

Potential Hazards of Microplastics to Human Health

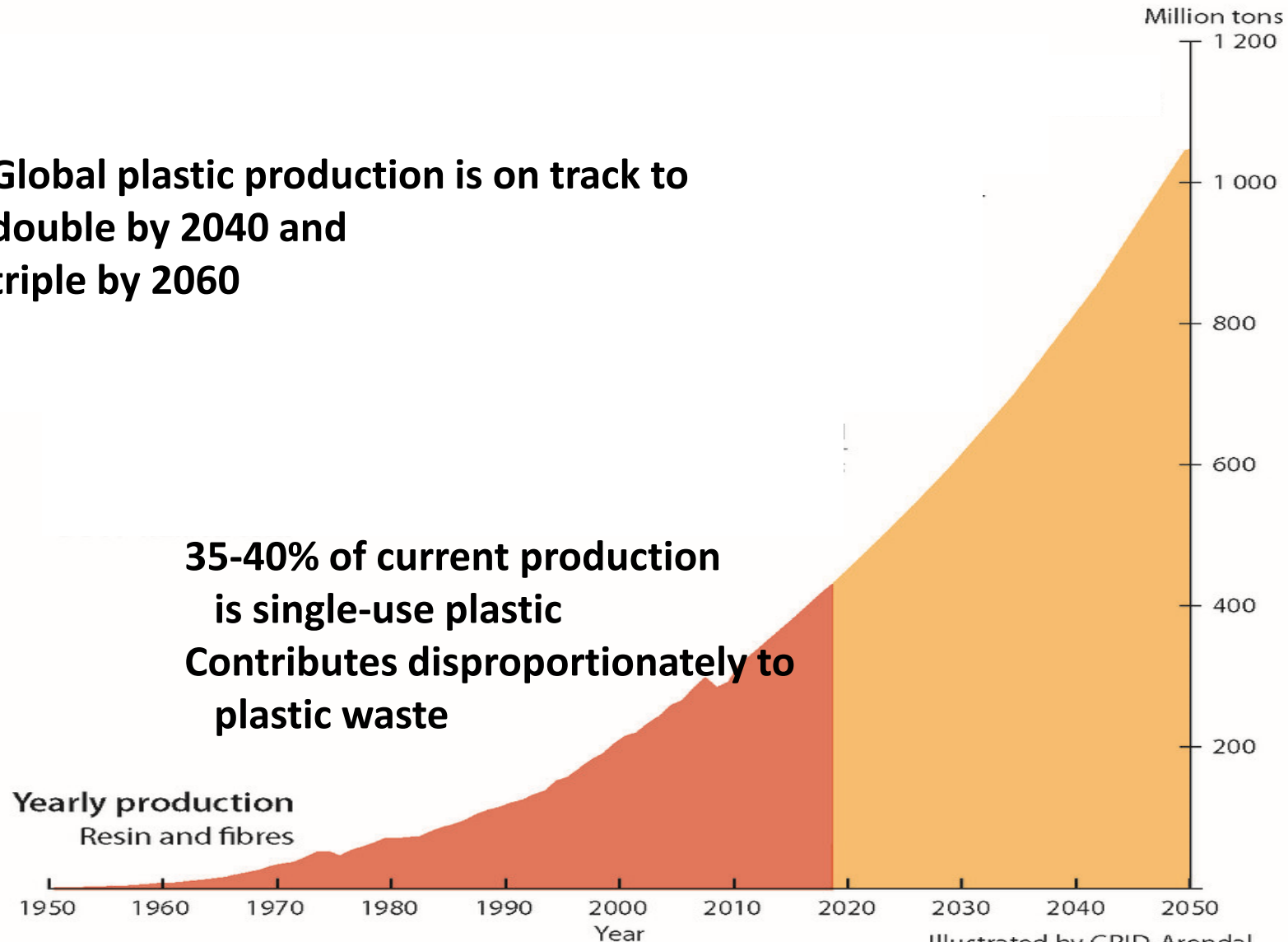
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Plastic Megatrends

- Plastic production is increasing almost exponentially. It is on track to double by 2040 and triple by 2060
- Plastic recovery and recycling rates are very low – under 10% globally
- Plastics, including microplastics, are persistent in the environment – years to decades
- Because of increasing production, low recycling, and long persistence, plastic pollution is increasing
- An estimated 6 billion metric tons of plastic waste now pollute the planet
- Human exposure to microplastics is increasing

Plastic Production, 1950-2050

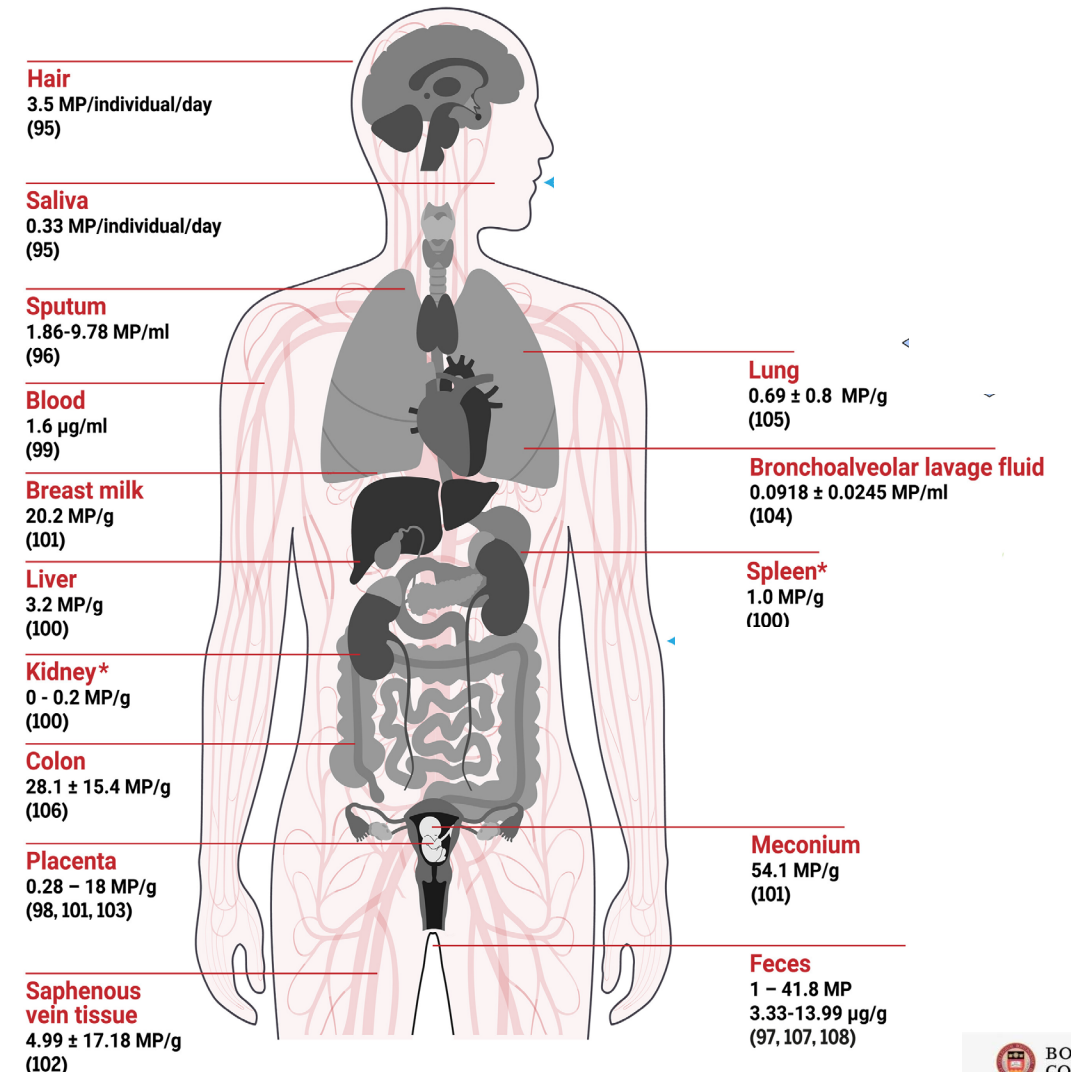
Global plastic production is on track to double by 2040 and triple by 2060



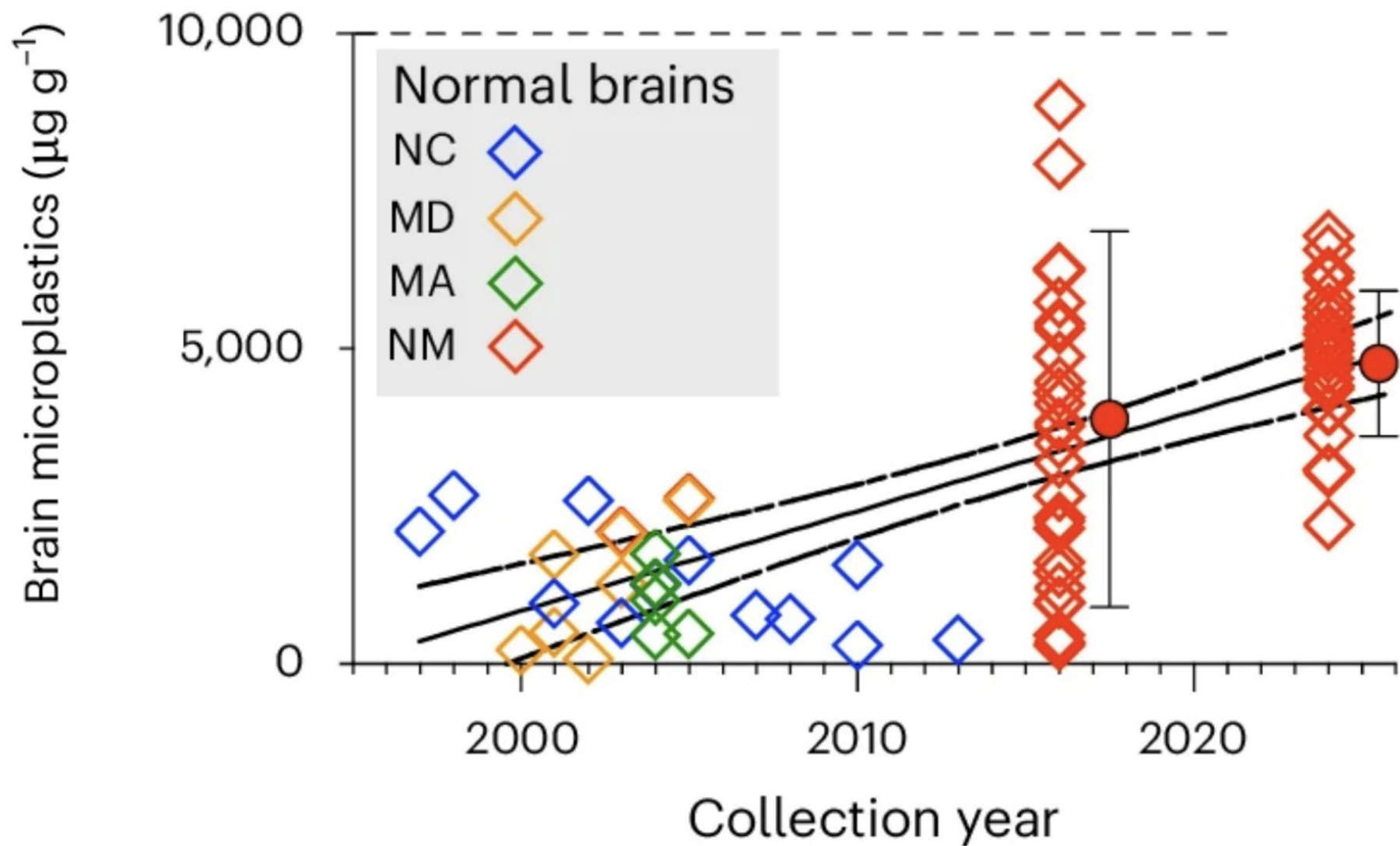
UNEP (2021). From Pollution to Solution: A global assessment of marine litter and plastic pollution. Nairobi.

Human Exposure to Microplastics

- Microplastic and nanoplastic particles are found today in virtually every organ of the human body
- These particles have two main components:
 - Polymers
 - Additives and other chemicals – PFAS, phthalates, bisphenols, flame retardants, and more
- Both components have potential to harm health and cause disease – chemicals can leach from microplastic particles
- Human body burden of microplastics appears to be increasing as plastic pollution increases

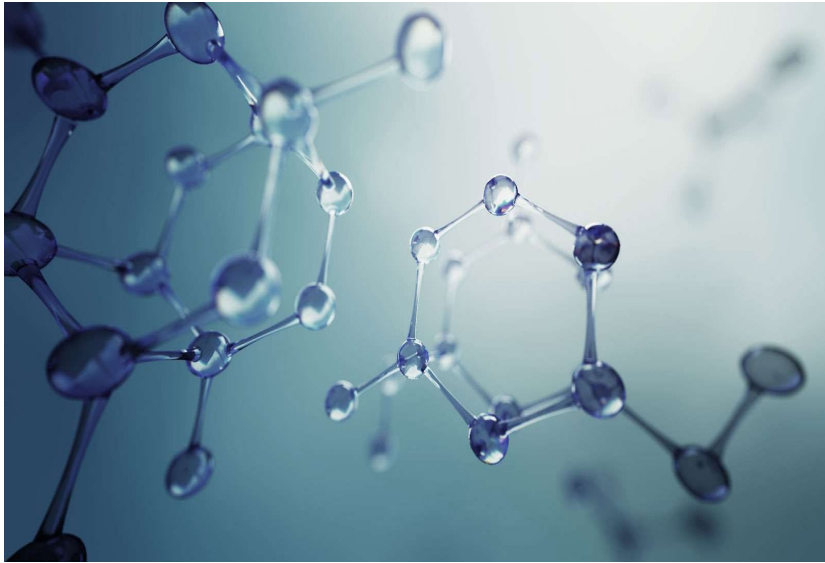


Microplastic Burden in Human Brain Tissue, 1995-2025



16,000 + Chemicals In Microplastics

Well-Established Hazards to Human Health



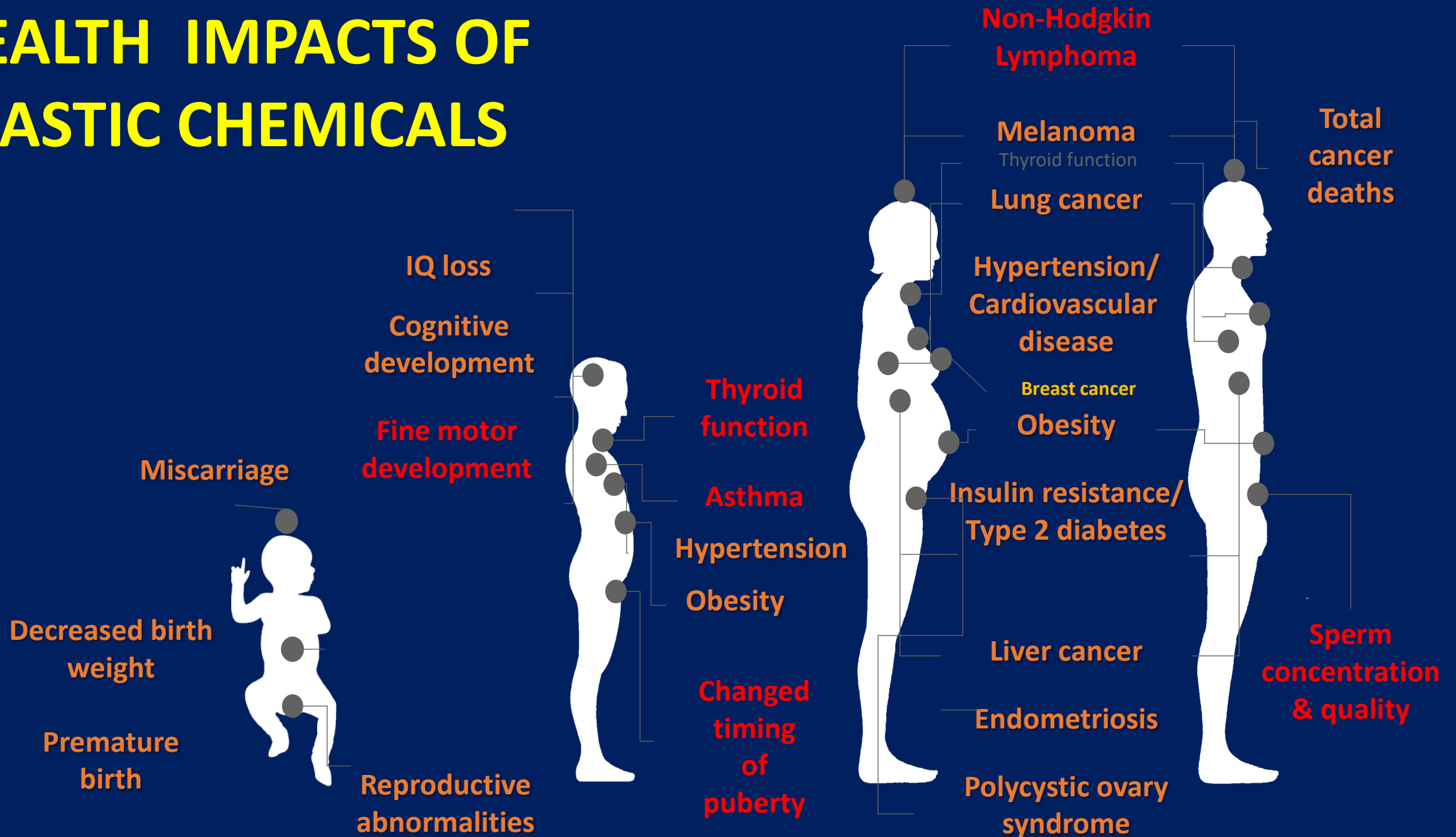
They include:

- Carcinogens - vinyl chloride, 1,3-butadiene, PFAS
- Developmental neurotoxins –brominated flame retardants, organophosphate flame retardants, lead
- Endocrine-disruptors – phthalates, BPA

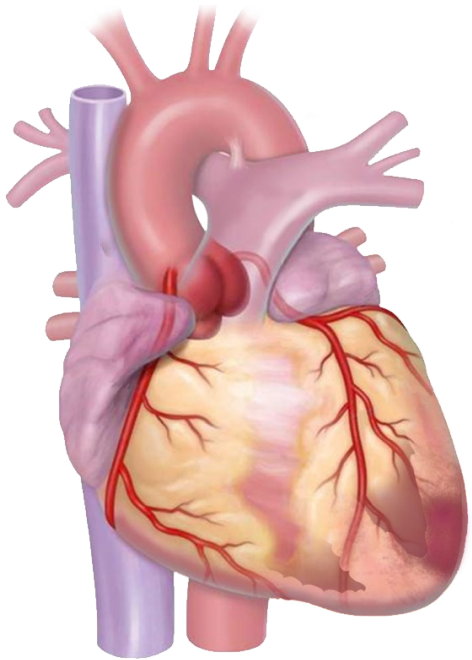
CDC surveys find nearly universal human exposure in persons of all ages, including newborn infants

The great majority of chemicals in plastics have never been tested for toxicity – potential hazards not known

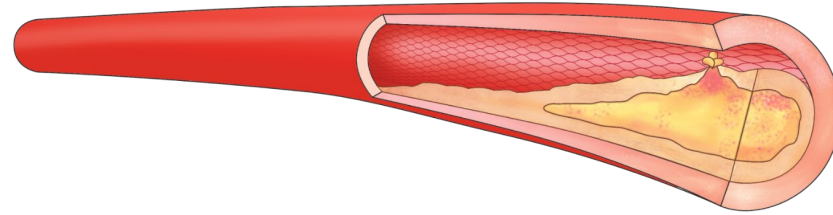
HEALTH IMPACTS OF PLASTIC CHEMICALS



CARDIOVASCULAR HAZARDS OF MICROPLASTICS



- *New England Journal of Medicine* – March 7, 2024
- 312 patients who underwent carotid endarterectomy



- Microplastics and nanoplastics (MNPs) were detectable in the excised plaque of 58% of the patients
- Patients with MNPs had a 4.5-fold (450%) increase in risk for nonfatal myocardial infarction, nonfatal stroke, or death over the next 3 years.
- Only one study. Does not prove causation. But a striking finding

Other Reported Health Effects of Microplastics

- Increased accumulation of micro and nanoplastic particles in decedent brains with dementia, Campen et al. doi.org/10.1038/s41591-024-03453-1
- Nanoplastics promote aggregation of α -synuclein, of a Parkinson Disease protein, Liu et al [DOI: 10.1126/sciadv.adi8716](https://doi.org/10.1126/sciadv.adi8716)
- Microplastics are associated with gut inflammation, Wang et al. doi.org/10.1038/s41565-023-013
- Placental microplastics linked to preterm birth, Garcia et al [DOI: 10.1093/toxsci/kfae021](https://doi.org/10.1093/toxsci/kfae021)
- Microplastics found in testis, Hu et al doi.org/10.1093/toxsci/kfae060

These are early data. Mostly small sample sizes. Methods not yet standardized. But the findings cannot be ignored

Next Steps

Research:

- Standardized analytical methodologies, Xu et al [doi: 10.1038/d41586-025-00702-2](https://doi.org/10.1038/d41586-025-00702-2)
- Rigorous, high-quality clinical and epidemiologic studies
- Studies of health impacts in early development
- In early development, even very small exposures can have severe effects, e.g., thalidomide. The timing of exposure can be as important as the dose, [NAS report, *Pesticides in the Diets of Infants and Children*, 1993](#)

Prevention

- The classic Risk Assessment/Risk Management paradigm should be refined with better data
- However, RA/RM will not be sufficient, given the great complexity and rapid escalation of the plastic pollution problem
- Need also for Primary Prevention at Source - Precautionary Principle – to complement RA/RM
 - Global cap on production of new plastics
 - Tight regulation and transparent disclosure of all chemicals in plastics – analogous to pharmaceutical regulation [doi: 10.1056/NEJMms2409092](https://doi.org/10.1056/NEJMms2409092)