23 APRIL 2025

The Health Threats of Plastics

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Chicago Center for Health and Environment

University of Illinois Chicago

Who We Are: Environmental Scientists at UIC

Gail Prins, PhD

- Michael Reese Distinguished Professor
- Departments of Urology, Pathology, and Physiology
- Director of Urologic Research
- Director, University Andrology Laboratory
- Co-Director, Chicago Center for Health and Environment
- Expert in the environmental drivers of reproductive disorders and cancer.

Robert M. Sargis, MD, PhD

- Associate Professor
- Departments of Medicine and Pathology
- Chicago Center for Health and Environment
- Proud CPS Grad: Von Steuben M.S.C.
- Physician-scientist with expertise in the environmental drivers of metabolic disorders.

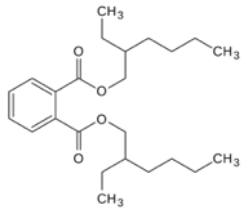
CACHET
ChicAgo Center for Health and EnvironmenT

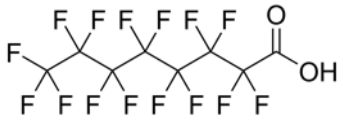
UIC

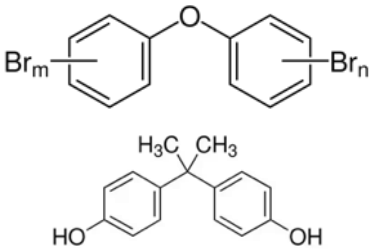
Health Impacts of Plastics

Chemicals in Plastics

Bisphenols, phthalates, per-polyfluoroalkyl substances, brominated flame retardants, toxic metals, dioxins, etc.







Nano- & Microplastics

Polyethylene, polypropylene, polystyrene, polyvinyl chloride, polycarbonate, polyethylene terephthalate, etc.

Climate Change*

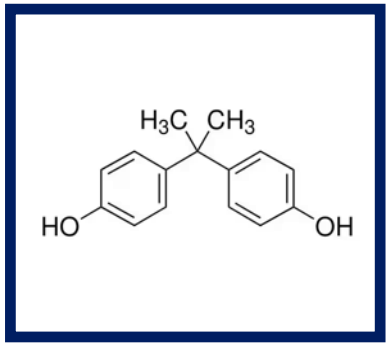
Extreme heat, extreme cold, natural disasters, etc.

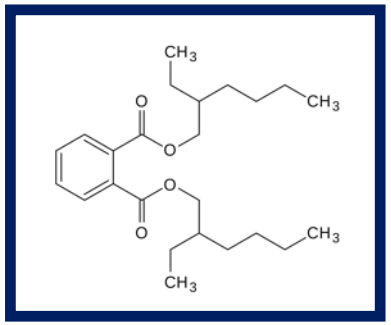

Chicago Sun-Times
35¢
COOLER Pages 2, 40
MONDAY, JULY 17, 1995
Late Sports Final
HEAT TOLL COULD HIT 300

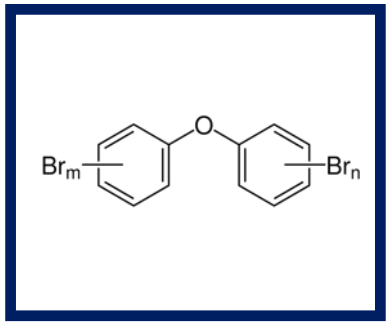
*Will not discuss in detail.

Chemicals in Plastics

Plastics are Associated with Diabetes





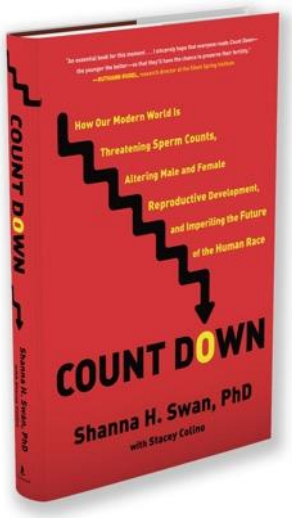


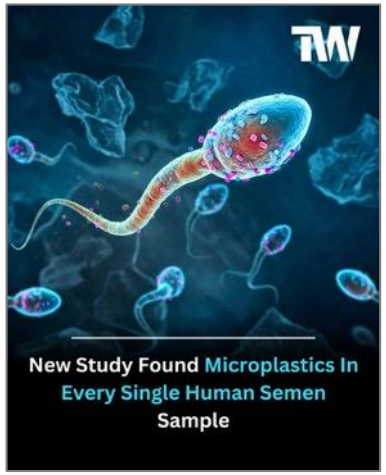
- **The precise impact of plastic-associated EDCs in an individual likely varies based on clinical and non-clinical factors.**
- **Our best human data (recent meta-analyses):**
  - Bisphenol A: OR of 1.28 (95%CI: 1.14-1.44) for T2DM among those with highest vs. lowest exposure. (Hwang et al., *BMC Endo Dis*, 2018)
  - Phthalates: OR of 2.15 (95%CI: 1.18-4.85) for diabetes for the summation of DEHP metabolites. (Zhang et al., *Environ Res*, 2022)
  - Dioxins: OR of 1.91 (95%CI: 1.44-2.54) for T2DM. (Song et al., *J Diabetes*, 2016)
  - PFAS: OR of 1.10 (95%CI: 1.01-1.19) for GDM. (Yao et al., *Chemosphere*, 2023)
  - PBDE: OR of 1.32 (95%CI: 1.15-1.53) for GDM. (Yan et al., *Environ Health*, 2022)
- **Moreover, these chemicals are associated with other adverse health outcomes, such as overweight/obesity, fatty liver, and others.**
- **Critically, the full scope of risk is often undercounted.**
  - Human exposures are mixtures.
  - Do not account for the full spectrum of exposure.
  - Impacts during unique windows of susceptibility.

Plastics Impair Reproductive Health

Strong evidence for a role of plastic chemicals in:

- Infertility
- Decreased Testosterone and Estrogen Levels
- Reduced Egg Quality
- Decreased Sperm Counts and Quality
- Hypospadias
- Erectile dysfunction
- Fibroids
- Endometriosis
- Early Ovarian Failure
- Early Puberty





The Guardian US

Birthrates are plummeting worldwide. Can governments turn the tide?

Tory Shepherd

Sat 10 Aug 2024 10.00 EDT

THE NEW YORKER

THE END OF CHILDREN

Birth rates are crashing around the world. Should we be worried?

By Gideon Lewis-Kraus

February 24, 2025

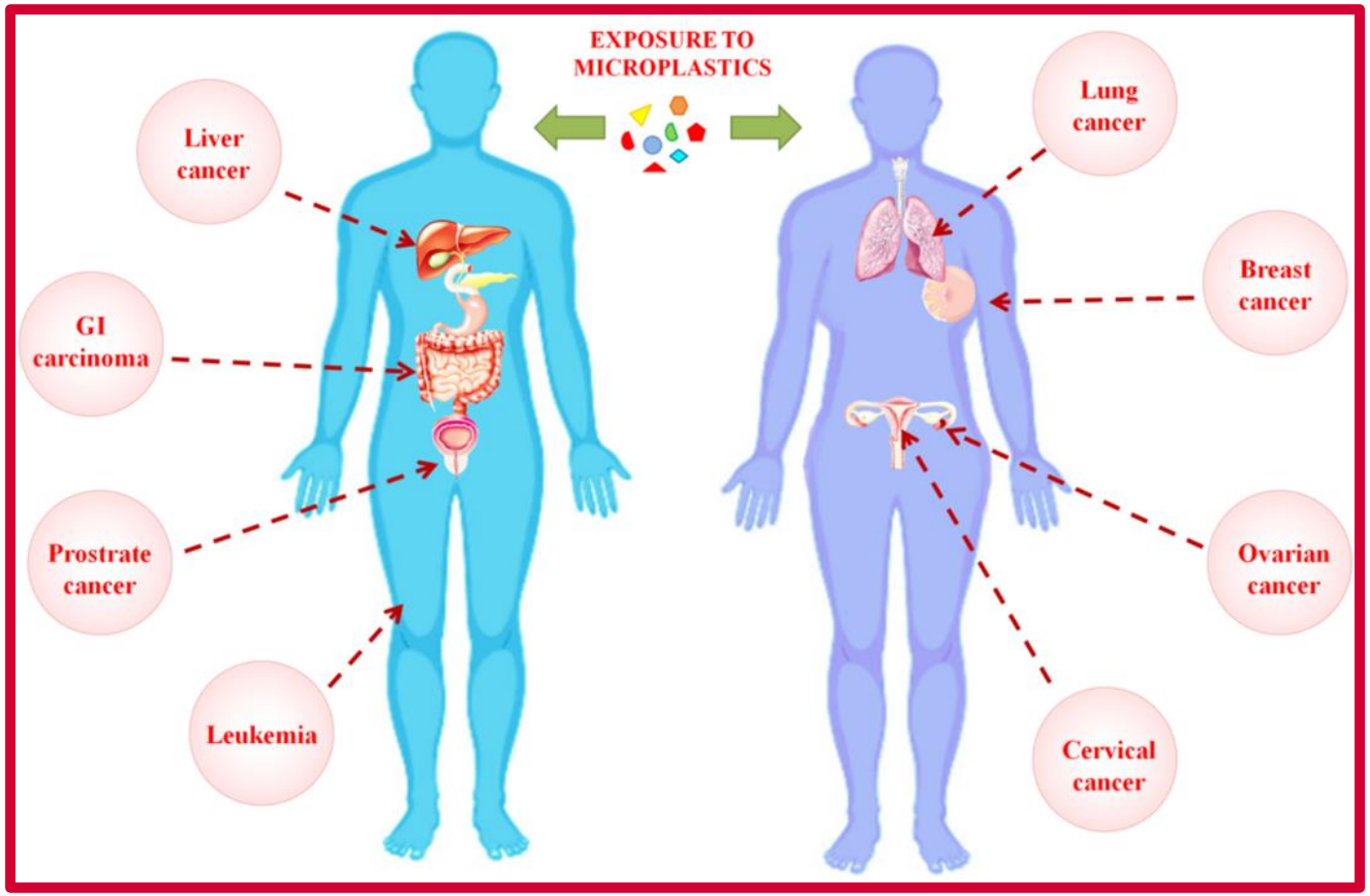
Rapid Fertility Decline Is an Existential Crisis

By Jesús Fernández-Villaverde

The American Enterprise

February 11, 2025

Plastics are Linked to Cancer

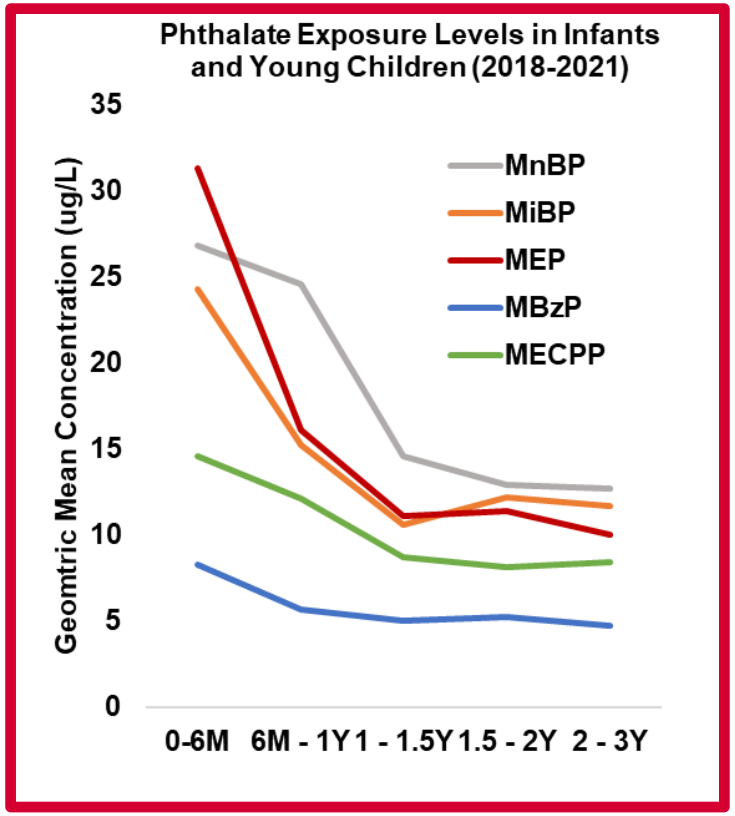


Chemicals in plastics are directly linked to increased incidence and aggressiveness of many cancers.

Gaswami et al., *Life Sci*, 2024.

Plastics are Toxic to the Brain

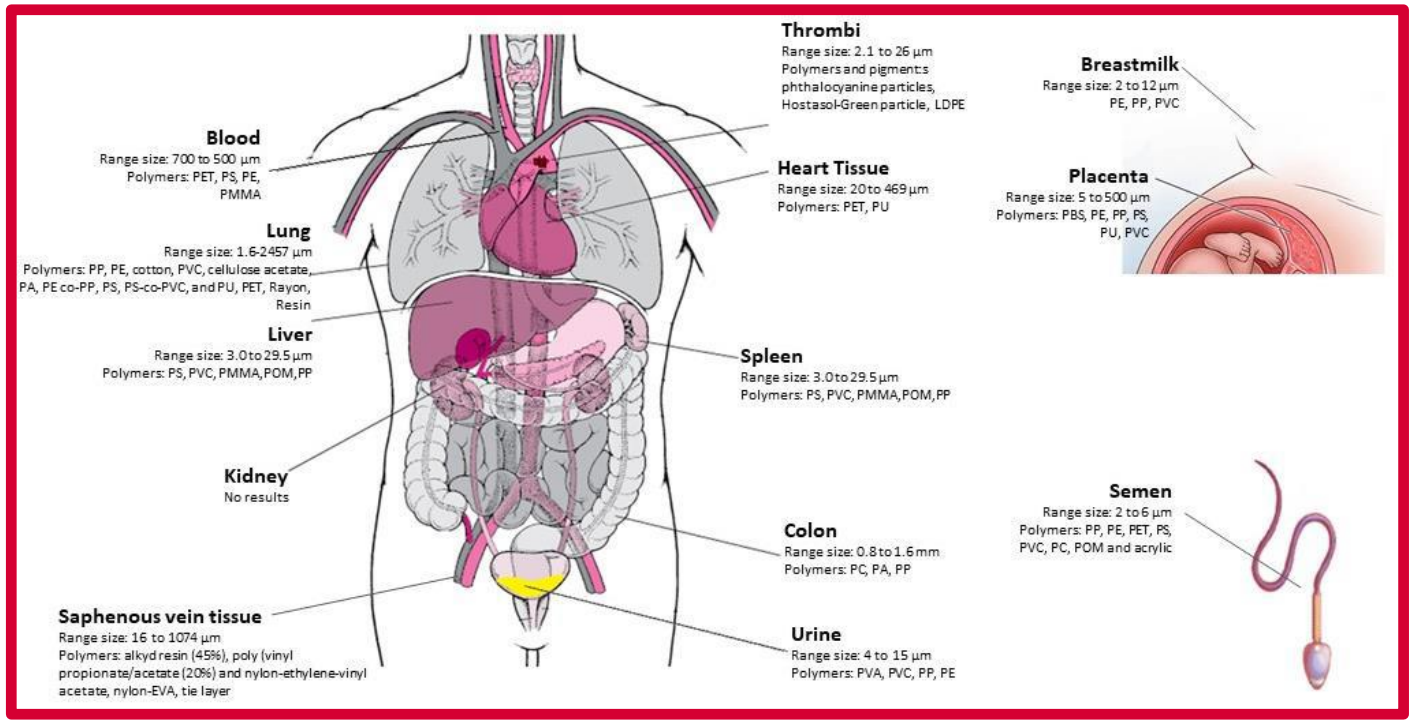
- **Chemicals in plastics include known neurotoxicants:**
  - Phthalates, Bisphenols, Brominated flame retardants
- **And likely neurotoxicants:**
  - Other organohalogen flame retardants, Organophosphate flame retardants, Chlorinated paraffins, PFAS
- **Plastic particles and/or chemical additives are associated with:**
  - Impaired fetal growth and development
  - Neurodevelopmental disorders
  - Impaired IQ, behavior, attention, autism, and ADHD
  - Anxiety and depression
  - Altered brain structure



The youngest kids have some of the highest exposures.

Nano- and Microplastics

Nano- and Microplastics Embed Throughout the Body

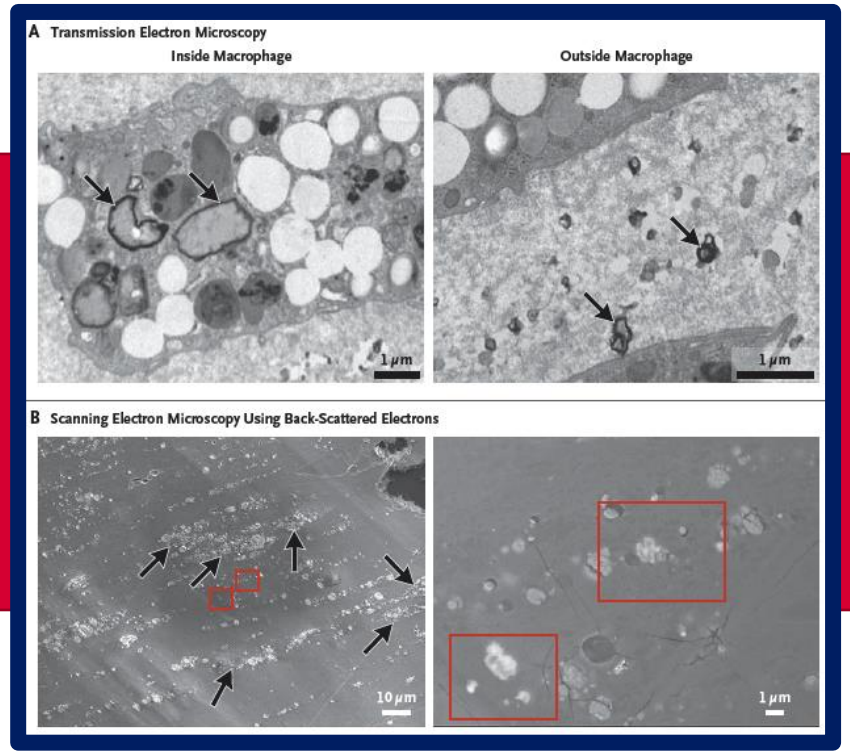


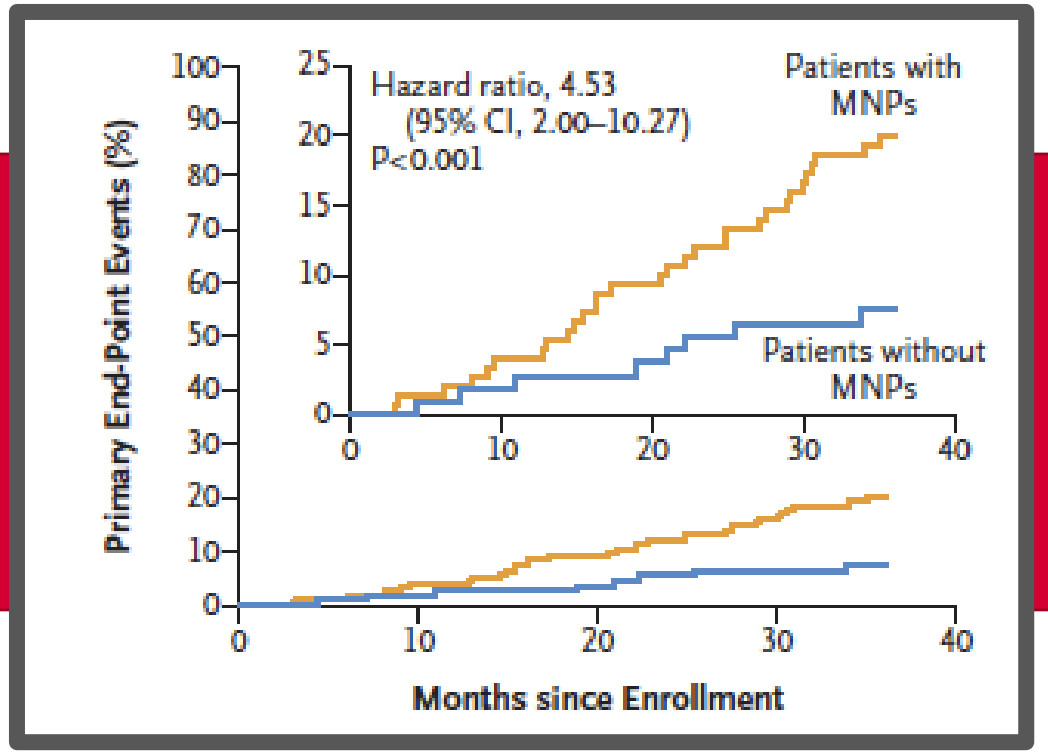
- Plastic particles and chemical additives are found in:
  - Placentas, the organ that supports fetal growth and development.
    - One study found 60% of placenta samples had NMPs in 2006, 90% in 2013, and **<u>100% in 2021</u>**.
  - Newborns' first stool
  - Breast milk
  - Infant formula
- NMPs and chemical additives cross the blood-brain barrier and enter neurons.

Babies enter the world today with their brains and bodies already contaminated with plastics.

La Porta et al., *Int J Mol Sci*, 2023

Insidious Insinuation of Micro- and Nanoplastics (MNPs)





- **Prospective study of 257(originally 304) patients undergoing carotid endarterectomy for asymptomatic disease followed for 33.7±6.9 months.**
- **58.4% had detectable polyethylene in their plaques; 12.1% had detectable polyvinyl chloride.**
- **For those with detectable atheroma MNPs, HR of 4.53 (95%CI: 2.00-10.27; P<0.001) for the primary composite end-point of MI, CVA, or death from any cause.**

Marfella et al., *NEJM*, 2024.

Micro-/Nanoplastics in Human Brains

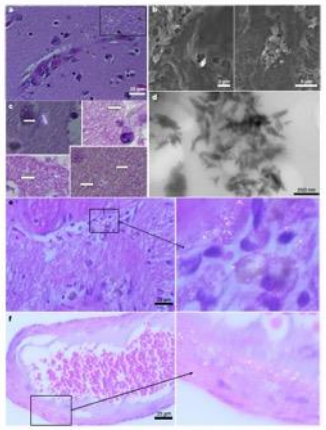
Smithsonian *magazine*

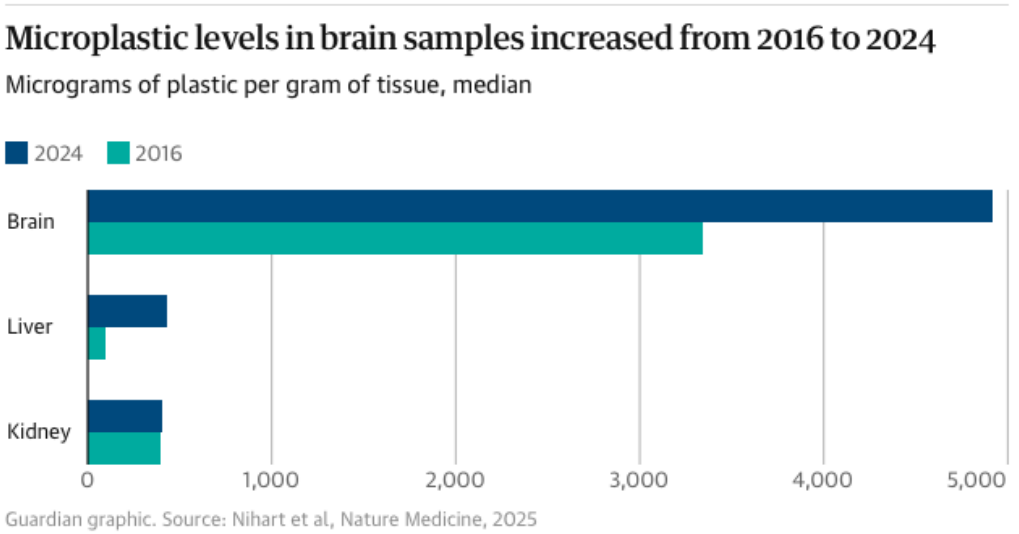
The Human Brain May Contain as Much as a Spoon's Worth of Microplastics, New Research Suggests

The amount of microplastics in the human brain appears to be increasing over time: Concentrations rose by roughly 50 percent between 2016 and 2024, according to a new study

Sarah Kuta - Daily Correspondent

February 4, 2025





- Nano-/Microplastics found in human brains.
- Higher concentrations among those with dementia.
- Concentrations increasing over time, potentially rapidly.

Nihart et al., *Nature Medicine*, 2025

Plastics as a Driver of Health Disparities

Diabetes, Disparities, and Environmental Justice

Table 1
Endocrine-disrupting chemical exposure disparities

Endocrine Disruptor	More Highly Exposed Groups	Endocrine Impacts
Polychlorinated biphenyls	Non-Hispanic Black populations[49] Pacific Islanders and Native Americans[49] US-born individuals[50] Immigrant women[119] Low income[51]	Thyroid dysfunction[43] Obesity[44] Diabetes[45,47] Adrenal dysfunction[10,58] NAFLD[48]
Phthalates	Women[60] Non-Hispanic Black populations[59] Mexican Americans[59] Low income[61]	Male infertility[56] Diabetes[43,44] Obesity[129,130]
Bisphenols	Women[67] Low income[67,70,71] Non-Hispanic Black populations[68,69]	Polycystic ovarian syndrome[65] Male infertility[56] Obesity[44] Diabetes[66] Adrenal dysfunction[58]
Organochlorine pesticides	Non-Hispanic Black populations[83] Asian populations[84] Women[84] Immigrants[7,50] Low income[85]	Thyroid dysfunction[75–77] Diabetes[46,80,81] Obesity[81,82] Adrenal dysfunction[58] NAFLD[131]
Air pollution	Non-Hispanic Black populations[93,94] Hispanic/Latinx Americans[97] Low income[93,94,98,99]	Diabetes[86,87] Obesity[88,89] Infertility[91,92]
Per- and polyfluoroalkyl substances	Women[103] Chinese populations[104] Black populations[102] Hispanic/Latinx populations[102] Low income[103,105]	Diabetes[100] Obesity[100] Reproductive dysfunction[100] NAFLD[101]
Toxic metals	Black populations[116,117] Hispanic/Latinx Americans[116,118] Low income[116,120] Immigrants[119]	Diabetes[111,132] Reproductive dysfunction[113] Infertility[114] Thyroid dysfunction[115]
Brominated flame retardants	Low income[124,125] Women[122] Non-Hispanic Black populations[126] Hispanic/Latinx populations[126]	Diabetes[123] Obesity[123] Thyroid dysfunction[123] Reproductive dysfunction[123]

- Low-income communities and communities of color have higher levels of various plastic-associated chemicals that are linked to common diseases associated with significant suffering.
  - Phthalates
  - Bisphenols
  - Per-/polyfluoroalkyl substances (PFAS)
  - Toxic metals
  - Brominated flame retardants

Weiss & Wang et al., *Endocrinol Metab Clin North Am*, 2023.
Ruiz et al., *Diabetes Care*, 2018.

Chemicals in plastics.

A Widening Threat that Demands Action

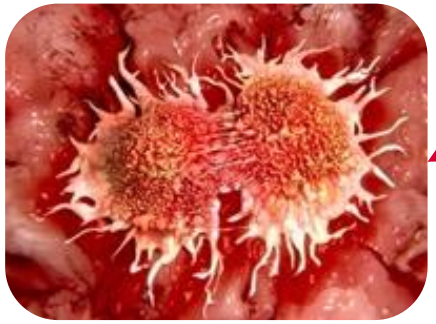
Obesity

Diabetes

Infertility

Thyroid Dz

Cancer



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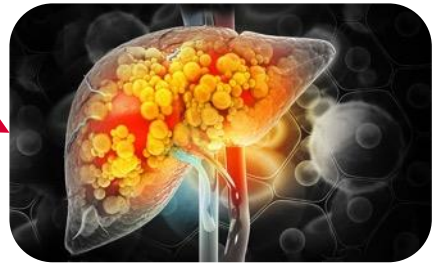


Neuropsych DO

Cardiovascular Dz

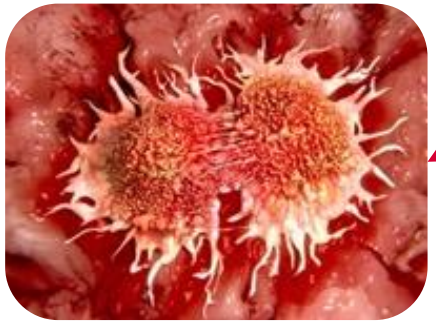
Obesity

Diabetes

Infertility

Thyroid Dz

Cancer



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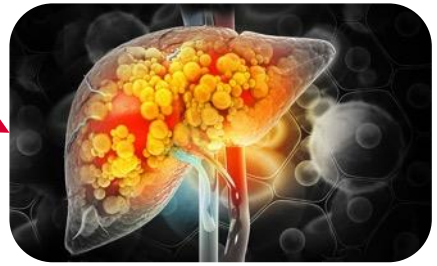

Neuropsych DO

Cardiovascular Dz

Separating Essential from Non-Essential

Plastics have undoubtedly saved lives…

…but their adverse effects mandate more judicious use.

Sources: Bloominglittles.com, Chicago Tribune, oman.whizzcart.com


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