
POISON PLASTICS

How Chemicals in Everyday Plastics
Are Harming Your Health



Paul Angell
Foundation



Protecting People and Planet



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Introduction

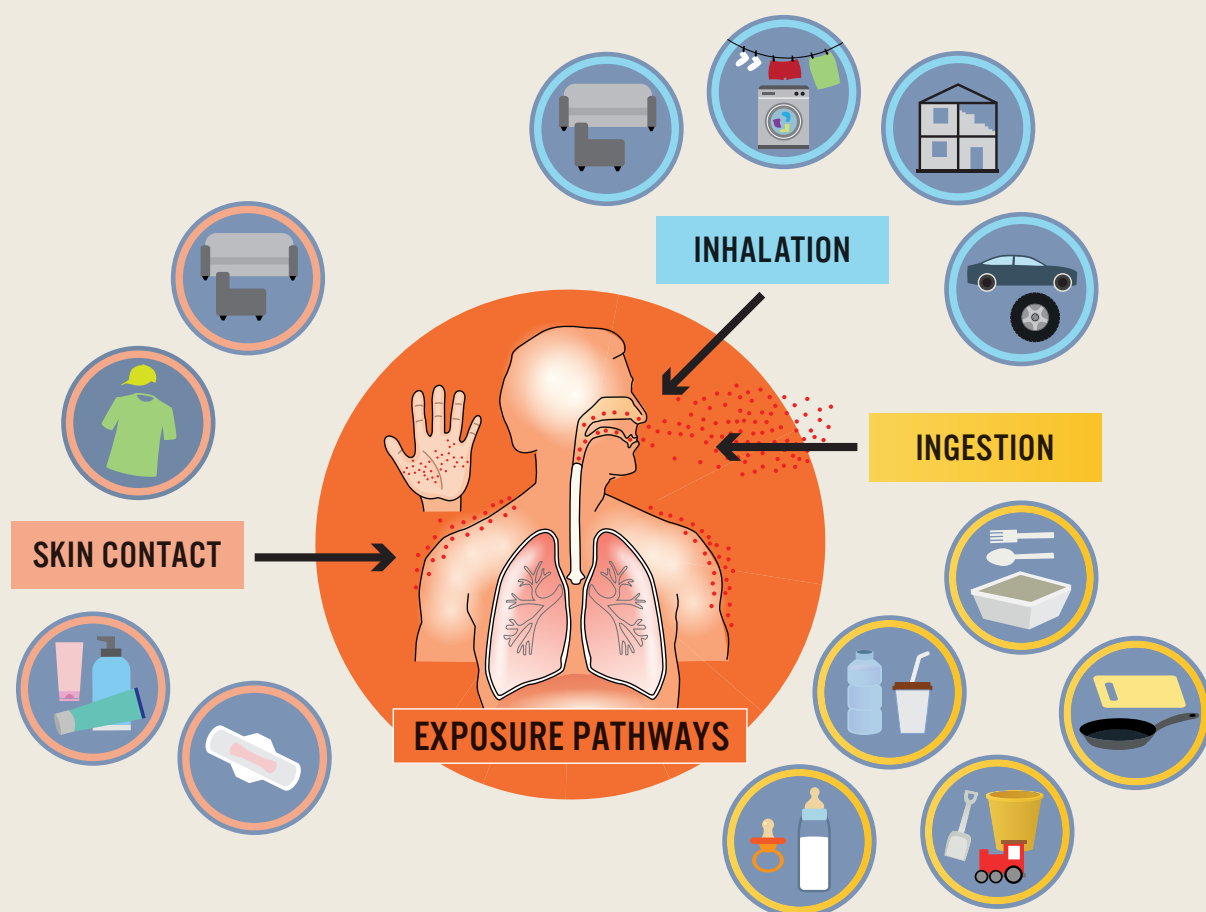
- We are facing an urgent plastics crisis. Plastics are choking our oceans, infiltrating our ecosystems and fuelling global climate breakdown. Plastics and the chemicals they contain have become deeply embedded in our lives within only a single generation. They are found in the vast majority of items we rely on every day – from food packaging and takeaway containers, to clothing, furniture, hygiene products, infant feeding bottles and children's toys.
- While global plastic production was under two million tonnes in 1950, today more than 430 million tonnes of plastics are produced annually.¹ Global plastic production has been projected to more than double by 2050 and more than triple by 2100,² and it has been estimated that we will have produced two billion tonnes of chemical plastic additives by the end of 2050.³
- Three-quarters of all plastic produced between 1950 and 2017 became plastic waste. Only 9% of the world's plastic waste is recycled – around half is sent to landfill, 19% is incinerated and the remaining 22% is either burnt, dumped or ends up in the natural environment.⁴ More than 50 million tonnes of plastic waste are projected to enter aquatic ecosystems each year by 2030.⁵
- The plastics industry is the fastest growing source of industrial greenhouse gas (GHG) emissions⁶ – currently accounting for 4-5% of global emissions⁷ – around 90% of which occur during the process of extracting and converting fossil fuels into plastics.⁸ Annual GHG emissions from the global plastic system are forecast to triple by 2050⁹, consuming nearly a third of the global carbon budget for limiting warming to 1.5°C.¹⁰ If the global plastic system were a country, it would be the third-largest greenhouse gas emitter in the world by 2040, behind only China and the United States.¹¹
- All plastics are made of chemicals. This includes their polymer backbone, intentionally added substances such as additives and processing aids, and non-intentionally added substances such as impurities, by-products and degradation products.¹² Examples of chemical additives include plasticisers, stabilisers, lubricants, colourants, flame retardants, anti-static agents and fillers among others.¹³ Additives provide functionality for many different uses while significantly contributing to the hazards of plastics.
- Alongside their rapidly mounting environmental impacts, plastics represent a direct and escalating threat to human health. Thousands of chemicals are present or marketed for use in plastics, and many have been shown to migrate from plastic products into surrounding environments, including the human body.¹⁴ Plastic chemicals have been linked to acute and/or chronic health conditions, including hormone disruption, damage to vital organs, impairment of fertility and neurodevelopment, and increased risk of cancer and heart disease.¹⁵ Vulnerable groups – in particular infants, children and pregnant people – face heightened risks. Plastic-associated exposures have been linked to severe reproductive impacts such as stillbirth and premature birth, while early-life exposures can have lasting developmental effects and increase the risk of non-communicable diseases later in life.¹⁶
- While research has already revealed serious risks to human health and development, major data gaps still remain for thousands of plastic-associated chemicals in common use. The PlastChem project – which synthesised evidence on more than 16,000 chemicals present or marketed for use in plastics – identified more than 4,200 plastic chemicals as hazardous for human health and/or the environment.¹⁷ Concerningly, the analysis found that hazard information is lacking for over 10,000 plastic chemicals, while less than 6% of chemicals potentially used or present in plastics are currently subject to international regulation.¹⁸ Many more plastic chemicals likely exist, particularly non-intentionally added substances, the majority of which are unknown and untested.¹⁹ In other words, there are likely tens of thousands of chemicals present in plastics worldwide – many in daily use – that may have severe but as yet unknown implications for human health.²⁰
- In the context of ongoing negotiations for a Global Plastics Treaty, the Environmental Justice Foundation (EJF) conducted novel analyses of the PlastChem data to shed light on the risks presented to human health by everyday items containing plastic-associated chemicals.²¹ Our analysis focused on the following use categories: (i) food-contact plastics, (ii) textiles, (iii) toys, (iv) household items, and (v) hygiene and medical items. A semi-structured questionnaire was used to gather insights from scientists who in recent years have published research on the impacts of plastics on human health in peer-reviewed journals. This report presents the findings of our analysis, which reveals both significant health risks and severe deficits in available hazard data for many chemicals found in everyday plastic items. Our findings highlight the urgent need to reduce plastic production and consumption and to eliminate hazardous chemicals across the plastics life cycle to safeguard global health.

The toxic chemistry of plastics

Human exposure to plastic chemicals

- Plastics carry both intentionally added and non-intentionally added chemicals.²² These tend not to be chemically bonded to plastics, and may therefore leach (migrate) directly from plastic products and materials into food, water, soil, the air, and living organisms, including the human body.²³ Leaching can occur from both primary plastic products and secondary micro- and nanoplastics that are released from the breakdown of larger plastics. Plastic chemicals can enter the body via ingestion, inhalation or other types of exposure or contact, such as through the skin.²⁴
- Ingestion often occurs via food-contact materials. Plastic-associated chemicals can leach from plastic bottles and containers, takeaway cups, fast food packaging, kitchen utensils, and cookware among other items.²⁵ They can also be ingested via non-food sources, such as toothpaste.²⁶ Babies and young children are particularly prone to ingesting plastic chemicals, from items such as infant feeding bottles²⁷ and pacifiers²⁸, and through unique behaviours such as mouthing of plastic toys²⁹.
- Inhalation is also an important exposure pathway, both in indoor and outdoor environments.³⁰ Chemicals can be inhaled through airborne microplastics from a range of sources, including the erosion of vehicle tyres, the washing, drying and general wear and tear of synthetic clothing, the deterioration of house furniture, as well as from landfills and construction materials.³¹ Car cabins contain high concentrations of plastic chemicals due to their interiors being made primarily of plastics and synthetic textiles.³²
- Skin contact is another type of exposure, as chemicals are capable of penetrating the skin barrier.³³ Sources include synthetic textiles and microfibres,³⁴ cosmetics,³⁵ and hygiene products among others.³⁶

Figure 1: Pathways of human exposure to plastic chemicals





Exposure to plastic chemicals during childhood is especially concerning due to the extreme sensitivity of early childhood development.
Credit: iStock.com/Olga Yastremska

Thousands of plastic chemicals are harming our health

- Exposure to chemicals used in the production of plastics has been linked to a range of adverse and often lifelong health impacts. These include but are not limited to infertility, neurodevelopmental disorders, cardiovascular disease and stroke, obesity and diabetes, renal disease, and cancers.³⁷ Many plastic chemicals are known to be endocrine disruptors, meaning that they interfere with the body's hormones.³⁸ They have been found to affect the reproductive system in both men and women, lowering sperm quality and increasing the risk of developing conditions such as endometriosis and polycystic ovarian syndrome (PMOS).³⁹
- Exposure during pregnancy or childhood is especially concerning due to the extreme sensitivity of fetal and early childhood development. Children's immature organs and tissues are less able to break down and excrete toxins, allowing these to accumulate in the body and cause harm.⁴⁰ Studies have identified links between plastic-associated chemicals and increased risks of miscarriage, premature birth, stillbirth, low birth weight, birth defects, impaired lung growth, lower IQ, increased prevalence of child autism and attention-deficit/hyperactivity disorder (ADHD), asthma and childhood cancer.⁴¹
- EJC summarised the status of available scientific information on the hazard level of priority plastic chemical groups of concern in terms of their potential for adverse health impacts. The proportion of chemicals classified as hazardous was assessed based on values in the PlastChem database for carcinogenicity, germ (reproductive) cell mutagenicity, reproductive toxicity, specific target organ toxicity and endocrine disruption (**Figure 2**). The findings were especially concerning given the widespread use of these chemicals in key categories of everyday plastic items – particularly food-contact plastics, textiles, toys and other household items (**Figure 3**). Widely used plasticisers such as alkylphenols and phthalates were found to be present in all categories of item reviewed, and include chemicals that have been assessed as hazardous to human health across at least four toxicity categories.

Figure 2: Hazard status of selected chemical groups in terms of their potential for adverse health impacts.

Proportion of hazardous chemicals was assessed based on values in the PlastChem database for carcinogenicity, germ cell mutagenicity, reproductive toxicity, specific target organ toxicity (STOT) and endocrine disruption.

Top 15 plastic chemical groups of concern	Proportion of hazardous chemicals				
	Carcinogenicity	Germ cell mutagenicity	Reproductive toxicity	Specific target organ toxicity (STOT)	Endocrine disrupting chemicals (EDC)
Aromatic amines	100%	100%	100%	100%	N/A
Aralkyl aldehydes	N/A	0%	100%	100%	N/A
Alkylphenols	50%	67%	92%	100%	100%
Salicylate esters	N/A	0%	100%	100%	N/A
Aromatic ethers	N/A	100%	100%	100%	N/A
Bisphenols	80%	100%	100%	100%	100%
Phthalates	83%	N/A	100%	100%	100%
Benzothiazoles	67%	0%	40%	60%	N/A
Benzotriazoles	100%	0%	100%	100%	N/A
Organometallics	88%	94%	99%	100%	N/A
Parabens	N/A	0%	0%	100%	100%
Azo dyes	87%	96%	83%	93%	N/A
Aceto- and benzophenones	67%	50%	80%	100%	N/A
Chlorinated paraffins	100%	0%	50%	67%	N/A
Per- and polyfluoroalkyl substances	88%	13%	91%	94%	N/A

Source: EJF analysis based on data in the PlastChem database. Percentages represent the proportion of chemicals classified as hazardous out of chemicals that have been assessed and resulted in a conclusive (hazardous vs non-hazardous) finding. Chemicals that are yet to be assessed, are currently under review, or where the findings of the hazard assessment are inconclusive were excluded from the analysis. N/A means no data available or no chemical in the group has a conclusive result. Hazardous thresholds: carcinogenic and mutagenic score ≥ 0.5 (Category 1A/1B, Category 2 or recognised but without a level); reproductive toxicity ≥ 1 (Category 1A/1B or Category 2); STOT = 2 (Category 1); EDC = 2 (Category 1). For the EDC group, no priority-group chemical has a conclusive score of 0 (non-hazardous). Therefore every value is 100% (hazardous) or N/A (no data/conclusive assessment). Note that many groups have very few assessed chemicals so these figures should be interpreted with caution.

Drinking water has been identified as a concerning source of human exposure to toxic plastic chemicals. Regardless of type, source and commercial brand, bottled water has been found to be contaminated with hundreds to thousands of microplastics per litre.⁴⁸



Workers examining bottled water on the production line of a Chinese factory.
Credit: iStock.com/Edwin Tan

Figure 3: Presence of chemical groups of concern in everyday plastic items

Top 15 plastic chemical groups of concern	Food-contact plastics	Textiles	Toys	Household items	Hygiene and medical items
Aromatic amines	PRESENT	PRESENT	PRESENT	PRESENT	
Aralkyl aldehydes		PRESENT		PRESENT	
Alkylphenols	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT
Salicylate esters	PRESENT	PRESENT	PRESENT	PRESENT	
Aromatic ethers		PRESENT	PRESENT	PRESENT	
Bisphenols	PRESENT	PRESENT	PRESENT	PRESENT	
Phthalates	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT
Benzothiazoles	PRESENT	PRESENT		PRESENT	
Benzotriazoles	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT
Organometallics	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT
Parabens	PRESENT				
Azo dyes	PRESENT	PRESENT	PRESENT	PRESENT	
Aceto/benzophenones	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT
Chlorinated paraffins	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT
Per- and polyfluoroalkyl substances	PRESENT	PRESENT	PRESENT	PRESENT	PRESENT

Source: EJF analysis based on data in the PlastChem database. See **Methodology** in **Appendix** of the full report⁴² for further details.

Everyday plastics: convenient or contaminating?

- EJF's analysis reveals both significant health risks and severe deficits in available hazard data for many chemicals found in everyday plastic items. Plastic products that have been marketed as convenient, durable and safe can contain a number of chemicals known or suspected to cause cancer, damage vital organs, disrupt hormones, impair fertility and development, and contribute to chronic disease. Evidence shows that many of these chemicals can be released from plastics during use, following which they can enter the body and exert toxic effects.
- The PlastChem database contains a total of 3,552 plastic chemicals categorised as used in the five analysed industrial sectors: food-contact plastics, textiles, toys, household items, and hygiene and medical items.⁴³ The majority of chemicals (79.2%) in the five use categories analysed lacked relevant data to assess human health toxicity, risk of exposure, or both (**Figure 4 - A**).
- Alarmingly, where this information was available, 92.8% of chemicals assessed were identified by EJF as presenting a high risk to human health based on their toxicity (carcinogenicity, mutagenicity, reproductive toxicity, organ toxicity, or endocrine-disrupting properties) and risk of exposure (presence in or evidenced release from plastics) (**Figure 4 - B**).

Experts consulted by EJF repeatedly identified food-contact materials as the most concerning and high-priority category for human exposure to plastic chemicals.

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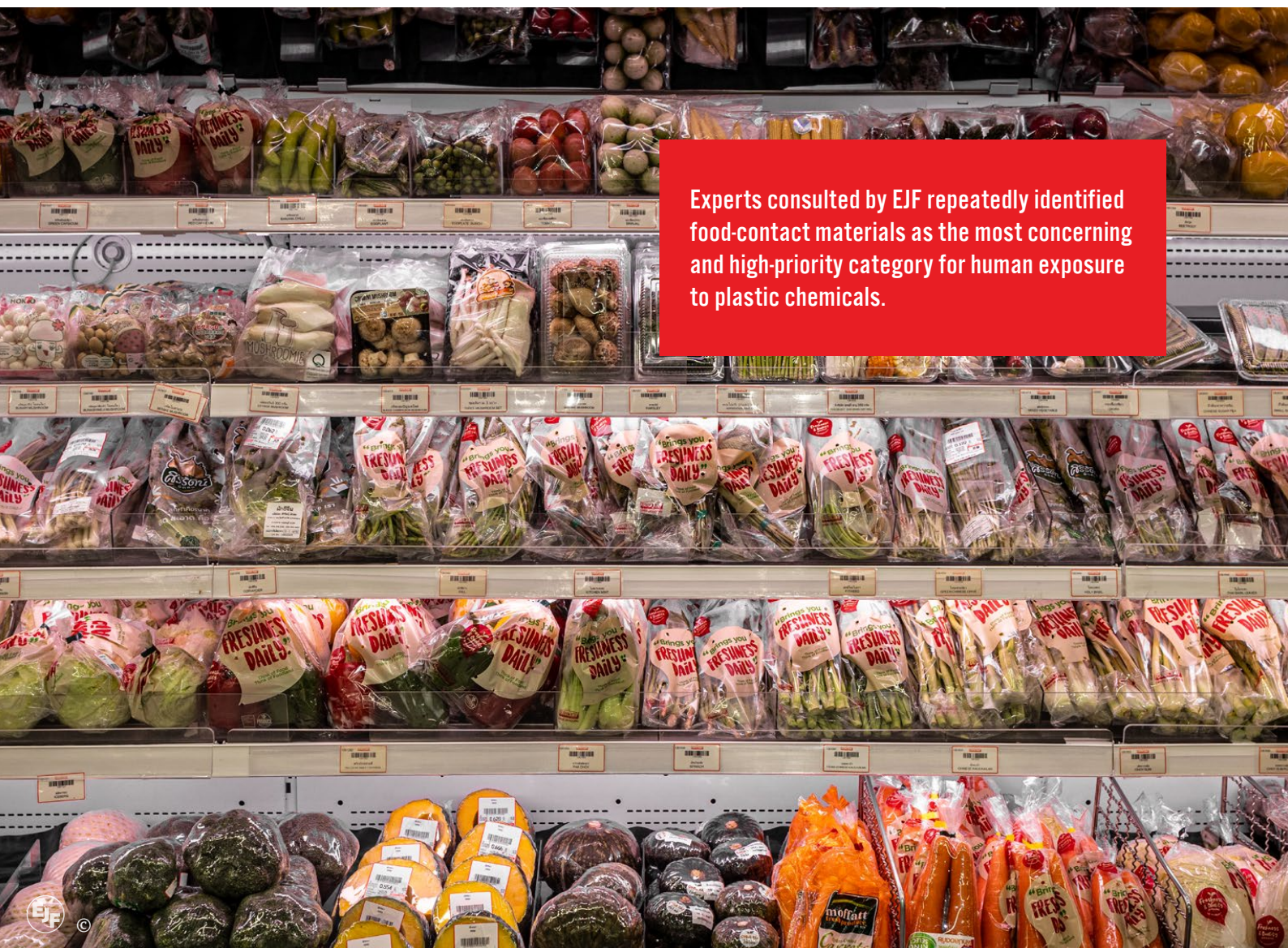
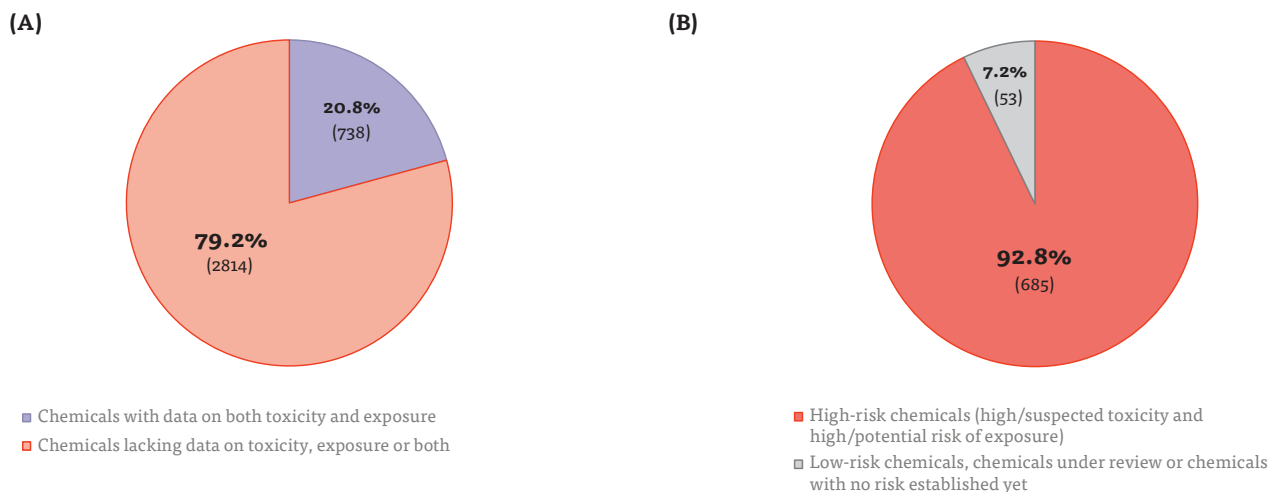


Figure 4: (A) Proportion of chemicals in examined use categories for which data are lacking on toxicity, exposure or both (B) Overall human health risk of plastic chemicals in examined use categories

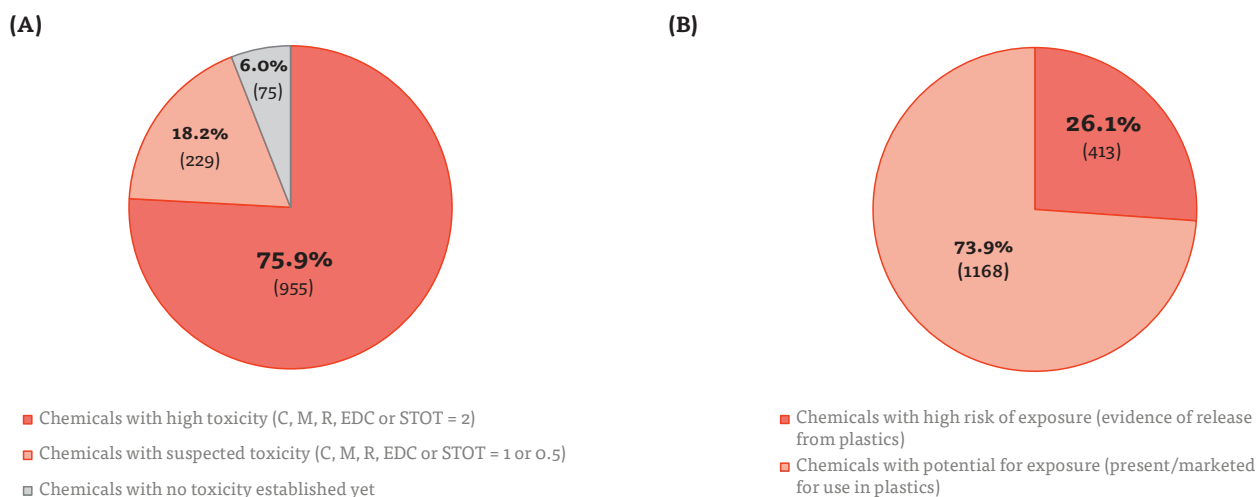


Source: EJV analysis of PlastChem data.

Note: Values are expressed as a proportion of the total number of chemicals with data on toxicity and exposure (B)

- Of those chemicals with information on toxicity, the vast majority (94.0%) have evidence of either high or suspected toxic health effects: 75.9% are considered highly toxic and 18.2% are suspected of being toxic to human health (**Figure 5 - A**).
- Of those chemicals with information on exposure, over a quarter (26.1%) are associated with a high risk of exposure (evidence of release from plastics during use), while 73.9% have a potential for exposure (present or marketed for use in plastics) (**Figure 5 - B**).

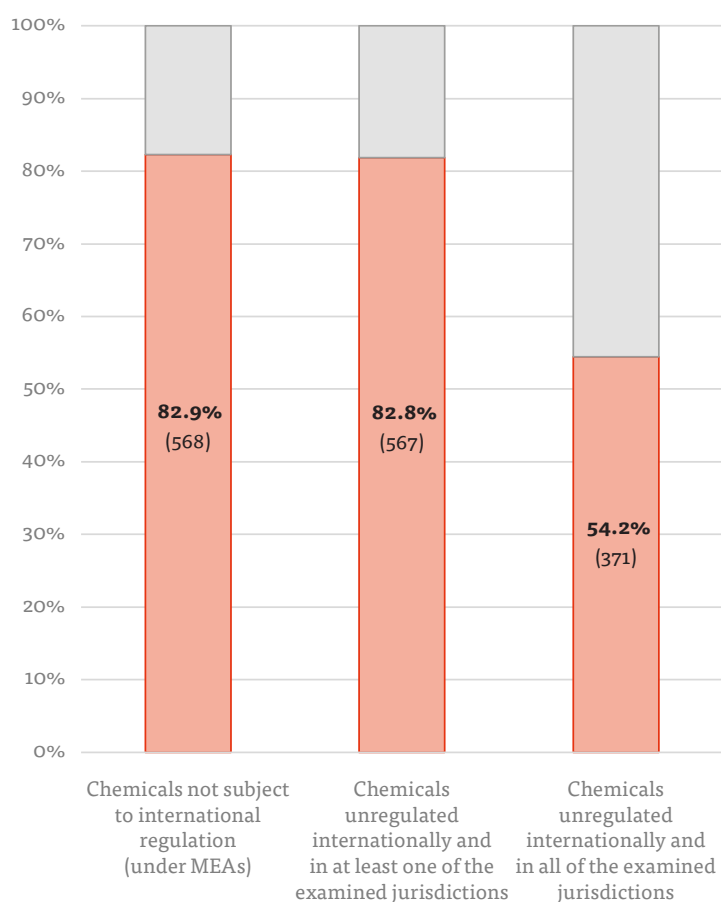
Figure 5: (A) Human health toxicity of plastic chemicals in examined use categories (B) Human exposure to plastic chemicals in examined use categories



Source: EJV analysis of PlastChem data. Note: Values are expressed as a proportion of the total number of chemicals with data on toxicity (A) and exposure (B). With regard to (A), the suspected toxicity group may include some high toxicity chemicals if the level was not specified in the PlastChem database – see **Methodology** in the full report⁴⁴ for further information.

- The implications are stark: we are facing a plastic-related health crisis. Experts consulted by EJF expressed strong concerns about all of the here examined everyday plastic uses and warned that these represent key sources of universal human exposure to toxic plastic chemicals. They expressed particular concern about food-contact plastics, toys, and hygiene and medical items, due to risks of direct ingestion and internal exposure. Experts also noted that, while this issue categorically affects us all, vulnerable groups such as infants, children, pregnant people, elderly people, and those with pre-existing conditions are likely to be especially susceptible to the adverse health effects of plastic chemicals.
- As scientific evidence continues to build, a precautionary approach to regulating the use of plastic chemicals must be followed to guard against the threat of significant harm to human health. EJF's analysis, however, revealed the sheer inadequacy of current regulation, which fails to address health risks even where these are well established. Of the high risk chemicals identified, 82.9% are not subject to regulation under any relevant multilateral environmental agreement (MEA), i.e. the Stockholm Convention, the Basel Convention, the Minamata Convention, the Montreal Protocol or the Rotterdam Convention. Crucially, 54.2% of the chemicals identified by EJF as presenting a high risk to human health are neither subject to regulation at the international level, nor in any of the four jurisdictions reviewed by PlastChem (the EU, Japan, South Korea and California) (**Figure 6**).

Figure 6: Regulatory status of high risk plastic chemicals in examined use categories



Source: EJF analysis of PlastChem data

Key findings by use:

Proportion of plastic chemicals used in everyday items that present a high risk to human health



FOOD-CONTACT PLASTICS

- **91.6%** of chemicals **present a high risk to human health***
- **90.6%** of high risk chemicals are **unregulated internationally**
- **76.4%** of chemicals **do not have available data** on toxicity and/or exposure



TOYS

- **88.9%** of chemicals **present a high risk to human health***
- **84.7%** of high risk chemicals are **unregulated internationally**
- **53.4%** of chemicals **do not have available data** on toxicity and/or exposure



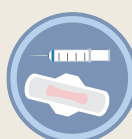
TEXTILES

- **92.8%** of chemicals **present a high risk to human health***
- **81.5%** of high risk chemicals are **unregulated internationally**
- **75.3%** of chemicals **do not have available data** on toxicity and/or exposure



HOUSEHOLD ITEMS

- **92.4%** of chemicals **present a high risk to human health***
- **85.0%** of high risk chemicals are **unregulated internationally**
- **65.7%** of chemicals **do not have available data** on toxicity and/or exposure



HYGIENE AND MEDICAL ITEMS

- **92.6%** of chemicals **present a high risk to human health***
- **92.0%** of high risk chemicals are **unregulated internationally**
- **50.6%** of chemicals **do not have available data** on toxicity and/or exposure

Source: EJF analysis of PlastChem data.

* Note: Values are expressed as a proportion of the total number of chemicals with data on toxicity and exposure.

For further details of **Methodology**, see **Appendix** of the full report.⁴⁹

Conclusion

Plastics have become embedded in every aspect of modern life – but at an immense hidden cost. Plastics are not just an environmental issue. They are a direct and escalating threat to human health. The plastics crisis weighs most heavily on vulnerable groups, compounding existing injustices. Without strong, binding global action, plastic production is projected to more than double by 2050, further increasing our exposure to toxic materials and deepening harm.⁴⁵

To protect both people and the planet, governments must act swiftly and decisively to reduce plastic production, eliminate hazardous chemicals across the plastics life cycle, and build toxic-free reuse, refill, repair, and other reduction-enabling systems and practices that allow people to live free from the damaging impacts of plastics. Producers must be held responsible and the burden of proof must be placed onto those who profit from this toxic and polluting industry. The ongoing negotiations to establish an international legally binding instrument to address plastic pollution present an opportunity to accomplish these goals and confront the plastics crisis on a global scale. A strong Global Plastics Treaty must place human health and environmental justice at its heart, ensuring transparency and accountability all the way from production to disposal.

Two women sorting plastic waste in a flooded area of Chattogram, Bangladesh.
Credit: Pexels/mumtahina-tanni

Recommendations

To reduce the human health impacts of plastics and their associated chemicals, EJF urges governments and their representatives to push for a strong Global Plastics Treaty, but not to rely on action at the global stage to initiate and implement solutions. We call on policy-makers to push for national, regional and plurilateral action while continuing to seek progress at the multilateral level. EJF recommends regulation that includes:

1. Binding targets to drastically reduce the production, supply and trade of primary plastic polymers, with clear and enforceable timeframes for implementation. EJF endorses the 40x40 target proposed by Rwanda and Peru to reduce global primary plastic production by 40% by 2040, with a 2025 baseline.
2. Strong provisions to regulate the use of chemicals of concern throughout the life cycle of plastics (as well as other materials), especially during production. These provisions must include mechanisms to prohibit the production, use and trade of hazardous chemicals based on a precautionary approach, with chemicals tested for hazard before market release.

A photograph showing two women in traditional attire sorting through a vast, flooded area covered in discarded plastic bottles. One woman is in the foreground, wearing a red and orange sari, and the other is slightly behind her, wearing a yellow and pink sari. They are both bent over, picking up bottles and placing them into a large, light-colored sack. The ground is a muddy brown, and the air is filled with the sea of green and clear plastic bottles. In the background, a corrugated metal wall is visible.

Alarmingly, where information relevant to assessing both toxicity and exposure risk was available, 92.8% of chemicals assessed by EJF were found to present a high risk to human health.

3. Strong provisions on transparency and traceability of plastics and associated chemicals throughout their life cycle, to fill information gaps on the threats from plastic-associated chemicals, hold chemical and polymer producers accountable and empower regulatory agencies.
4. Strong provisions to prohibit and restrict the production, use, trade, sales and distribution of toxic and inessential plastic products, especially single-use plastics and plastics with high risk of toxicity and exposure.
5. Strong provisions to improve the design of plastic products with the goal of protecting human health.
6. Strong provisions to support the implementation of toxic-free reuse, refill, repair and other reduction-enabling systems in place of toxic single-use systems.
7. Mechanisms for cross-border cooperation, as well as transparency and traceability measures, to ensure restrictions on production and trade can be effectively enforced.
8. The protection of health and human rights as a primary objective and cross-cutting theme throughout. Regulations should aim to tackle the plastics crisis from a One Health perspective, recognising the need for an integrated approach to addressing threats to the biosphere as a whole, including humans, other living organisms, and ecosystems alike.⁴⁶
9. Support for urgent multidisciplinary research and education on the human health and environmental impacts of plastics, in order to fill knowledge gaps and align plastics governance with environmental and public health governance.
10. Support for robust, transparent and up-to-date data on the climate, health and biodiversity impacts of plastic production.

EJF calls on governments to guarantee our 'Right to Reduce', i.e. the right to a clean and healthy environment through reducing plastic production and consumption, replacing single-use plastics with toxic-free reuse, refill, repair and other reduction-enabling systems, and regulating the use of toxic plastic chemicals based on a precautionary approach.⁴⁷

A water refill station installed in Bangkok under EJF's Bottle Free Seas project.





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Front cover photo credit: Alamy/Tim Gainey.
Additional illustration by EJF.

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