper cups due to the degradation of microplastics and other hazardous components from the lining material of the cup. Paper cups are usually lined by a thin layer of hydrophobic film which is made of mostly plastic (polyethylene) and sometimes co-polymers to hold the liquid in the paper cup. Within 15 minutes this microplastic layer degrades as a reaction to hot water, according to the study, 25,000 micron-sized (10 µm to 1000 µm) microplastic particles are released into 100 mL of hot liquid (85 — 90 degrees C) residing in the paper cups for 15 minutes. Thus, an average person drinking 3 regular cups of tea or coffee daily, in a paper cup, would be ingesting 75,000 tiny microplastic particles which are invisible to the human eye. The researchers followed two different procedures - in the first process, hot ultrapure (MilliQ) water (85—90ºC) was poured into the disposable paper cups, and it was allowed to sit for 15 minutes. Ms. Goel, explained that the homogeneously mixed water was then analyzed for the presence of microplastics as well as additional ions that may have leached into the liquid from the paper cups. In the second process, paper cups were initially dipped in lukewarm (30—40 degrees C) MilliQ water. "Thereafter the hydrophobic film was carefully separated from the paper layer and exposed to hot MilliQ water (85—90ºCelsius) for 15 minutes. Changes in the physical, chemical and mechanical properties of the plastic films were examined before and after exposure to hot water." "These microplastics can act as carriers for contaminants like ions, toxic heavy metals such as Palladium, Chromium, and Cadmium, and organic compounds that are similarly hydrophobic in nature thus allowing them to conveniently cross over to the animal kingdom. When ingested, the health implications could be serious,”. So far, studies comparing the exposure and effects of microplastic particles have compared apples and oranges. This is because two microplastic particles are never the same, and the methods used to measure exposure and effects are all different. They use different types of microplastics, all of which are very different from the mixtures we are exposed to. An important element of the new approach is that microplastics should no longer be regarded as a material that can be characterized as separate categories of sizes, shapes or polymers. This is the traditional approach, but it takes too many parameters: dozens of polymers, about ten shape categories and also the use of ten size categories is the rule rather than the exception. Such categories are also imprecise because they lump everything together per category. Bart Koelmans: “Instead, we describe microplastics as a continuum of properties. If the particles occur in large numbers, and they do, those properties are best described with mathematical distributions and if you know the distributions, you can align all kinds of data between studies, which is a huge improvement”. So far there are only two studies that calculated how much microplastic people have been exposed to. But these studies did not yet give a complete picture of the actual number of particles that the body absorbs. “For example, they looked at part of our diet and didn't calculate how much of the smallest particles the body absorbs,” says PhD candidate and first author Nur Hazimah Mohamed Nor. “Our new model does all of this. It can look at the entire diet and can intelligently estimate the missing data.

Risk assessment of microplastic: The problem of plastic pollution is high on the agenda of policymakers and the public, and society demands an assessment of the risks of plastic debris to people and the environment. Quantitative methods such as these are expected to be of great help in informing the public about where and when risks from microplastics will arise. As long as analytical methods to detect plastic particles and methods to assess impacts are all different and still under construction, the new method provides a valuable tool to assess the risk of this new contamination. Until now, the method has been used by the authors’ team to assess risks for surface water and freshwater sediments on a global scale, with a risk for a few percent of the locations worldwide. In California, the new methods have recently been applied to derive standards for microplastics in the marine environment and in drinking water in a regulatory setting. Results are expected early 2022.At Wageningen University & Research, several new projects aim to further develop tools for the risk assessment of nano- and microplastic, further emphasizing risks for human health.

CONCLUSION

Plastics are extensively used in our daily life. However, a significant amount of plastic waste is discharged to the environment directly or via improper reuse or recycling. Degradation of plastic waste generates micro- or nano-sized plastic particles that are defined as micro- or nanoplastics (MNPs). Microplastics (MPs) are plastic particles with a diameter less than 5 mm, while nanoplastics (NPs) range in diameter from 1 to 100 or 1000 nm. In the current review, we first briefly summarized the environmental contamination of MNPs and then discussed their health impacts based on existing MNP research. Our review indicates that MNPs can be detected in both marine and terrestrial ecosystems worldwide and be ingested and accumulated by animals along the food chain. Evidence has suggested the harmful health impacts of MNPs on marine and freshwater animals. Recent studies found MPs in human stool samples, suggesting that humans are exposed to MPs through food and/or drinking water. However, the effect of MNPs on human health is scarcely researched. In addition to the MNPs themselves, these tiny plastic particles can release plastic additives and/or adsorb other environmental chemicals, many of which have been shown to exhibit endocrine disrupting and other toxic effects. In summary, we conclude that more studies are necessary to provide a comprehensive understanding of MNP pollution hazards and also provide a basis for the subsequent pollution management and control.

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REFERENCES

1. Rochman, Chelsea M.; Kross, Sara M.; Armstrong, Jonathan B.; Bogan, Michael T.; Darling, Emily S.; Green, Stephanie J.; Smyth, Ashley R.; Veríssimo, Diogo "Scientific Evidence Supports a Ban on Microbeads". Environmental Science & Technology, 2015; 49(18): 10759–61.
2. Katsnelson, Alla "News Feature: Microplastics present pollution puzzle". Proceedings of the

National Academy of Sciences, 2015; 112(18): 5547–49.
3. Napper, Imogen E.; Thompson, Richard C. "Release of synthetic microplastic plastic fibres from domestic washing machines: Effects of fabric type and washing conditions". Marine Pollution Bulletin, 2016; 112(1–2): 39–45.
4. Dris, Rachid; Gasperi, Johnny; Mirande, Cécile; Mandin, Corinne; Guerrouache, Mohamed; Langlois, Valérie; Tassin, Bruno "A first overview of textile fibers, including microplastics, in indoor and outdoor environments" (PDF). Environmental Pollution (Submitted manuscript), 2017; 221: 453–8.
5. Pruter, A.T. "Sources, quantities and distribution of persistent plastics in the marine environment". Marine Pollution Bulletin, 1987; 18(6): 305–310.
6. Tanaka, Kosuke; Takada, Hideshige; Yamashita, Rei; Mizukawa, Kaoruko; Fukuwaka, Masa-aki; Watanuki, Yutaka "Accumulation of plastic-derived chemicals in tissues of seabirds ingesting marine plastics". Marine Pollution Bulletin, 2013; 69(1–2): 219–22.
7. Derraik, José G.B. "The pollution of the marine environment by plastic debris: a review". Marine Pollution Bulletin, 2002; 44(99): 842–52.
8. Derraik, José G.B. "The pollution of the marine environment by plastic debris: A review". Marine Pollution Bulletin, 2002; 44(9): 842–52.
9. Teuten, E. L.; Saquing, J. M.; Knappe, D. R. U.; Barlaz, M. A.; Jonsson, S.; Bjorn, A.; Rowland, S. J.; Thompson, R. C.; Galloway, T. S.; Yamashita, R.; Ochi, D.; Watanuki, Y.; Moore, C.; Viet, P. H.; Tana, T. S.; Prudente, M.; Boonyatumanond, R.; Zakaria, M. P.; Akkhavong, K.; Ogata, Y.; Hirai, H.; Iwasa, S.; Mizukawa, K.; Hagino, Y.; Imamura, A.; Saha, M.; Takada, H. "Transport and release of chemicals from plastics to the environment and to wildlife". Philosophical Transactions of the Royal Society B: Biological Sciences, 2009; 364(1526): 2027–45.
10. Thompson, R. C.; Moore, C. J.; Vom Saal, F. S.; Swan, S. H. "Plastics, the environment and human health: Current consensus and future trends". Philosophical Transactions of the Royal Society B: Biological Sciences, 2009; 364(1526): 2153–66.
11. Li, Dunzhu; Shi, Yunhong; Yang, Luming; Xiao, Liwen; Kehoe, Daniel K.; Gun'ko, Yurii K.; Boland, John J.; Wang, Jing Jing "Microplastic release from the degradation of polypropylene feeding bottles during infant formula preparation". Nature Food, 2020; 1(11): 746–54.
12. Helcoski, Ryan; Yonkos, Lance T.; Sanchez, Alterra; Baldwin, Andrew H. "Wetland soil microplastics are negatively related to vegetation cover and stem density". Environmental Pollution, 2020; 256: 113391.
13. Eerkes-Medrano, D.; Thompson, R.C.; Aldridge, D.C. "Microplastics in freshwater systems: A review of the emerging threats, identification of knowledge gaps and prioritisation of research needs". Water Research, 2015; 75: 63–82. doi:10.1016/j.watres.2015.02.012. PMID 25746963.
14. Baldwin, Austin K.; Corsi, Steven R.; Mason, Sherri A. "Plastic Debris in 29 Great Lakes Tributaries: Relations to Watershed Attributes and Hydrology". Environmental Science & Technology, 2016; 50(19): 10377–85. Bibcode:2016EnST...5010377B. doi:10.1021/acs.est.6b02917. PMID 27627676.
15. Watts, Andrew J. R.; Lewis, Ceri; Goodhead, Rhys M.; Beckett, Stephen J.; Moger, Julian; Tyler, Charles R.; Galloway, Tamara S. "Uptake and Retention of Microplastics by the Shore Crab Carcinus maenas". Environmental Science & Technology, 2014; 48(15): 8823–30.
16. Thompson, R. C.; Olsen, Y.; Mitchell, R. P.; Davis, A.; Rowland, S. J.; John, A. W.; McGonigle, D.; Russell, A. E. "Lost at Sea: Where is All the Plastic?". Science, 2004; 304(5672): 838.
17. Li, Bowen; Liang, Weiwenhui; Liu, Quan-Xing; Fu, Shijian; Ma, Cuizhu; Chen, Qiqing; Su, Lei; Craig, Nicholas J.; Shi, Huahong "Fish Ingest Microplastics Unintentionally". Environmental Science & Technology, 2021; 55(15): 10471–10479.
18. Reichert, Jessica; Schellenberg, Johannes; Schubert, Patrick; Wilke, Thomas "Responses of reef building corals to microplastic exposure". Environmental Pollution, 2018; 237: 955–960.