

# PFAS and health

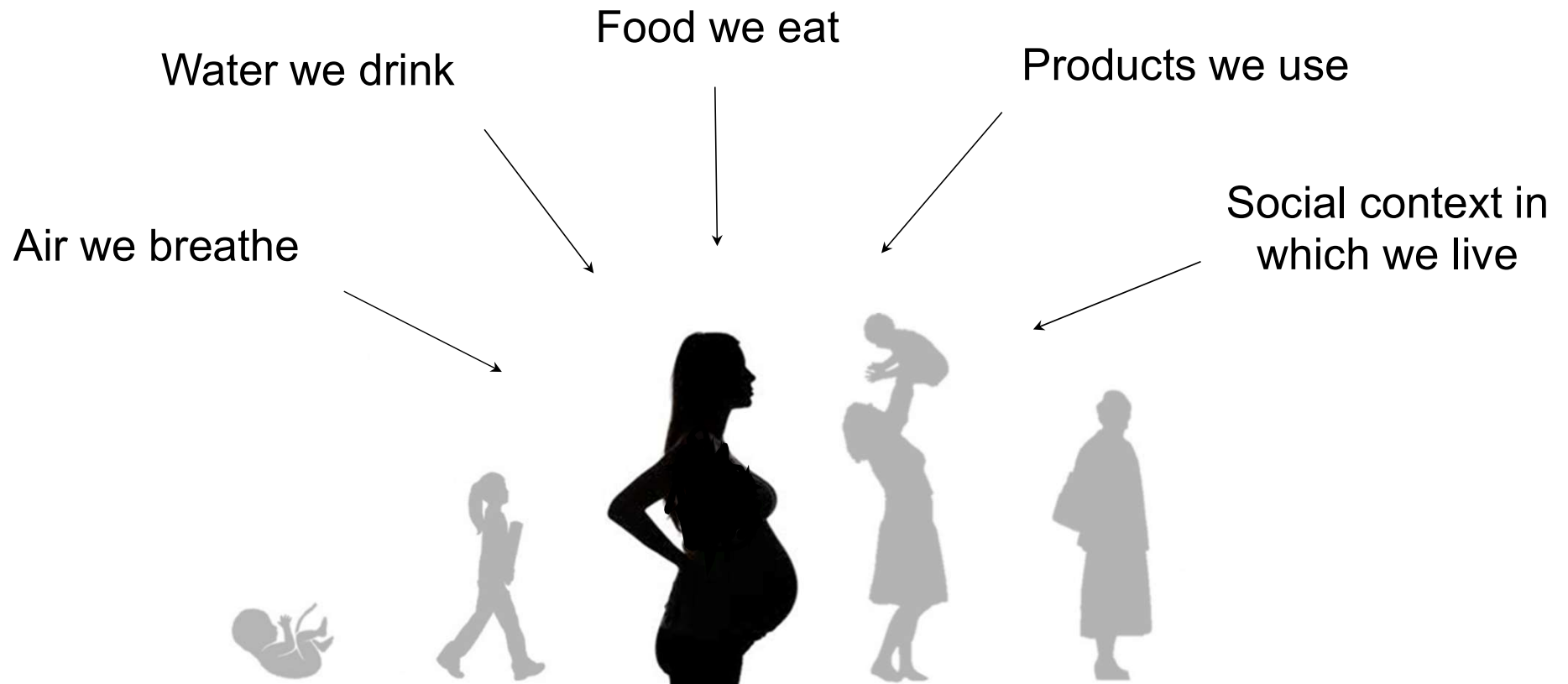
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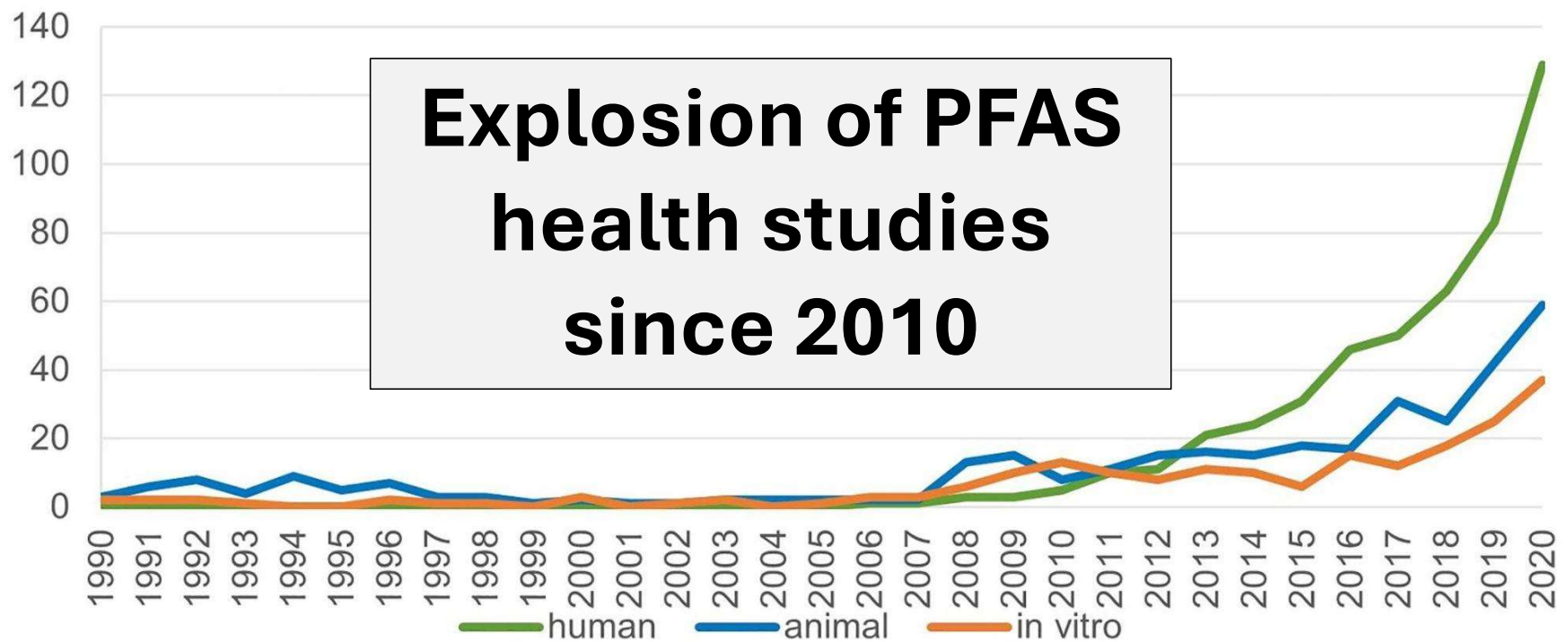
Northeastern University

<https://coe.northeastern.edu/people/varshavsky-julia/>

# PFAS exposures and human health: pregnancy as a sensitive period for maternal and fetal health



## PFAS Health and Toxicology Papers Published Each Year (1969-1989 not shown)



# PFAS exposure and immune system effects

- 2016 – National Toxicology Program (NTP) recognizes PFOA as immune hazard to health based on immunosuppression of antibody response
- 2022 – National Academies of Science Engineering and Medicine (NASEM) finds sufficient evidence for association of exposure to multiple PFAS and decreased antibody response to vaccination or infection
- 2024 – Review highlights strong evidence that exposure to PFAS causes decreased antibody response to vaccines (Bline et al., 2024)

***The public health risks of PFAS-related immunotoxicity are real***

***It is time to stop downplaying the potential for harm to the immune system posed by PFAS***

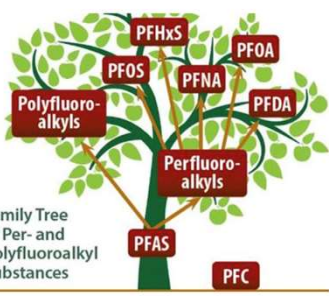


NRDC blog, March 24, 2024 <https://www.nrdc.org/bio/katie-pelch/public-health-risks-pfas-related-immunotoxicity-are-real>

PFAS exposure can harm the immune system. People with high PFAS exposure may choose additional health protective behaviors like increased mask wearing or hand washing. | Arman Zhenikev/Alamy

# PFAS exposure and cancer risk

National Cancer Institute <https://dceg.cancer.gov/>



Family Tree of Per- and polyfluoroalkyl Substances

In Utero PFAS Exposure and Childhood Leukemia

First study of PFAS levels in pregnancy and risk of leukemia in offspring.

The diagram shows a tree structure with 'PFAS' at the base. Branches include 'Polyfluoroalkyls' (with sub-nodes PFOS, PFNA, PFDA, PFHxS, PFOA) and 'Perfluoroalkyls' (with sub-node PFC).

Jones et al., 2024




PFAS Levels and Kidney Cancer Risk in the Multiethnic Cohort Study

This is the first study to explore the relationship between blood levels of PFAS and risk of kidney cancer in different racial and ethnic groups.

The image shows a whiteboard with several red and blue markers and chemical structures of PFAS.

Rhee et al., 2023



PFAS Linked with Testicular Cancer Risk in U.S. Air Force Servicemen

Dr. Mark Purdue and colleagues report a link between serum PFOS levels and testicular cancer.

The image shows two Air Force servicemen in uniform standing next to a large plume of white smoke or steam.

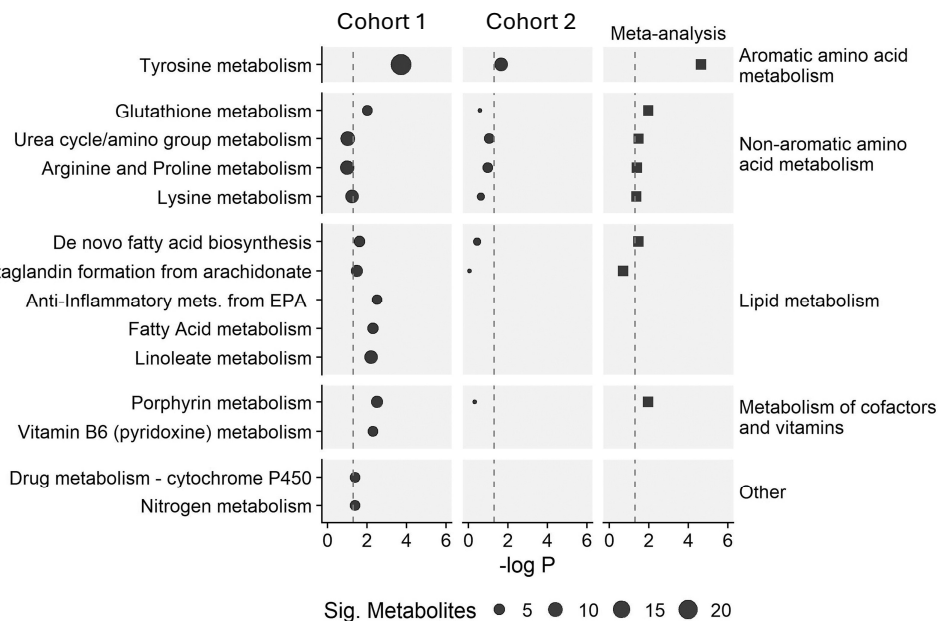
Purdue et al., 2023

## International Agency for Research on Cancer (IARC 2025)

- PFOA = carcinogenic to humans (Group 1)
- PFOS = possibly carcinogenic to humans (Group 2B)

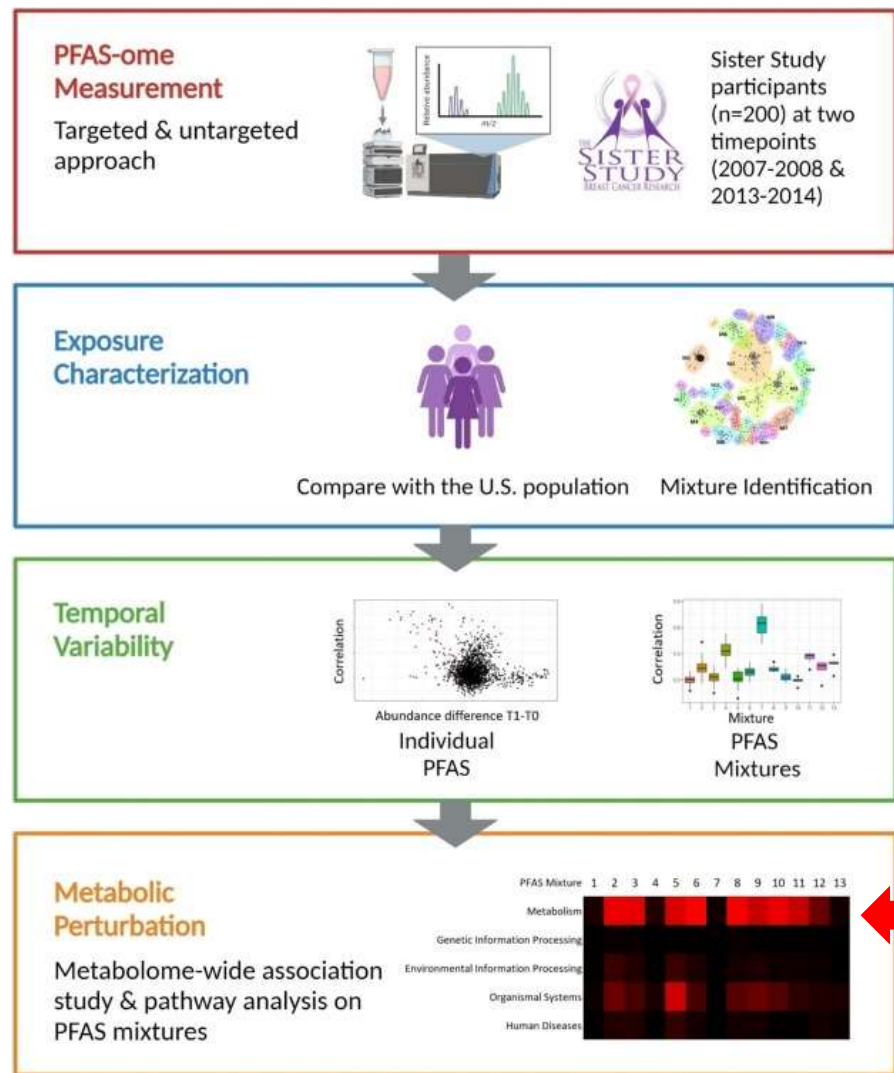
PFAS contamination in U.S. drinking water associated with increased cancer incidence in the digestive, endocrine, oral cavity/pharynx, and respiratory systems (Li et al., 2025)

# PFAS exposure and cardiometabolic effects



**Metabolic “super” pathways linked to PFAS exposure: Amino acids, lipids, cofactors, vitamins**

Goodrich et al., 2023, *Environmental Health Perspectives*



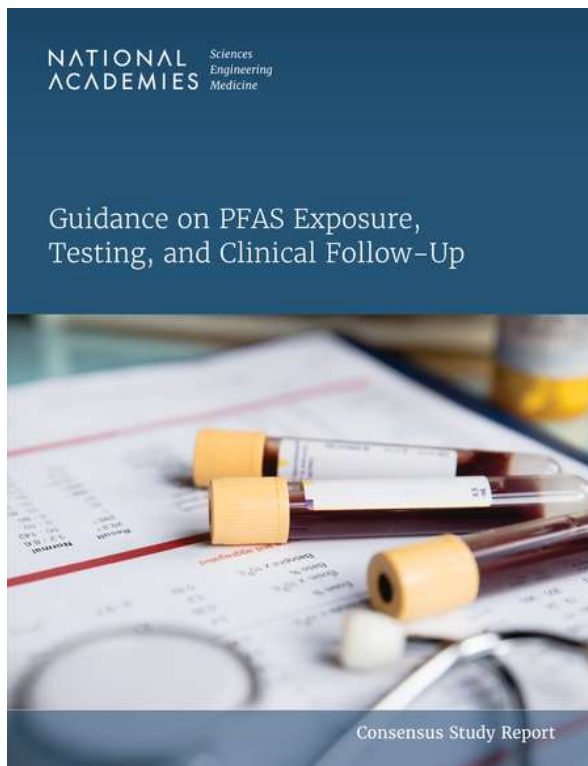
Chang et al., 2025, *Environment International*

# PFAS exposure and pregnancy outcomes

- Higher PFAS levels associated with low birthweight in largest U.S. study across 11 cohorts in 7 states (Padula et al., 2023)
- Suggestive evidence of increased risk of preterm birth
- PFAS associated with gestational diabetes and hypertensive disorders of pregnancy in multiple studies (Varshavsky et al., 2020)



# Data gaps identified on PFAS exposure and neurodevelopmental effects



- **Sufficient evidence of association**
  - Decreased antibody response
  - Dyslipidemia (e.g., high cholesterol)
  - Decreased infant and fetal growth
  - Increased risk of kidney cancer
- **Limited (suggestive) evidence** on other cancers (breast, testicular), thyroid function, hypertensive disorders of pregnancy, ulcerative colitis
- **Inconclusive evidence for neurodevelopmental effects** – keep an eye on upcoming ECHO studies!

# PFAS safety levels and clinical guidance

## Clinical guidance outlined in 2022 NASEM report

### **≥ 20 (ng/mL) PFAS**

Encourage PFAS exposure reduction AND screen for dyslipidemia (>2 yrs), thyroid function, kidney cancer, testicular cancer, ulcerative colitis

### **2 – <20 (ng/mL) PFAS**

Encourage PFAS exposure reduction AND screen for dyslipidemia in older patients, hypertensive disorders of pregnancy, and breast cancer

### **<2 (ng/mL) PFAS**

Provide usual standard of care

## Federal Maximum Contaminant Levels (MCLs)

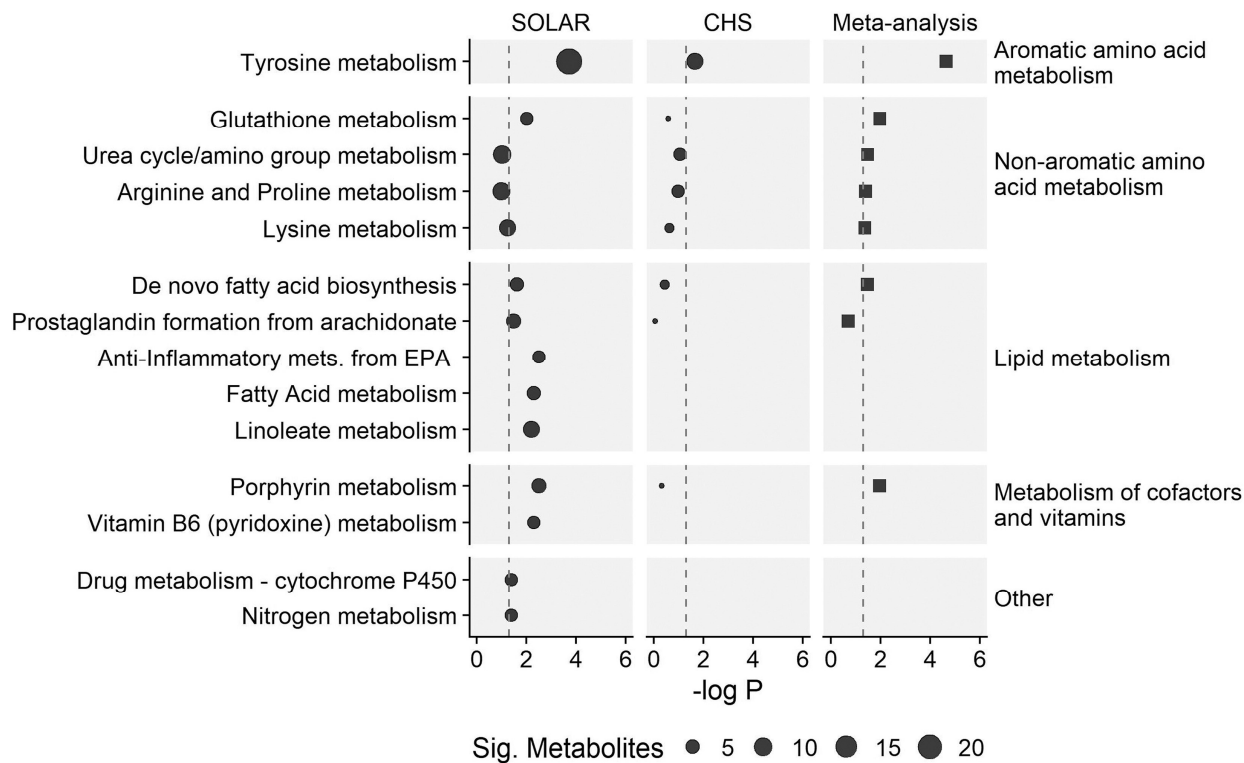
- **April 10, 2024:** Biden-Harris Administration finalizes first-ever MCLs on multiple PFAS
- **May 14, 2025:** Environmental Protection Agency (EPA) announces it will keep current MCLs for PFOA and PFOS but will rescind regulations for PFHxS, PFNA, HFPO-DA (GenX), and the Hazard Index mixture including PFBS

<https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas>

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# PFAS exposure and cardiometabolic outcomes



SOLAR = Study of Latino Adolescents at Risk; CHS = Southern California Children's Health Study

## Metabolic “super” pathways linked to PFAS exposure:

- Aromatic amino acid
- Nonaromatic amino acids
- Lipids
- Cofactors and vitamins