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GENERATION PLASTIC

Unpacking the impact of plastic on children

Healthy Environments
for Healthy Children

GENERATION PLASTIC

Unpacking the impact of plastic on children

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Foreword

George Laryea-Adjei
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This week, stakeholders from around the world are convening in Busan, Republic of Korea, to negotiate a historic treaty to end plastic pollution – a crisis that strikes at the heart of our future: our children. Today's children, the so-called 'Generation Plastic', are growing up on a planet overwhelmed by plastic waste and chemical contamination. Yet, the devastating impact of plastics on their health, rights and future opportunities is far too often overlooked.

Plastic pollution is not just about visible waste; it is a silent and insidious health emergency. Children absorb more pollutants relative to their size, are less able to detoxify harmful substances, and carry these impacts throughout their lives. Toxic chemicals in plastic products, pollution from plastic production, and hazardous waste in their communities are robbing children of the opportunity to thrive. In vulnerable communities, the crisis is even more severe, exacerbating inequalities, damaging livelihoods and exposing children to lifelong harm from toxic chemicals and environmental degradation.

Our report highlights five urgent hazards plastics pose to children – from toxic exposures and harmful chemicals in everyday products to flooding and disease caused by plastic waste. These dangers are compounded by fragmented global policies and insufficient research into the long-term effects of plastic exposure on children's health. Without decisive action, plastic production is projected to rise 70 per cent by 2040, and its mismanaged waste will only grow.

But there is hope. Children around the world are not just victims; they are agents of change, demanding stronger regulations and a shift towards circularity. They call on us to advance transparency, invest in safer alternatives and fight for environmental justice for those bearing the greatest burden. General Comment 26 reminds us that every decision we make about the environment must prioritize the best interests of the child.

This is our moment to act boldly. The plastic crisis is not an abstract challenge – it is a direct assault on the rights of every child to grow up in a clean, healthy and sustainable environment. We must seize this opportunity to reimagine the plastic life cycle, commit to systemic transformation, and deliver a future where children are free from the toxic shadow of plastic pollution.

Let Busan be remembered as the turning point where ambition triumphed over inertia. The world is watching, and future generations will hold us accountable. The health and hope of millions of children depend on your courage and commitment. Now is the time to act.

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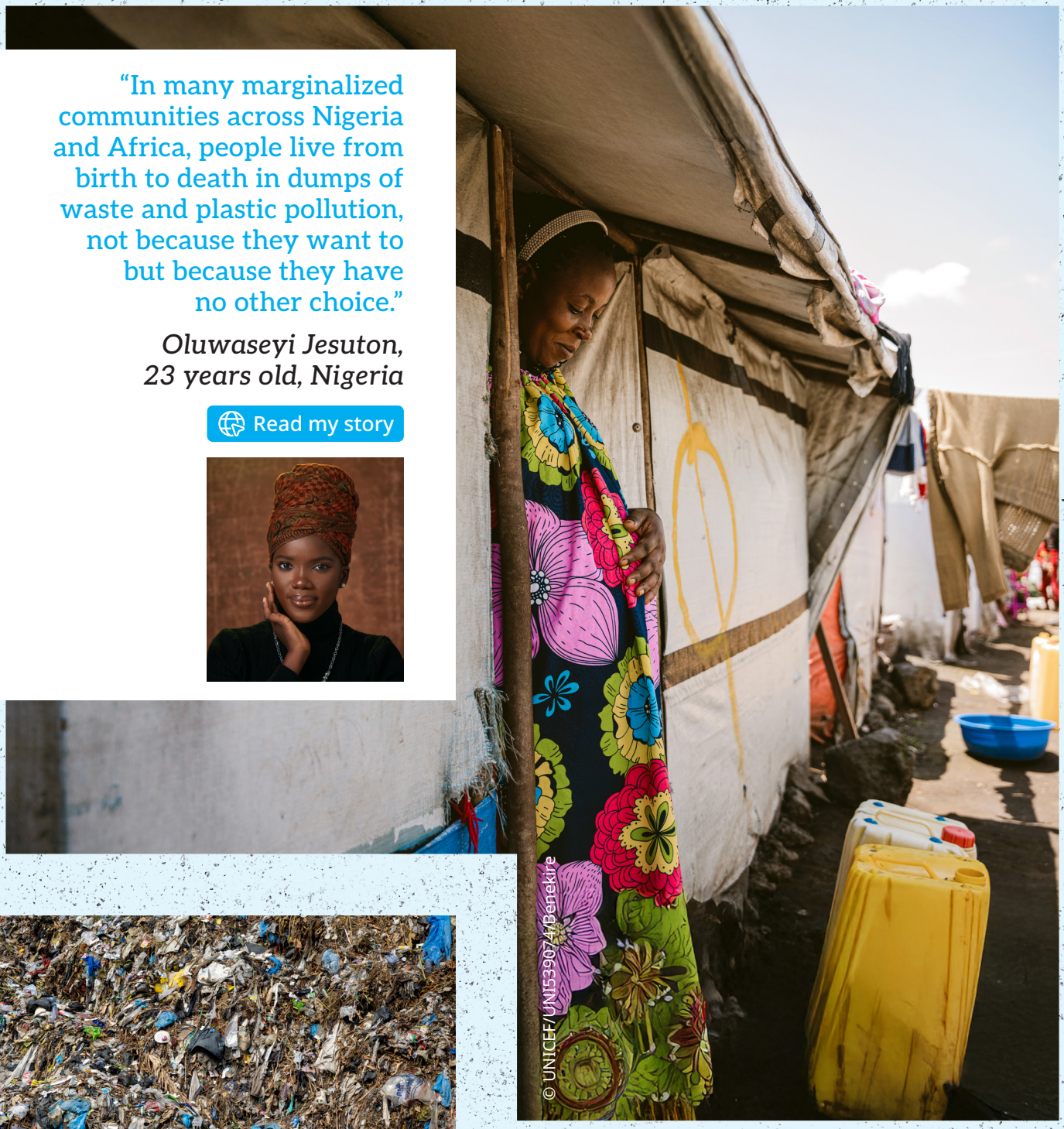
Acronyms

ABS	Acrylonitrile butadiene styrene
ADHD	Attention deficit hyperactivity disorder
ANSES	French Agency for Food, Environmental and Occupational Health and Safety
BBP	Butylbenzyl phthalate
BDE	Brominated diphenyl ether
BPA	Bisphenol A
BPF	Bisphenol F
BPS	Bisphenol S
DBP	Dibutyl phthalate
DEHP	Di-2-ethylhexyl phthalate
DEHT	Bis(2-ethylhexyl) terephthalate
DIBP	Diisobutyl phthalate
DIDP	Diisodecyl phthalate
DINP	Diisononyl phthalate
DnBP	Di-n-butyl phthalate
DNOP	Di-n-octyl phthalate
ECHA	European Chemicals Agency
EEA	European Economic Area
EU	European Union
HBCD	Hexabromocyclododecane
HDPE	High density polyethylene
HIPS	High impact polystyrene
INC	Intergovernmental Negotiating Committee
MBzP	Mono-benzyl phthalate
MEP	Mono-ethyl phthalate
NMPs	Nano- and microplastics
OctaBDE	Octabromodiphenyl ether
PAHs	Polycyclic aromatic hydrocarbons
PBDE	Polybrominated diphenyl ether
PCBs	Polychlorinated biphenyls
PCDD/Fs	Polychlorinated dibenzo-p-dioxins and dibenzofurans
PentaBDE	Pentabromodiphenyl ether
PET	Polyethylene terephthalate
PFAS	Per- and polyfluoroalkyl substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
$PM_{2.5}$	Particulate matter 2.5 microns or less in diameter
PVC	Polyvinyl chloride
SVOCs	Semi-volatile organic compounds
TURI	Toxics Use Reduction Institute
UNEP	United Nations Environment Programme
VOCs	Volatile organic compounds
WASH	Water, sanitation and hygiene
WHO	World Health Organization



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"In many marginalized communities across Nigeria and Africa, people live from birth to death in dumps of waste and plastic pollution, not because they want to but because they have no other choice."

Oluwaseyi Jesuton, 23 years old, Nigeria

Read my story

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EXECUTIVE SUMMARY

Today's children are surrounded by more plastics than ever before. Despite this, our knowledge of the lifelong and intergenerational effects of exposure to this chemical cocktail remains limited. Plastic pollution in places where children live, learn and play, along with the presence of toxic chemicals in plastic products they use, highlight only part of this growing crisis.

The invisible aspect of the crisis is the lasting health effects that will shape children's well-being from early development through adulthood. Compared to adults, children absorb more pollutants relative to their size and are less able to eliminate them from their bodies, while they also have more years of life ahead of them during which disease and disability may develop.

Generation Plastic draws attention to five types of hazards plastics present for children:

Plastic production is projected to rise **70%** by 2040

1. Toxic exposures from plastic waste

Children who live in communities with open dumping and burning of plastic waste deserve the world's attention and concerted action. Here, socio-economic vulnerabilities amplify the toxic effects of pollution.[1,2] Recent research estimates that around 57 per cent of plastic pollution is openly burned each year.[3] The dark smoke released by burning plastic generates large amounts of toxic ash and hazardous air pollutants including heavy metals, carbon monoxide, hydrogen cyanide, styrene gas and persistent organic pollutants like dioxins, chlorinated furans and PCBs.[4,5] Children are particularly vulnerable because they breathe more per unit of body weight than adults, leading to higher exposure.[6] Toxic chemicals from informal dumpsites are released into the air, water and soil and can contaminate nearby water and food sources.[7]


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Exposure to these toxicants via inhalation as well as ingestion and absorption through the skin has been associated with birth defects, cancer, respiratory disorders, eye damage and even death.[5]

The most disadvantaged are the most vulnerable. Globally, there are over 20 million adult and child waste pickers, who collect approximately 60 per cent of all the plastic gathered for recycling globally.[8] Children as young as 5 years of age and pregnant women are known to work in the sorting, dismantling and recycling of e-waste,[9] which is made of approximately 20 per cent plastic.[10] Prenatal exposure to hazardous chemicals in e-waste recycling is linked to increased rates of stillbirth, preterm birth and lower birth weight.[9] Because children's bodies metabolize and eliminate toxic substances differently compared to adults, children are less able to break down and eliminate some hazardous substances.[7] Meanwhile, their rapidly developing organs are more vulnerable to hazardous substances that can potentially lead to lifelong health consequences and permanent damage.

2. Pollution from plastic production

Pollution from plastic production – from natural resource extraction to plastics manufacturing – includes the release of toxic petrochemicals that can reach nearby 'fenceline' communities.[4] Studies have shown that families living near fossil fuel extraction sites in fenceline communities experience higher rates of childhood cancer, especially leukaemia, compared to those who live further away.[4,11] Children's unique vulnerabilities and child-specific behaviours mean that their bodies absorb more of the contaminants in the environment compared to adults.[6] Ninety-nine per cent of plastic is produced from fossil fuels,[12] and plastic production is responsible for over 5 per cent of global greenhouse gas emissions,[13] contributing to climate change. Today's children and youth are sounding the alarm that climate change is one of their greatest concerns.[14]

3. Impact of plastic waste on livelihoods and flooding

Children are affected when families' livelihoods are impacted by plastic pollution. Examples include impacts on tourism, the marine sector and agriculture,[15,16,17,18] although the scale of these impacts on children has not been sufficiently assessed. Plastic waste including bottles, nylon threads from the fishing industry, plastic bags, used diapers and sachets are commonly found in drainage systems.[19,20] Additional effort is needed to address the potential for flooding that is aggravated by plastics and other waste.[19] Plastic waste such as discarded tyres provides breeding grounds for transmission of vector-borne diseases.[21] Flooding damages important water, sanitation and hygiene (WASH) infrastructure, contaminating food and water supplies. Children's dependence on caregivers and their susceptibility to killer infectious diseases like malaria make them uniquely vulnerable in these situations.

4. Toxic chemicals in everyday plastic products

Certain chemicals in plastics are linked to cancer, birth defects, damage to organs and hormone disruption.[22] Common children's products contain hazardous plastic-associated chemicals – such as phthalates, bisphenols, PFAS, flame retardants, styrene, PVC, crumb tyre infill on playgrounds, and more. Yet, among many other findings, science has shown that bisphenols such as BPA are endocrine disruptors with neurotoxic effects, styrene is neurotoxic and classified as a possible human carcinogen, and pregnant women's blood levels of flame retardants like PBDEs have been linked to lower IQ in their children.[4]

Some plastic chemicals have been regulated. The European Union (EU) restricted use of the phthalates DEHP, DBP, DIBP and BBP, which are added to plastics to increase flexibility, transparency and longevity but are toxic to human reproduction and interfere with the human hormonal system. The policy is estimated to save approximately 2,000 boys each year from impaired fertility later in life.[23] Children are exposed to plastic chemicals through inhalation, ingestion, absorption via the skin, and in utero.[24] Because children eat and drink more per unit of body weight than adults, have immature detoxification mechanisms, crawl on the ground, and frequently put objects and hands in their mouths, they are more susceptible to environmental contaminants than adults, especially during 'windows of vulnerability' when vital organs are forming.[6] Despite this, known hazardous plastic materials are widely used in school and preschool buildings (e.g., PVC flooring) and on playgrounds (e.g., crumb rubber infill).[25,26]

5. Knowledge gaps on plastic chemicals and particles

The more than 16,000 chemicals potentially used and present in plastics are responsible for many of plastic's known harms, of which approximately 3,600 chemicals of concern are not currently regulated under global policies.[27] Thousands more have never been tested for toxicity,[4,28] though recent research has highlighted priority groups of concern for plastic chemicals.[27] The absorption and potential health effects of exposure to plastics lacks comprehensive post-market monitoring.[29] Numerous plastic products are marketed towards children and families, ranging from disposable diapers to plastic baby bottles, toys, food packaging and cosmetics. An approach based on the precautionary principle is needed to protect children

from unknown harms from plastic production, use and waste. This includes avoiding regrettable substitution of a known hazardous plastic chemical with a material with similar or worse hazardous properties (as has occurred with bisphenols, flame retardants and others).[30] Research is needed that prioritizes children's exposures to plastic chemicals, particles, products and waste.

Fragmented policies for regulating plastics and chemicals at local, regional and international levels are a key challenge.[22] Without stronger policies, plastic production and use are projected to rise 70 per cent from 2020 to 2040, while mismanaged plastic waste and leakage into the environment will increase by about half.[31] Only about 21 per cent of plastic today is designed to be recyclable, but opportunities to reduce, reuse, refill, redesign and reorient are available.[32]

Today, children around the world are taking action as agents of change and participating in the fight against plastic pollution. In a recent UNICEF survey of over 214,000 children and young people, respondents urged governments to take stronger measures to protect the environment, and called for improvements to waste management and recycling as well as regulations to limit plastics.[14] Where possible, children and caregivers can empower themselves by avoiding single-use plastics, choosing safer building materials, and regularly washing hands and cleaning areas where children spend time.

General Comment 26 outlines that "the best interests of the child shall be a primary consideration in the adoption and implementation of environmental decisions".[33] As the world addresses the plastic pollution crisis, ambitious regulation, international cooperation, feasible alternatives and rigorous clean-up will be needed to protect children from hazardous plastic chemicals, particles and waste.

Generation Plastic calls for integrated, systemic shifts to protect children:

1. **Address the plastic pollution crisis through systems change:** Plastic production and the plastic life cycle must be reshaped in order to reduce the most problematic and unnecessary plastic uses. The market should be transformed towards circularity through accelerating the shifts towards Reuse, Recycle, and Reorient and Diversify. Decision makers must deal with the legacy of plastic pollution.[32]

2. **Advance chemical transparency and product safety for children:** Transparency in chemicals in products can empower consumers, simplify recycling processes and promote circularity. Products that are marketed towards children should be prioritized according to the precautionary principle. Awareness-raising in communities and schools can empower children and youth. Research on the lifelong health impacts of widespread exposure of children to plastic chemicals and particles should be a high priority.

3. **Concerted action for children bearing the greatest burden:** Every child has the right to a "clean, healthy, and sustainable environment".[34] The rights and livelihoods of child waste pickers and fenceline communities must be respected, protected and fulfilled. Underlying structural causes need to be prioritized together with better waste management systems. Children and families living in the communities most strongly impacted by plastic production and waste deserve environmental justice.

Decisions are being made today by adults that will impact children. States must act to spare the next generation a plastic-choked future. Future generations will hold us accountable.

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1. INTRODUCTION TO PLASTICS AND CHILDREN

'Generation Plastic' refers to today's generation of children growing up in a world full of plastic. Every stage of the plastic life cycle – from production to use and waste – impacts children around the globe.

Today's children are surrounded by more plastics than ever before. Despite this, our knowledge of the lifelong and intergenerational effects of exposure to this chemical cocktail remains limited. Plastic pollution in places where children live, learn and play, along with the presence of toxic chemicals in plastic products they use, highlight only part of this growing crisis.

> Less than **10%** of plastics have ever been recycled

The invisible aspect of the crisis is the lasting health effects that will shape children's well-being from early development through adulthood. Compared to adults, children absorb more pollutants relative to their size and are less able to eliminate them from their bodies, while they also have more years of life ahead of them during which disease and disability may develop.[6]

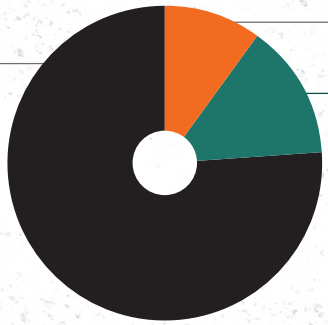
Since 1950, plastic production has increased more than 200-fold, and in just the last two decades, global plastic production has doubled.[35] A recent estimate pegged global plastic production at a staggering 435 million metric tons in 2020 alone.[31] This is roughly the equivalent mass of 2.6 trillion pairs of flip flop sandals – or over 1,000 pairs of flip flops per child on earth, every year. And this scale of production is not expected to peak anytime soon: plastic production and use are projected to increase by 70 per cent from 2020 to 2040.[31]

This report aims to frame plastics in the context of children's health and rights. On the one hand, lightweight and flexible plastics have been used to extend the life of foodstuffs, produce electronics and facilitate global vaccination campaigns. Some of these uses lack accessible and affordable alternatives. On the other hand, children's unique vulnerabilities have too often been left unaddressed.[4] Evidence shows that harmful plastic-associated chemicals interfere with the body's development, starting in utero.[36] Plastic is also a driver of climate change.[13,37] Yet regulations and risk assessment to protect children from plastic are inadequate.[27]

Generation Plastic will assess the entire plastic life cycle in the context of children, summarize early life health impacts of plastics, describe the policy landscape, and provide recommendations. Given the large and rapidly growing volume of global research on the topic, however, the report is not intended to be exhaustive. References are provided for more detail.

Figure 1 **Children's exposure to plastic globally**

76%
of all plastic waste is in landfills, dumps or the environment



14%
incinerated

with less than
10%
recycled

Source: Geyer, 'Production, Use, and Fate of Synthetic Polymers'.

Children face risks from plastic around the world, but the greatest burden is concentrated among those who are already vulnerable. These children and families are often also facing social and economic risks, such as poverty; marginalization; inequitable access to nutrition, education and health care; and concern for the future.[1,9,18,38,39,40]

Generation Plastic draws attention to five types of hazards children face from plastics: open dumping and burning of plastic waste, pollution from production, livelihood and flooding impacts, presence of toxic chemicals in everyday products, and gaps in knowledge and regulation.

Figure 2 **Plastics in children's communities**

Figure 3 Children's unique vulnerabilities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Children are exquisitely sensitive to their environment.[6] For these reasons, the early years are a critical window to prevent harmful exposures and promote lifelong health and well-being.

- Children eat and drink more proportional to their body weight, such that they will be proportionately more exposed to contaminants in food and drink.
- Compared to adults, they also breathe proportionately more and have a developing respiratory system.
- Due to the rapid growth involved in each stage, pregnancy, infancy and childhood are windows of vulnerability for the development of neurobehavioural, immune, metabolic, cardiovascular and other important body systems, while at the same time the body's detoxification mechanisms are still immature.
- Numerous toxicants can cross the placenta during pregnancy and through breast milk.
- Child-specific behaviours, such as crawling and frequent object- and hand-to-mouth activity, bring children in contact with their environment in unique ways.
- When it comes to plastics, young children also use different plastic products compared to adolescents and adults: disposable diapers, baby bottles, plastic toys and packaged baby foods are marketed specifically at infants and young children.
- Children rely on adults and are less aware of risks.
- Finally, because they have more years of life ahead of them, diseases with long latency linked to early exposures may emerge years or decades later.

2. IMPACT OF PLASTICS ON CHILDREN'S HEALTH AND THEIR FUTURE

Children are more exposed to plastics in early life, a time of essential development of the neurobehavioural, immune, metabolic, cardiovascular and other important body systems. In a major 2024 umbrella review,[28] every plastic chemical group studied was associated with at least one adverse human health impact. Around a quarter of the over 16,000 unique plastic-associated chemicals are of potential concern to human health and safety.[27]

> Around a quarter of the over **16,000** unique plastic-associated chemicals are unregulated and of potential concern to human health and safety

Across pregnancy, infancy, childhood and adolescence, plastic-related exposures have contributed to worse health effects throughout the body. This section summarizes major findings regarding child health impacts of plastic on birth outcomes; neurobehavioural development; reproductive development; nutrition and obesity; circulatory, respiratory and immune systems; allergy; infectious disease; kidney function; and cancer.

There is no single agreed-upon definition of plastics. Their diversity of materials and wide range of uses makes it exceedingly difficult to benchmark all potential health impacts of plastics. The fragmented evidence base and lack of epidemiological data from many world regions limit a full understanding of the health risks of early life exposures to plastics.

Research considering the developmental origins of health and disease have shed light on linkages between early exposures to plastic-associated chemicals and health outcomes.[41] In particular, considerable research has focused on plastic chemicals that are endocrine-disrupting chemicals, defined as exogenous chemicals or mixtures of chemicals that interfere with any aspect of hormone action.[42] Numerous endocrine disruptors can pass through the placenta during pregnancy and through breast milk during lactation. Because many endocrine-disrupting chemicals from plastic are attracted to fatty tissue, they can accumulate there and be gradually released back into the body over time, for example through lactation.[42] These chemicals are especially hazardous during early life development (including pregnancy) because hormone signaling directs important processes in the body, from body growth to

development of the brain, reproductive system and immune system.[43]

The following section provides a non-exhaustive illustration of early life health effects linked to plastic. For additional detail, consult Landrigan et al., 'Minderoo-Monaco Commission on Plastics and Human Health'[4] and Symeonides et al., 'Umbrella Review of Meta-analyses Evaluating Associations between Human Health and Exposure to Major Classes of Plastic-Associated Chemicals'.[28]

Figure 4 **Negative health effects of plastic exposure in early life**

Prenatal exposures

Studies have documented these negative health effects:

Birth and infancy

- Miscarriage
- Preterm birth
- Decreased birthweight
- Decreased birth length
- Genital structure
- Bronchitis
- Increased BMI

Childhood

- Childhood cancer
- Poorer psychomotor development
- Lower IQ
- ADHD in girls
- Obesity
- Increased BMI
- Asthma
- Allergic rhinitis
- Atopic dermatitis

Childhood exposures

Studies have documented these negative health effects:

- Lower IQ
- Vector-borne diseases
- Precocious (early) puberty in girls
- Abnormal timing of breast development
- Higher systolic blood pressure
- Obesity
- Allergic rhinitis
- Thyroid function
- Insulin resistance
- Increased waist circumference

Source: Landrigan et al., 'Minderoo-Monaco Commission on Plastics and Human Health'; Symeonides et al., 'Umbrella Review of Meta-analyses Evaluating Associations between Human Health and Exposure to Major Classes of Plastic-Associated Chemicals'.


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Birth outcomes

Plastic chemicals can be transferred through the placenta during pregnancy into the developing fetus.[4] Increased risk of miscarriage is linked to a woman's higher exposure to the phthalates DnBP and DEHP during pregnancy.[28] The impact of prenatal plastic exposures appears as early as birth. Decreased birthweight is linked with higher exposure to certain phthalates, PCBs, PBDE flame retardants and certain PFAS chemicals.[28] Decreased birth length is linked with prenatal exposure to PFOA. These health impacts – for example, preterm birth and low birthweight – can have ripple effects for years to come.

Neurotoxicity

Neurotoxic plastic additives like phthalates, bisphenols (BPA, BPS, BPF and others) and brominated and organophosphate flame retardants cause injury to the developing brain.[36,44] This injury can begin in utero when exquisitely sensitive sequences of brain development are pushed off track by chemicals that mimic, block or alter the body's own signals. Neurodevelopmental disorders, behavioural change and diminished cognitive function (i.e., reduced IQ) in childhood have all been linked to plastics.[28]

Lower IQ is linked to higher current exposure to the phthalate DEHP and higher prenatal exposure to the flame retardant BDE-47.[28] Follow-up research on seven-year-old children born to mothers with high exposure to phthalates scored at least six IQ points lower than their less heavily exposed peers, suggesting that the negative cognitive impact of early exposure to plastics can last into the school years. One study found that the brains of ten-year-old children had smaller grey matter volume if their mothers had higher urinary concentrations of the phthalate MEP during pregnancy, and that this was linked to lower IQ at age 14.[45] Certain phthalates are associated with decreased fine motor development in preschool children.[4,28] Prenatal PFOA exposure in girls is linked to higher risk of attention deficit hyperactivity disorder (ADHD).[28] Brominated flame retardants have been found in breast milk; these chemicals are endocrine disruptors that are associated with reduced IQ, reduced birthweight, reproductive abnormalities and impacts on thyroid function.[46] A recent study found that prenatal BPA exposure and sluggish testosterone metabolism were linked to a higher risk of autism spectrum disorder in boys.[47]

The NeuroTox study in Norway examined prenatal exposure to plastic-associated chemicals in 3,500 mother-child pairs from the 'Norwegian Mother, Father and Child Cohort Study'. The study identified that elevated maternal levels of phthalates DBP and MBzP and PFAS mixtures were associated with a reduction in cognitive functions (such as working memory) in the child.[48,49] Elevated maternal levels of PFAS (PFOA, PFOS, carboxylate PFAS, and PFAS mixtures) were associated with increased risk of autism spectrum disorder in the child, while an elevated maternal level of PFOA was associated with ADHD in the child.[50] Finally, elevated maternal levels of organophosphate esters and the phthalates DINP and DEHP were associated with increased risk of ADHD.[51,52,53]

Researchers are also studying whether early life exposures to plastic chemicals can increase the risk for neurodegenerative disorders like dementia in later life.

Neurotoxic metals like lead and cadmium are added to some plastics as pigments or heat stabilizers and are found in old plastic toys.[54,55] Exposure to these toxic metals via plastic is one of numerous sources that must be considered in major public health campaigns, such as the recently launched Partnership for a Lead-Free Future.

Child reproductive development

Researchers are studying the potential impact of plastic chemicals on reproductive development. Differences in reproductive development (i.e., location of genital openings) have been shown in girls with higher prenatal BPA exposure and in boys with higher prenatal exposure to certain phthalate chemicals.[28] Higher postnatal exposure to certain phthalate chemicals in girls has been linked to precocious (early) puberty and abnormal timing of breast development.[28] In the 2024 umbrella review of plastic chemicals, boys' postnatal exposure to certain phthalate chemicals was associated with a decreased risk of abnormal timing of pubarche; further research is needed to understand the extent of these associations.

Ingestion, nutrition and overweight

Children are exposed to plastics via food and drinks – not only through the food itself but also through food packaging and contact materials – and unintentional ingestion of plastic in dust, toys and other items. Plastic particles have been found in seafood, salt, drinking water and other food and drinks.[24] The 2024 umbrella review found increased body mass index related to pre- and postnatal exposure to certain PFAS chemicals; increased waist circumference with higher postnatal exposure to certain phthalate chemicals and BPA; increased risk of obesity and overweight with BPA exposure; and increased risk of obesity with pre- or postnatal PFOA exposure.[28]


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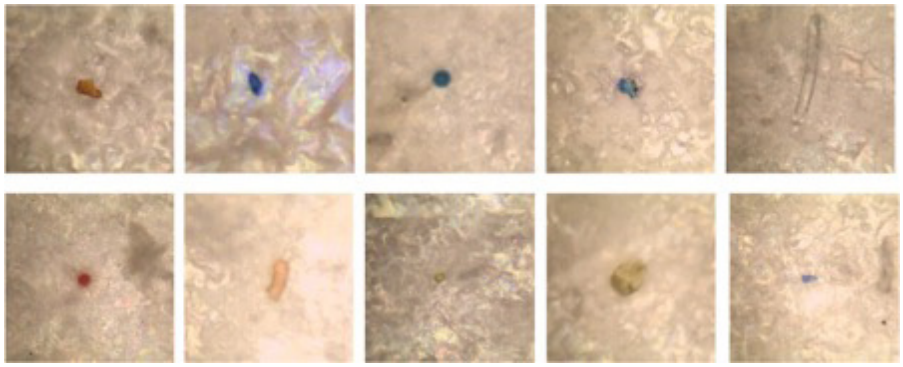
Heart, lungs, immune system and allergy

Plastic-associated chemicals are linked to poorer lung development, respiratory conditions and allergy. Children already have much higher rates of respiratory infections and asthma than adults due to their bodies' immature defense mechanisms, including the lungs and immune system.[6] The 2024 umbrella review identified several findings from systematic reviews.[28] Asthma in children has been associated with prenatal exposure to the phthalate BBP. Bronchitis in infants has been linked to prenatal exposure to certain PCB chemicals. Children with pre- or postnatal exposure to PFOA were more likely to suffer from allergic rhinitis (i.e., inflammation inside the nose). Children had increased risk of atopic dermatitis with higher prenatal exposure to PFOS.

Children are more at risk of inhaling plastic particles because of their tendency to breathe through their mouth, smaller airway geometry, and higher flow rates through their entire respiratory system.[56] Microplastics were recently documented in lung fluid of children with respiratory illness.[57] Inhaling microfibers is linked to elevated risk for respiratory symptoms, decreased lung function and accumulation in pulmonary tissue. Smaller, irregularly-shaped nano- and microplastics (NMPs) with sharp edges appear to have the highest toxicity.[4,58] A 2024 modelling study indicated that highly exposed people in East and Southeast Asian countries can inhale up to 2.8 million microplastic particles per day, compared to just 300,000 particles per day in Norway and Sweden.[59] NMPs may have the ability to deposit in sensitive areas (e.g., deep in the alveoli region of the lungs with limited removal mechanisms) and may induce acute or chronic inflammatory reactions; research is needed to benchmark these processes in children.[24,60] In one of the only studies of plastic particles and child health, Malmberg et al. studied a plastic-based floor polish (acrylate–styrene copolymer) in a Swedish school that began powdering after layers of polish peeled off and turned to dust; teenage students at the school reported irritation in their eyes and lower airways.[61]

In terms of cardiovascular effects, children with higher postnatal exposure to certain phthalate chemicals have shown increased systolic blood pressure (i.e., hypertension).[28]

Microplastics documented in lung fluid of children with respiratory illness



Reprinted with permission from Chen et al., Environmental Science & Technology (2023).[57]
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Infectious disease

Mismanaged plastic waste can be a substrate for microbes and parasites that carry disease – potentially over long distances – and threaten children's health.[4,18] Each plastic particle can be a 'Trojan horse' for bacteria and microbes as well as other toxicants riding on the plastic.[62] Plastic pollution is expanding the spread of vector-borne diseases by providing habitats for mosquitoes to breed.[21] Microplastics can be vectors for pharmaceuticals, and emerging evidence suggests that microplastics can carry antibiotic-resistant bacteria, with hospital waste water being studied in relation to this.[63,64]

Kidney function

A known nephrotoxic chemical found in plastics is melamine, a high-production-volume chemical commonly used in tableware and consumer goods. Melamine has been detected in breast milk[65] and children's urine[66] and further research is needed to understand the impact of low-dose exposures on kidney function in children. In 2019, the European Chemicals Agency (ECHA) added melamine to the 'Candidate List of substances of very high concern for Authorisation' under the EU's REACH regulation on the registration, evaluation, authorization and restriction of chemicals.

Cancer

Families living near a plastic manufacturing plant – so-called 'frontline' or 'fenceline' communities – experience higher rates of childhood cancer, especially leukaemia, compared to those who live further away.[4] This is also the case for those living near oil and gas extraction sites. Oil and gas extraction releases chemical compounds into the air and surroundings, and some, such as benzene, 1,3-butadiene and formaldehyde, are human carcinogens that can cause leukaemia and other cancers.[4] Studies of children born or living near fracking sites have found elevated rates of childhood cancer, especially leukaemia, and congenital heart defects.[11]

Burning of waste and plastic contributes a large proportion of $PM_{2.5}$ air pollution and is linked to a significant fraction of lung cancer cases.[4] In Aspropyrgos, Greece, a 2015 fire in a plastic recycling plant emitted high levels of toxic PCDD/Fs into the air. Follow-up research in the community found a 13 per cent increase in 30-year cancer risk, and even higher lifetime cancer risk in neonates exposed in utero or via breast milk.[67]

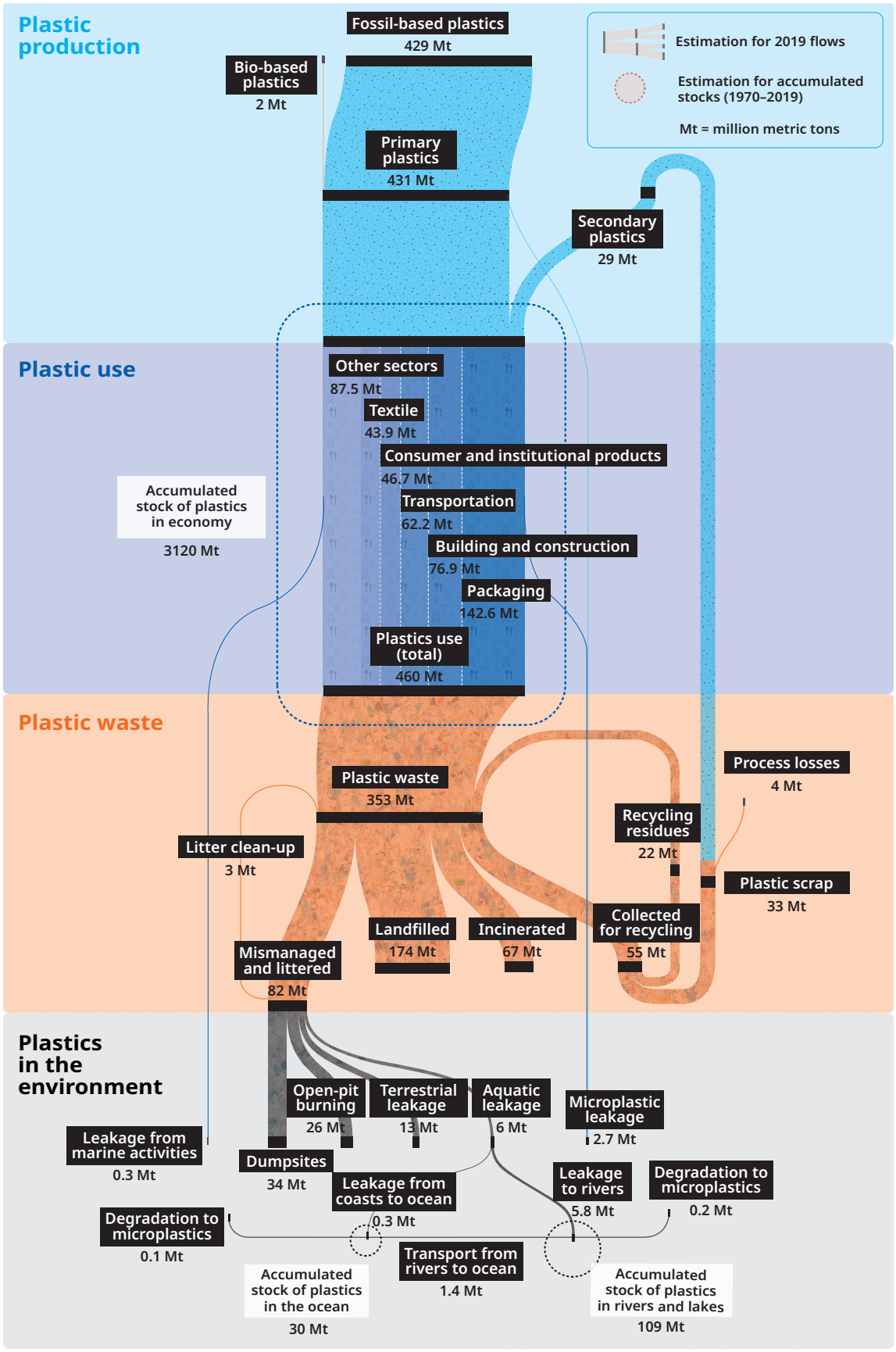
Research is ongoing to understand potential carcinogenicity of specific plastic-associated chemicals. In 2019, the International Agency for Research on Cancer classified melamine as a substance that is possibly carcinogenic to humans (Group 2B)[68] and styrene as probably carcinogenic to humans (Group 2A).[69] The 2024 umbrella review identified an increased risk among children and adults from PCB exposure for all non-Hodgkin lymphoma subtypes, as well as limited evidence that PCB exposure is associated with a lower chance of one subtype of non-Hodgkin lymphoma; more research is needed to understand the extent of this effect.[28]

3. HAZARDS OF PLASTICS FOR CHILDREN

Plastics enter children's environments throughout their life cycle. *Generation Plastic* draws attention to five types of hazards plastics present for children, summarizing research findings and highlighting knowledge gaps.

Figure 5 **Plastic risks are concentrated among the most vulnerable children**

Figure 6 Plastic life cycle



Source: Plastic Pollution Science, UNEP/PP/INC.4/INF/1; *Global Plastics Outlook*.

3.1 Toxic exposures from plastic waste

Plastic waste has become a major threat to children's health and rights. Plastic waste ends up landfilled, incinerated or openly dumped or burned. Moreover, international flows of plastic waste are an issue of environmental justice which current generations have created yet leave as a burden for the youngest and future generations to fix.

Plastic waste predominantly flows from higher-income regions that are well-prepared to manage waste but have high recycling costs to lower-income countries facing higher rates of waste mismanagement and inadequate enforcement capacities.[32] Mismanaged plastic waste (i.e., dumped, openly burned, inadequately disposed of or littered) could increase by almost 50 per cent, from 81 million metric tons annually in 2020 to 119 million metric tons annually in 2040.[31] The environment could be further degraded by a 50 per cent increase in leakage of mismanaged plastics into rivers, oceans and land over the same time frame.[31]

While less than 21 per cent of plastics today are designed to be recyclable,[32] less than 10 per cent of plastics have ever been recycled,[70] compared to 65–70 per cent for paper and cardboard and 90 per cent for glass.[4] Many types of plastic cannot be recycled, especially those made of mixtures of materials that are difficult to disassemble. The chemistry of plastics means that the quality of the material inevitably degrades during recycling. The best solution to plastic waste is prevention. Zero waste approaches are being encouraged and tested.[71,72]

Children on the front lines of plastic waste are most vulnerable to its well-documented harms. Toxic chemicals from open dumps and burning of plastic waste are released into the air, water and soil and can contaminate nearby water and food sources.[7] Because children's bodies metabolize and eliminate toxic substances differently compared to adults, children are less able to break down and eliminate some hazardous substances.[7] Meanwhile, their rapidly developing organs are more vulnerable to hazardous substances that can potentially lead to permanent damage and lifelong health consequences.

Children working in plastic waste picking

Globally, there are over 20 million adults and children who work as waste pickers, collecting approximately 60 per cent of all the plastic gathered for recycling globally.[8] Pickers look to reclaim value from any material, including certain plastics. To collect one kilogram of plastic, a child must collect 20–24 large empty plastic bottles or over 40 small bottles; a recent International Labour Organization assessment in Pakistan found that many child waste pickers suffer from back pain.[73]

Many child pickers are not able to attend school, and child care facilities are often far from waste management sites where their parents work.[74]

In Idlib province in Syria, following the stoppage of public waste collection services, a former stone quarry was repurposed as the Al-Habbat open landfill. Here, young children collect plastic and copper alongside hazardous medical waste, discarded food, e-waste, and even bullets and munitions. In 2020, several boys were killed as garbage heaps collapsed onto them while they were picking waste.[75]

As policymakers and industry work to identify sustainable and circular systems for plastic production, use and waste, the dignity and livelihoods of waste pickers – especially children – must be respected. Understanding children's involvement in plastic waste requires a broader look at solid waste systems and structural causes. Underinvestment in waste management systems (e.g., access to disposal sites, collection infrastructure) and limited worker organization (e.g., unions, cooperatives) are important aspects to address.

Box 1 Child plastic waste pickers in Ghana

The Ghana National Plastic Action Partnership conducted a national survey of 390 informal waste actors in the plastic waste value chain and found that 15 per cent are children aged 5 to 12 with another 8 per cent aged 12 to 16, with boys outnumbering girls.[74] About 80 per cent of the child respondents report not being in school, with the remaining 20 per cent attending school inconsistently. The survey identified a number of health problems, including visible skin infections, diarrhoea, coughing and runny nose. There were geographic differences: About 80 per cent of total waste pickers in the Northern Region were children aged 5 to 12, while well-managed waste management centres had no child workers. About 40 per cent of the child pickers were the breadwinners of their families, with some working full-time. Among all waste pickers, children are most likely to face physical injuries and death. Children are often cheated out of their full pay from collecting plastics due to their inability to read the measurement scales used by the purchasers.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"We want to go back to school or learn trade, but we also need the money to support our families."

– A child picker at the Gbalahi dump site[74]

Figure 7 **Waste management hierarchy**

Source: United Nations Environment Programme, Division of Technology, Industry and Economics, International Environmental Technology Centre, *Global Waste Management Outlook*, UNEP, Osaka, Japan, 2015.

Box 2 Participatory approach to urban waste management in Brazil: A look back at UNICEF's role

Beginning in 1992, UNICEF responded to the hospitalization of several pickers of the Aguazinha dump area of Olinda city, Brazil, leading to a launch in 1994 of a campaign to eradicate child labour at dumpsites. A 1998 study carried out by UNICEF estimated that 45,000 children in Brazil worked in waste picking (including mixed plastics), 30 per cent of them not enrolled in school. Under UNICEF's leadership, a National Forum with 19 partners was launched in 1998 to advocate, mobilize, train and coordinate to eradicate child and adolescent labour at open dumps across Brazil. In the same year, UNICEF supported the creation of a multistakeholder platform called Fórum Nacional Lixo e Cidadania (National Waste and Citizenship Forum). Together with the Forum, UNICEF launched the "Criança no Lixo, Nunca Mais" campaign ("No more children in dump areas") which kicked off in 1999 and supported a local pilot programme to strengthen pickers' organizations. UNICEF's initial leadership in the campaign was successfully passed on to Água e Vida, a Brazilian non-governmental organization.

For more details, see Dias, 'Waste and Citizenship Forums'.[76]

Open burning of mixed plastic waste

Some 2.7 billion people do not have their waste collected; of these, 2 billion live in rural areas and 700 million in urban areas.[77] Around 57 per cent of plastic pollution is estimated to be openly burned each year.[3] In some African cities as much as 75 per cent of garbage is openly burned.[78] In 2022, a survey of 700 villages across India estimated that over 67 per cent of rural households routinely burn plastic waste.[79]

Burning plastic is dangerous to children. The dark smoke is not only irritating and foul smelling, but also generates large amounts of particulate air pollution, toxic ash and hazardous air pollutants including heavy metals, carbon monoxide, hydrogen cyanide, styrene gas and persistent organic pollutants like dioxins, chlorinated furans and PCBs.[4,5] Exposure to these chemicals has been associated birth defects, various cancers, respiratory disorders, eye damage and even death at high exposures.[5] High impact polystyrene, a plastic commonly used for packaging and in the construction and health product industries, produces black smoke, drips, and poses hazards to human safety when burned.[80] These are hazardous substances for all people, but children – with their developing respiratory systems and higher breathing rates – bear the greatest risk and greatest burden.[6]

E-waste and plastic

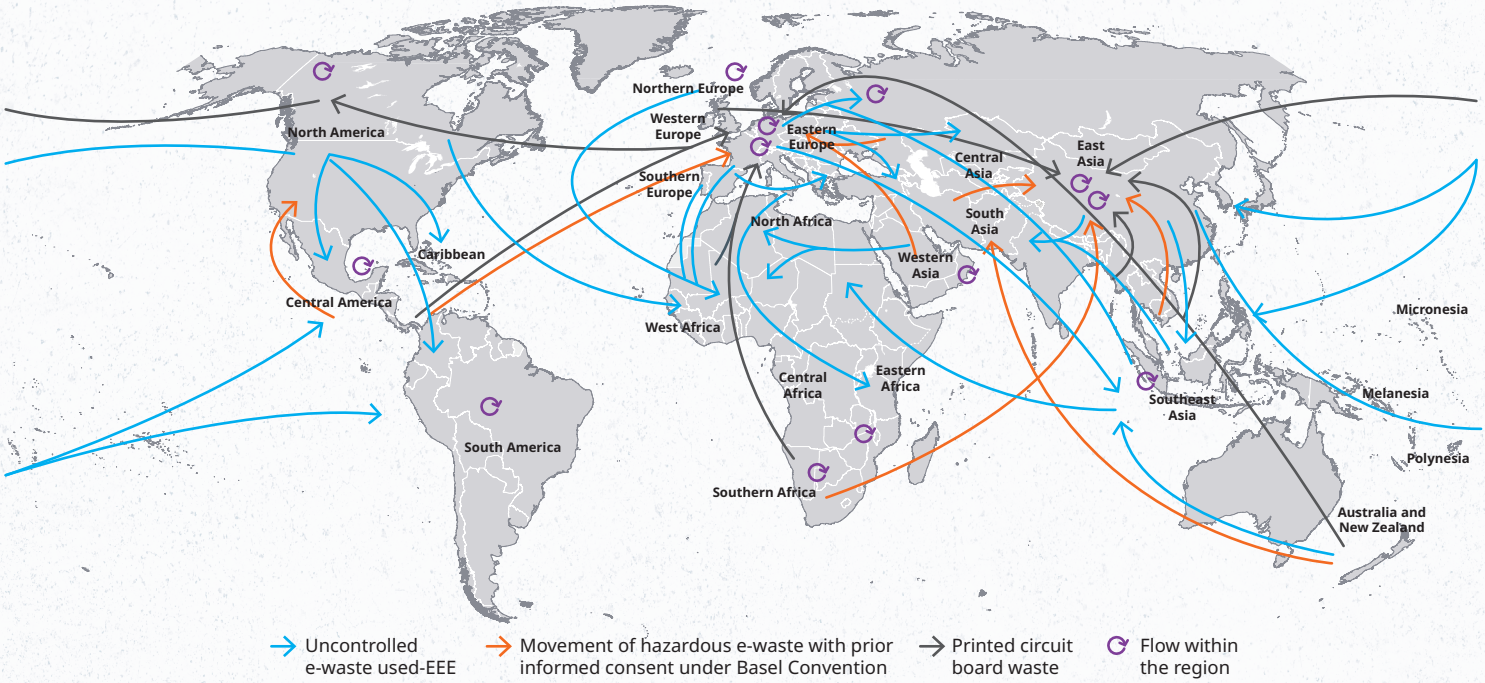
A record 62 billion kilograms of e-waste was produced in 2022, containing 17 billion kilograms of plastics.[81] Children as young as 5 years of age work in the sorting, dismantling and recycling of e-waste. Of the 18 million children working in the industrial sector, the number working in waste management is unknown but could be substantial, since waste processing is a major subsector.[9,82] E-waste recycling can, when improperly managed, expose children and adolescents to toxic lead, mercury, dioxins and countless other toxicants, representing numerous breaches of their child rights. E-waste plastic mixtures are complex and require advanced separation techniques.[22] While responsible e-waste management exists, it is not being practiced in much of the world.

Plastic makes up approximately 20 per cent of e-waste material.[10] Plastics commonly used in electronics manufacture and found in e-waste are polystyrene, polycarbonate, polypropylene, polyethylene, ABS and PVC. Flame retardants and PFAS chemicals are abundant in e-waste. Children's toys like vehicles, musical toys, gaming devices and talking dolls increasingly contain hidden electronic components. These toys, which are made with plastic, are marketed towards children and youth. Around 7.3 billion e-toys are discarded every year, accounting for around one third (3.2 billion kilograms) of all so-called 'invisible' e-waste thrown away every year, with an estimated value of nearly US$10 billion.[83]

Infrastructure to manage e-waste is growing quickly but not quickly enough; most e-waste is managed outside formal waste management and recycling systems.[81] Due to this lack of oversight, 45 million kilograms of plastics containing toxic brominated flame retardants are released into the environment every year, posing a major threat to children's health.[81]

Ingestion is the main route of children's exposure to e-waste contaminants in home and community settings.[9] A study by the Basel Action Network and the International Pollutants Elimination Network found that eggs from free-range chickens in the Agbogbloshie e-waste scrap yard in Ghana had extremely high levels of numerous toxicants, including brominated dioxins, HBCD flame retardants and persistent organic pollutants including dioxins and dioxin-like PCBs.[84] Children living near a computer e-waste recycling site in China demonstrated abnormal thyroid function correlated with PCB, dioxins and PBDE exposures.[85]

Map 1 Global e-waste flows, 2019



Source: C.P. Baldé, E. D'Angelo, V. Luda O. Deubzer, and R. Kuehr, *Global Transboundary E-waste Flows Monitor* – 2022, United Nations Institute for Training and Research (UNITAR), Bonn, Germany, 2022, p. 13.

Landfills, incineration, cement kilns and energy recovery

An estimated 76 per cent of all plastic waste ever produced has accumulated in landfills, dumps or the natural environment, while 14 per cent has been incinerated.[70,86] Plastic waste management techniques and strategies are different around the world based on capacity levels and socio-economic conditions.[87] Upper-middle-income countries have the highest percentage of waste in landfills (54 per cent), while high-income countries landfill 39 per cent and divert 36 per cent of solid waste to recycling and composting and 22 per cent to incineration.[88]

In high-, middle- and low-income countries, landfills have become clogged with enormous quantities of plastic waste. Plastic waste in landfills can catch fire, exposing children living nearby to toxic particulate matter and chemicals.[4] Inside the landfill, plastic garbage breaks down into nano- and microplastics and releases leachate into surface water and groundwater that serve as sources of drinking water.[89,90]

Incineration or waste-to-energy facilities that burn plastic waste generate a wide range of toxic chemicals, including chlorine, hydrogen chloride and phosgene (mustard gas); hydrogen cyanide; ammonia; formic acid; formaldehyde; benzene; phenol; and PCDD/Fs.[4] Children can be exposed to these toxic remnants via inhaling contaminated air, touching and ingesting contaminated soil and dust, and consuming foods and livestock grown in contaminated areas.[4] Municipal incineration is used primarily in high-capacity, high-income and land-constrained countries. For example, rates are relatively high in several European countries, which use incineration for electricity and district heating.[91] Proper management of energy recovery efficiency, flue gas cleaning technologies and

residue containment are critical and should be handled locally. Still, high levels of dioxins and furans were found in 2013 in the eggs from chickens living near the Reststoffen Energie Centrale incinerator in the Netherlands, despite the plant having advanced emissions control technologies and stringent emissions limits.[92,93] On the waste management hierarchy, energy recovery and controlled deposit are considered significantly worse than prevention and recycling, but preferable in some circumstances to open burning and dumping. The United Nations Environment Programme (UNEP) estimates that a ton of plastic waste ending in an incineration plant emits around 20 per cent fewer greenhouse gas emissions than if the same ton is openly burned.[32]

Globally, types of incineration range from contained burning to specialized incineration facilities that recover energy and treat the waste. High-temperature incineration is required to prevent and control exposure to dioxins.[94] Uncontrolled waste incinerators may lead to too-low temperatures and incomplete burning.[95]

The cement industry is one of the largest drivers of climate change, and cement is historically produced using fossil fuels. Some cement kilns have begun to use so-called co-processing in which waste, such as plastic wrappers (known as multilayered packaging), serves as an alternative fuel.[96]

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3.2 Pollution from plastic production

Each step of the production process, from extracting fossil fuels to the final shaping of the plastic products, has an impact on children. Fossil fuels – gas, oil and coal – provide the raw materials to make 99 per cent of plastics.[12] Extraction of oil and gas takes place both on land and offshore. Land-based fossil fuel extraction, which includes coal mining, oil drilling and fracking, releases toxic chemicals into the surrounding area.[97] Spills from offshore fossil fuel extraction and maritime transport create risks to children in coastal communities.[38]

Materials for the manufacture of plastics are then transported for further processing, sometimes over long distances. Transportation networks, whether by sea, train or pipeline, pose additional environmental risks to children living in adjacent communities. In 2023, a train derailed in the town of East Palestine, Ohio, USA, and spilled large quantities of chemicals including vinyl chloride, which is used to make polyvinyl chloride (PVC), a common toy and building material. While a cleanup effort and monitoring followed the spill, researchers and medical professionals have acknowledged substantial uncertainty regarding potential long-term health impacts that may emerge months or years later, and emphasized the need for continued monitoring and follow-up, especially for children and pregnant women.[98]

Pollution from both natural resource extraction and plastics manufacturing also includes the release of toxic petrochemicals that can reach nearby 'fenceline' communities.[4] Industrial air pollution is considered one of the seven deadly sources of air pollution for children.[99] Emissions of particulate matter and volatile organic compounds (VOCs) can contribute to elevated rates of asthma in children and adults, along with lung and respiratory infections and cardiovascular problems.[4] Prenatal exposures to hazardous chemicals in fenceline communities also contribute to higher rates of premature rupture of membranes, preterm births and low birthweight babies.[4] Some emitted compounds (e.g., benzene, 1,3-butadiene, formaldehyde) are human carcinogens.[4] In a US study, children born or living within

2 kilometres of fracking sites (where the technique known as fracking is used to extract oil and gas) had elevated rates of childhood cancer, especially leukaemia, and congenital heart defects.[11] Children from marginalized communities living near natural resource extraction sites face additional social risks.[38,39,40]

Plastic production and climate change

Together, UNICEF, the World Health Organization (WHO) and the United Nations Population Fund have shown that children bear the greatest burden of climate change.[100] Plastic is a driver of climate change. Plastic production is responsible for over 5 per cent of global greenhouse gas emissions, and greenhouse gas emissions from primary plastic production could double or triple by 2050.[13] As of 2024, plastic production globally accounts for an estimated 12 per cent of total demand for oil and 8.5 per cent of total demand for natural gas.[13] Scientists estimate that to have a 50 per cent chance of staying below the 1.5°C temperature cutoff in the Paris Agreement, plastic production must be cut more than 11 per cent every year beginning in 2024; and if the world wants a 67 per cent chance to stay below 1.5°C, plastic production must be cut more than 16 per cent annually.[101] Only 6 per cent of plastics come from recycled sources – and this figure may not increase meaningfully by 2040 without dedicated policy attention.[31]

Prevention of plastic production is key to protecting children.

UNICEF's latest strategic plan underscores that climate change and environmental degradation undermine the rights of every child. In fact, today's children and youth are sounding the alarm that climate change is one of their greatest concerns, along with mental health and inequality and discrimination.[14] In a recent UNICEF survey of over 214,000 children and young people, respondents urged governments to take stronger measures to protect the environment, and called for improvements to waste management and recycling and regulations to limit plastics.[14]

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3.3 Impact of plastic waste on livelihoods and flooding

Impact of plastic waste on livelihoods

Plastic waste impacts ocean health. It causes environmental and economic harms through habitat degradation; cost burdens to tourism; damage to vessels, fishing gear and facilities; and losses to fishing operations, among other impacts.[15,17] Although research has grown, there is still a poor understanding of the total effects of marine plastic on human well-being and the economy.[16] In particular, the global scale of impacts on families' livelihoods and children's well-being – especially in coastal and island economies that depend on marine ecosystem services – has not been assessed.

Plastic pollution on land also has an impact on agricultural livelihoods.[18] A study in Ethiopia found that cattle had ingested significant quantities of plastic waste due to absence of waste collection or plastic recycling, posing risks to the cattle's health and economic loses to the owner.[102] Given their immaturity and dependence on adults, children and youth may be directly and indirectly impacted.

Plastic waste contributes to flood risk

Plastic bottles, nylon threads from the fishing industry, plastic bags, used diapers and sachets commonly block drainage systems, and may contribute to risk of flooding. Tearfund estimated that hundreds of millions of people are at significant risk of plastic-aggravated flooding events.[19] Flooding damages important WASH infrastructure and contaminates food and water supplies. Plastic waste, ranging from discarded automobile tyres to bottle caps, collect rainwater and serve as breeding grounds for vector mosquitos in close proximity to humans.[21] Children's dependence on caregivers and their susceptibility to killer infectious diseases like malaria make them uniquely vulnerable in these situations. Better estimates of the number of children affected, mapping of at-risk locations, and clean-up efforts can support disaster risk reduction and recovery.

Box 3 Deadly mudslide and plastic-aggravated flooding in Sierra Leone, 2017

On 14 August 2017, Freetown – the capital of Sierra Leone – and surrounding areas were hit by a devastating mudslide and flooding worsened by plastic pollution. Over 1,100 individuals were declared dead or missing, of which 369 were school-aged children. Plastic bags and other waste clogging drains during heavy rains exacerbated the disaster. Around 4,000 children were left homeless in the immediate aftermath of the mudslide and flooding,[103] and nearly half of those affected by the disaster were under 14 years old. The disaster struck just before the first day of school, throwing families' stability and financial resources into uncertainty at a critical moment. In the aftermath of the disaster, some mothers reported that the sound of rain made them anxious for their families.

The mudslide and flooding occurred in the context of an epidemic of mixed plastic waste. Children and pregnant women are among the waste pickers who live and work in Freetown's largest waste dumpsite, climbing metres-high cliffs of waste to collect recyclables and breathing in the dark fumes of burning plastic. They have no option but to use "toxic water, and eat meat contaminated by waste," reported the United Nations Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes, during a 2017 mission.[104] Unsound management and disposal of hazardous substances and wastes – including plastic – is a major risk to children's rights.

Sorting and collecting items for reuse at a metres-high mixed plastic waste open dump in Freetown, Sierra Leone.

3.4 Toxic chemicals in everyday plastic products

Plastics are part of every child's life. Today, children are surrounded by unnecessary or problematic plastics and hazardous chemicals. Common children's products contain hazardous plastic-associated chemicals such as phthalates, bisphenols, PFAS, flame retardants, styrene, PVC, crumb tyre infill on playgrounds, and more.

This section will focus on plastic uses relevant to children and highlight children's unique vulnerabilities to plastics. Because children eat and drink more per unit of body weight than adults, have immature detoxification mechanisms, crawl on the ground and frequently put objects and hands in their mouth, they are more susceptible to hazardous chemicals from plastic and other environmental contaminants than adults, especially during 'windows of vulnerability' when vital organs are forming.[6]

Over time and through use, many plastic products break down into particles and chemicals which can be absorbed by children's bodies.[4] Sometimes a plastic item's useful life is measured in just minutes! For instance, one million plastic bottles are purchased every minute, and up to five trillion plastic bags are used worldwide annually.[105] Other plastics – like in building materials – are made to last for years. Materials from plastics enter children's bodies through inhalation, intentional and unintentional ingestion, and through the skin.[106] Some plastics, including building materials, also release ('off-gas') volatile and semi-volatile organic compounds (VOCs and SVOCs) which can spread through the room.[106,107] Transfer of plastic chemicals and particles through the placenta and breast milk has been documented.[4]

Figure 8 **Time, use, temperature, pressure and UV radiation break down plastic products and waste into particles and chemicals**

Size of nano- and microplastics

Human hair
50–180µm

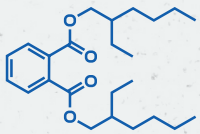
Fine beach sand
90µm

Microplastics
1 to <1,000µm
Plastic particles can carry chemicals and acquire pollution and microbes on their surface

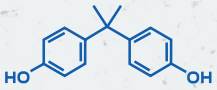
Nanoplastics
<1,000nm

Thousands of plastic chemicals

DEHP

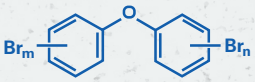


BPA

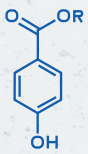


PFOA

PBDE flame retardants



Parabens



Note: Size definitions of nano- and microplastics vary; definitions used here are from the International Organization of Standardization, ISO/DIS 24187(en).[108]

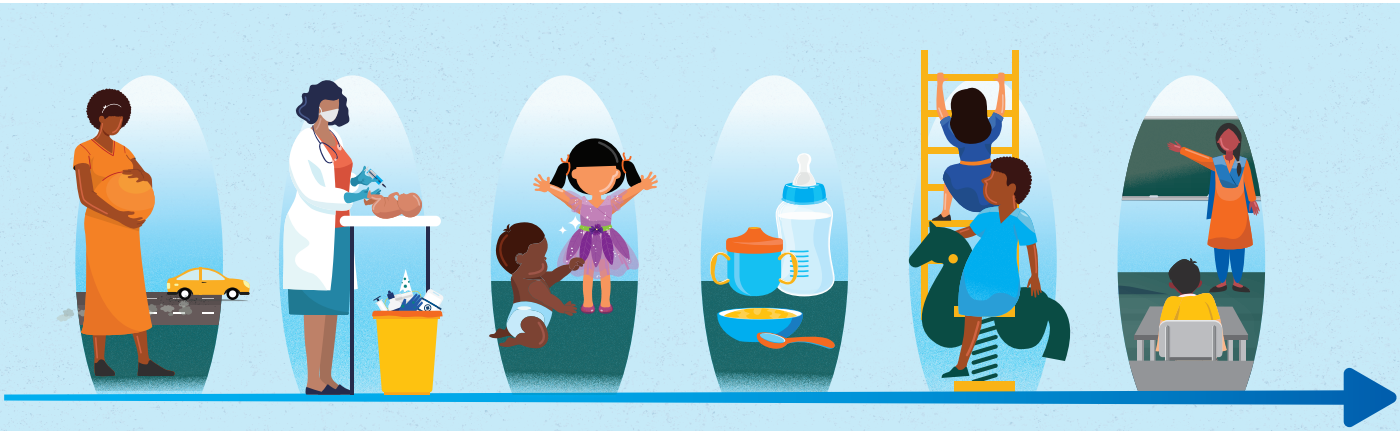
Exposure to chemical additives in plastics occurs throughout the use stage of plastic products[109] including food packaging, building materials, electronics, toys, textiles and household items.[32,110] Most plastic chemicals do not form a strong bond with the polymer backbone, which means they are easily released into food, beverages, toys, children's personal care products and the environment.[111] As plastic chemicals are released into air, water and soil during all stages of the plastic life cycle, they can impose significant social and environmental costs.[32,112] Research is also emerging on the extent of microplastic release globally[59,113,114,115] and the implications for child health.[24,116,117]

Plastics are complex and children of all ages come in contact with plastic objects, particles and chemicals. They encounter real-world mixtures of plastic and other pollutants, sometimes called chemical cocktails. Plastics may, for instance, contain persistent organic pollutants such as PBDEs, PCBs and other potentially hazardous chemicals.[22] Plastic-associated chemicals also include those identified by the Strategic Approach to International Chemicals Management as emerging policy issues or issues of concern, such as endocrine-disrupting chemicals, hazardous substances associated with electrical and electronic products, and PFAS.[22] *Global Chemicals Outlook II*[118] has identified additional plastic-associated chemicals, such as BPA, cadmium, lead, microbeads in personal care products and cosmetics, PAHs, phthalates and triclosan, as issues for which evidence indicates a risk to human health and the environment.[22] The current evidence based around children's environmental health is fragmented and should be strengthened to gain a fuller picture of the health effects of chemical cocktails, including plastics.

Reducing the size of the problem

Without stronger policies, plastic production and use are projected to rise 70 per cent from 2020 to 2040.[31] Moving towards reusable and refillable products and removing unnecessary plastic (e.g., excessive headspace in packaging) are steps towards eliminating the use of unnecessary or problematic plastics and hazardous chemicals.[32] In some cases, safe and sustainable materials can offer a substitute for unnecessary plastics.[32]

Figure 9 **Children live among plastics at every age**



Prenatal exposures to plastic chemicals and particles

Paediatric medical equipment

Synthetic textiles and disposable diapers

Food contact materials and single-use packaging

Toys, playground equipment, fake turf and crumb tyre infill

School building materials including PVC flooring and recycled plastic

Chemicals in plastic

The 2024 PlastChem report identified over 16,000 unique plastic chemicals – much higher than previous estimates.[27] Around a quarter of these – more than 3,600 – are unregulated chemicals of potential concern to human health and safety. The sections below provide an overview of selected child-relevant plastic uses and highlight the presence of known toxicants across diverse product groups. The toxic effects of BPA, phthalates, styrene and selected others are well documented, but represent just the tip of the iceberg of unregulated chemicals of concern.

Box 4 Priority groups of concern for plastic chemicals, identified by the PlastChem project[27]

- Aromatic amines
- Aralkyl aldehydes
- Alkylphenols
- Salicylate esters
- Aromatic ethers
- Bisphenols
- Phthalates
- Benzothiazoles
- Organometallics
- Parabens
- Azo dyes
- Aceto/benzophenones
- Chlorinated paraffins
- Per- and polyfluoroalkyl substances (PFAS)

Box 5 Priority use sectors of concern for plastic

UNEP has identified 10 priority use sectors of concern for plastic, due to their high likelihood of chemical exposures in humans, ecosystems and vulnerable populations, and because chemicals of concern are known to be used in production.[22] All of these sectors are relevant for children.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- Toys and other children's products
- Packaging, including food contact materials
- Electrical and electronic equipment
- Transport
- Synthetic textiles
- Furniture
- Building materials
- Medical equipment and devices
- Personal care and household products
- Agriculture, aquaculture and fisheries

Selected child-relevant plastic uses

Diapers, wipes and menstrual products

Diapers and hygiene products account for around 1 per cent of global plastic production.[119] Disposable diapers (nappies) are used extensively in low-, middle- and high-income countries.[120] For babies using exclusively disposables, several thousand diapers will be used and discarded before potty training. Disposable diapers are typically made from wood pulp, cotton, viscose/rayon and several plastics (e.g., polyester, polyethylene, polypropylene, etc.). Personal care products such as diapers and menstrual products represent a sector with the potential for big impacts from an ambitious shift to reuse, but may require further support.[32]

In 2019, the French Agency for Food, Environmental and Occupational Health and Safety (ANSES) conducted a survey of bestselling diaper brands and found the presence of 38 "very severe hazard" chemicals such as dioxins, furans, dioxin-like PCBs, formaldehyde and PAHs.[121,122] ANSES noted that an estimated 90 per cent of babies in Europe (approximately 14.5 million babies) are "exposed to hazardous chemicals contained in their diapers every year." ANSES pointed to scientific evidence demonstrating that these chemicals in general (i.e., not specific to diapers) are associated with health effects ranging from skin tumours to impacts on fertility and other reprotoxic effects, endocrine-disrupting effects and skin sensitization. Contaminants were found in both standard diaper products and those marketed as 'eco-friendly'. In a 2020 follow-up survey in France, all chemicals were at satisfactory lower levels except formaldehyde.[123] The EU has not followed up on this finding, however, with additional regulations specific to diapers.

Every minute, more than 300,000 disposable diapers around the world are incinerated, sent to landfill or dumped in the environment.[124] A 2018 hotspot assessment by the World Bank of marine debris in 15 coastal cities in Western and Central Indonesia found that, on average, 21 per cent of waste content in urban waterways was comprised of disposable diapers.[20] In addition to diapers, single-use baby wipes are commonly made from PET, polypropylene or a combination of PET and cellulose[125] and have been found as waste in the environment.[126]

Movement away from disposable diapers could include alternatives like cloth diapers, compostable diapers – which are available to a limited extent and currently have a small market share – or a mix of these. Such replacements require thorough analysis of the pros and cons of different alternatives in the local context (e.g., presence of adequate waste collection and composting facilities), including a gender perspective. UNEP has pulled together life cycle assessment studies comparing the use of disposable diapers to reusable diapers.[127] Consumers' geographical and technology context, such as washing practices, reuse (or not) of cloth diapers and available disposal systems, influence whether reusable or single-use diapers are preferred.


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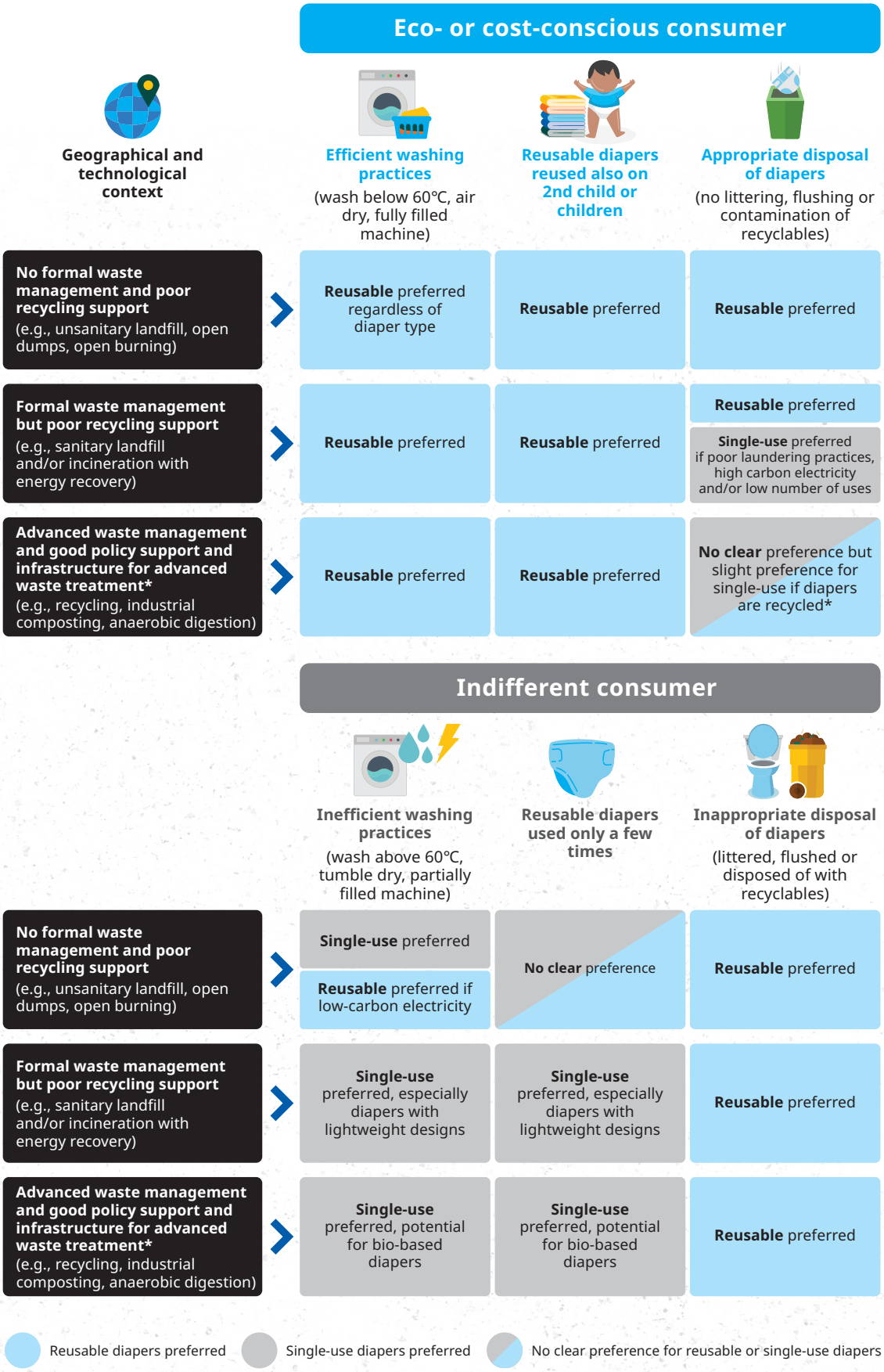
Figure 10 Life cycle assessments of diapers



* Recycling of single-use diapers is yet to be implemented on a large scale, with the main logistical and infrastructural challenges currently being the separate collection and storage of dirty ones. Recycling and other advanced waste treatment options for single-use diapers have, however, been shown to be technically feasible with good environmental outcomes in pilot studies.

Source: United Nations Environment Programme, *Single-use nappies and their alternatives: Recommendations from Life Cycle Assessments*, 2021, p.5.

Box 6 Vanuatu targets disposable diapers

The Pacific countries of Kiribati, Tuvalu and Vanuatu have led the way in proposing or implementing import controls on disposable diapers.[128] In 2019, Vanuatu was set to become the world's first country to ban disposable diapers[129] after discovering that diapers were a major component of Vanuatu's waste, accounting for 27 per cent of waste nationally.[130] This policy was postponed, however, due to insufficient support and infrastructure for alternatives.[131]

In late 2019, the idea to run a feasibility trial of reusable diapers was developed at a meeting between the Vanuatu Department for Environmental Protection and Conservation, UNICEF, Mamma's Laef Vanuatu, Bambino Mio and the Vanuatu Environmental Science Society.[130] In a 2020 trial with 59 participants, the Ni-Vanuatu-owned social enterprise Mamma's Laef Vanuatu produced reusable diapers which were distributed to households to test their feasibility over a two-week period accompanied by community workshops and outreach. Most participants liked the reusable diapers and 81 per cent supported the ban on disposables. Challenges included the higher up-front expense of reusable diapers (despite long-term savings); perception of reusable diapers as inconvenient and more time-consuming; poor fit on baby in some cases; and the burden of laundering diapers.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Handwashing in Vanuatu is the most common laundry practice, and disposing of faeces and wastewater is a challenge. Good WASH practices are essential for public health, and survey respondents commented on the time, water and energy needed to clean reusable diapers. Prototypes for non-electric washing machine technology were trialed in Vanuatu in collaboration with Engineers Without Borders Australia[131] and could offer a missing puzzle piece in the move towards alternatives to plastic disposable diapers. In 2023, Vanuatu's Government announced a 5 per cent import duty on disposable diapers, both to incentivize locally made reusable diapers and to reduce waste volume to the rapidly filling landfill.

It is estimated that over 12 billion disposable menstrual hygiene products are used annually.[132] Menstrual products have been found to contain measurable levels of endocrine-disrupting chemicals including phthalates, phenols and parabens, although research in this field is limited.[133,134]

Single-use menstrual products such as tampons and pads are a significant contributor globally to single-use plastic waste, containing up to 90 per cent plastic.[135] Most are landfilled or incinerated; those landfilled can take up to 500 years to break down, potentially releasing toxic chemicals as they degrade.[135]

In its review of life cycle assessments, UNEP highlighted that reusable menstrual products, in particular the menstrual cup, have lower environmental impacts.[135] It is crucial to assess alternatives in the context of local conditions, as well as using an age- and gender-sensitive lens to avoid imposing unjustified burdens.


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Baby bottles and infant formula

Babies post-World War II were the first to use plastic feeding bottles. These began to replace feeding bottles made of glass, metal and natural materials, some of which were unhygienic. Plastic baby bottles made of polycarbonate and polypropylene soon entered wider use. Recently, scientists have tested the extent to which nano- and microplastics are released from these bottles. Based on shaking warm water in plastic baby bottles from several countries, a single infant's intake of microplastics from feeding bottles is estimated in the range of 14,600–4,550,000 particles per day – and trillions of nanoplastics.[113] A follow-up study found more than 2 billion nanoplastics and 4 million microplastics were released when microwaving water in a baby bottle.[136] (Microwaving is discouraged for child safety due to uneven heating.) Plastic-associated chemicals and microplastics have also been found in baby food pouches,[137] formula powder,[138,139] and from plastic bags used to store expressed breast milk.[140] When these plastics are either frozen or heated, breakdown of the plastic is accelerated. Polycarbonate bottles also contain BPA.[141] Glass feeding bottles may be an alternative to reduce exposure to plastic, but may not be widely accessible and affordable. Life cycle assessment of baby bottle alternatives would provide important perspectives for environmental impact.

Textiles

Synthetic (plastic-based) textiles (e.g., polyester, acrylic, nylon) have become increasingly common, accounting for over 60 per cent of clothing material today.[22] Fast fashion is resource intensive and contributes an estimated 9 per cent of microplastic losses into the oceans.[142] At the end of life, the volume of discarded clothes traded globally has increased sevenfold over the past four decades, growing 10 per cent annually, and contributes to plastic pollution, in some cases in disadvantaged communities.[143]

High levels of hazardous plastic chemicals have been found in textiles ranging from clothing to diaper changing mats and crib mattress protectors.[4] For example, crib mattresses and protectors to keep mattresses dry often include a layer of PVC or 'vinyl' that contains phthalates and emits VOCs linked to asthma.[144,145] Phthalates in concentrations above 0.1 per cent of mass (i.e., above EU limits) have been reported in nylon sheets, cot mattresses and diaper changing mats.[146] High concentrations of bisphenols like BPA and BPS have been detected in textiles marketed to infants.[147] In a 2004 study of popular brands of children's clothing, PVC prints contained 20 per cent phthalates by weight.[148] Clothing, sheets, rugs and furniture marketed

towards or used by children and adolescents – especially those advertised as water- or stain-resistant – have been found to contain PFAS,[149] a large group of chemicals of concern known as 'forever chemicals', which include persistent organic pollutants recognized under the Stockholm Convention. Such chemicals are not labelled on textile products, making it virtually impossible for consumers to know what they are buying and for recyclers to process these products safely.[22]

Laundry causes around half a million tons of plastic microfibers to be released into the ocean each year.[142] Scented laundry detergent, softeners and dryer sheets can contain fragrance compounds encapsulated in plastic microcapsules that contribute to microplastic pollution.[150,151] Less-frequent washing and front-loading machines can reduce wear and tear, and technology is emerging at a household level to capture microplastics from laundry.[142]

Manufacture of synthetic textiles and garments should be assessed for impacts on workers – in particular women, who account for about 80 per cent of workers in garment manufacturing.[152] Pregnant women's occupational exposures to plastic particles and chemicals are also relevant for children.

Schools, playgrounds and building materials

Schools, playgrounds and homes are important environments for children, and it is therefore critical that they strive to use safe materials, both indoors and out.

Building materials can emit plastic additives and other chemicals, reducing indoor air quality, accumulating in dust and resulting in human exposure.[22,153] Because plastic building materials can last for several decades, new safety regulations may have come into effect since the time of construction, making waste management a challenge.[154]

PVC is a commonly used flooring material which has been associated with increased levels of BBP in indoor air and children's urine, and higher BBP metabolite concentrations were associated with an increased incidence of childhood asthma.[155] Mats made of PVC are commonly used for physical activity and in gymnasiums.[156] It is critical that building materials – including materials made of recycled plastics – are safe for children. Parents' exposure to PVC flooring during pregnancy has also been studied in the context of child asthma.[157]

Crumb rubber made from recycled tyres (also known as styrene butadiene rubber or tyre crumb) is widely used as infill on sporting grounds with artificial turf and playgrounds with a synthetic cushioned surface. In a study on crumb rubber commonly used on children's playgrounds and recreational sports surfaces, the United States Environmental Protection Agency confirmed the presence of chemicals such as polycyclic aromatic hydrocarbons, benzene, lead and phthalates, which have been linked to cancer, nervous system toxicity and impaired reproductive development.[158] The EU recently approved a ban on granular infill material used on artificial sport surfaces, which will take effect in 2031.[159]

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Box 7 'Chemical-Smart Preschool' initiative in Sweden's capital, Stockholm

In Sweden, a 'Chemical Smart' initiative was launched for schools and preschools in Stockholm to help staff prioritize identifying hazards and finding alternatives. "Parents should feel comfortable leaving their children in a good environment. It is difficult to change everything at once in and outside the classroom, but the staff can complete the work gradually and keep track of what issues remain," says Michael Klomark, principal of Trollboda and Smedshagen preschools in Stockholm.

A study comparing participating preschools and schools between 2015 and 2018 found that levels of BPA and BPF had decreased, but BPS (a replacement for BPA) increased; exposure to traditional phthalates were reduced, but replacements increased; and PVC flooring was still used extensively.[160] Following renovation with approved materials, exposure to plastic-associated SVOCs decreased significantly.[25]

"Plastic products often use plasticizers and flame retardants, such as phthalates and organophosphates. These can contribute to an increased incidence of asthma and allergies in children. Through the Chemical-Smart Preschool initiative, we could see that that the levels of these substances decreased significantly when schools took action. In particular, remodeling with building materials that were approved with respect to content of restricted chemicals had a greater effect than phasing out classroom items. This shows that construction has a major impact on the chemical load in the indoor environment," said Sarka Langer of the IVL Swedish Environmental Research Institute in Gothenburg.

Katarina Luhr, Member of Parliament and former Environment and Climate Councilor for the City of Stockholm, stated, "This initiative has shown that the regulation of hazardous chemicals, the removal of certain hazardous items, and our work to set chemical requirements for both building materials and business-related materials in the preschool environment, have had a measurable positive effect. We hope that the project can serve as a national example of successful chemical work in preschools and provide guidance to other municipalities."

Participating preschools in Stockholm's 'Chemical-Smart Preschool' project replaced old toys made from plastic (left) with natural materials (right).

Box 8 Fire safety for young athletes without toxic chemical flame retardants

Contribution by the Toxics Use Reduction Institute, USA

Polyurethane foam cubes used in foam pits in children's play centres and gyms have long provided safe landings. The toxic chemical flame retardants that are often added to the foam, however, escape from the cubes and enter the children's bodies. Decades of research indicate that chemical flame retardants, particularly halogenated flame retardants, cause adverse human health effects including endocrine and thyroid disruption, immunotoxicity, reproductive and developmental toxicity, neurobehavioural impacts and cancer.[161]

The Toxics Use Reduction Institute (TURI) at the University of Massachusetts Lowell worked with local gymnastics facilities to evaluate this concern and replace flame-retardant-containing foam cubes with a flame-retardant-free alternative.[156] An exposure study was conducted which confirmed that replacing flame-retardant-containing foam cubes with flame-retardant-free foam cubes substantially reduced the gymnasts' exposure to flame retardants.[162] Concurrently, both cube types underwent flammability testing to determine the technical necessity of flame retardants in the cubes. These flammability tests showed that both flame retardant and non-flame retardant cubes produce severe fires when exposed to a small open flame ignition source.[156] The decision was made to eliminate flame retardant cubes in the facility to reduce exposure to harmful chemicals. TURI and its community partners went on to work with local fire departments to ensure that fire safety was maintained using other facility-wide fire prevention measures such as sprinkler systems, evacuation plans and restriction of ignition sources.

As a result, several other gyms and play centres are replacing flame-retardant-containing foam cubes with flame-retardant-free foam cubes to ensure healthier spaces for children while maintaining fire safety.

Food contact materials and packaging

Because children eat more proportionally than adults, they are more highly exposed to plastic contaminants in their food, yet their metabolic pathways are immature.[6]

Scientists recently identified 3,601 chemicals present in food contact materials that have been detected in humans.[163] At least 30 of these chemicals have been found in samples directly related to infants (i.e., in breast milk, umbilical cord and placenta).

Ultra-processed food consumption has been associated with higher levels of urinary phthalates, bisphenols and other chemicals among children[164,165] and pregnant women.[166] A study in Brazil found that pregnant women who were high consumers of ultra-processed foods during the third trimester had higher PFAS concentrations in umbilical cord blood.[167] In the US, plastic chemicals such as ortho-phthalates and replacement plasticizers, like DEHT, have been found abundantly present in prepared meals at popular fast-food restaurants.[168] These endocrine-disrupting chemicals are an additional risk to children consuming unhealthy and ultra-processed foods.[169] The WHO-UNICEF-*Lancet* Commission underscored that children are frequently targets of marketing for fast foods and

sugar-sweetened beverages,[170] which are commonly packaged in single-use plastic.

Children's plates and tableware are often made of plastic. For example, melamine tableware is commonly marketed towards children as durable dishes that are not easily broken. Other kitchen equipment used to prepare food for children, such as nonstick pans coated with PFAS and plastic cutting boards, have been found to shed microplastics.[171,172] Metal cans contain an interior coating of epoxy to reduce corrosion and lengthen the shelf life of canned foods, which can contaminate the contents with bisphenols.[141]


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Toys and electronics

Toys made of plastic began appearing in shops in the late 1940s. An estimated 90 per cent of toys available on the market are made of plastic,[173,174] most commonly PVC, ABS, HIPS, polypropylene, polyethylene and polyurethane.[110] In Brazil alone, 1.38 million tons of plastic toys will be manufactured between 2018 and 2030, the equivalent of 198,000 garbage trucks lined up from New York to Miami.[173] A 2021 UNEP-commissioned report found 31 plasticizers, 18 flame retardants and 8 fragrances across hard plastic, soft plastic and foam plastic toys from 25 individual studies, with plasticizers in soft plastics showing the highest risk.[110]

Moreover, a study commissioned by the Norwegian Environment Agency found that 45 plastic children's toys together emitted hundreds of different VOCs, including the hazardous compounds cyclohexanone and xylene.[175] In its risk assessment, the agency indicated that most exposure levels were low, but the risks from the highest-emitting toy over repeated and prolonged exposure (especially bedside) would result in an increased risk of neurotoxicity and liver toxicity.[176] A forthcoming study found the presence of four toxic metals (arsenic, cadmium, lead and mercury) in plastic toys sold in the Philippines and Bangladesh, most of which target low-income communities (with prices ranging from US$1.00 to US$3.50).[55] Due to the lack of transparency in toy materials, it is difficult for families to identify which plastic toys may release hazardous chemicals.

Plastic toys and play jewellery manufactured prior to public health regulations often stay in circulation for years or decades, through hand-me-downs, donations and the second-hand market. Plastic toys that are decades old may still appear in good condition due to colour-fast pigments and durable surface materials, and can move unregulated through the marketplace. Many of these plastic toys are exempt from more recent regulations and contain high levels of known toxicants, such as lead and cadmium used as pigments, and PVC.[54]

Box 9 A policy lesson from plastic toys made from recycled e-waste

By the early 2000s, brominated flame retardants were widely added to foam and plastics used in consumer and electronic products. In 2009, the Stockholm Convention Conference of Parties (COP4) agreed to list commercial brominated flame retardants (specifically, PentaBDE and OctaBDE) for global elimination.

This decision, however, included an exemption that permitted the recycling of plastics, foam and other materials containing these substances until 2030. The designated expert Persistent Organic Pollutants Review Committee warned against the practice and issued a recommendation to "eliminate brominated diphenyl ethers from the recycling streams as swiftly as possible", noting in 2011 that this exemption "will inevitably result in wider human and environmental contamination and the dispersal of brominated diphenyl ethers into matrices from which recovery is not technically or economically feasible and in the loss of the long-term credibility of recycling".[177]

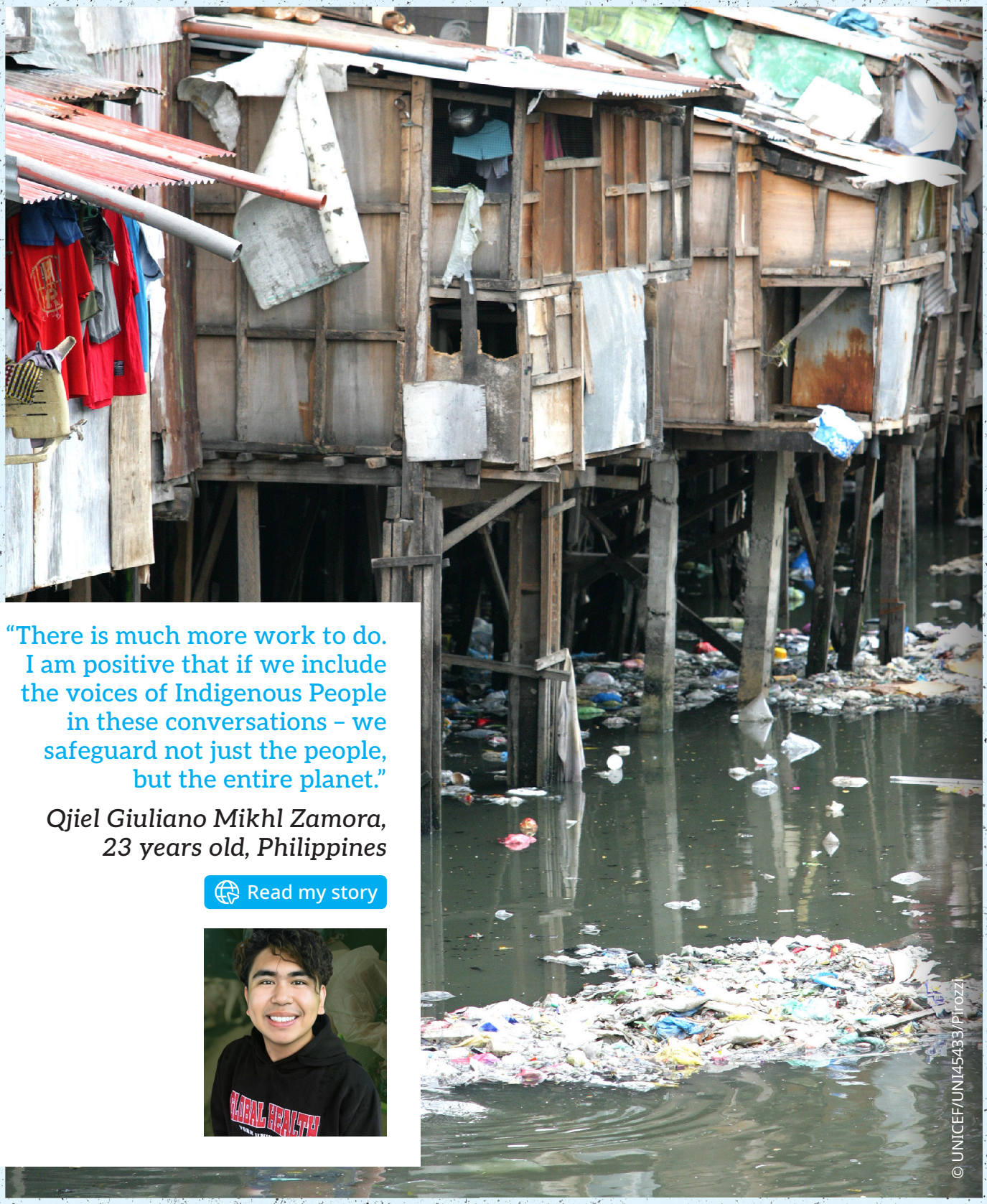
In the years following this exemption, persistent organic pollutants and hazardous chemicals from recycled e-waste were found in children's toys that would normally not contain those chemicals.[178] In one study, 92 per cent of laboratory-tested consumer products, including toys, purchased in 19 European countries were contaminated with BDEs coming primarily from recycled electronic waste.[179] A study from Japan found PBDE in toys and children's jewellery, especially in black and painted components of cheap products.[180]

Reorienting the market towards recycling and reuse are vital for tackling plastic pollution.[32] Policies on how and where recycled plastics can be used, along with chemical simplification of plastics, transparency and traceability are necessary steps towards safer recycled plastic products for children.[181]

Personal care products and make-up

Make-up, cosmetics and other personal care products are documented sources of microplastics and hazardous plastic-associated chemicals. Lotions, creams, sunscreen, oils, hair products, make-up and fragrances can all contribute to early life exposures to plastics, from both the packaging and the product itself. Children's skin is more immature than that of adults, and they are prone to eczema, which can create weaknesses in the skin barrier.[182] A recent US study found that 70 per cent of children younger than 13 years of age use beauty items like glitter, lip gloss, hair products and face paint, which frequently contain endocrine-disrupting plastic-associated chemicals such as phthalates, parabens and PFAS.[183] A recent study found that increasing use of skin care products was linked to increased body levels of phthalates and phthalate-replacement chemicals in children between 4 and 8 years old.[184] Glitter is itself a microplastic intentionally added to many beauty products marketed towards children.

In the Global South, children's cosmetics like soap and shampoo are often sold in individual sachets.[18] Customers can 'choose to refuse' plastic bags and packaging and, where available, opt instead for zero-waste stores that dispense goods with less packaging.[185]



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"There is much more work to do. I am positive that if we include the voices of Indigenous People in these conversations – we safeguard not just the people, but the entire planet."

Qjiel Giuliano Mikhl Zamora, 23 years old, Philippines

Read my story

Disposable e-cigarettes (vapes)

E-cigarettes have been aggressively marketed to young people, and their use has risen rapidly among adolescents. WHO reports that while 34 countries ban the sale of e-cigarettes, 88 countries have no minimum age at which e-cigarettes can be bought and 74 countries have no regulations in place for these harmful products. Children ages 13 to 15 are using e-cigarettes at rates higher than adults in all WHO regions. In Canada, the rates of e-cigarette use among 16–19-year-olds doubled between 2017 and 2022.[186] Disposable e-cigarettes are commonly made from a polycarbonate casing with a nylon wick, posing a risk of inhaling microplastic fibers or plastic foam as the components heat up and the wick deteriorates.[187] An estimated 844 million e-cigarettes are thrown away every year. As poorly recyclable e-waste, disposable e-cigarettes can pollute the environment with plastic, nicotine salts, heavy metals, lead, mercury, fluorinated microplastics and flammable lithium-ion batteries. The WHO-UNICEF-*Lancet* Commission specifically calls out the growing threat of exploitative advertising and marketing of tobacco and e-cigarettes to children.[170]

Health care and medical equipment

Plastics are widely used in paediatric health care, from packaging to medical devices. The use of plastics in health care is growing, and has been estimated to account for 2 per cent of all plastic production. Evidence indicates that medical devices are a source of exposure to plasticizers such as DEHP for patients in the neonatal intensive care unit.[188,189]

Single-use medical devices made of plastics facilitate screening, diagnosis, treatment and care.[22] These include, for example, intravenous tubing, bags, catheters, nasogastric tubes, dialysis bags and tubing, blood bags, transfusion tubing and air tubes.[190]

This widespread use of plastics means that plastic has been estimated to comprise 30 per cent of all health care waste.[191] Inappropriate handling of health care waste is a problem in countries with limited resources. It is necessary to make the use of plastics in health care more sustainable by eliminating unnecessary use, reusing when possible, developing innovative product and packaging design, and strengthening waste management practices. Health products are subject to regulatory controls and technical specifications, and so the process of replacing health products with alternatives requires sufficient time to permit regulatory approvals.

Box 10 What is the precautionary principle?

> "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for avoiding measures to prevent harm to human health or the environment."

The precautionary principle is among the Principles of the Rio Declaration on Environment and Development[192] and is a guiding principle of the Common Approach to Pollution of the United Nations System.[193]

Box 11 What are 'essential' uses of plastics?

Some plastic products and chemicals currently provide essential uses and functions for health, safety and society.[194] For policymaking, the 'essential use' concept could maintain essential uses through alternatives or safe substitutes. In the case that these are not available, time-bound exemptions accompanied by risk minimization, planning and support for subsequent phase-out could be implemented. This may be relevant for specific child uses, for example in paediatric medicine. The concept of essential use as applied in the Montreal Protocol was, for example, deployed successfully.[194]

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3.5 Knowledge gaps on plastic chemicals and particles

The complexity and growing, widespread use of plastics, combined with limited monitoring of health effects, have created large gaps in knowledge and regulation.

Over 16,000 plastic-associated chemicals

Plastics carry a wide range of chemicals: monomers, additives, processing aids and non-intentionally added substances. Additives are added to the polymer backbone intentionally during the production process and function as fillers, flame retardants, plasticizers

(i.e., softeners), antioxidants, antimicrobial agents, ultraviolet stabilizers, colourants and more. In reality, a large number of different chemicals are added to achieve relatively few desired functions (e.g., flexibility, stability, colour, etc.),[195] indicating opportunities for simplifying the production process. In some products, chemical additives can comprise between 5 and 50 per cent of final plastic product by weight. PET and HDPE are generally considered to have fewer intentionally added chemicals than other types of plastic.[196] Non-intentionally added substances range from impurities of starting materials to unwanted by-products and various contaminants from recycling.

The 2024 PlastChem report identified over 16,000 unique chemicals potentially used and present in plastics (also referred to as 'plastic-associated chemicals'), which is much higher than previous estimates.[27] Around a quarter of these – more than 3,600 – are unregulated chemicals of potential concern to human health and safety. Thousands more have never been tested for toxicity.[4,28] Hazard information is available on less than 40 per cent of these chemicals – and even that information which is available is incomplete, with very little known about prenatal or early exposures. Less than 6 per cent of plastic-associated chemicals are currently subject to global regulation, and even those regulations are based on incomplete hazard data, especially for children's health. Scientists are also working to identify polymers of concern.[197]

For additional detail, consult the 2024 PlastChem report, *State of the Science on Plastic Chemicals: Identifying and addressing chemicals and polymers of concern*.[27]

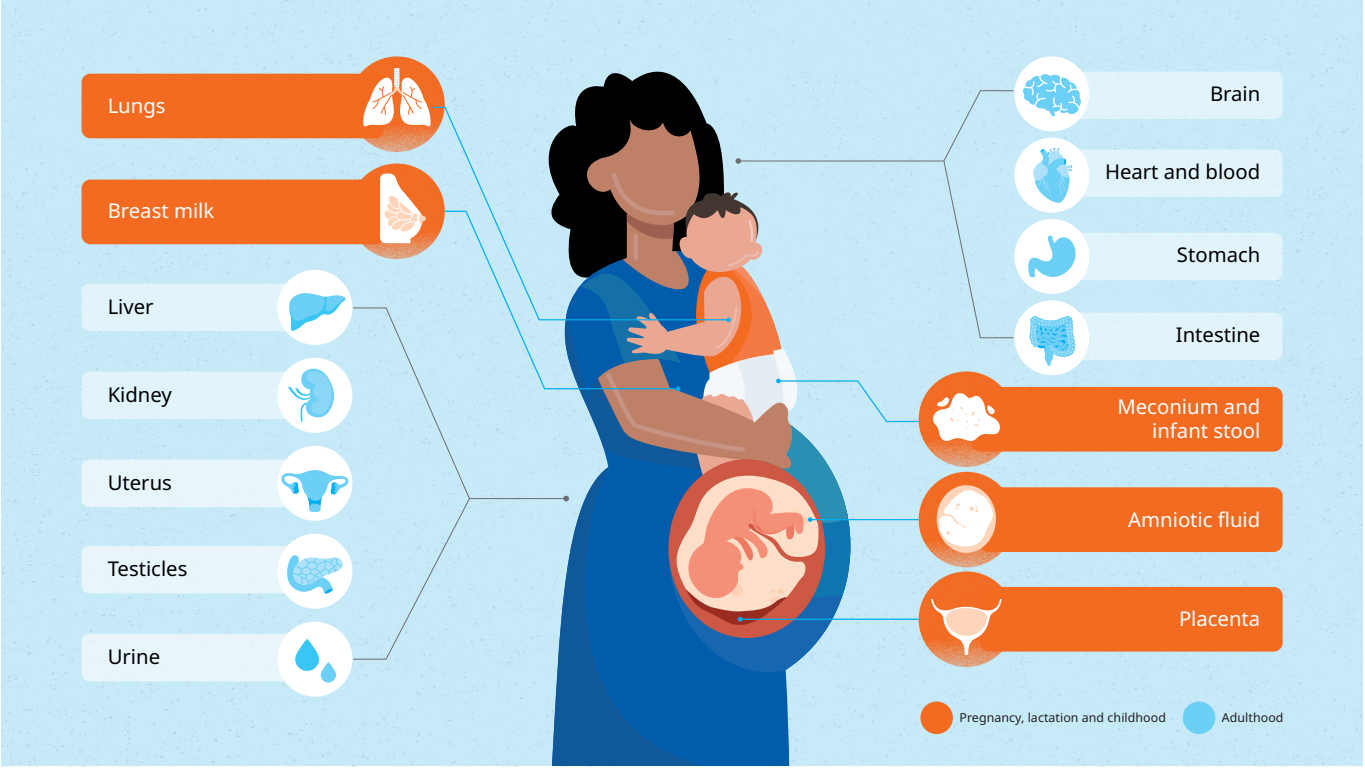
Nano- and microplastics

NMPs have been documented in amniotic fluid and are believed to travel across the placenta, based on evidence of NMPs in meconium, ex vivo human research and research on animal models. Research on microplastics is in its infancy, but already microplastics have been documented throughout the environment – from Antarctic snow to indoor air.[24] Particles from tyre wear are an abundant type of microplastic discharged into the environment.[198] Microplastic uptake in the general population has been estimated to have grown sixfold on average from 1990 to 2018, according to a 2024 modelling study of microplastic uptake in coastal regions.[59]

Plastics are a source of exposure to both particles and chemicals, representing two sides of the same coin.[24] To what extent microplastics function as a 'Trojan horse' – bringing into the human body chemicals, pollutants and microbes in or on the particles – is an area of active study.[62] Potential routes of exposure to nano- and microplastics in early life include via the placenta, breast milk, ingestion, inhalation and through the skin.[24]

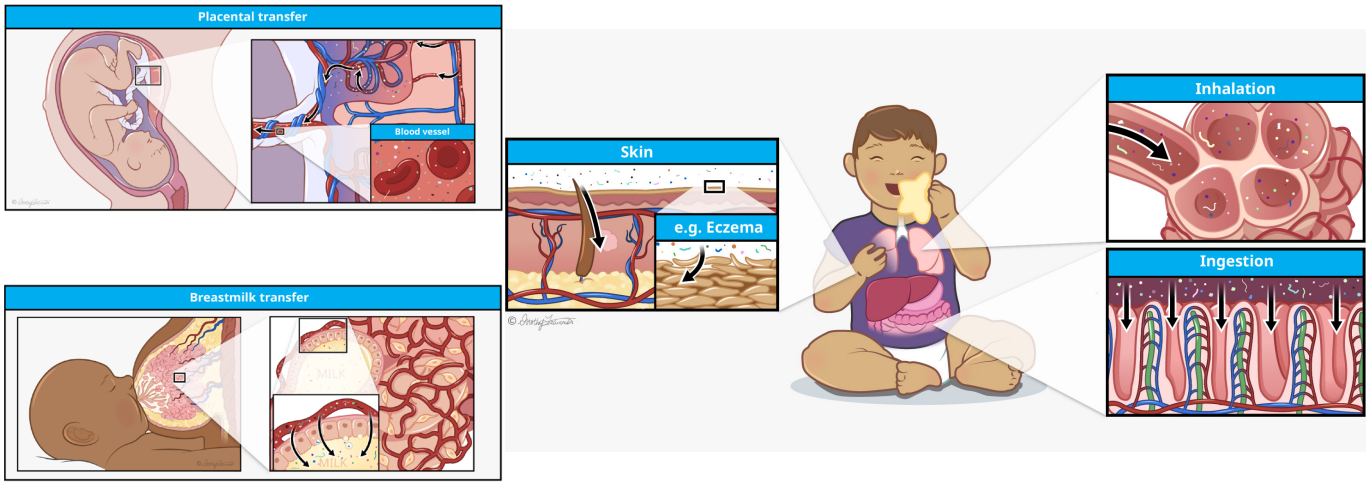
Research on microplastics in the human body is challenging. Recently, several studies have documented microplastics in the placenta.[117] In 2006, 60 per cent of placentas from a Hawaiian biobank contained plastic particles, rising to 90 per cent in 2013 and fully 100 per cent in 2021.[199] In humans, the presence of nano- and microplastics in the placenta has been associated with narrowing of the fetal capillaries and changes in placental anatomy,[4] both of which can harm the fetus during a critical window of development. In a recent study from Iran, all babies who were born small for gestational age were found to have microplastics in their placenta, compared to only 3 of 30 placentas from normal-weight babies; and birthweight, length, head circumference and one-minute Apgar score were all negatively associated with increased exposure to microplastics in utero.[200]

Figure 11 Where microplastics have been documented in the human body



Note: Meconium is a newborn's first stool.

Figure 12 How children are exposed to plastics



Potential prenatal, lactation, and early life exposure routes to nano- and microplastic particles, as well as to plastic-associated chemicals.
Source: Sripada et al., 'A Children's Health Perspective on Nano- and Microplastics'.[24] Medical Illustrations used with permission, © Dorothy Fatunmbi.

Putting the precautionary principle into practice

The absorption and potential health effects of exposure to plastics lacks comprehensive post-market monitoring.[29] Moreover, there is poor traceability in the supply chain from polymer production, to compounding (i.e., the process of blending in additives), to conversion into the plastic product. Because of this, manufacturers themselves may not know exactly which chemicals are in the final product. Comprehensive information on chemicals in plastics is therefore unavailable to regulatory authorities, consumers and waste managers, and this lack of information hampers assessments of risk and product safety.[22]

An approach based on the precautionary principle is needed to protect children from unknown harms from plastic production, use and waste. This includes avoiding regrettable substitution of a known hazardous plastic chemical with a material with similar or worse hazardous properties (as has occurred with bisphenols, flame retardants and others).[30] Research is needed that prioritizes children's exposures to plastic chemicals, particles, products and waste.

Risk assessment of plastic safety for children

Ideally, all plastics that children come in contact with should be thoroughly tested prior to entering the market for potential negative impacts on health, and mechanisms should be in place for monitoring for and identifying unanticipated health impacts. Yet globally, today's risk assessment of plastic and other chemicals is inadequate for protecting the young. Few risk assessments consider early life and prenatal exposures, low-level chronic exposures, the long timescales needed to understand how early exposures can lead to poorer health years and decades later, or the complexity of interactions within intricate human systems such as the endocrine system, immune system and neurodevelopment. What's more, risk assessment focuses on a single chemical at a time (e.g., BPA, specific phthalates, PFOA) and does not consider children's real-world exposures to so-called 'chemical cocktail' mixtures, a task which has become increasingly difficult in the context of the huge number and complexity of plastic chemicals. Moreover, assessment does not adequately account for the limitations of predicting safety given our incomplete knowledge of human biology and the unique susceptibility of the developing child. Safety is only assumed with different degrees of confidence, and there will always remain the possibility of unexpected harms and the need to mitigate those risks.[201]

To better protect children, a new and explicitly child-protective approach to hazard and risk assessment would be needed,[6] with strong international collaboration. Such an approach would implement the precautionary principle and create materials that are 'benign by design'.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Box 12 What is 'regrettable substitution' for plastics?

'Regrettable substitution' refers to replacing one material or chemical found to be harmful with an alternative that has similar or even worse hazardous properties, which may be known or unknown to the entity implementing the substitution.[30,202] In many cases, the replacements have been less researched and regulated. Regrettable substitution may resolve one problem but result in burden shifting elsewhere, for example from one health impact to another; from the Global North to the Global South; or from human health to the environment.[203] BPA and phthalates, now ubiquitous in our environment, are cautionary examples of regrettable substitution.

BPA, starting in the early 20th century, was added to consumer products like polycarbonate plastics and the lining of metal cans to prevent corrosion. Scientific evidence indicated that BPA disrupted hormone functioning.[204] In recent years, BPA has gradually been banned in certain products in some countries, including baby bottles. But BPA is often replaced by other similar bisphenols, such as BPS or BPF.[205] Although there is less research on BPS and BPF, scientists believe that these can be expected to have similar effects on health.[204] Moreover, regulations vary significantly across regions, and policies on baby bottles do not account for children's other routes of exposure, such as in utero and via breast milk.[206] In 2023, the European Food Safety Authority proposed a much more protective limit for human contact with BPA, but not bisphenols as a group.[207]

Phthalates, chemicals which soften plastics, are another cautionary tale. When policymakers decided to act on evidence that phthalates are endocrine-disrupting chemicals with negative health consequences, the EU began restricting several phthalates – namely DEHP, DBP, BBP, DIBP, DINP, DIDP, and DNOP – in toys and childcare articles that children may touch with their mouths. Brazil, Canada, Israel and the US also have some restrictions for phthalates in children's toys or items they may put in their mouths. Restrictions or labelling requirements for phthalates are very rare in most developing countries or countries with economies in transition.[22] Reported levels of phthalate chemicals in humans have changed over time, in some cases showing declines likely related to regulation such as in the EU[208] and in other cases showing increases as plastic production moves to substitute chemicals with similar functions.[209] Indeed, alternative plasticizers (e.g., newer ortho-phthalates, adipates, citrates, cyclohexanoates, terephthalates, trimellitates, polymerics, benzoates and phosphates) have rapidly replaced phthalates, including for children's products, while research and regulations on these chemicals lag behind.[210,211]

Safeguards based on the precautionary principle would protect children from known and unknown hazards stemming from regrettable substitution. Green product design and green chemistry will be important approaches for phasing out materials and chemicals in plastics that are hazardous to children.

Box 13 What are bio-based and biodegradable plastics, and are they safer for kids?

Bio-based plastics are now being used in children's items like toys and tableware in certain countries and markets. Approximately 1 per cent of plastic is produced from biomass, such as starch or cellulose, instead of fossil fuels like crude oil and gas.[12] A portion of this biomass comes from renewable sources (which may include food crops), although some products, like beverage bottles that are marketed as being plant-based, are actually a mix of bio-based and fossil-based plastics. Both types of plastic may contain hazardous additives, such as plasticizers. In a study of common food packaging materials in Norway, both bio-based and biodegradable plastics contained a wide range of chemicals found to be toxic to cells.[111] In terms of toxicity, bio-based plastics should therefore not be automatically considered safer than conventional plastics.[22]

Biodegradable and/or compostable plastics include both fossil-based and bio-based plastics that are designed to be biodegradable under specific conditions (e.g., temperature, humidity, oxygen content, presence of specific microorganisms, etc.). Industrial composting facilities are often required to enable this, however – which in turn require separate collection streams.[212] As these conditions are often not met and separate waste collection is not always available, some biodegradable plastics do not completely degrade within the advertised time frame, causing further pollution.

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4. REGULATORY LANDSCAPE

Fragmented policies for regulating plastics and chemicals at local, regional and international levels are a key challenge.[22]

The Basel Convention was created in 1989 to control the "international waste trade in response to cases of hazardous waste dumping in Africa, Asia and the Caribbean," but countries in the Global South continue to receive plastic waste, sometimes mismarked for recycling. After China enacted its National Sword policy, which banned most types of plastic waste imports, plastic waste was diverted to other recipient countries, such as India, Indonesia, Malaysia, Thailand, Türkiye and Viet Nam.[32,213] Some of these countries have also implemented restrictions, temporary freezes or bans on material imports, and are increasingly returning containers of 'illegal' plastic waste that does not meet standards.[32] In 2020, Interpol reported a sharp increase in crime related to the plastic waste trade, with criminal networks attempting to disguise plastic waste as recycling to exploit loopholes in regulations and weak enforcement.[214] Such actions result in further degradation of children's environments.

> Over **150** countries have at least one national policy on plastic

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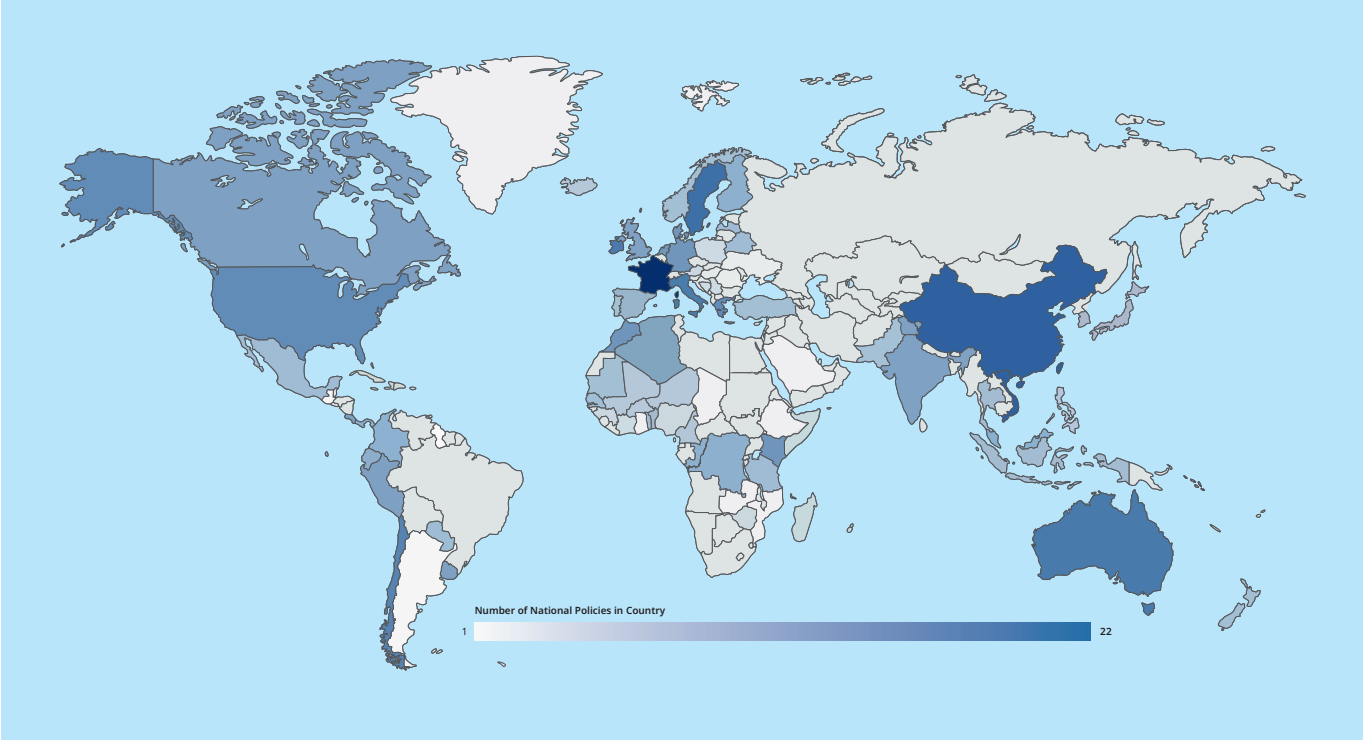
Map 2 Over 150 countries have at least one national policy on plastic



Disclaimer: This map does not reflect a position by UNICEF on the legal status of any country or territory or the delimitation of any frontiers.
Source: Karasik et al. 2023. Annual Trends in Plastics Policy: A Brief. Nicholas Institute for Energy, Environment and Sustainability. Duke University.[21]

Nearly 150 countries have at least one national or subnational policy on plastic, according to the Duke University Plastics Policy Inventory analysis.[215] Since 2017, national policies have increasingly targeted plastic bags and other single-use macroplastics. Substitution of fossil-based, single-use plastics with biodegradable or compostable alternatives has gained traction. By contrast, there has been little momentum towards curbing macro- or microplastics at the national level.

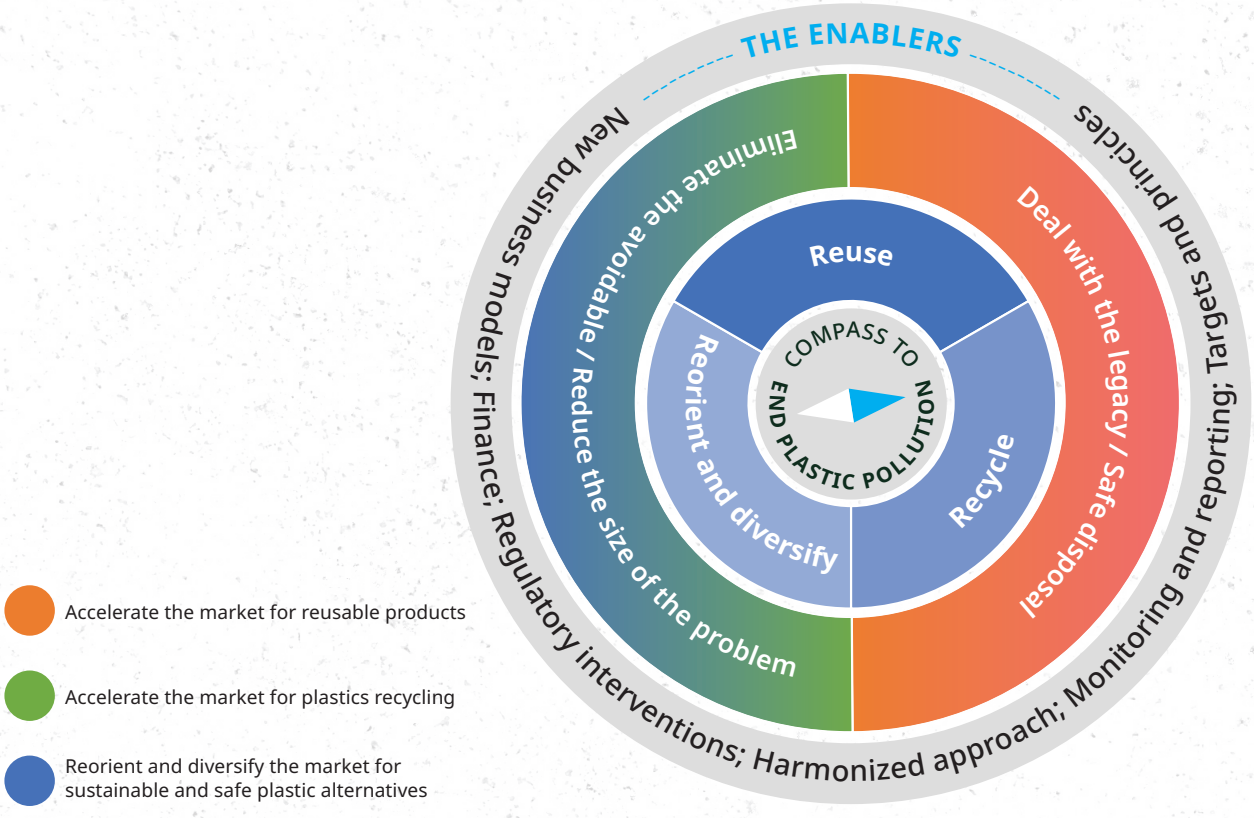
Some countries in both the Global North and Global South have implemented regulations to protect children, such as restrictions on chemicals in plastic toys, baby bottles and other child-specific products.[216] These policies are a step in the right direction but must be bolstered by stronger overall systems for plastic safety. This will involve a wide variety of sectors that appear to go beyond children, but in fact have a strong impact on them, such as waste management, transportation, building materials and electronics.

Some policies have already had measurable impact. The EU has regulated the phthalates DEHP, DBP, DIBP and BBP, which are added to plastics to increase flexibility, transparency and longevity, but are toxic for reproduction and interfere with the human hormonal system. Since use of these chemicals were restricted in the EU/EEA in July 2020, the ECHA estimates that the policy could save approximately 2,000 boys each year from impaired fertility later in life.[23] While the costs were around €17 million, the expected benefits are estimated to be €235 million annually.[23] Elsewhere, the costs continue to pile up: a 2024 analysis of the economic impact of disease and disability due to exposure to plastic chemicals for children in the US was over US$165 billion for the year 2018, driven in large part by exposure to flame retardant chemicals from plastic.[217]

To ensure a future for children with healthier environments and fewer risks from plastic to their health and rights, movement towards stronger regulatory safeguards and a circular economy must be accelerated. This means prevention and minimization of plastic production and use, emphasis on sharing and reuse, enhanced repair and recycling systems, and equitable and effective waste management. Extended producer responsibility will be a key piece of this transition. Schemes like plastic 'credits' (similar to carbon credits) must be scrutinized and greenwashing avoided. Types of recycling and waste management which may be harmful to human health or the environment should be prohibited. Policymakers should avoid reintroduction of chemicals of concern through reuse and recycling. Conflicts of interest can derail constructive dialogue, and evidence-based policymaking should be advanced. Enhancing transparency and access to information are important steps.

Given the enormous scale of plastic production, use and waste, it is most realistic and efficient to take a precautionary and hazard-based approach to identifying plastic chemicals of concern. Children should be prioritized in this work, given their unique vulnerabilities and long timescale during which they can develop and suffer from health consequences. A full-life-cycle approach as mandated by the United Nations Environment Assembly is necessary to address children's hazardous exposures at all points of the plastic life cycle.

Figure 13 **The compass to end plastic pollution**



Source: United Nations Environment Programme, *Turning off the Tap. How the world can end plastic pollution and create a circular economy*, Nairobi, 2023, p. 14.

5. VOICES OF YOUTH TAKING ACTION AGAINST PLASTIC POLLUTION

Read inspirational stories of youth around the world advocating for a solution to the global plastic pollution crisis; also available online.

Reuse for a Reformed Bangladesh

By Sharif Mohammed Sadat, 24

I am Sharif Mohammed Sadat, a medical student and passionate global health advocate from Bangladesh. Growing up in a densely populated city, I have seen first hand the profound impact of plastic pollution on both our environment and public health.

My journey into advocacy began when I recognized the inextricable link between plastic waste and the well-being of our communities, especially in under-resourced areas where waste management is often overlooked. As a youth advocate, I have organized numerous community clean-ups and awareness campaigns to educate young people about the dangers of plastic pollution. Among the most impactful initiatives I led was 'Reuse for a Reformed Bangladesh' where my team and I collected plastic bottle caps and transformed them into vibrant art.

This creative project not only encouraged the reuse of plastics, but it also sparked a trend across the country, inspiring others to explore innovative ways to repurpose waste. The art we created became a powerful symbol of how creativity can drive awareness and action towards a more sustainable future.

I firmly believe that when children understand the impact of plastic waste, they become powerful agents of change. By educating the younger generation, we empower them to influence their families and communities to adopt more sustainable practices. One of my most memorable experiences was seeing the enthusiasm of young students as they gathered plastic waste, shared their ideas for alternatives, and advocated for change with local authorities. It reaffirmed my belief that, given the right platform, children can be the spark for collective action.

Looking to the future, my hope is that by continuing to engage youth in environmental initiatives, we can create a cleaner, healthier planet for generations to come.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A Costa Rican youth teaches the next generation the health cost of single-use plastics

© Daniela Macaya

By Daniela Macaya, 22

Collecting shells as a young girl along the pristine shores of Coyote Beach, Costa Rica, was nirvana. However, I now find more plastic to pick up than shells, spending hours frantically gathering every piece that washes ashore – a noble but futile effort. It is like trying to clean up an oil spill while oil still gushes out of an open pipe. We need to shut the valve, and the key lies in education.

At 17 years old, during the COVID-19 quarantine, I wrote and illustrated Throw It 'Away' to sound the alarm on the hidden dangers of single-use plastics and inspire children that anyone – no matter their age or physical boundaries – can take meaningful action for the environment.

The book follows the journey of a plastic bag from a Costa Rican supermarket, traveling to unimaginable places and eventually returning to us full circle through the food we eat – a reality most children and even adults are unaware of. The story concludes with hands-on activities, like turning an old T-shirt into a reusable bag, to empower children to be part of the solution.

The translated Spanish version, *Desechada*, was published in 2022 by UNICEF Costa Rica and Editorial de la Universidad Estatal a Distancia (EUNED), the largest university publisher in Central America, as the special 40th anniversary book. Over 1,500 copies have been distributed to 60+ public libraries in Costa Rica. Furthermore, I have conducted book readings at schools, libraries and United Nations events for audiences of all ages. Ripples of change are visible, as I receive messages from youth showing me drawings reflecting their own concerns. I have also seen a bottom-up approach, as parents share conversations their children sparked at the dinner table about minimizing their plastic consumption.

Most recently, the book was adapted into an animated video and showcased at the United Nations stand during the High-Level Event on Ocean Action: 'Immersed in Change', in Costa Rica, in June 2024.

This book is more than a story; it is a call to action. We can't solve the plastic crisis overnight, but by empowering youth to act, we are planting the seeds for a cleaner, more sustainable future.

On the banks of the plastic-choked Brantas River, youth begin advocating for change

By Nina, 17

My name is Nina, and I represent the youth organization River Warrior Indonesia. I am the daughter of two Indonesian scientists who have taught me to take care of my environment.

Our house is located along the Brantas River, a drinking water source for more than 5 million people. My family drinks and uses water from this river, as do my schoolmates.

But the Brantas River has become a dumping ground for wastewater from plastic recycling industries. These industries mainly recycle imported plastic scraps from developed countries. We found garbage with labels from Australia, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands and the USA.

We collected trash for over three years and discovered that sachets, styrofoam, plastic bottles, diapers and plastic bags are the biggest polluters of the Brantas River. My team at River Warrior found almost 4,000 microplastic particles in 100 litres of river water.

I have tirelessly campaigned against the harmful practice of exporting plastic waste from developed countries to my home and other developing nations in the Global South.

My advocacy includes writing letters to influential global leaders, urging them to take action to end the illegal and unjust shipment of plastic waste.

This year, I spoke at the Plastic Health Summit in the Netherlands and the INC-4 Global Plastics Treaty negotiations in Canada, aiming to help country delegations see the human face behind the issue – children like me, whose future is being suffocated by increasing plastic waste and the petrochemicals driving its production, which destabilize our climate and ecosystems.

Through my activism, I aspire to create a world that is clean, safe, healthy and free from pollution. I hope to inspire others to join me in taking collective action for the future – especially if you are in high school like me. It is never too early to speak out about the future you want.

Zero Waste LunchKit inspires lunchrooms to drop single-use plastics

By Priyanka Lalla, UNICEF Youth Advocate and Child Rights Ambassador, 18

Plastic pollution in Trinidad and Tobago could easily be described as a national crisis, both for the environment and for child rights. Like other Small Island Developing States, Trinidad and Tobago faces unique vulnerabilities which exacerbate climate change impacts.

After Hurricanes Irma and Maria devastated the Leeward Islands, I felt compelled to act to ensure that such a disaster would not affect my country. The plastic pollution that washed up on the islands was alarming, threatening the biodiversity of coastal waters and mangroves. While some young people I spoke to felt that a transition away from plastic, wasteful habits, and landfills could not be achieved, I refused to give up. I saw the way my grandparents lived: their homes and lives were plastic free, healthy and ultimately sustainable. I knew that if I wanted to see change, I could not only ask others to change their habits – I needed to lead by example.

I created the Zero Waste LunchKit initiative at my school, where I encouraged students to pack a LunchKit with no plastic. Instead of processed foods packaged in plastic bags or disposable cutlery, students were encouraged to pack homemade, healthier food in reusable containers, with only sustainable lunch kit accessories such as cutlery and water bottles. The purpose of this initiative was to reduce plastic waste in the school community and hopefully share the initiative region-wide to show the impact of simple, individual action. If every Caribbean student packed a Zero Waste LunchKit, the impact would be great. Ultimately, it is not about reinventing the wheel or uprooting your life to become the perfect environmentalist. It is about being conscious of your daily actions to realize the choice between plastic and sustainability – and to choose sustainability when possible.

By confronting the plastic challenge head-on, Trinidad and Tobago can protect its citizens and preserve its natural heritage, fostering a more sustainable future amidst the realities of climate change. The crisis disproportionately affects marginalized populations, highlighting inequalities in environmental governance and access to sustainable practices. This will require a multifaceted approach that encompasses stricter regulations on plastic production, enhanced waste management practices, and community education. Intergenerational collaboration is needed to mobilize our youth for a more sustainable, plastics-free and circular future.

6. RECOMMENDATIONS

General Comment 26 outlines that "the best interests of the child shall be a primary consideration in the adoption and implementation of environmental decisions".[33] As the world addresses the plastic pollution crisis, ambitious regulation, international cooperation, feasible alternatives and rigorous clean-up will be needed to protect children from hazardous plastic chemicals, particles and waste.

Decisions are being made today by adults that will impact children. States must act to spare the next generation a plastic-choked future. Future generations will hold us accountable.

Generation Plastic calls for integrated, systemic shifts to protect children

1. Address the plastic pollution crisis through systems change

Plastic production and the plastic life cycle must be reshaped in order to reduce the most problematic and unnecessary plastic uses. The market should be transformed towards circularity through accelerating the shifts towards Reuse, Recycle, and Reorient and Diversify. Decision makers must deal with the legacy of plastic pollution.[32]

2. Advance chemical transparency and product safety for children

Transparency in the chemicals found in products can empower consumers, simplify recycling processes and promote circularity. Products that are marketed towards children should be prioritized according to the precautionary principle. Awareness-raising in communities and schools can empower children and youth. Research on the lifelong health impacts of widespread exposure of children to plastic chemicals and particles should be a high priority.

3. Concerted action for children bearing the greatest burden

Every child has the right to a "clean, healthy, and sustainable environment".[32] The rights and livelihoods of child waste pickers and fenceline communities must be respected, protected and fulfilled. Underlying structural causes need to be prioritized together with better waste management systems. Children and families living in the communities most strongly impacted by plastic production and waste deserve environmental justice.

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"With the Global Plastics Treaty, we are hopeful for the countries to end plastic pollution and its harms, while we continue to pick them out from our sidewalks, rivers, coastlines, homes, as well as reserves and natural habitats of our animals."

Marinda Imakulata Tagiilima Leiataua, 21 years old, Samoa

Read my story

ANNEX: KEY PLASTIC POLICY INVENTORY

Global (selected examples)

The Fifth Session of the Intergovernmental Negotiating Committee on Plastic Pollution (INC-5), 25 November–1 December, 2024, in Busan, Republic of Korea, was organized to develop an international legally binding instrument on plastic pollution, including in the marine environment.
https://www.unep.org/inc-plastic-pollution/session-5/documents#WorkingDocumentsINC5

In 2023, the Secretariat of the Basel, Rotterdam and Stockholm Conventions issued *Global governance of plastics and associated chemicals*.
https://www.basel.int/Portals/4/Basel%20Convention/docs/plastic%20waste/UNEP-FAO-CHW-RC-POPS-PUB-GlobalGovernancePlastics-2023.pdf

In 2019, the Plastic Waste Partnership was established under the Basel Convention BC-14/13. This group works to further actions to address plastic waste.
https://www.basel.int/Implementation/Plasticwaste/PlasticWastePartnership/tabid/8096/Default.aspx

Regional, national and subnational policies (selected examples)

Argentina

In 2021, Argentina banned intentionally added microplastics in personal care products.
https://www.argentina.gob.ar/normativa/nacional/ley-27602-345720

In 2012, BPA was banned in baby bottles and similar articles for use in children younger than 12 months.
https://www.argentina.gob.ar/normativa/nacional/disposici%C3%B3n-1207-2012-194516/texto

China

In 2017, the General Office of the State Council issued the Implementation Plan for Banning the Entry of Foreign Waste and Promoting the Reform of the Solid Waste Import Management System.
https://www.gov.cn/zhengce/content/2017-07/27/content_5213738.htm

European Union

ECHA scientific committees for Risk Assessment (RAC) and for Socio-Economic Analysis (SEAC) are currently evaluating a proposal to restrict PFAS in the EU/EEA.
https://echa.europa.eu/hot-topics/perfluoroalkyl-chemicals-pfas

In 2023, restrictions on microplastics and a ban on granular infill material used on artificial sport surfaces entered into force.
https://echa.europa.eu/hot-topics/granules-mulches-on-pitches-playgrounds

In 2011, Directive 2011/65/EU was issued on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011L0065

In 2009, the Toy Safety Directive 2009/48/EC laid down the safety criteria that toys must meet before they can be marketed in the EU.
https://single-market-economy.ec.europa.eu/sectors/toys/toy-safety_en

France

In 2018, the French National Assembly voted unanimously to adopt a law amendment that bans plastic containers used for cooking, heating and serving food in child care, school and university catering services.
http://www.assemblee-nationale.fr/15/ta/tap0171.pdf

India

In 2021, the Ministry of Environment, Forest and Climate Change issued the Plastic Waste Management Amendment Rules prohibiting certain single-use plastics.
https://leap.unep.org/en/akn/in/act/directive/2021/571e/eng%402021-08-12/overview

Rwanda

In 2019, Law No. 17/2019 relating to the prohibition of the manufacture, importation, use and sale of plastic carry bags and single-use plastic items was enacted.
https://rema.gov.rw/fileadmin/templates/Documents/rema_doc/Laws%20updated/Law%20relating%20to%20the%20prohibition%20of%20manufacturing,%20importation,%20use%20and%20sale%20of%20plastic%20carry%20bags.pdf

In 2008, Law No. 57/2008 relating to the prohibition of the manufacture, importation, use and sale of polythene bags was enacted.
https://nicholasinstitute.duke.edu/plastics-policies/law-no-572008-10092008-relating-prohibition-manufacturing-importation-use-and

Singapore

Singapore has introduced Mandatory Packaging Reporting for companies in the packaged goods sector, serving as a foundation for extended producer responsibility.
https://www.nea.gov.sg/our-services/waste-management/mandatory-packaging-reporting

United States

In 2024, the United States Environmental Protection Agency released the National Strategy to Prevent Plastic Pollution.
https://www.epa.gov/circulareconomy/national-strategy-prevent-plastic-pollution

In 2024, the Biden Administration's Interagency Policy Committee on Plastic Pollution and a Circular Economy published *Mobilizing Federal Action on Plastic Pollution: Progress, principles, and priorities.*
https://www.whitehouse.gov/wp-content/uploads/2024/07/Mobilizing-Federal-Action-on-Plastic-Pollution-Progress-Principles-and-Priorities-July-2024.pdf

California

In 2020, SB-1422 California Safe Drinking Water Act: Microplastics went into effect, requiring the State Water Board to adopt a definition of microplastics in drinking water, to adopt a standard methodology for testing drinking water for microplastics, and requirements for testing and reporting of microplastics in drinking water, including public disclosure of those results.
https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB1422

Vanuatu

In 2019, the second phase of the ban on single-use plastics went into effect. Note that the proposed diaper ban was later excluded from the enacted measures.
https://environment.gov.vu/images/News/press_release-30042019103417.pdf

References

1 Heacock, Michelle, et al., 'E-waste and Harm to Vulnerable Populations: A growing global problem', *Environmental Health Perspectives*, vol. 124, no. 5, May 2016, pp. 550–555.

2 Lancet, 'Electronic Waste – Time to Take Stock', *Lancet*, vol. 381, no. 9885, 29 June 2013, p. 2223.

3 Cottom, Joshua W., Ed Cook and Costas A. Velis, 'A Local-to-Global Emissions Inventory of Macroplastic Pollution', *Nature*, vol. 633, no. 8028, 5 September 2024, pp. 101–108.

4 Landrigan, Philip J., et al., 'The Minderoo-Monaco Commission on Plastics and Human Health', *Annals of Global Health*, vol. 89, no. 1, art. 23, 21 March 2023.

5 Pathak, Gauri, et al., 'The Open Burning of Plastic Wastes Is an Urgent Global Health Issue', *Annals of Global Health*, vol. 90, no. 1, art. 3, 12 January 2024.

6 Etzel, Ruth A., and Philip J. Landrigan, eds., *Textbook of Children's Environmental Health*, 2nd ed., Oxford University Press, New York, 2024.

7 Lebbie, Tamba S., et al., 'E-waste in Africa: A serious threat to the health of children', *International Journal of Environmental Research and Public Health*, vol. 18, no. 16, art. 8488, August 2021.

8 Tearfund, 'Plastic Pollution and Poverty: A briefing to inform negotiations on a UN treaty on plastics', Briefing paper, Tearfund, Teddington, UK, 2022.

9 World Health Organization, *Children and Digital Dumpsites: E-waste exposure and child health*, WHO, Geneva, 2021.

10 Butturi, Maria Angela, et al., 'Ecotoxicity of Plastics from Informal Waste Electric and Electronic Treatment and Recycling', *Toxics*, vol. 8, no. 4, art. 99, December 2020.

11 Clark, Cassandra J., et al., 'Unconventional Oil and Gas Development Exposure and Risk of Childhood Acute Lymphoblastic Leukemia: A case-control study in Pennsylvania, 2009–2017', *Environmental Health Perspectives*, vol. 130, no. 8, art. 087001, August 2022.

12 United Nations Environment Programme, *Drowning in Plastics: Marine litter and plastic waste vital graphics*, UNEP, Nairobi, 2021.

13 Karali, Nihan, Nina Khanna and Nihar Shah, *Climate Impact of Primary Plastic Production*, Lawrence Berkeley National Laboratory, Berkeley, Calif., April 2024.

14 United Nations Children's Fund, *Engaging Children and Young People on UNICEF's Strategic Plan 2022–2025*, UNICEF, New York, July 2021.

15 McIlgorm, Alistair, and Jian Xie, *The Costs of Environmental Degradation from Plastic Pollution in Selected Coastal Areas in the United Republic of Tanzania*, World Bank Group, Washington, D.C., 2023.

16 Beaumont, Nicola J., et al., 'Global Ecological, Social and Economic Impacts of Marine Plastic', *Marine Pollution Bulletin*, vol. 142, May 2019, pp. 189–195.

17 Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), *Sea-Based Sources of Marine Litter*, IMO, FAO, UNESCO-IOC, UNIDO, WMO, IAEA, UN, UNEP, UNDP, ISA, London, 2021.

18 Tearfund, Fauna and Flora International (FFI), WasteAid and the Institute of Development Studies (IDS), *No Time to Waste: Tackling the plastic pollution crisis before it's too late*, Tearfund, Teddington, UK, 2019.

19 Tearfund, *The Impact of Plastic Pollution on Urban Flooding Events: Estimating the number of people impacted globally*, Tearfund, Teddington, UK, May 2023.

20 World Bank Group, *Indonesia – Marine Debris Hotspot Rapid Assessment: Synthesis report*, World Bank Group, Washington, D.C., April 2018.

21 Adebote, D. A., et al., 'Epidemiological Significance of the Breeding of Mosquitoes in Discarded Automobile Tyres in Zaria, Northern Nigeria', *Journal of Communicable Diseases*, vol. 43, no. 3, September 2011, pp. 183–192.

22 United Nations Environment Programme and Secretariat of the Basel, Rotterdam and Stockholm Conventions, *Chemicals in Plastics: A technical report*, UNEP, Geneva, 2023.

23 European Chemicals Agency, 'Phthalates', <https://echa.europa.eu/hot-topics/phthalates>, accessed 20 November 2024.

24 Sripada, Kam, et al., 'A Children's Health Perspective on Nano- and Microplastics', *Environmental Health Perspective*, vol. 130, no. 1, art. 015001, January 2022.

25 Langer, Sarka, et al., 'The Effect of Reduction Measures on Concentrations of Hazardous Semivolatile Organic Compounds in Indoor Air and Dust of Swedish Preschools', *Indoor Air*, vol. 31, no. 5, September 2021, pp. 1673–1682.

26 European Chemicals Agency, *Investigation Report: PAHs in rubber crumbs – Limits under REACH and risk for children*, ECHA, Helsinki, 14 June 2023.

27 Wagner, Martin, et al., *State of the Science on Plastic Chemicals: Identifying and addressing chemicals and polymers of concern*, Martin Wagner et. al, Trondheim, Norway, 2024.

28 Symeonides, Christos, et al., 'An Umbrella Review of Meta-analyses Evaluating Associations between Human Health and Exposure to Major Classes of Plastic-Associated Chemicals', *Annals of Global Health*, vol. 90, no. 1, art. 52, 19 August 2024.

29 Seewoo, Bhedita J., et al., 'The Plastic Health Map: A systematic evidence map of human health studies on plastic-associated chemicals', *Environment International*, vol. 181, art. 108225, November 2023.

30 Strategic Approach to International Chemicals Management, 'Guidance: Avoid regrettable substitution', sect. 5.7 in 'International Chemicals Management Toolkit for the Toy Supply Chain', <https://saicmknowledge.org/sites/default/files/inline-files/5_7_guidance_avoiding_regrettable_substitution_fin_tracked.pdf>, accessed 29 November 2024.

31 Organisation for Economic Co-operation and Development, *Policy Scenarios for Eliminating Plastic Pollution by 2040*, OECD Publishing, Paris, 2024.

32 United Nations Environment Programme, *Turning off the Tap: How the world can end plastic pollution and create a circular economy*, UNEP, Nairobi, 2023.

33 Committee on the Rights of the Child, General Comment No. 26 (2023) on Children's Rights and the Environment, with a Special Focus on Climate Change, CRC/C/GC/26, CRC, Geneva, 22 August 2023.

34 Resolution adopted by the United Nations General Assembly, 'The Human Right to a Clean, Healthy and Sustainable Environment', A/RES/76/300, 28 July 2022.

35 Ritchie, Hannah, Veronika Samborska and Max Roser, 'Plastic Pollution', Our World in Data, 2023, <https://ourworldindata.org/plastic-pollution>, accessed 20 November 2024.

36 Project TENDR, 'Protecting the Developing Brains of Children from the Harmful Effects of Plastics and Toxic Chemicals in Plastics: Recommendations for essential policy reforms in the new global treaty on plastics', Briefing paper, Project TENDR, Washington, D.C., April 2024.

37 Villarrubia-Gómez, Patricia, et al., 'Plastics Pollution Exacerbates the Impacts of All Planetary Boundaries', *One Earth*, 7 November 2024.

38 Abramson, David, et al., 'Children's Health after the Oil Spill: A four-state study – Findings from the Gulf Coast Population Impact (GCPI) Project', NCDP Briefing Report 2013_1, Columbia University Mailman School of Public Health, New York, January 2013.

39 Nkem, Augusta C., et al., 'The Impact of Oil Industry-Related Social Exclusion on Community Wellbeing and Health in African Countries', *Frontiers in Public Health*, vol. 10, 2022.

40 Proville, Jeremy, et al., 'The Demographic Characteristics of Populations Living Near Oil and Gas Wells in the USA', *Population and Environment*, vol. 44, no. 1, September 2022, pp. 1–14.

41 Wager, Jessica L., and Jennifer A. Thompson, 'Development and Child Health in a World of Synthetic Chemicals', *Pediatric Research*, 2024.

42 Gore, A. C., et al., 'EDC-2: The Endocrine Society's second scientific statement on endocrine-disrupting chemicals', *Endocrine Reviews*, vol. 36, no. 6, 1 December 2015, pp. E1–E150.

43 Flaws, Jodi, et al., *Plastics, EDCs and Health: A guide for public interest organizations and policy-makers on endocrine disrupting chemicals and plastics*, Endocrine Society and International Pollutants Elimination Network, Washington, D.C., December 2020.

44 Ghassabian, Akhgar, and Leonardo Trasande, 'Disruption in Thyroid Signaling Pathway: A mechanism for the effect of endocrine-disrupting chemicals on child neurodevelopment', *Frontiers in Endocrinology*, vol. 9, 2018.

45 Ghassabian, Akhgar, et al., 'Prenatal Exposure to Common Plasticizers: A longitudinal study on phthalates, brain volumetric measures, and IQ in youth', *Molecular Psychiatry*, vol. 28, no. 11, November 2023, pp. 4814–4822.

46 Schreder, Erika, et al., 'Brominated Flame Retardants in Breast Milk from the United States: First detection of bromophenols in U.S. breast milk', *Environmental Pollution*, vol. 334, art. 122028, 1 October 2023.

47 Symeonides, Christos, et al., 'Male Autism Spectrum Disorder Is Linked to Brain Aromatase Disruption by Prenatal BPA in Multimodal Investigations and 10HDA Ameliorates the Related Mouse Phenotype', *Nature Communications*, vol. 15, art. 6367, 2024.

48 Choi, Giehae, et al., 'Prenatal Phthalate Exposures and Executive Function in Preschool Children', *Environment International*, vol. 149, art. 106403, April 2021.

49 Skogheim, Thea S., et al., 'Prenatal Exposure to Perfluoroalkyl Substances and Associations with Symptoms of Attention-Deficit/Hyperactivity Disorder and Cognitive Functions in Preschool Children', *International Journal of Hygiene and Environmental Health*, vol. 223, no. 1, January 2022, pp. 80–92.

50 Skogheim, Thea S., et al., 'Prenatal Exposure to Per- and Polyfluoroalkyl Substances (PFAS) and Associations with Attention-Deficit/Hyperactivity Disorder and Autism Spectrum Disorder in Children', *Environmental Research*, vol. 202, art. 111692, November 2021.

51 Kamai, Elizabeth M., et al., 'Gestational Phthalate Exposure and Preschool Attention Deficit Hyperactivity Disorder in Norway', *Environmental Epidemiology*, vol. 5, no. 4, art. e161, August 2021.

52 Engel, Stephanie M., et al., 'Prenatal Phthalates, Maternal Thyroid Function, and Risk of Attention-Deficit Hyperactivity Disorder in the Norwegian Mother and Child Cohort', *Environmental Health Perspectives*, vol. 126, no. 5, art. 057004, May 2018.

53 Choi, Giehae, et al., 'Pregnancy Exposure to Organophosphate Esters and the Risk of Attention-Deficit Hyperactivity Disorder in the Norwegian Mother, Father and Child Cohort Study', *Environment International*, vol. 154, art. 106549, September 2021.

54 Turner, Andrew, 'Concentrations and Migratabilities of Hazardous Elements in Second-Hand Children's Plastic Toys', *Environmental Science and Technology*, vol. 52, no. 5, 19 January 2018, pp. 3110–3116.

55 Lorenzo, J., et al., *Not Suitable for Children: Toxic chemicals in plastic toys sold in Bangladesh and the Philippines*, BAN Toxics and Environment and Social Development Organization, Quezon City and Dhaka, forthcoming in 2024.

56 Sripada, Kam, 'Nanomaterials and Child Health', ch. 38 in *Textbook of Children's Environmental Health*, 2nd ed., edited by Ruth A. Etzel and Philip J. Landrigan, Oxford University Press, New York, 2024.

57 Chen, Chunzhao, et al., 'Microplastics in the Bronchoalveolar Lavage Fluid of Chinese Children: Associations with age, city development, and disease features', *Environmental Science and Technology*, vol. 57, no. 34, 29 August 2023, pp. 12594–12601.

58 Danopoulos, Evangelos, et al., 'A Rapid Review and Meta-regression Analyses of the Toxicological Impacts of Microplastic Exposure in Human Cells', *Journal of Hazardous Materials*, vol. 427, art. 127861, 5 April 2022.

59 Zhao, Xiang, and Fengqi You, 'Microplastic Human Dietary Uptake from 1990 to 2018 Grew across 109 Major Developing and Industrialized Countries but Can Be Halved by Plastic Debris Removal', *Environmental Science and Technology*, vol. 58, no. 20, 21 May 2024, pp. 8709–8723.

60 World Health Organization, *Dietary and Inhalation Exposure to Nano- and Microplastic Particles and Potential Implications for Human Health*, WHO, Geneva, 2022.

61 Malmberg, B., et al., 'Powdering Floor Polish and Mucous Membrane Irritation in Secondary School Pupils', *International Archives of Occupational and Environmental Health*, vol. 73, no. 7, September 2000, pp. 498–502.

62 Vethaak, A. Dick, and Juliette Legler, 'Microplastics and Human Health', *Science*, vol. 371, no. 6530, 12 February 2021, pp. 672–674.

63 Tuvo, Benedetta, et al., 'Microplastics and Antibiotic Resistance: The magnitude of the problem and the emerging role of hospital wastewater', *International Journal of Environmental Research and Public Health*, vol. 20, no. 10, art. 5868, May 2023.

64 Tumwesigye, Edgar, et al., 'Microplastics as Vectors of Chemical Contaminants and Biological Agents in Freshwater Ecosystems: Current knowledge status and future perspectives', *Environmental Pollution*, vol. 330, art. 121829, 1 August 2023.

65 Yalçin, S. S., B. Güneş and S. Yalçin, 'Presence of Melamine in Human Milk and the Evaluation of the Effects on Mother-Infant Pairs in a Cohort Study', *Human and Experimental Toxicology*, vol. 39, no. 5, May 2020, pp. 624–633.

66 Sathyanarayana, Sheela, et al., 'Melamine and Cyanuric Acid Exposure and Kidney Injury in US Children', *Environmental Research*, vol. 171, April 2019, pp. 18–23.

67 Sarigiannis, D. A., 'Assessing the Impact of Hazardous Waste on Children's Health: The exposome paradigm', *Environmental Research*, vol. 158, October 2017, pp. 531–541.

68 International Agency for Research on Cancer, *Some Chemicals that Cause Tumours of the Urinary Tract in Rodents: IARC monographs on the evaluation of carcinogenic risk to humans, volume 119*, IARC, Lyon, France, 2019.

69 International Agency for Research on Cancer, *Styrene, Styrene-7, 8-Oxide, and Quinoline: IARC monographs on the evaluation of carcinogenic risks to humans, volume 121*, IARC, Lyon, France, 2019.

70 Geyer, Roland, 'Production, Use, and Fate of Synthetic Polymers', ch. 2 in *Plastic Waste and Recycling: Environmental impact, societal issues, prevention, and solutions*, edited by Trevor M. Letcher, Academic Press, London, 2020.

71 Global Alliance for Incinerator Alternatives, *Zero Waste to Zero Emissions: How reducing waste is a climate gamechanger*, GAIA, Berkeley, Calif., 2022.

72 United Nations Environment Programme, *Towards Zero Waste: A catalyst for delivering the Sustainable Development Goals*, UNEP, Nairobi, 2023.

73 International Labour Organization, *Rapid Assessment of Child Labour in Waste-Picking in Pakistan*, ILO, Geneva, 2023.

74 Ghana National Plastic Action Partnership, *Intersectional and Inclusive Social Context Assessment of Ghana's Informal Plastics and Plastics Waste Sector*, Global Plastic Action Partnership, Geneva, March 2024.

75 Business Insider, *How Syria's 'Valley of Death' Became One of the Largest Landfills in the Country*, 14 May 2024, <www.youtube.com/watch?v=2NesfDyrGHE>, accessed 20 November 2024.

76 Dias, Sonia Maria, 'Waste and Citizenship Forums: Achievements and limitations', CWG-WASH Workshop paper no. 11, Collaborative Working Group on Solid Waste Management in Low- and Middle-Income Countries, Kolkata, 1–5 February 2006.

77 United Nations Environment Programme, *Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource*, UNEP, Nairobi, 2024.

78 Lerner, Sharon, 'Africa's Exploding Plastic Nightmare: As Africa drowns in garbage, the plastics business keeps booming', *Intercept*, 19 April 2020, <https://theintercept.com/2020/04/19/africa-plastic-waste-kenya-ethiopia/>, accessed 20 November 2024.

79 Pratham Education Foundation, *Plastic STORI: Study of rural India – Provisional report*, Pratham Education Foundation, Delhi, July 2022.

80 Sun, Xiaoyan, et al., 'Multi-element Synergistic Effects to Improve the Flame Retardancy of High Impact Polystyrene', *Polymer Testing*, vol. 115, art. 107766, November 2022.

81 Baldé, Cornelis P., et al., *Global E-waste Monitor 2024*, International Telecommunication Union and United Nations Institute for Training and Research, Geneva and Bonn, Germany, 2024.

82 International Labour Office and United Nations Children's Fund, *Child Labour: Global estimates 2020, trends and the road forward*, ILO and UNICEF, New York, 2021.

83 Baldé, Cornelis P., T. Yamamoto and V. Forti, 'Datasets on Invisible E-waste Supporting the International E-waste Day 2023', Statistical briefing, United Nations Institute for Training and Research, Bonn, Germany, 2023.

84 Petrlik, Jindrich, et al., *Weak Controls: European e-waste poisons Africa's food chain*, International Pollutants Elimination Network and Basel Action Network, Seattle, Wash., April 2019.

85 Han, GuanGen, et al., 'Correlations of PCBs, DIOXIN, and PBDE with TSH in Children's Blood in Areas of Computer E-waste Recycling', *Biomedical and Environmental Sciences*, vol. 24, no. 2, April 2011, pp. 112–116.

86 United Nations Environment Programme, *From Pollution to Solution: A global assessment of marine litter and plastic pollution*, UNEP, Nairobi, 2021.

87 Nayanathara Thathsarani Pilapitiya, P. G. C., and Amila Sandaruwan Ratnayake, 'The World of Plastic Waste: A review', *Cleaner Materials*, vol. 11, art. 100220, March 2024.

88 Kaza, Silpa, et al., *What a Waste 2.0: A global snapshot of solid waste management to 2050*, Urban Development Series, World Bank Group, Washington, D.C., 2018.

89 Wojnowska-Baryła, Irena, Katarzyna Bernat and Magdalena Zaborowska, 'Plastic Waste Degradation in Landfill Conditions: The problem with microplastics, and their direct and indirect environmental effects', *International Journal of Environmental Research and Public Health*, vol. 19, no. 20, art. 13223, October 2022.

90 Xiang, Rui, et al., 'Isolation Distance between Municipal Solid Waste Landfills and Drinking Water Wells for Bacteria Attenuation and Safe Drinking', *Scientific Reports*, vol. 9, art. 17881, 29 November 2019.

91 Organisation for Economic Co-operation and Development, *Global Plastics Outlook: Policy scenarios to 2060*, OECD Publishing, Paris, 2022.

92 Zero Waste Europe, 'Hidden Emissions: A story from the Netherlands', Case study, Zero Waste Europe, Brussels, November 2018.

93 United Nations Environment Programme, *Waste to Energy: Considerations for informed decision-making*, UNEP, Nairobi, 2019.

94 World Health Organization, 'Dioxins', 29 November 2023, <www.who.int/news-room/fact-sheets/detail/dioxins-and-their-effects-on-human-health>, accessed 20 November 2024.

95 World Health Organization, 'Training Modules in Health-Care Waste Management', <www.who.int/teams/environment-climate-change-and-health/water-sanitation-and-health-(wash)/health-care-facilities/health-care-waste/training-modules>, accessed 20 November 2024.

96 Pathak, Gauri, et al., 'Plastic Pollution and the Open Burning of Plastic Wastes', *Global Environmental Change*, vol. 80, art. 102648, May 2023.

97 Pinnell, Owen, Sarah Ibrahim and Esme Stallard, 'Toxic Gas Putting Millions at Risk in the Middle East, BBC Finds', 28 November 2023, <https://www.bbc.com/news/science-environment-67522413>, accessed 20 November 2024.

98 National Academies of Sciences, Engineering, and Medicine, 'Public Health Research and Surveillance Priorities from the East Palestine Train Derailment: Proceedings of a workshop – In brief', National Academies Press, Washington, D.C., 2024.

99 United Nations Children's Fund, 'Clean Air, Healthy Children: An agenda for action – Protecting children from seven deadly sources of air pollution', Policy brief, UNICEF, New York, September 2024.

100 World Health Organization, United Nations Children's Fund and United Nations Population Fund, 'Protecting Maternal, Newborn and Child Health from the Impacts of Climate Change: A call for action', WHO, Geneva, 2023.

101 Tangri, Neil, Sam Adu-Kumi and Jorge Emmanuel, 'Plastic Production Reduction: The climate imperative', Policy brief, Global Alliance for Incinerator Alternatives, Berkeley, Calif., 18 April 2024.

102 Ramaswamy, V., and Hardeep Rai Sharma, 'Plastic Bags – Threat to Environment and Cattle Health: A retrospective study from Gondar city of Ethiopia', *IIOAB Journal*, vol. 2, no. 1, January 2011, pp. 7–12.

103 World Bank Group, *Sierra Leone: Rapid damage and loss assessment of August 14th, 2017 – Landslides and floods in the western area*, World Bank Group, Washington, D.C., 2017.

104 Office of the United Nations High Commissioner for Human Rights, 'End-of-Visit Statement by the United Nations Special Rapporteur on Toxics and Human Rights: Baskut Tuncak on his visit to Sierra Leone, 14–25 August 2017', 25 August 2017, <www.ohchr.org/en/statements/2017/08/end-visit-statement-united-nations-special-rapporteur-toxics-and-human-rights>, accessed 21 November 2024.

105 United Nations Environment Programme, 'Our Planet Is Choking on Plastic', <http://unep.org/interactive/beat-plastic-pollution/>, accessed 21 November 2024.

106 Weschler, C. J., and W. W. Nazaroff, 'SVOC Exposure Indoors: Fresh look at dermal pathways', *Indoor Air*, vol. 22, no. 5, October 2012, pp. 356–377.

107 Stone, Alex, *Formaldehyde and 15 Volatile Organic Chemicals in Children's Products*, Washington State Department of Ecology, Olympia, Wash., June 2021.

108 International Organization for Standardization, 'ISO/DIS 24187(en): Principles for the analysis of plastics and microplastics present in the environment', ISO, Geneva, 2021, <www.iso.org/obp/ui#iso:std:iso:24187:dis:ed-1:v1:en>, accessed 21 November 2024.

109 Fantke, Peter, et al., 'Coupled Near-Field and Far-Field Exposure Assessment Framework for Chemicals in Consumer Products', *Environment International*, vol. 94, September 2016, pp. 508–518.

110 Aurisano, Nicolò, et al., 'Chemicals of Concern in Plastic Toys', *Environment International*, vol. 146, art. 106194, January 2021.

111 Zimmermann, Lisa, et al., 'Are Bioplastics and Plant-Based Materials Safer than Conventional Plastics? In vitro toxicity and chemical composition', *Environment International*, vol. 145, art. 106066, December 2020.

112 Grandjean, Philippe, and Martine Bellanger, 'Calculation of the Disease Burden Associated with Environmental Chemical Exposures: Application of toxicological information in health economic estimation', *Environmental Health*, vol. 16, no. 1, art. 123, December 2017.

113 Li, Dunzhu, et al., 'Microplastic Release from the Degradation of Polypropylene Feeding Bottles during Infant Formula Preparation', *Nature Food*, vol. 1, no. 11, November 2020, pp. 746–754.

114 Mohamed Nor, Nur Hazimah, et al., 'Lifetime Accumulation of Microplastic in Children and Adults', *Environmental Science and Technology*, vol. 55, no. 8, 20 April 2021, pp. 5084–5096.

115 Cox, Kieran D., et al., 'Human Consumption of Microplastics', *Environmental Science and Technology*, vol. 53, no. 12, 18 June 2019, pp. 7068–7074.

116 Street, Maria Elisabeth, and Sergio Bernasconi, 'Microplastics, Environment and Child Health', *Italian Journal of Pediatrics*, vol. 47, no. 1, art. 75, December 2021.

117 Ragusa, Antonio, et al., 'Plasticenta: First evidence of microplastics in human placenta', *Environment International*, vol. 146, art. 106274, January 2021.

118 United Nations Environment Programme, *Global Chemicals Outlook II: From legacies to innovative solutions – Implementing the 2030 Agenda for Sustainable Development*, UNEP, Nairobi, 2019.

119 Pew Charitable Trusts and SYSTEMIQ, *Breaking the Plastic Wave: A comprehensive assessment of pathways towards stopping ocean plastic pollution*, Pew Charitable Trusts, Philadelphia, Pa., 2020.

120 Thomas-Possee, Mair L. H., et al., 'Disposable Diaper Consumption in Sub-Saharan Africa: Estimating the risks of associated unsafe waste', *PLOS Sustainability and Transformation*, vol. 3, no. 4, art. e0000106, April 2024.

121 French Agency for Food, Environmental and Occupational Health and Safety, *Safety of Baby Diapers: ANSES revised opinion – Collective expert appraisal report, scientific edition*, ANSES, Maisons-Alfort, France, January 2019.

122 French Agency for Food, Environmental and Occupational Health and Safety, *Annex XV Restriction Report: Proposal for a restriction on the following substances in single-use baby diapers*, ANSES, Maisons-Alfort, France, 15 December 2020.

123 Direction générale de la Concurrence, de la Consommation et de la Répression des fraudes, 'Substances chimiques dans les couches pour bébés: l'enquête de la DGCCRF confirme l'amélioration de la qualité des produits et l'absence de dépassement des seuils sanitaires', Press release, DGCCRF, Paris, 2 July 2020.

124 Edmond, Charlotte, 'Disposable Nappies are One of the Biggest Contributors to Plastic Waste – but How Green Are the Alternatives?', World Economic Forum, Geneva, 23 August 2023, <www.weforum.org/stories/2023/08/disposable-nappies-landfill-plastic-circular-economy/>, accessed 21 November 2024.

125 Ó Briain, Oisín, et al., 'The Role of Wet Wipes and Sanitary Towels as a Source of White Microplastic Fibres in the Marine Environment', *Water Research*, vol. 182, art. 116021, 1 September 2020.

126 Shruti, V. C., Fermín Pérez-Guevara and Gurusamy Kutralam-Muniasamy, 'Wet Wipes Contribution to Microfiber Contamination under COVID-19 Era: An important but overlooked problem', *Environmental Challenges*, vol. 5, art. 100267, December 2021.

127 United Nations Environment Programme, *Single-Use Nappies and Their Alternatives: Recommendations from life cycle assessments*, UNEP, Nairobi, 2021.

128 Secretariat of the Pacific Regional Environment Programme, *Research Report: Assessment of alternatives to single-use disposable diapers – Volume 2 – Literature review*, Apia, Samoa, 2022.

129 Vanuatu Department of Environmental Protection and Conservation, 'Second Phase of the Ban on Single-Use Plastics', Press release, DEPC, Port Vila, Vanuatu, 29 Apr 2019.

130 Savvy Vanuatu, Mamma's Laef Vanuatu and Bambino Mio, *Introducing Modern Reusable Nappies into Vanuatu: A trial study*, Bambino Mio, Northamptonshire, UK, 2021.

131 United Nations Environment Programme, 'Solutions to Social and Environmental Impacts of Disposal Diaper Waste in Vanuatu', Perspectives Series issue no. 43, UNEP, Nairobi, April 2023.

132 Barth, Theresa, 'Making Menstruation Products Eco Friendly', Plastic Oceans International, 10 February 2021, <https://plasticoceans.org/making-menstruation-products-eco-friendly/>, accessed 21 November 2024.

133 Upson, Kristen, Jenni A. Shearston and Marianthi-Anna Kioumourtzoglou, 'Menstrual Products as a Source of Environmental Chemical Exposure: A review from the epidemiologic perspective', *Current Environmental Health Reports*, vol. 9, no. 1, March 2022, pp. 38–52.

134 Marroquin, Joanna, et al., 'Chemicals in Menstrual Products: A systematic review', *BJOG: An international journal of obstetrics and gynaecology*, vol. 131, no. 5, April 2024, pp. 655–664.

135 United Nations Environment Programme, *Single-Use Menstrual Products and Their Alternatives: Recommendations from life cycle assessments*, UNEP, Nairobi, 2021.

136 Hussain, Kazi Albab, et al., 'Assessing the Release of Microplastics and Nanoplastics from Plastic Containers and Reusable Food Pouches: Implications for human health', *Environmental Science and Technology*, vol. 57, no. 26, 21 June 2023, pp. 9782–9792.

137 Tang, Cheng, et al., 'Evaluation and Identification of Chemical Migrants Leached from Baby Food Pouch Packaging', *Chemosphere*, vol. 340, art. 139758, November 2023.

138 Zhang, Qiji, et al., 'Microplastics in Infant Milk Powder', *Environmental Pollution*, vol. 323, art. 121225, 15 April 2023.

139 Kadac-Czapska, Kornelia, et al., 'Isolation and Identification of Microplastics in Infant Formulas: A potential health risk for children', *Food Chemistry*, vol. 440, art. 138246, 15 May 2024.

140 Liu, Liping, et al., 'Release of Microplastics from Breastmilk Storage Bags and Assessment of Intake by Infants: A preliminary study', *Environmental Pollution*, vol. 323, art. 121197, 15 April 2023.

141 Trasande, Leonardo, 'Further Limiting Bisphenol A in Food Uses Could Provide Health and Economic Benefits', *Health Affairs*, vol. 33, no. 2, February 2014, pp. 316–323.

142 United Nations Environment Programme, 'Fashion's Tiny Hidden Secret', UNEP, Nairobi, 13 March 2019, <www.unep.org/news-and-stories/story/fashions-tiny-hidden-secret>, accessed 21 November 2024.

143 United Nations Economic Commission for Europe, *Reversing Direction in the Used Clothing Crisis: Global, European and Chilean perspectives*, United Nations, Geneva, 2024.

144 Boor, Brandon E., et al., 'Identification of Phthalate and Alternative Plasticizers, Flame Retardants, and Unreacted Isocyanates in Infant Crib Mattress Covers and Foam', *Environmental Science and Technology Letters*, vol. 2, no. 4, 14 April 2015, pp. 89–94.

145 Boor, Brandon E., et al., 'Infant Exposure to Emissions of Volatile Organic Compounds from Crib Mattresses', *Environmental Science and Technology*, vol. 48, no. 6, 18 March 2014, pp. 3541–3549.

146 Negev, Maya, et al., 'Concentrations of Trace Metals, Phthalates, Bisphenol A and Flame-Retardants in Toys and Other Children's Products in Israel', *Chemosphere*, vol. 192, February 2018, pp. 217–224.

147 Liu, Wenbin, Jingchuan Xue and Kurunthachalam Kannan, 'Occurrence of and Exposure to Benzothiazoles and Benzotriazoles from Textiles and Infant Clothing', *Science of the Total Environment*, vol. 592, 15 August 2017, pp. 91–96.

148 Pedersen, Henrik, and Jacob Hartmann, *Greenpeace Investigations: Corporate crimes – Toxic textiles by Disney*, Greenpeace, Brussels, April 2004.

149 Rodgers, Kathryn M., et al., 'How Well Do Product
Labels Indicate the Presence of PFAS in Consumer Items Used by Children and Adolescents?', *Environmental Science and Technology*, vol. 56, no. 10, 17 May 2022, pp. 6294–6304.

150 European Chemicals Agency, *Annex XV Restriction Report: Intentionally added microplastics*, ECHA, Helsinki, 22 August 2019.

151 De Falco, Francesca, et al., 'The Contribution of Washing Processes of Synthetic Clothes to Microplastic Pollution', *Scientific Reports*, vol. 9, art. 6633, 29 April 2019.

152 International Labour Organization, 'The Future of Work in Textiles, Clothing, Leather and Footwear', Working paper no. 326, ILO, Geneva, 2019.

153 Lucattini, Luisa, et al., 'A Review of Semi-volatile Organic Compounds (SVOCs) in the Indoor Environment: Occurrence in consumer products, indoor air and dust', *Chemosphere*, vol. 201, June 2018, pp. 466–482.

154 Li, Li, et al., 'Long-Term Emissions of Hexabromocyclododecane as a Chemical of Concern in Products in China', *Environment International*, vol. 91, May 2016, pp. 291–300.

155 Whyatt, Robin M., et al., 'Asthma in Inner-City Children at 5–11 Years of Age and Prenatal Exposure to Phthalates: The Columbia Center for Children's Environmental Health cohort', *Environmental Health Perspectives*, vol. 122, no. 10, October 2014, pp. 1141–1146.

156 Toxics Use Reduction Institute, 'Gym Creates Healthier and Safer Foam Pits: Removes toxic flame retardants', TURI, Lowell, Mass., n.d.

157 Shu, H., et al., 'PVC Flooring at Home and Development of Asthma among Young Children in Sweden: A 10-year follow-up', *Indoor Air*, vol. 24, no. 3, June 2014, pp. 227–235.

158 United States Environmental Protection Agency, 'Federal Research on Recycled Tire Crumb Used on Playing Fields and Playgrounds', EPA, Washington, D.C., 17 April 2024, <https://www.epa.gov/chemical-research/federal-research-recycled-tire-crumb-used-playing-fields-and-playgrounds>, accessed 21 November 2024.

159 European Chemicals Agency, 'Granules and Mulches on Sports Pitches and Playgrounds', ECHA, Helsinki, <https://echa.europa.eu/hot-topics/granules-mulches-on-pitches-playgrounds>, accessed 21 November 2024.

160 Giovanoulis, Georgios, et al., 'Reduction of Hazardous Chemicals in Swedish Preschool Dust through Article Substitution Actions', *Environment International*, vol. 130, art. 104921, September 2019.

161 United States National Institute of Environmental Health Sciences, 'Flame Retardants and Your Health', NIEHS, Research

Triangle Park, N.C., April 2023.

162 Broadwater, Kendra, et al., *Evaluation of Occupational Exposure to Flame Retardants at Four Gymnastics Studios: Health hazard evaluation report no. 2014-0131-3268*, United States National Institute for Occupational Safety and Health, Cincinnati, Ohio, September 2017.

163 Food Packaging Forum, 'FCChumon Database', <https://foodpackagingforum.org/resources/databases/fcchumon>, accessed 21 November 2024.

164 Buckley, Jessie P., et al., 'Ultra-processed Food Consumption and Exposure to Phthalates and Bisphenols in the US National Health and Nutrition Examination Survey, 2013–2014', *Environment International*, vol. 131, art. 105057, October 2019.

165 Steele, Eurídice Martínez, et al., 'Association between Dietary Contribution of Ultra-processed Foods and Urinary Concentrations of Phthalates and Bisphenol in a Nationally Representative Sample of the US Population Aged 6 Years and Older', *PLOS One*, vol. 15, no. 7, art. e0236738, 31 July 2020.

166 Baker, Brennan H., et al., 'Ultra-processed and Fast Food Consumption, Exposure to Phthalates during Pregnancy, and Socioeconomic Disparities in Phthalate Exposures', *Environment International*, vol. 183, art. 108427, January 2024.

167 Naspolini, Nathalia Ferrazzo, et al., 'Maternal Consumption of Ultra-processed Foods and Newborn Exposure to Perfluoroalkyl Substances (PFAS)', *Cadernos de saúde pública*, vol. 37, no. 11, art. e00152021, 1 December 2021.

168 Edwards, Lariah, et al., 'Phthalate and Novel Plasticizer Concentrations in Food Items from U.S. Fast Food Chains: A preliminary analysis', *Journal of Exposure Science and Environmental Epidemiology*, vol. 32, no. 3, May 2022, pp. 366–373.

169 Yates, Joe, et al., 'A Toxic Relationship: Ultra-processed foods and plastics', *Globalization and Health*, vol. 20, no. 1, art. 74, December 2024.

170 Clark, Helen, et al., 'A Future for the World's Children? A WHO–UNICEF–Lancet Commission', *Lancet*, vol. 395, no. 10224, 22 February 2020, pp. 605–658.

171 Luo, Yunlong, et al., 'Raman Imaging for the Identification of Teflon Microplastics and Nanoplastics Released from Non-stick Cookware', *Science of the Total Environment*, vol. 851, part 2, art. 158293, 10 December 2022.

172 Yadav, Himani, et al., 'Cutting Boards: An overlooked source of microplastics in human food?', *Environmental Science and Technology*, vol. 57, no. 22, 6 June 2023, pp. 8225–8235.

173 Green Chemistry, Sustainability and Education Research Group and the Federal University of São Carlos, *Plasticized Childhood: The impact of plastic toy advertising to children on their health and the environment*, Alana Institute Child and Consumerism Program, São Paulo, June 2020.

174 Plastics le mag, 'Christmas: Plastic toys in vogue', 23 November 2011, <https://plastics-themag.com/Plastic-shakes-up-the-toy-industry>, accessed 21 November 2024.

175 Bohlin-Nizzetto, Pernilla, and Norbert Schmidbauer, *Survey of Emissions of Volatile Organic Chemicals from Handheld Toys for Children above 3 Years*, Norwegian Institute for Air Research, Kjeller, Norway, December 2020.

176 DHI, *Risk Assessment of VOCs in Handheld Toys for Children*, Norwegian Environment Agency, Trondheim, Norway, November 2021.

177 DiGangi, Joseph, and Jitka Straková, *Toxic Toy or Toxic Waste: Recycling POPs into new products – Summary for decision-makers*, Arnika and International Pollutants Elimination Network, Prague, October 2015.

178 DiGangi, Joseph, Jitka Straková and Lee Bell, *POPs Recycling Contaminates Children's Toys with Toxic Flame Retardants*, Arnika and International Pollutants Elimination Network, Prague, November 2017.

179 Straková, Jitka, Joseph DiGangi and Génon K. Jensen, *Toxic Loophole: Recycling hazardous waste into new products*, Arnika, Health and Environment Alliance and the International Pollutants Elimination Network, Prague and Brussels, October 2018.

180 Kajiwara, Natsuko, et al., 'Recycling Plastics Containing Decabromodiphenyl Ether into New Consumer Products including Children's Toys Purchased in Japan and Seventeen Other Countries', *Chemosphere*, vol. 289, art. 133179, February 2022.

181 Carney Almroth, Bethanie, et al., 'Chemical Simplification and Tracking in Plastics', *Science*, vol. 382, no. 6670, 3 November 2023, p. 525.

182 Mack, Mary Catherine, et al., 'Water-Holding and Transport Properties of Skin Stratum Corneum of Infants and Toddlers Are Different from Those of Adults: Studies in three geographical regions and four ethnic groups', *Pediatric Dermatology*, vol. 33, no. 3, May/June 2016, pp. 275–282.

183 Medley, Eleanor A., et al., 'Usage of Children's Makeup and Body Products in the United States and Implications for Childhood Environmental Exposures', *International Journal of Environmental Research and Public Health*, vol. 20, no. 3, art. 2114, February 2023.

184 Bloom, Michael S., et al., 'Impact of Skin Care Products on Phthalates and Phthalate Replacements in Children: the ECHO-FGS', *Environmental Health Perspectives*, vol. 132, no. 9, art. 097001, September 2024.

185 Global Alliance for Incinerator Alternatives, *Sachet Economy: Big problems in small packets*, GAIA, Quezon City, July 2020.

186 World Health Organization, 'Urgent Action Needed to Protect Children and Prevent the Uptake of E-cigarettes', News release, WHO, Geneva, 14 December 2023, <https://www.who.int/news/item/14-12-2023-urgent-action-needed-to-protect-children-and-prevent-the-uptake-of-e-cigarettes>, accessed 21 November 2024.

187 Turner, Andrew, et al., 'Deconstructing Contemporary Disposable Vapes: A material and elemental analysis', *Science of the Total Environment*, vol. 954, art. 176292, 1 December 2024.

188 Bernard, Lise, et al., 'Medical Devices Used in NICU: The main source of plasticisers' exposure of newborns', *Science of the Total Environment*, vol. 858, part 3, art. 159994, 1 February 2023.

189 Health Care Without Harm, *Plastics and Health: An urgent environmental, climate, and health issue*, HCWH, n.p., November 2022.

190 Weber, Roland, et al., *20 Case Studies on How to Prevent the Use of Toxic Chemicals Frequently Found in the Mediterranean Region*, Technical University of Denmark, Kongens Lyngby, Denmark, 2018.

191 Rizan, Chantelle, et al., 'Plastics in Healthcare: Time for a re-evaluation', *Journal of the Royal Society of Medicine*, vol. 113, no. 2, February 2020, pp. 49–53.

192 Report of the United Nations Conference on Environment and Development, 'Rio Declaration on Environment and Development', A/CONF.151/26 (Vol. 1), 12 August 1992.

193 United Nations Environment Management Group, *The United Nations System: Common approach towards a pollution-free planet*, United Nations, Geneva, 2023.

194 Scientists' Coalition for an Effective Plastics Treaty, 'Policy Brief: The essential use concept for the global plastics treaty', Scientists' Coalition for an Effective Plastics Treaty, Oslo, 2024.

195 European Chemicals Agency, *Describing Uses of Additives in Plastic Material for Articles and Estimating Related Exposure: Practical guide for industry*, ECHA, Helsinki, March 2020.

196 Stevens, Sarah, et al., 'Plastic Food Packaging from Five Countries Contains Endocrine- and Metabolism-Disrupting Chemicals', *Environmental Science and Technology*, vol. 58, no. 11, 19 March 2024, pp. 4859–4871.

197 Suh, Sangwon, et al., 'Conceptual Framework for Identifying Polymers of Concern', *Frontiers in Sustainability*, vol. 5, 23 April 2024.

198 United Nations Environment Programme, 'Vehicle Tyre Particles in the Environment', Foresight Brief no. 034, UNEP, Nairobi, September 2024.

199 Weingrill, Rodrigo Barbano, et al., 'Temporal Trends in Microplastic Accumulation in Placentas from Pregnancies in Hawai'i', *Environment International*, vol. 180, art. 108220, October 2023.

200 Amereh, Fatemeh, et al., 'Placental Plastics in Young Women from General Population Correlate with Reduced Foetal Growth in IUGR Pregnancies', *Environmental Pollution*, vol. 314, art. 120174, 1 December 2022.

201 World Health Organization, *Principles for Evaluating Health Risks in Children Associated with Exposure to Chemicals*, WHO, Geneva, 2006.

202 United Nations Environment Programme, 'Some Chemical Pollutants Reducing in Humans and the Environment, but New Ones Keep Popping Up', Press release, UNEP, Nairobi, 17 June 2024, <www.unep.org/news-and-stories/press-release/some-chemical-pollutants-reducing-humans-and-environment-new-ones>, accessed 21 November 2024.

203 Fantke, Peter, Roland Weber and Martin Scheringer, 'From Incremental to Fundamental Substitution in Chemical Alternatives Assessment', *Sustainable Chemistry and Pharmacy*, vol. 1, June 2015, pp. 1–8.

204 vom Saal, Frederick S., and Laura N. Vandenberg, 'Update on the Health Effects of Bisphenol A: Overwhelming evidence of harm', *Endocrinology*, vol. 162, no. 3, art. BQAA171, March 2021.

205 Parkinson, Lindsey, 'Regrettable Substitution and the Precautionary Principle', Food Packaging Forum, 6 September 2022, <https://foodpackagingforum.org/resources/background-articles/regrettable-substitution-the-precautionary-principle>, accessed 21 November 2024.

206 Fernandez, Marina Olga, and Leonardo Trasande, 'The Global Plastics Treaty: An endocrinologist's assessment', *Journal of the Endocrine Society*, vol. 8, no. 1, art. BVAD141, January 2024.

207 EFSA Panel on Food Contact Materials, Enzymes and Processing Aids, et al., 'Re-evaluation of the Risks to Public Health Related to the Presence of Bisphenol A (BPA) in Foodstuffs', EFSA Journal, vol. 21, no. 4, art. e06857, April 2023.

208 Katsikantami, Ioanna, et al., 'A Global Assessment of Phthalates Burden and Related Links to Health Effects', *Environment International*, vol. 97, December 2016, pp. 212–236.

209 Domínguez-Romero, Elena, et al., 'Time-Trends in Human Urinary Concentrations of Phthalates and Substitutes DEHT and DINCH in Asian and North American Countries (2009–2019)', *Journal of Exposure Science and Environmental Epidemiology*, vol. 33, no. 2, March 2023, pp. 244–254.

210 Bølling, Anette Kocbach, et al., 'Phthalate Exposure and Allergic Diseases: Review of epidemiological and experimental evidence', *Environment International*, vol. 139, art. 105706, June 2020.

211 Walters, Perry, David F. Cadogan and Christopher J. Howick, 'Plasticizers', in *Ullmann's Encyclopedia of Industrial Chemistry*, edited by Claudia Ley, Wiley-VCH, Weinheim, Germany, 2020.

212 United Nations Environment Programme, Plastic Pollution Science (Updated for the Fourth Session of the Intergovernmental Negotiating Committee), UNEP/PP/INC.4/INF/1, 16 April 2024.

213 Moyen Massa, Gilbert, and Vasiliki-Maria Archodoulaki, 'An Imported Environmental Crisis: Plastic mismanagement in Africa', *Sustainability*, vol. 16, no. 2, art. 672, January 2024.

214 INTERPOL, *Strategic Analysis Report: Emerging criminal trends in the global plastic waste market since January 2018*, INTERPOL, Lyon, France, August 2020.

215 Karasik, Rachel, et al., *2023 Annual Trends in Plastics Policy: A brief*, Duke University Nicholas Institute for Energy, Environment & Sustainability, Durham, N.C., 2023.

216 United Nations Environment Programme, *Review of Chemicals-Related Toy Safety Policies and Regulations in Selected Low- and Middle-Income Countries*, UNEP, Geneva, 30 April 2021.

217 Trasande, Leonardo, et al., 'Chemicals Used in Plastic Materials: An estimate of the attributable disease burden and costs in the United States', *Journal of the Endocrine Society*, vol. 8, no. 2, art. BVAD163, February 2024.

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