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The Plastic Paradox: Implications for Chronic Disease, and What We Can Do About It

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Plastics have transformed health care.

Plastics have transformed the world.

- 2 million tons produced each year in 1950s
- Today: 400 million tons produced each year
- Growing demand from emerging economies

Of the virgin plastics produced globally in 2020, 52% produced in Asia (32% in China), followed by North America (19%), Europe (17%), the Middle East and Africa (7%), and Latin America (4%)

Plastics have created a crisis.

- Ecosystem effects
- Climate change
- Chemicals and human health

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- **Ecosystem effects**
- Climate change
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Ecosystem effects

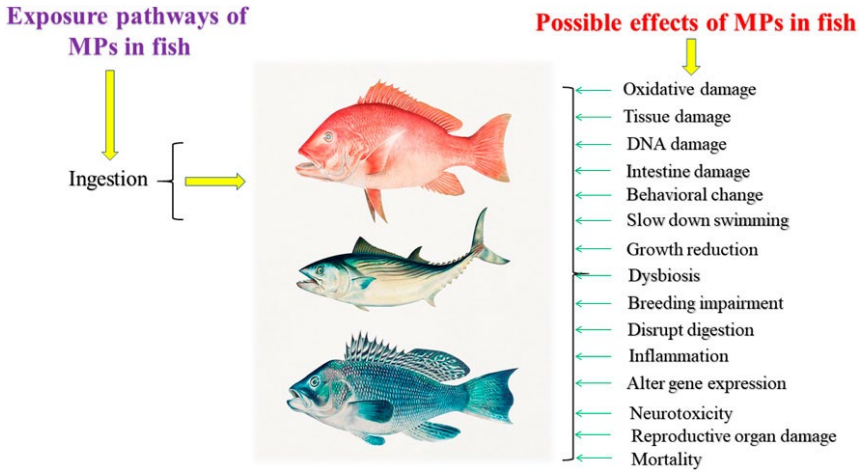
- 22 million tons of plastic waste enter the environment annually

- 9% of all plastic used to date has been recycled

Fates for unrecycled plastic:

- Controlled and uncontrolled landfills
- Burning Export

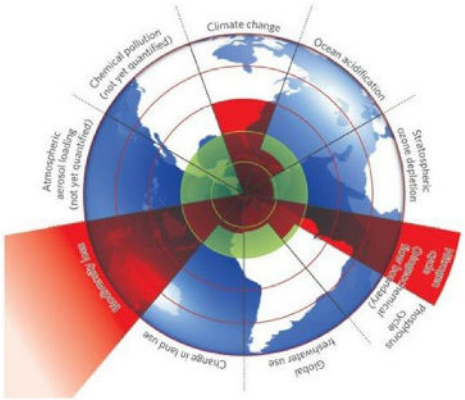
Visible and micro-plastics in wildlife



Bhuyan Front. Environ. Sci., 16 March 2022 | https://doi.org/10.3389/fenvs.2022.827289

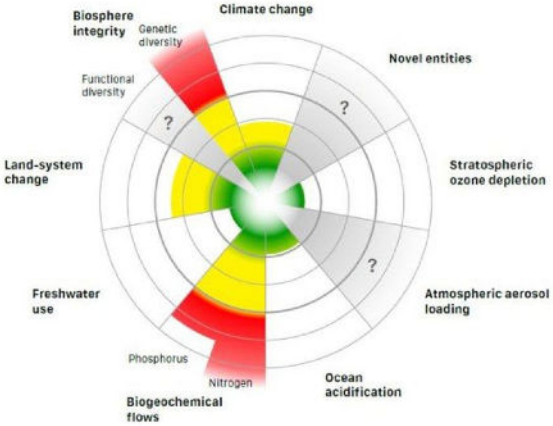
ALERT! Crossing boundaries.

2009



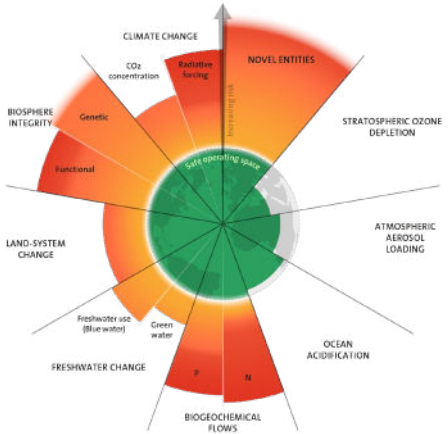
3 boundaries crossed

2015



4 boundaries crossed

2022



6 boundaries crossed

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It’s the plastic!

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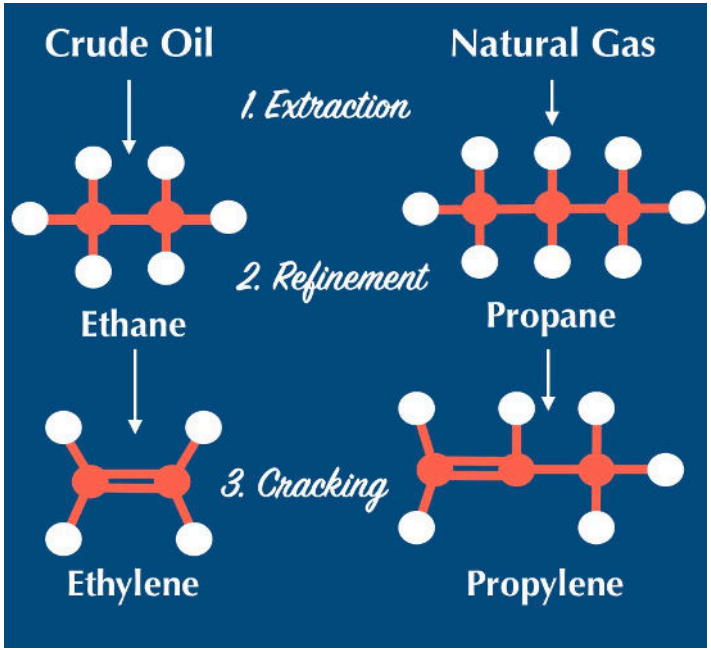
Plastics have created a crisis.

- Ecosystem effects
- **Climate change**
- Chemicals and human health

Plastics come from fossil fuels

- Nearly all plastics are made from fossil fuel feed stocks
- Polyethylene plastics are produced by cracking ethane, which is readily separated from natural gas.
- In fact, multinational fossil companies are pivoting from making fuels to plastic
  - Sinopec (+36% growth in plastic production between 2020-2025),
  - ExxonMobil (+35%)
  - PetroChina (+38%)
  - Russian-owned SIBUR (+240%),
  - Oman Oil Refineries and Petroleum (+269%)
  - Indian HPLC-Mittal (+343%)



Climate change

- Estimates from Karali et al (https://escholarship.org/uc/item/6cc1g99q):
  - Primary plastic production contributed 2.24 gigatonnes of carbon dioxide emissions in 2019, 5.3% of total emissions globally.
  - Approximately 22% comes from polyethylene plastics while polyvinylchloride and other plastics are responsible for 23% of global emissions from plastic production.
  - Under conservative assumptions were projected to double by 2050, accounting for 21-26% of the remaining global carbon budget to keep average temperature increases below 1.5°C.

- Microplastics in the ocean also reduce the planet's capacity to sequester carbon dioxide

Accidents as other downstream consequences of plastic use

- East Palestine, Ohio
- Vinyl chloride burned widely (five rail cars worth)
- Newly released data shows soil contains dioxin levels hundreds of times greater than cancer risk threshold set by US Environmental Protection Agency

Plastics have created a crisis.

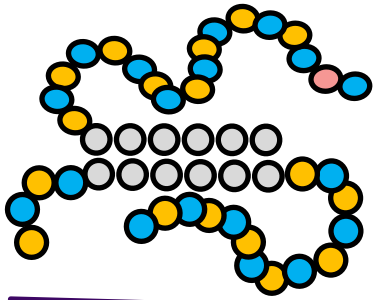
- Ecosystem effects
- Climate change
- Chemicals and human health

Human Exposure to Plastics: a two-domain issue

Synthetic polymer debris and particles

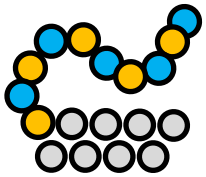
Macroplastics fragment

> 5 mm

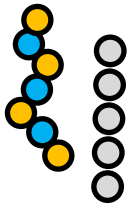


(secondary) MPs and NPs

< 5 mm



< 1—0.1 µm

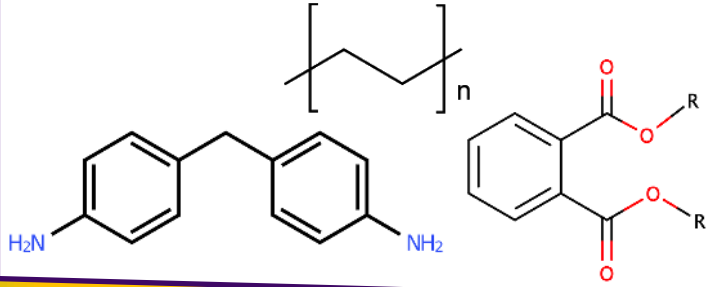


Dissolved organic chemicals

Plastic-derived Dissolved Organic Chemicals

Leachates: oligomers, monomers, additives, adsorbed/desorbed pollutants

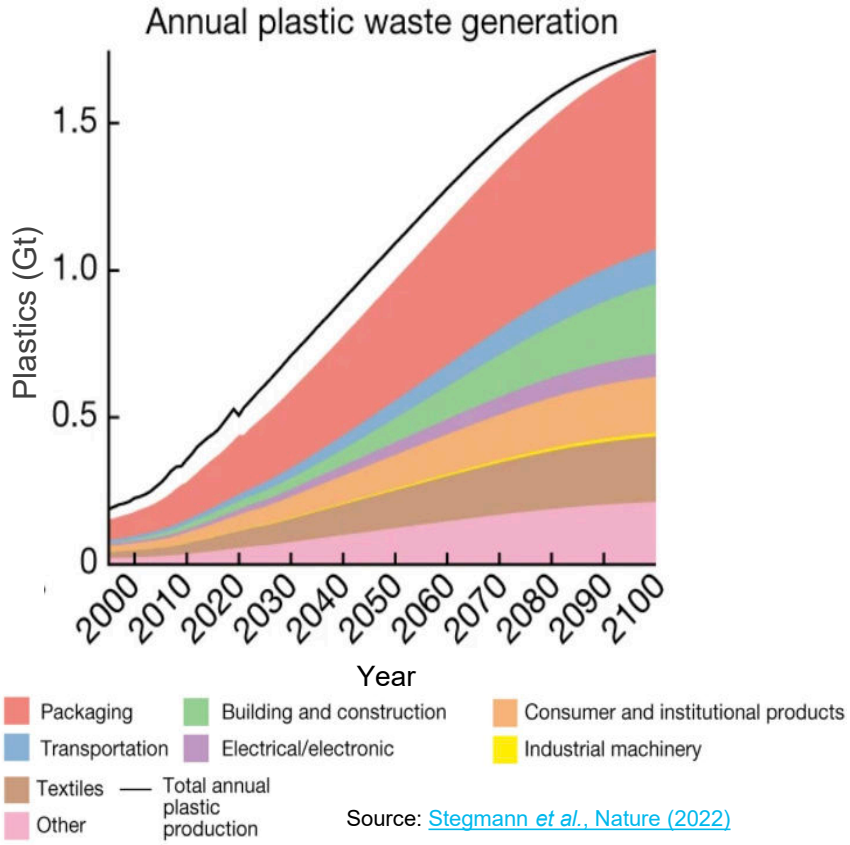
< 1—10 kDa



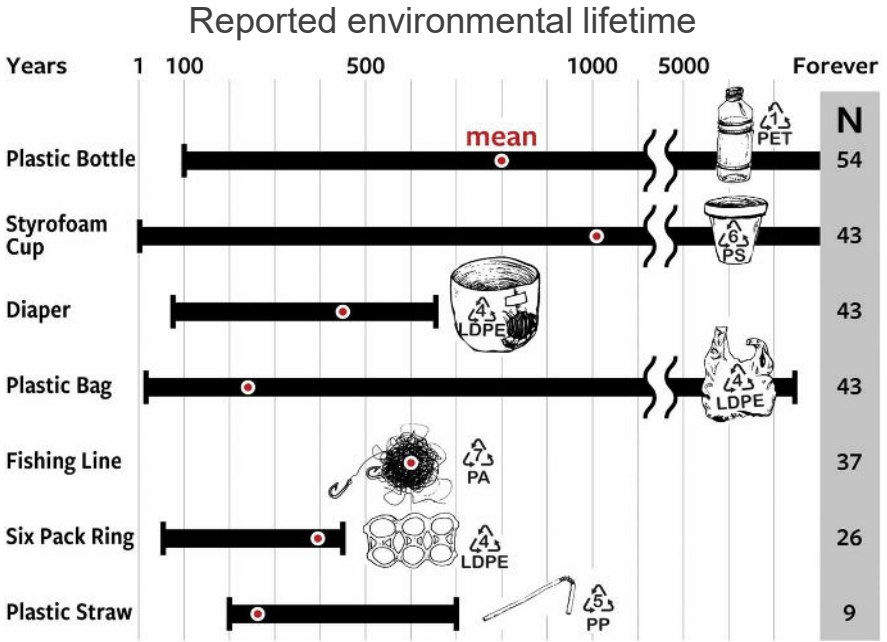
Molecular weight (Da)

human exposure

More (micro)plastics will accumulate in the environment



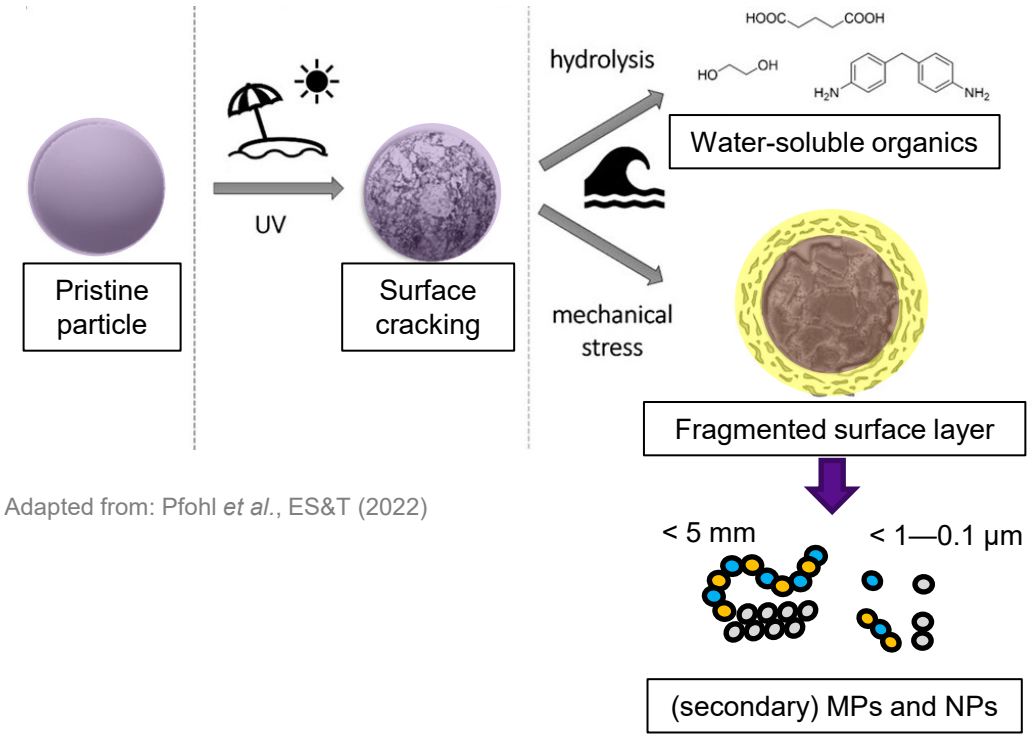
Source: Stegmann *et al.*, Nature (2022)



Source: Ward & Reddy, PNAS (2020)

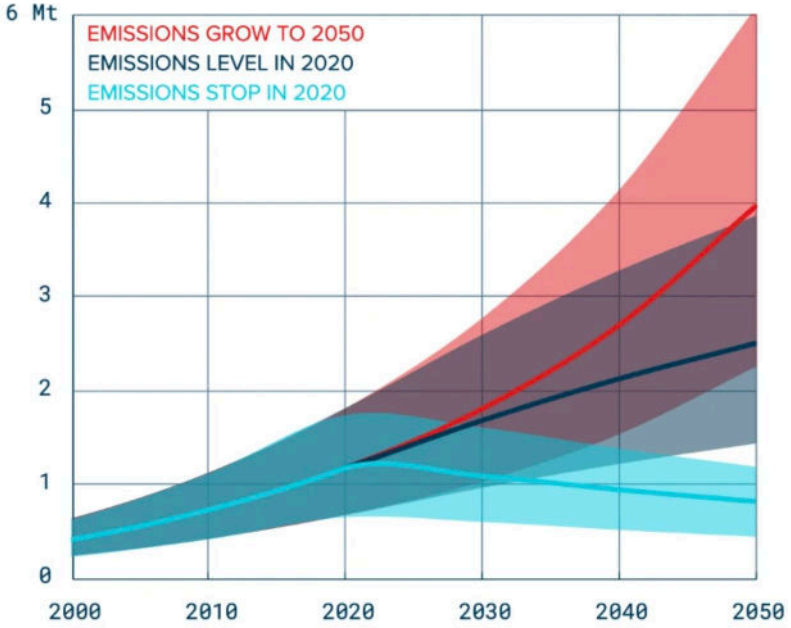
More (micro)plastics will accumulate in the environment

Environmental degradation and fragmentation



Adapted from: Pfohl *et al.*, ES&T (2022)

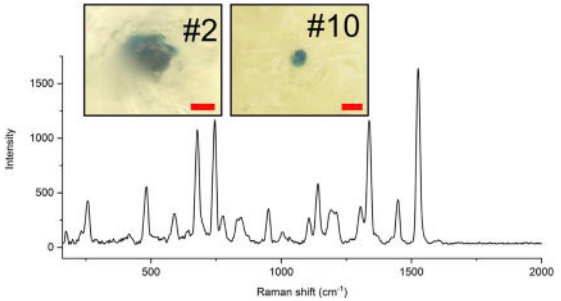
Scenarios for marine MPs pollution



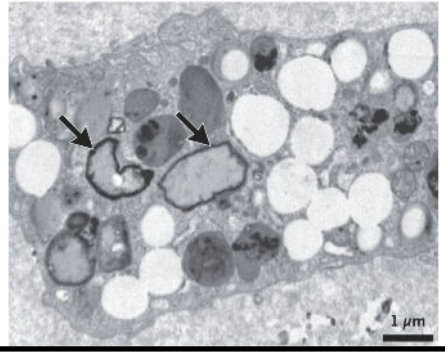
Source: Lebreton *et al.*, Nature Scientific Reports (2019)

Micro- and nanoplastics are increasingly detected in human samples

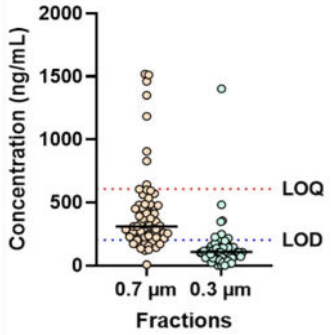
Placenta:
Stained PP, coating, dyes.
MPs size 5—10 µm
Ragusa *et al.*, Env. Int. (2021)

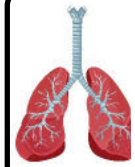


Carotid artery plaque:
PE and PVC.
Up to 22 µg/mg plaque
Marfella *et al.*, N Engl J Med (2024)

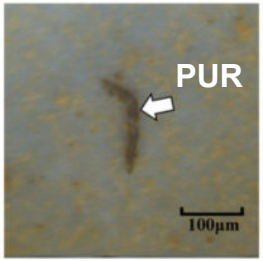


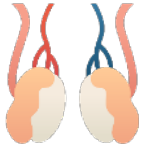
Blood:
PE, PVC, PET, PMMA.
Σ_{MNPs}: 170—2490 ng/mL
Brits *et al.*, Micropl.&Nanopl. (2024)





Lungs:
PP, PET, PE, PFTE, PS, PUR.
Up to 1.65 MP/g
(49% fiber, 43% fragment)
Jennner *et al.*, *STotEN* (2022)





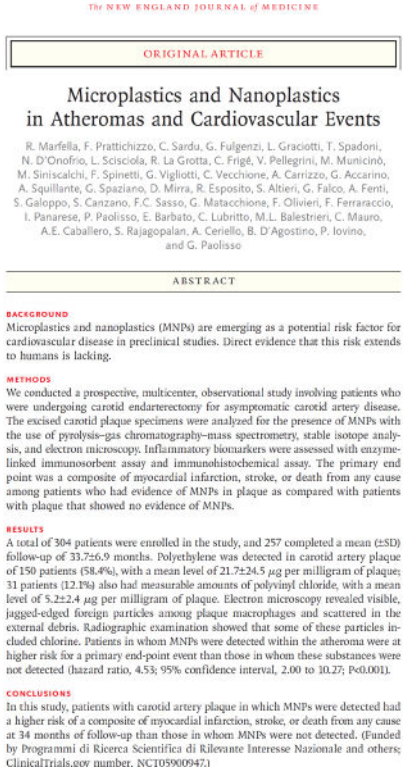
Testicles
PE>>ABS, N66, PVC, PU
Up to 328.44 µg/g
Hu *et al.*, *Tox. Sci.* (2024)

What do we know about microplastics and human health?

Early findings raise serious concerns

Cautions

- Particle size
- Assays not harmonized yet
- Chemicals on lining of microplastics may vary



The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Microplastics and Nanoplastics in Atheromas and Cardiovascular Events

R. Marfella, F. Prattichizzo, C. Sardu, G. Fulgenzi, L. Graciotti, T. Spadoni, N. D'Onofrio, L. Scisciola, R. La Grotta, C. Frigé, V. Pellegrini, M. Municinò, M. Siniscalchi, F. Spinetti, G. Vigliotti, C. Vecchione, A. Carrizzo, G. Accarino, A. Squillante, G. Spaziano, D. Mirra, R. Esposito, S. Altieri, G. Falco, A. Fenti, S. Galoppo, S. Canzano, F.C. Sasso, G. Matacchione, F. Olivieri, F. Ferraraccio, I. Panarese, P. Paolisso, E. Barbato, C. Lubritto, M.L. Balestrieri, C. Mauro, A.E. Caballero, S. Rajagopalan, A. Ceriello, B. D'Agostino, P. Iovino, and G. Paolisso

ABSTRACT

BACKGROUND

Microplastics and nanoplastics (MNPs) are emerging as a potential risk factor for cardiovascular disease in preclinical studies. Direct evidence that this risk extends to humans is lacking.

METHODS

We conducted a prospective, multicenter, observational study involving patients who were undergoing carotid endarterectomy for asymptomatic carotid artery disease. The excised carotid plaque specimens were analyzed for the presence of MNPs with the use of pyrolysis–gas chromatography–mass spectrometry, stable isotope analysis, and electron microscopy. Inflammatory biomarkers were assessed with enzyme-linked immunosorbent assay and immunohistochemical assay. The primary end point was a composite of myocardial infarction, stroke, or death from any cause among patients who had evidence of MNPs in plaque as compared with patients with plaque that showed no evidence of MNPs.

RESULTS

A total of 304 patients were enrolled in the study, and 257 completed a mean (±SD) follow-up of 33.7±6.9 months. Polyethylene was detected in carotid artery plaque of 150 patients (58.4%), with a mean level of 21.7±24.5 μg per milligram of plaque; 31 patients (12.1%) also had measurable amounts of polyvinyl chloride, with a mean level of 5.2±2.4 μg per milligram of plaque. Electron microscopy revealed visible, jagged-edged foreign particles among plaque macrophages and scattered in the external debris. Radiographic examination showed that some of these particles included chlorine. Patients in whom MNPs were detected within the atheroma were at higher risk for a primary end-point event than those in whom these substances were not detected (hazard ratio, 4.53; 95% confidence interval, 2.00 to 10.27; P<0.001).

CONCLUSIONS

In this study, patients with carotid artery plaque in which MNPs were detected had a higher risk of a composite of myocardial infarction, stroke, or death from any cause at 34 months of follow-up than those in whom MNPs were not detected. (Funded by Programmi di Ricerca Scientifica di Rilevante Interesse Nazionale and others; ClinicalTrials.gov number, NCT05900947.)

N Engl J Med 2024;390:900-10.
DOI: 10.1056/NEJMoa2309822

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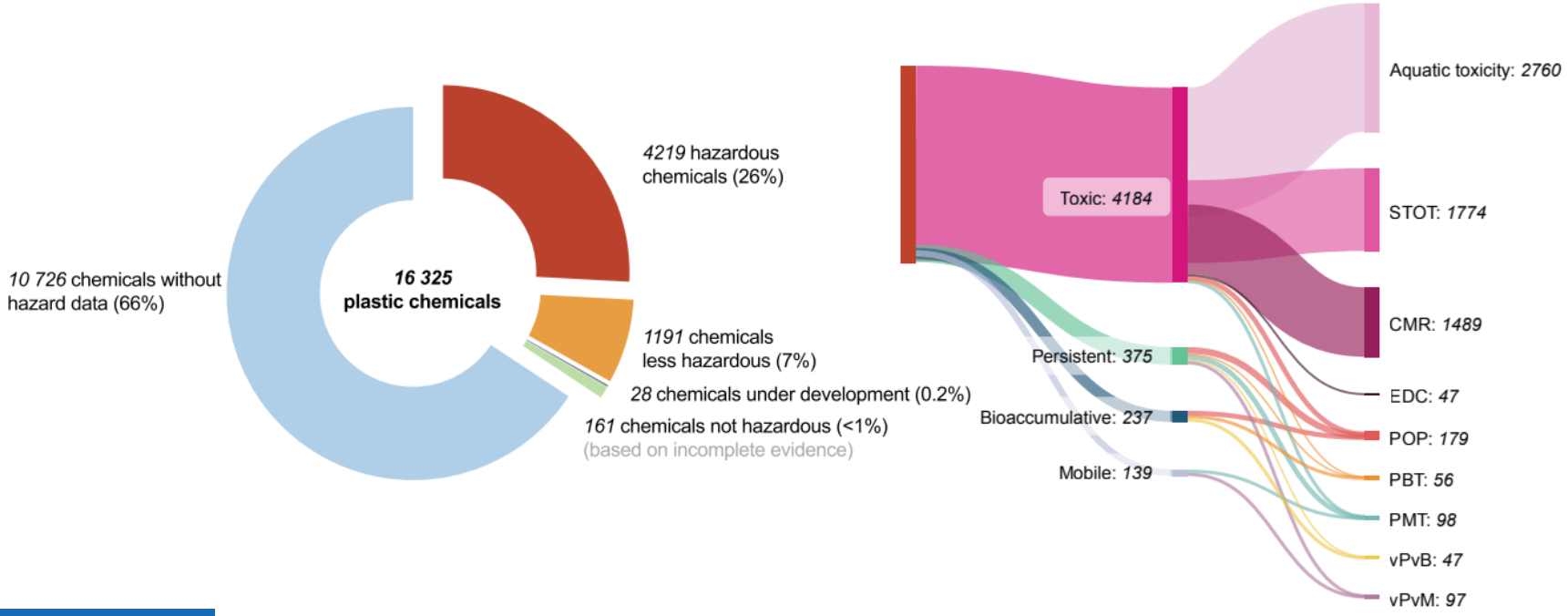

PlastChem

Wagner et al (2024)

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Plastics are a crucial source of endocrine disrupting chemicals

- Bisphenols (polycarbonate plastics, aluminum can linings)
- Phthalates (food packaging)
- Per- and polyfluoroalkyl substances (PFAS, nonstick cooking and fluoropolymer plastics)
- Flame retardants (additives to plastics)
- Burning plastics → dioxins

Chemicals used in plastic contribute to noncommunicable diseases

- Bisphenols (obesity and cardiovascular disease, estrogen-sensitive cancers)
- Phthalates (neurodevelopmental disability, preterm birth, cardiovascular disease, infertility)
- Per- and polyfluoroalkyl substances (intrauterine growth restriction, childhood obesity, diabetes, adult weight gain)
- Flame retardants (neurodevelopmental disability, thyroid cancer)
- Dioxins (cancers, diabetes)

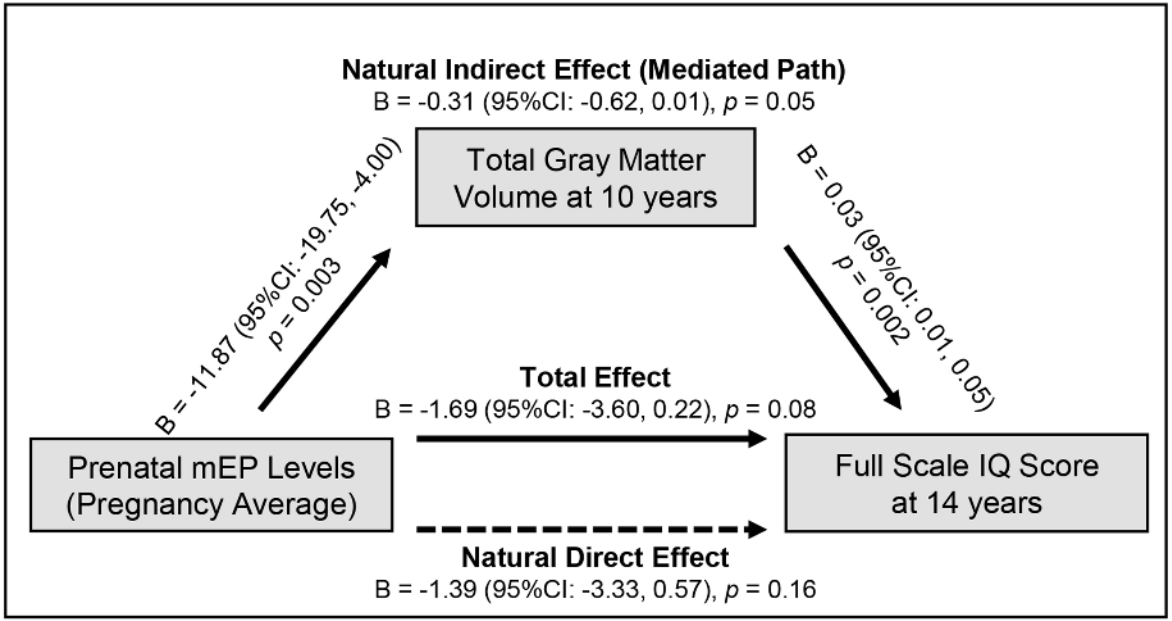
Brominated flame retardants

- Thyroid hormone has long been known to be critical to early brain development
  - Predictable outcomes of its disruption include global IQ deficits, as well as neurodevelopmental disabilities such as autism spectrum disorder (ASD), and attention-deficit hyperactivity disorder (ADHD).

- Four well-designed longitudinal birth cohorts have identified PBDE effects on child neurodevelopment, despite controlling for many potential confounders (alternate explanatory factors).

Chen et al EHP 2014; Eskenazi et al EHP 2013; Herbstman et al EHP 2010, Gascon et al Environment International 2011

Reductions in total gray matter explain lower IQs due to phthalates



Ghassabian et al Mol Psychiatry. 2023 Nov; 28(11): 4814–4822.

Chemical exposure and thyroid function in pregnancy

	Free T4 (ng/dL) beta [95% CI]	Total T4 (ng/dL) beta [95% CI]	Free T4/Free T3 (pg/mL) beta [95% CI]	TSH (mU/L) beta [95% CI]	TSH/Free T4 (ng/dL) OR [95% CI]
∑Bisphenols	-0.01 [-0.02, 0.00]	-0.16 [-0.32, -0.00]*	0.00 [-0.00, 0.00]	0.05 [-0.03, 0.13]	0.06 [-0.03, 0.14]
OP pesticides ∑DM	0.01 [-0.01, 0.02]	0.12 [-0.06, 0.29]	0.00 [-0.00, 0.01]	-0.08 [-0.16, 0.01]	-0.12 [-0.23, -0.01]*
OP pesticides ∑DE	0.01 [-0.01, 0.02]	0.06 [-0.12, 0.23]	0.00 [-0.00, 0.01]	-0.08 [-0.16, 0.01]	-0.13 [-0.24, -0.02]*
OP pesticides ∑DAP	0.01 [-0.01, 0.02]	0.14 [-0.04, 0.31]	0.01 [0.00, 0.01]*	-0.09 [-0.18, -0.00]*	-0.15 [-0.26, -0.04]*
∑PAHs	-0.01 [-0.02, 0.01]	0.04 [-0.14, 0.22]	0.00 [-0.01, 0.01]	-0.03 [-0.12, 0.06]	-0.03 [-0.14, 0.09]
Phthalates ∑LMW	-0.01 [-0.02, 0.00]	-0.08 [-0.24, 0.08]	-0.00 [-0.01, 0.00]	-0.01 [-0.09, 0.07]	-0.02 [-0.11, 0.06]
Phthalates ∑HMW	-0.02 [-0.03, -0.00]*	-0.22 [-0.38, -0.06]*	-0.00 [-0.01, 0.00]	-0.01 [-0.09, 0.06]	0.00 [-0.08, 0.09]
Phthalates ∑DEHP	-0.02 [-0.03, -0.01]*	-0.32 [-0.48, -0.16]*	-0.00 [-0.01, 0.00]	-0.04 [-0.11, 0.04]	-0.01 [-0.10, 0.08]
Phthalates ∑DnOP	-0.02 [-0.03, -0.00]*	-0.23 [-0.39, -0.08]*	-0.00 [-0.01, 0.00]	0.07 [-0.01, 0.15]	0.09 [0.01, 0.18]*
Phthalates ∑DiNP	-0.00 [-0.02, 0.01]	-0.03 [-0.19, 0.12]	-0.00 [-0.01, 0.00]	0.03 [-0.04, 0.11]	0.05 [-0.04, 0.13]

Models were adjusted for age, educational levels, race and ethnicity, parity, insurance type, environmental exposure to tobacco, depressive symptoms, and gestational age at the time of thyroid measurement

Phthalates and preterm birth: NIH ECHO Program

- 5006 mother–child dyads from 13 cohorts in the ECHO Program
- Phthalic acid, diisodecyl phthalate (DiDP), di-n-octyl phthalate (DnOP), and diisononyl phthalate (DiNP) were most strongly associated with gestational age, birth length, and birthweight, especially compared with DEHP or other metabolite groupings.
- Although DEHP was associated with preterm birth (odds ratio 1·45 [95% CI 1·05–2·01]), the risks per $\log_{10}$ increase were higher for phthalic acid (2·71 [1·91–3·83]), DiNP (2·25 [1·67–3·00]), DiDP (1·69 [1·25–2·28]), and DnOP (2·90 [1·96–4·23]).
- We estimated 56 595 (sensitivity analyses 24 003–120 116) phthalate-attributable preterm birth cases in 2018 with associated costs of US$3·84 billion (sensitivity analysis 1·63– 8·14 billion).

Trasande et al Lancet Planet Health
. 2024 Feb;8(2):e74-e85. doi: 10.1016/S2542-5196(23)00270-X.

Phthalates and bisphenols in Generation R First

- Pregnancy-averaged phthalic acid (PA, end metabolite of all phthalates; -0.08 SD: 95% CI -0.14, -0.02) and LMW (-0.09 SD: 95% CI -0.16, -0.02): lower fetal weight through 40 weeks postpartum.
- Pregnancy-averaged MEOHP (DEHP metabolite): increased risk of preterm birth (OR 1.43; 95% CI: 1.03-1.97)
- First trimester BPS: decreased bone mineral density (6.13 mg/cm^2; 95% CI: -10.02, -2.23) and content (0.12 g, 95% CI: -0.20, -0.04) at age 10 (no sex specific differences, endured multiple testing). (van Zwol-Janssens et al Env Res 2020)
- First trimester PA: 0.13 (95% CI: 0.04, 0.21) SD deviation score increase in pericardial fat index (stronger among boys, significant after multiple comparison). (Sol et al Int J Obesity 2020)

Phthalates and bisphenols in Generation R First: fat mass, insulin resistance and BP

- Second trimester maternal urine total bisphenol and BPA: higher systolic BP (0.13; 95% CI 0.03, 0.23 and 0.14; 95% CI 0.04; 0.23) among boys.
- Third trimester PA: 0.20 (95% CI 0.07, 0.34) SD higher triglycerides among boys at age 10. (Sol et al Env Int 2020)

Some opposite (beneficial) sexually-dimorphic effects:

- Second trimester maternal HMW and DEHP: (0.19; 95% CI 0.31-0.07 and 0.18; 95% CI 0.31-0.06) lower glucose concentration among boys.
- Third trimester BPF: lower non-fasting insulin and glucose concentrations (-0.22; 95% CI -0.35, -0.09 and 0.19; 95% CI 0.32; 0.05) among boys. (Sol et al Env Int 2020)

Phthalates → cardiovascular mortality

- Low T either predictor of or marker of cardiovascular mortality in adult men

- High molecular weight phthalates were associated with lower total, free, and bioavailable testosterone among men age ≥60.
  - Attina et al Lancet Diab Endo 2016; Hauser et al JCEM 2015

Cardiovascular mortality was significantly increased in relation to a prominent DEHP metabolite, mono-(2-ethyl-5-oxohexyl)phthalate.

- Extrapolating to the population of 55-64 year old Americans, 50,200 attributable deaths and $23.4 billion in lost economic productivity.

Trasande et al Env Pollution 2021

Bisphenols → cardiovascular mortality

BPA associated with:

- Reduced carotid intima-media thickness of 12-30 and >70 year olds

  Lin et al Atherosclerosis 2015, Lind et al Atherosclerosis 2011)

- Severity of coronary artery disease in angiography

  Melzer et al PLOS One 2012

- Reduced heart rate variability in adults

  Bae et al Hypertension 2012

- All-cause mortality, and cardiovascular disease mortality

  Bao et al JAMA Network Open 2020

Table 3. Adjusted associations between exposure to BPA and BPS and the risk of type 2 diabetes in the D.E.S.I.R. cohort (single-pollutant models).

	At baseline		At year 3		Average exposure at baseline-year 3	
Bisphenol exposure/detections	n/N^a	aHR (95% CI)[b]	n/N^a	aHR (95% CI)[c]	n/N^a	aHR (95% CI)[d]
BPA exposure		$N = 726$		$N = 623$		$N = 623$
BPA-G concentration (ng/mL)						
<0.71	62/233	1	11/94	1	10/75	1
0.71–1.75	48/182	0.80 (0.53, 1.21)	28/162	1.42 (0.66, 3.07)	33/176	2.56 (1.16, 5.65)
1.75–3.78	39/158	1.01 (0.65, 1.55)	44/190	2.40 (1.16, 4.98)	36/198	2.35 (1.07, 5.15)
≥3.78	38/153	0.85 (0.54, 1.35)	25/177	0.99 (0.44, 2.21)	29/174	1.56 (0.68, 3.55)
BPS detection		$N = 644$		$N = 579$		$N = 529$
BPS-G concentration ≥LOD						
No	139/546	1	92/522	1	61/389	1
Yes	32/98	1.68 (1.09, 2.58)	15/57	1.92 (1.02, 3.62)	38/140	2.81 (1.74, 4.53)

Note: Groups of BPA exposure were defined on the pooled baseline and year 3 BPA-G concentrations in subcohort members. aHR, adjusted hazard ratio; BMI, body mass index; BPA-G, BPA-glucuronide; BPS-G, BPS-glucuronide; CI, confidence interval; D.E.S.I.R., Data from an Epidemiological Study on the Insulin Resistance Syndrome; LOD, limit of detection (0.3 ng/mL).

[a]n/N indicates the numbers of type 2 diabetes cases relative to the total number of participants in each exposure category.

[b]aHRs quantify the association between exposure to BPA/BPS and incidence of diabetes between baseline and year 9. Cox models with age as the timescale and stratified on smoking status were adjusted for sex and the following variables from baseline: urinary creatinine level, education level, employment, marital status, physical activity, caloric intake, family history of diabetes, hypertension, and BMI.

[c]aHRs quantify the association between exposure to BPA/BPS and incidence of diabetes between year 3 and year 9. Cox models with age as the timescale and stratified on smoking status were adjusted for sex and the following variables from year 3: urinary creatinine level, education level, employment, marital status, physical activity, caloric intake, family history of diabetes, hypertension, and BMI.

[d]aHRs quantify the association between exposure to BPA/BPS and incidence of diabetes between year 3 and year 9. Cox models with age as the timescale and stratified on smoking status were adjusted for sex, average urinary creatinine level, and the following variables from year 3: education level, employment, marital status, physical activity, caloric intake, family history of diabetes, hypertension, and BMI.

Ranciere et al EHP 2019

HASSENFELD CHILDREN'S HOSPITAL AT NYU LANGONE

Per- and polyfluoroalkyl substances (PFAS)

Synthetic organic fluorinated compounds with high stability and thermal resistance

Detectable in blood of >98% of the US population.

Food packaging is a major route of exposure (nonstick cooking, microwaveable popcorn bags)

Meta-analysis of 24 studies: −10·5 g (95% CI: −16·7, −4·4) birth weight per ng/ml increase in maternal or cord blood PFAS

Steenland et al Epidemiology 2018

PFAS and adult weight gain/diabetes

Diabetes Prevention Program lifestyle intervention trial:

- Total PFAS were associated with increased weight gain exclusively among the control group.

Cardenas et al 2018

Follow-up of the successful POUNDS LOST trial:

- Perfluorooctane sulfonate (PFOS) and perfluorononanoic acid (PFNA), were associated with reductions in resting metabolic rate.

Liu et al 2018

PIVUS (Sweden), Nurses (US), DPPOS (US):

- PFAS associated with incident diabetes

Cardenas et al 2019, Sun et al 2018, Lind et al 2014

Endocrine disruption and fertility

- Fertility is a condition of a couple, where reproductive health of both sexes plays a role

Louis et al 2013

- Fetal exposure to phthalates with reduced infant anogenital distance (AGD)

Swan et al EHP 2005, Bornehag et al EHP 2014

- Shortened adult AGD is associated with reduced semen quality and testosterone level

- Multiple studies have identified reduced male fertility and poor semen quality with multiple EDCs, including phthalates, bisphenol A, and polyfluorinated chemicals

Juul et al Nat Rev Endo 2014

How much disease burden is due to plastic in the US?

- 97.5% for bisphenol A (96.25-98.75% for sensitivity analysis)
- 98% (96%-99%) for di-2-ethylhexylphthalate
- 100% (71%-100%) for butyl phthalates and benzyl phthalates,
- 98% (97%-99%) for PBDE-47
- 93% (16%-96%) for PFAS

Chemicals Used in Plastic Materials: An Estimate of the Attributable Disease Burden and Costs in the United States

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Abstract

Context: Chemicals used in plastics have been described to contribute to disease and disability, but attributable fractions have not been quantified to assess specific contributions. Without this information, interventions proposed as part of the Global Plastics Treaty cannot be evaluated for potential benefits.

Objective: To accurately inform the tradeoffs involved in the ongoing reliance on plastic production as a source of economic productivity in the United States, we calculated the attributable disease burden and cost due to chemicals used in plastic materials in 2018.

Methods: We first analyzed the existing literature to identify plastic-related fractions (PRF) of disease and disability for specific polybrominated diphenylethers (PBDE), phthalates, bisphenols, and polyfluoroalkyl substances and perfluoroalkyl substances (PFAS). We then updated previously published disease burden and cost estimates for these chemicals in the United States to 2018. By uniting these data, we computed estimates of attributable disease burden and costs due to plastics in the United States.

Results: We identified PRFs of 97.5% for bisphenol A (96.25-98.75% for sensitivity analysis), 98% (96%-99%) for di-2-ethylhexylphthalate, 100% (71%-100%) for butyl phthalates and benzyl phthalates, 98% (97%-99%) for PBDE-47, and 93% (16%-96%) for PFAS. In total, we estimate $249 billion (sensitivity analysis: $226 billion-$289 billion) in plastic-attributable disease burden in 2018. The majority of these costs arose as a result of PBDE exposure, though $66.7 billion ($64.7 billion-67.3 billion) was due to phthalate exposure and $22.4 billion was due to PFAS exposure (sensitivity analysis: $3.85-$60.1 billion).

Conclusion: Plastics contribute substantially to disease and associated social costs in the United States, accounting for 1.22% of the gross domestic product. The costs of plastic pollution will continue to accumulate as long as exposures continue at current levels. Actions through the Global Plastics Treaty and other policy initiatives will reduce these costs in proportion to the actual reductions in chemical exposures achieved.

- In total, we estimate $249 billion (sensitivity analysis: $226 billion-$289 billion) in plastic-attributable disease burden in 2018.
- The majority of these costs arose as a result of PBDE exposure, though $66.7 billion ($64.7 billion-67.3 billion) was due to phthalate exposure and $22.4 billion was due to PFAS exposure (sensitivity analysis: $3.85-$60.1 billion).

Trasande et al J Endo Soc 2024

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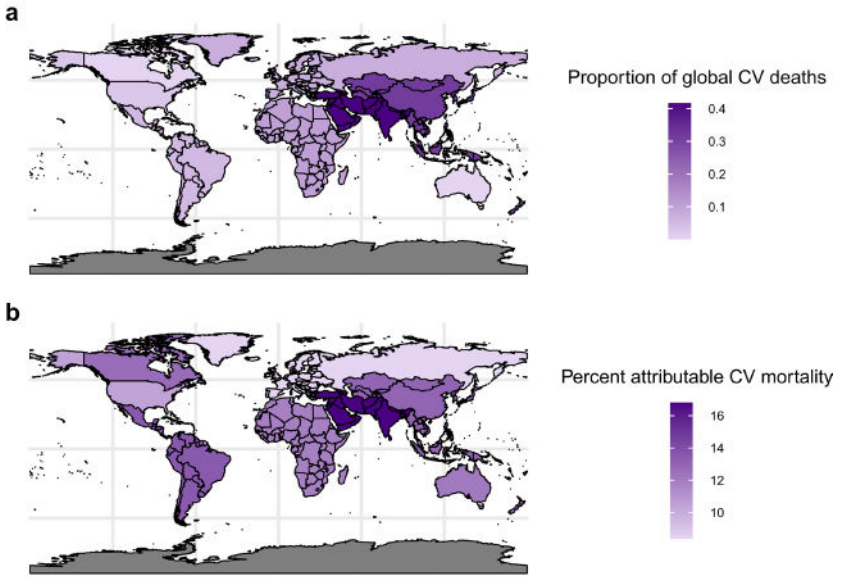
Global cardiovascular mortality due to phthalates

- In 2018, an estimated 356,238 deaths globally were attributed to DEHP exposure, representing 13.5% of all cardiovascular deaths among individuals aged 55–64.
  - Of these, 349,113 were attributed to the use of plastics.
- The Middle East, South Asia, East Asia, and the Pacific accounted for the largest shares of DEHP-attributable CVD deaths (73.163%).
- Globally, DEHP resulted in 10,473 million YLL.
- Social costs of plastic-induced mortality total $510 billion-3.74 trillion.



Hyman et al Lancet eBiomedicine 2025

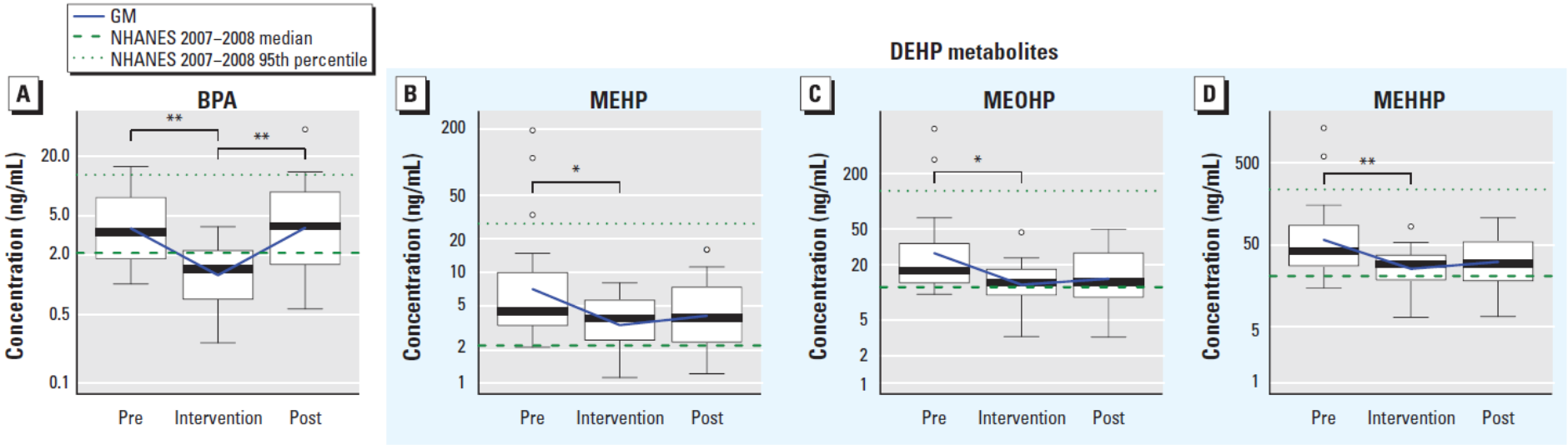
Unequal impacts in low- and middle-income countries

- OECD predicts majority of chemical production and consumption will occur in low- and middle-income countries by 2030
- Landfills in low- and middle-income countries are teeming with plastic waste as well.
- Waste picking increasingly a way of life for people in these communities.
- Women of childbearing age comprise a substantial proportion of waste pickers, setting in motion multigenerational consequences of plastic production and consumption.

What can we do limit EDC exposures?

- **Fortunately, there are safe and simple steps families can take at home to limit these exposures.**

- We can also advocate for proactive policies that limit exposures.



Rudel et al EHP 2011

Bisphenol and phthalate exposures are preventable (also in high SES populations)…

- Youth-led, community-based participatory research intervention
- 100 Latina girls using personal care products whose labels stated they did not contain these chemicals for 3 days
- Urinary concentrations of monoethyl phthalate decreased by 27.4% (95% CI: –39.3, –13.2) on average over the 3-day intervention

Harley et al EHP 2016

…and low-resource communities as well

What can we do limit EDC exposures?

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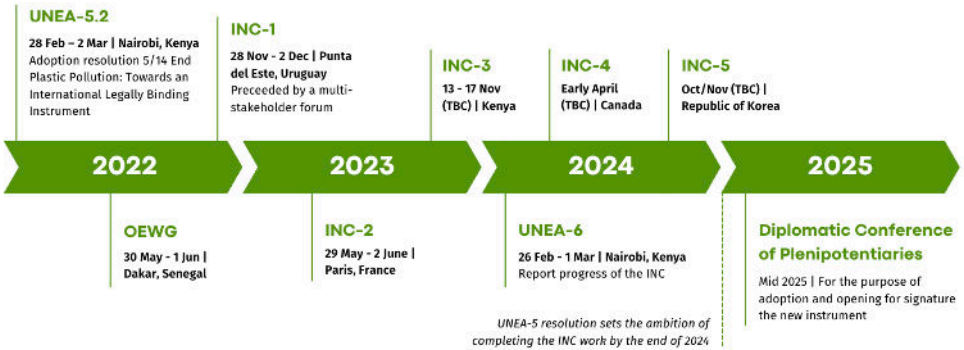
- **We can also advocate for proactive policies that limit exposures.**

A Global Plastics Treaty

- March 2022 at resumed fifth session of the UN Environment Assembly: resolution requested the Executive Director of the UN Environment Programme to convene an Intergovernmental Negotiating Committee
- Purpose: to develop an international legally binding instrument on plastic pollution, including in the marine environment, which addresses the full life cycle of plastic, including its production, design, and disposal.



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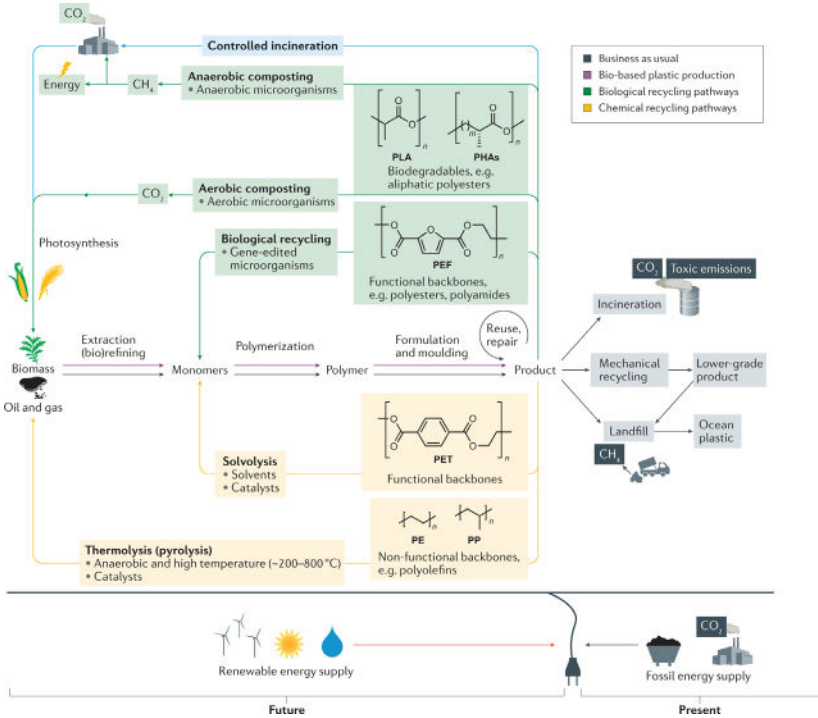
Bioplastics?

- Plant- and other bio-based plastics have also been touted as a planet-friendly alternative and form of sustainable innovation.
- However, they require high temperature to be recycled, and when the high costs force bioplastics into landfills, they produce methane, which is more potent than carbon dioxide in driving climate change.
- Laboratory studies also suggest greater oxidative stress and antiandrogenicity of chemicals found in liquids obtained from bioplastic bottles.



Expanding biomonitoring globally

If persist with risk based approach, need broader and stronger human biomonitoring platform

- Particularly to address gaps in low- and middle-income countries
- Can also inform educational campaigns about safe and simple steps to limit exposure

- Disclosure of ingredients also crucial (right-to-know)

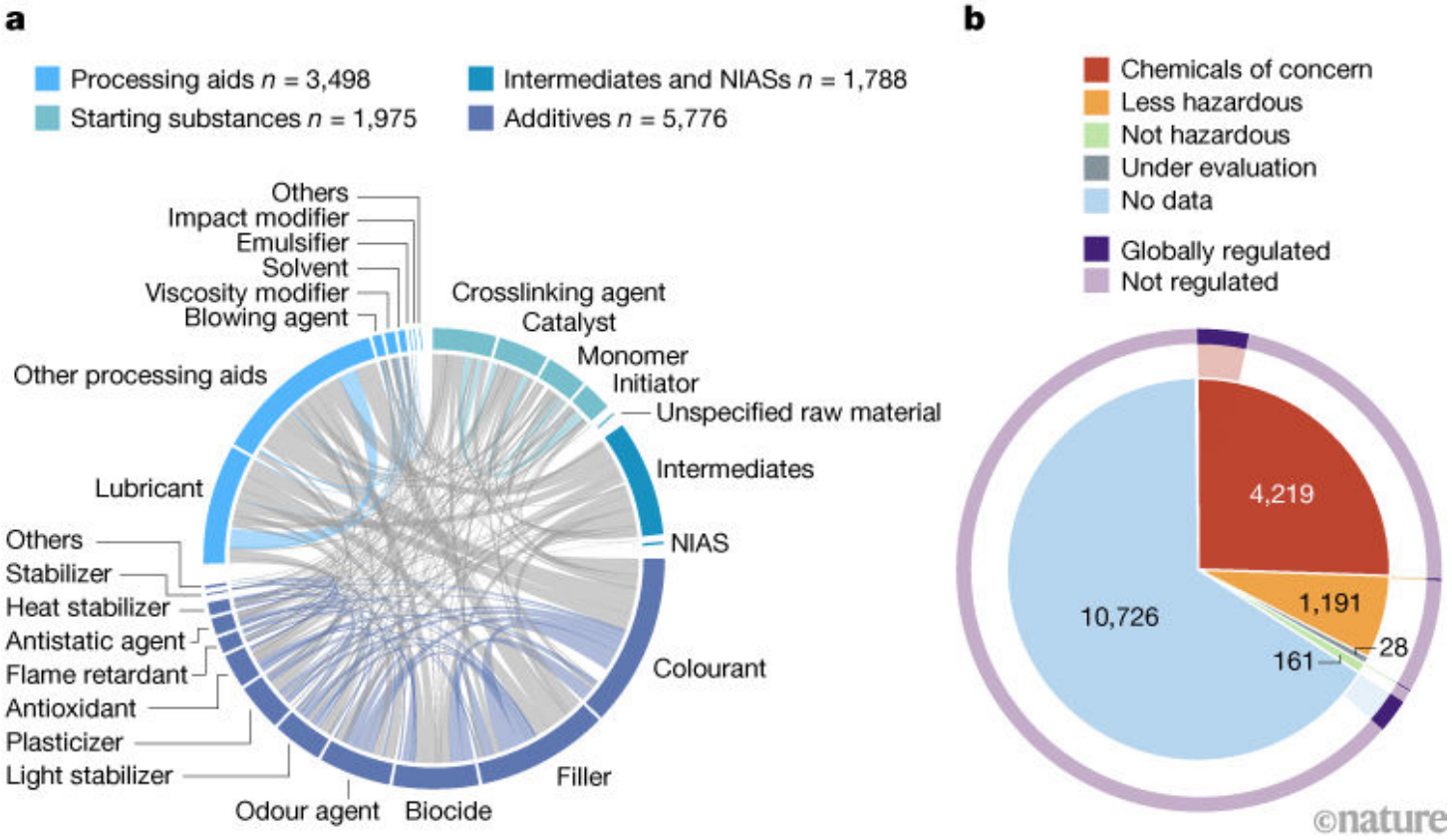
Reduce, reuse or recycle?

- Recycled plastics themselves present health threats.

- Recycling itself is energy intensive and more expensive than creating plastic from fossil fuels.

- Recycled polyethylene plastic bottles also have been identified to contain higher levels of bisphenols, phthalates and metals than newly-produced bottles due to cross-contamination during disposal, collection and reprocessing.

Gaps in chemical regulation



Monclus et al Nature 2025

An International Agency for Research on EDCs*

We suggest the establishment of a new international agency, or a broadening of the International Agency for Research on Cancer (IARC)'s scientific charge, to include endocrine disruption

- Established in 1965, IARC tasked with evaluating the evidence of carcinogenesis due to environmental hazards
- Autonomous body like IARC can bring together diverse experts for international collaborative reports on EDCs would foster global movement on regulations
- An International Agency for Research in Endocrine Disruption would further support post-2020 process of Strategic Alliance for International Chemicals Management

*Given the substantial use of EDCs in plastics, could substitute plastics here except that it would exclude pesticides

Thank you

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