



Chemicals and Pregnancy Complications

Findings from non-targeted analysis

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Tracey Woodruff, PhD, MPH

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Nothing to Declare



UCSF Program on Reproductive Health
and the Environment



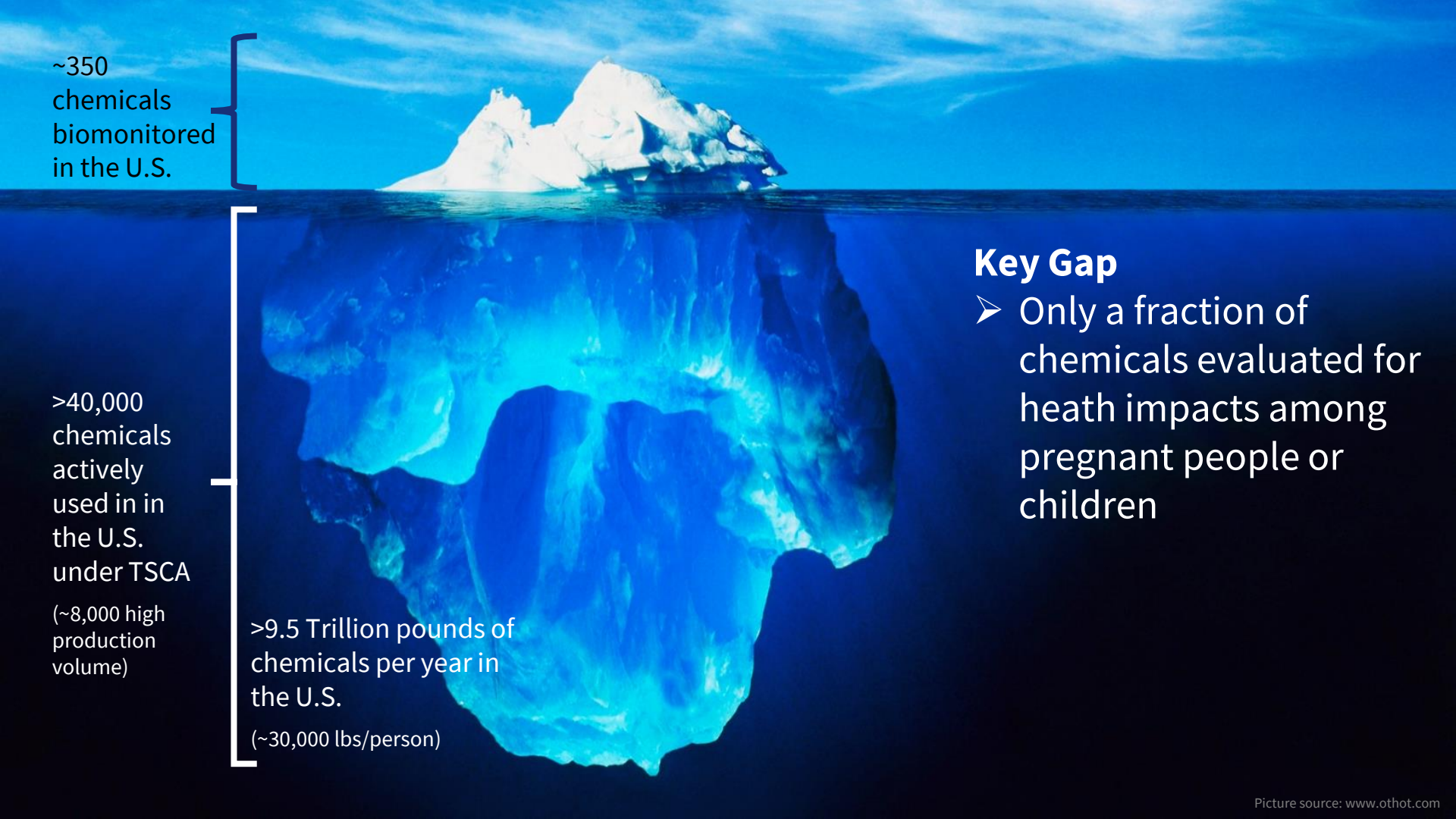
**“We live in a
chemical
soup.”**

**- Linda Birnbaum
Former Director, NIEHS**





“to a disturbing extent
babies
are born
‘pre-
polluted’”

An iceberg floating in the ocean. The small tip above the water surface represents the limited number of chemicals monitored in the U.S. The much larger, submerged part below the surface represents the vast majority of chemicals that are not monitored. The background is a clear blue sky and dark blue ocean.

~350
chemicals
biomonitored
in the U.S.

>40,000
chemicals
actively
used in in
the U.S.
under TSCA

(~8,000 high
production
volume)

>9.5 Trillion pounds of
chemicals per year in
the U.S.

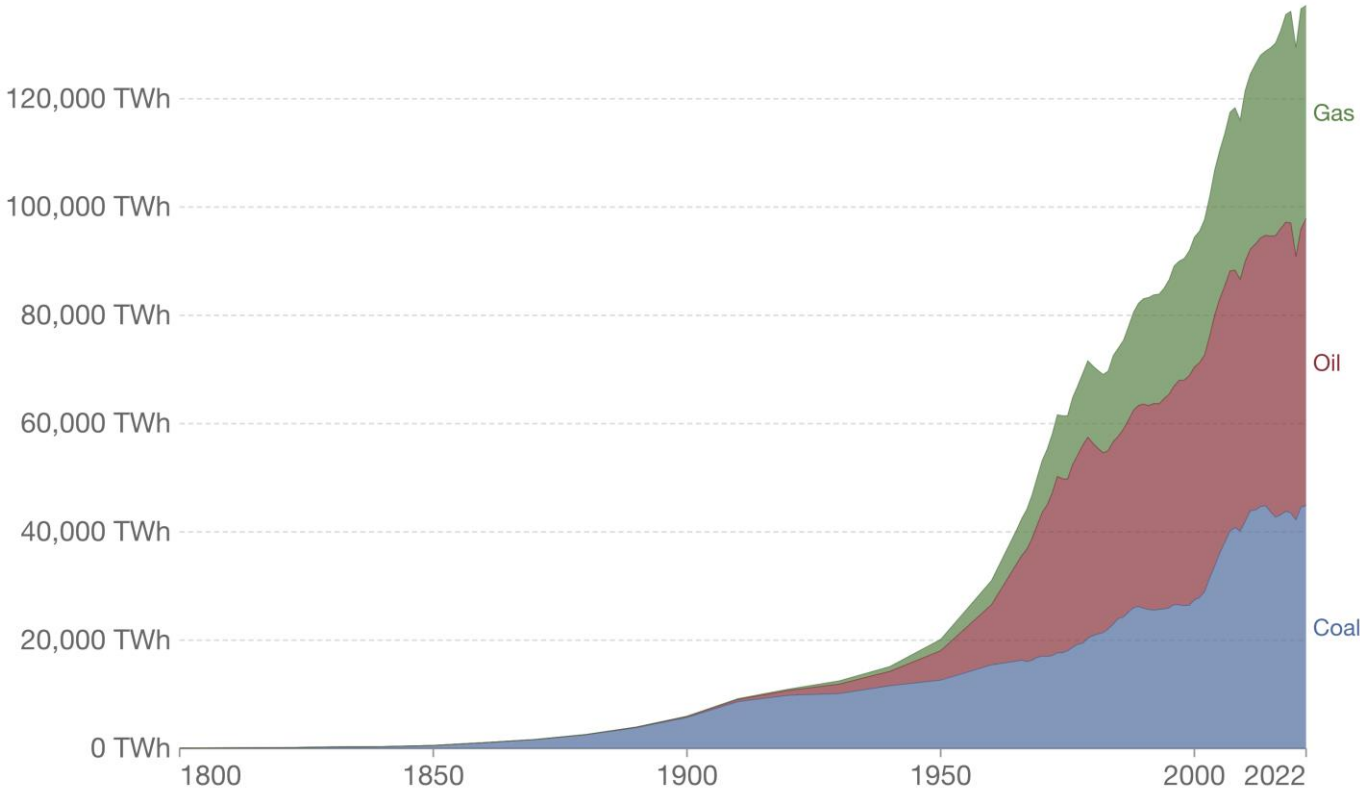
(~30,000 lbs/person)

Key Gap

- Only a fraction of chemicals evaluated for health impacts among pregnant people or children

Global fossil fuel consumption

Global primary energy consumption by fossil fuel source, measured in terawatt-hours (TWh).



Source: Energy Institute Statistical Review of World Energy (2023); Vaclav Smil (2017)
OurWorldInData.org/fossil-fuels/ • CC BY

The toxic toll on our health



Birth defects

Low birth weight

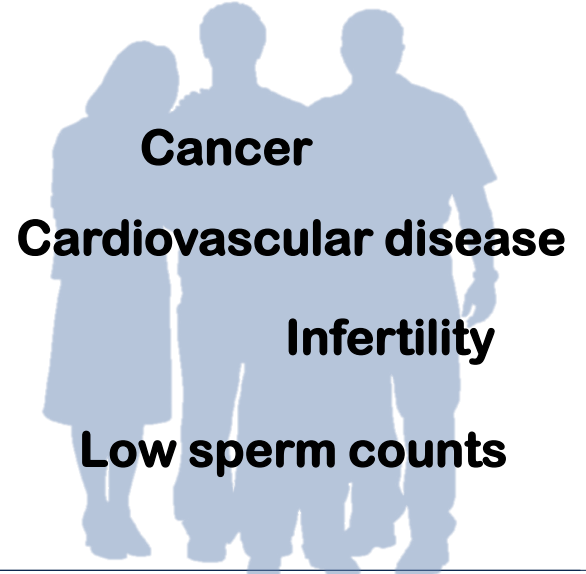
Infant mortality

Childhood cancers

Asthma

Learning disabilities

Behavioral disorders
Autism



Cancer

Cardiovascular disease

Infertility

Low sperm counts

The toxic toll on our health



Neurological Disorders
28% increase



Chronic Respiratory Disease
66% Increase



Diabetes
132% increase



Birth defects

Infant mortality

Low birth weight

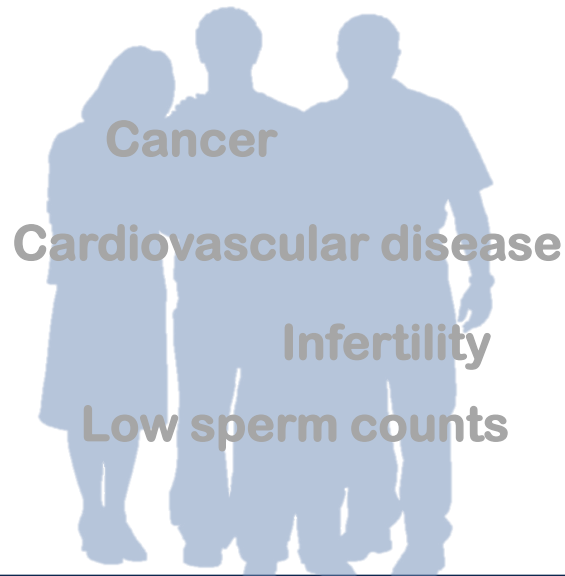
Childhood cancers



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Cancer

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Low sperm counts

Exposures in pregnant people associated with adverse health outcomes

Breast Cancer

As you prepare for lactation, mammary glands differentiate into milk-producing buds.

Pregnancy also dramatically increases production of hormones, the signaling molecules that coordinate major physiological changes.

Gestational Diabetes

As the metabolism shifts to preserve glucose for the growing fetus, maternal blood sugar and insulin resistance increase.

Preeclampsia

The placenta remodels blood vessels, redirecting blood flow toward the "maternal-fetal interface" to support the growing fetus.



Pregnancy complications are also increasing



**Gestational
Diabetes Mellitus**
30% increase in
last decade 2011 -
2019



**Pregnancy related
hypertension**
**increase from 11 to
31% per 1k births**
between 1987 and
2004



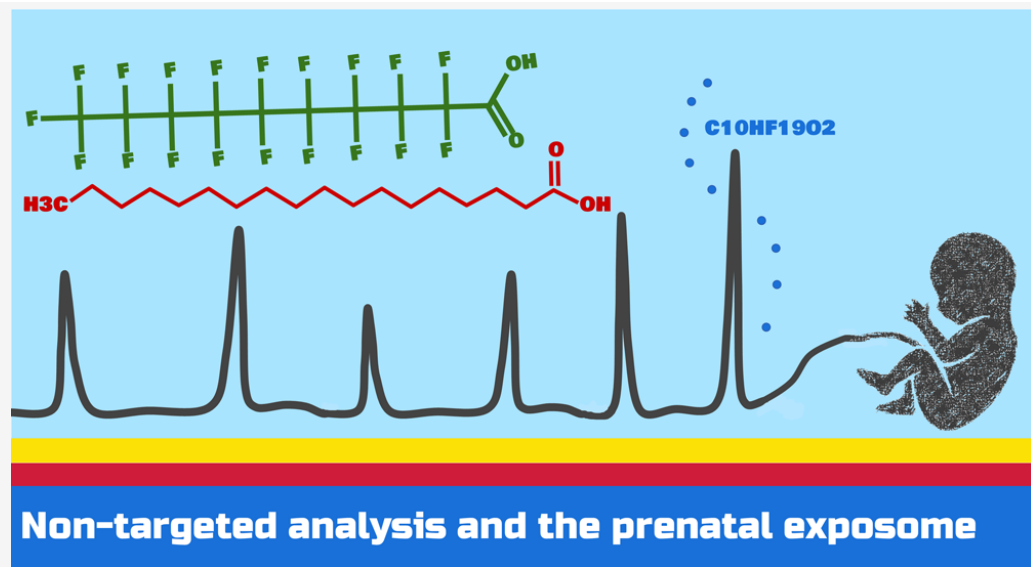
Preeclampsia
**increase from 24
to 29% per 1K
births** between
1987 and 2004

Discovery of novel environmental chemicals in a diverse population of maternal-infant pairs

- Goal of grant was to apply non-targeted analysis techniques to comprehensively screen blood samples and discover unknown environmental chemicals in pregnant people
-

A Comprehensive Non-targeted Analysis Study of the Prenatal Exposome

Dimitri Panagopoulos Abrahamsson, Aolin Wang, Ting Jiang, Miaomiao Wang, Adi Siddharth, Rachel Morello-Frosch, June-Soo Park, Marina Sirota,[#] and Tracey J. Woodruff^{*,#}



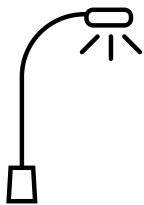
- Matched samples (cord and maternal blood)
- Applied Non-targeted analysis and computational workflow
- Confirmed 8 chemicals to analytical standard

Discovery of novel environmental chemicals in a diverse population of maternal-infant pairs

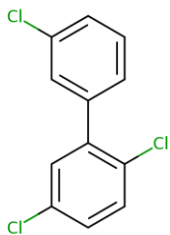
- Goal of grant was to apply non-targeted analysis techniques to comprehensively screen blood samples and discover unknown environmental chemicals in pregnant people
 - **The goal of this study was to quantify novel chemicals**
 - Compare chemical levels between maternal and fetal samples**
 - Evaluate association between chemicals and adverse pregnancy outcomes**
-

Biomonitoring Chemical analysis

Targeted analysis

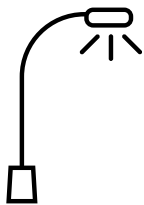


Identify chemicals *a priori*
Develop targeted analytic chemistry
method (analytic standards)
e.g., a list of 10 PCBs

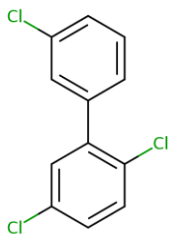


Biomonitoring Chemical analysis

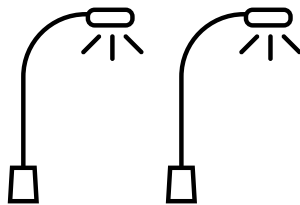
Targeted analysis



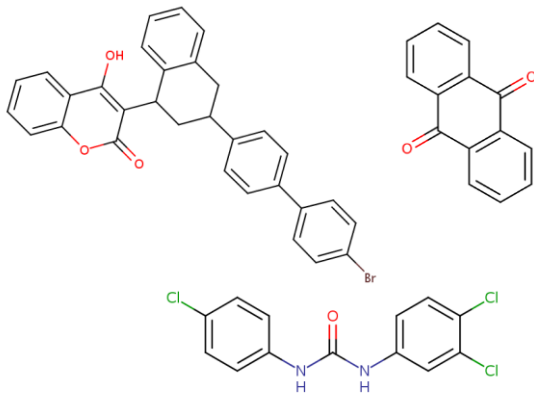
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Suspect screening

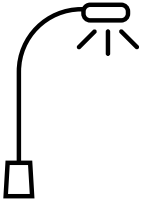


Using nontargeted analytic chemistry methods +
Set list of chemicals for analysis
e.g., a list of 1000 pesticides

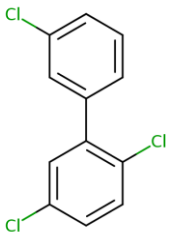


Biomonitoring Chemical analysis

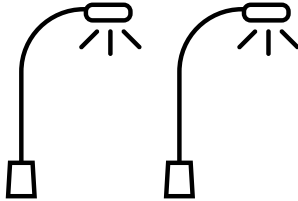
Targeted analysis



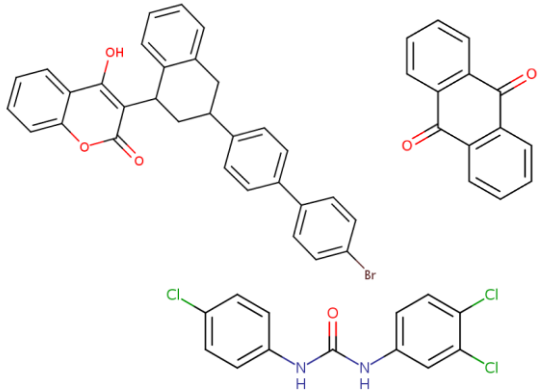
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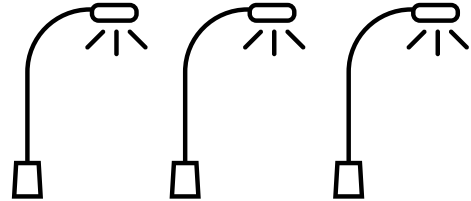
Suspect screening



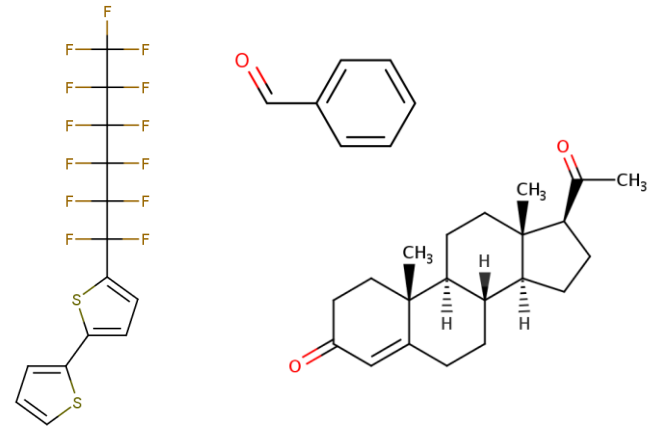
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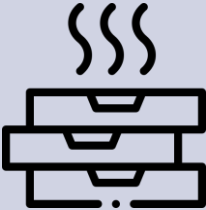
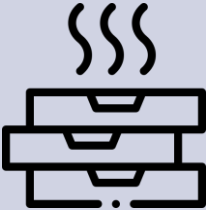

Non-targeted analysis



Use nontargeted analytic chemistry methods
e.g., all detectable masses in an LC/QTOF system



Chemicals of interest

Chemical	Uses	Annual volume produced (2019 CDR)	Previously biomonitored?
Linear and Branched PFOS		>1 million lbs	Y
PFHxS		>1 million lbs	Y
Octadecanedioic acid		25,990 lbs	N
Tridecanedioic acid		<1 million lbs	N

Chemicals in our bodies cohort (2014-2018)

San Francisco, California

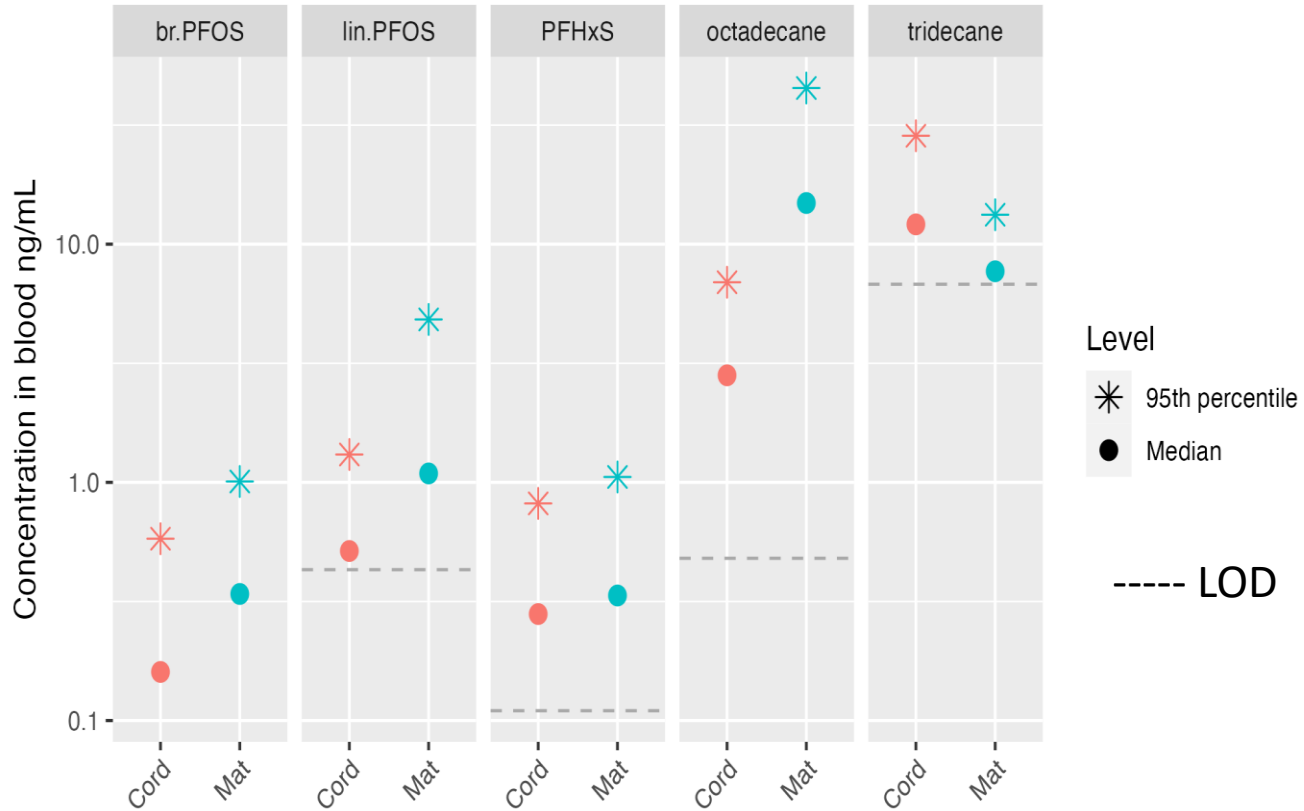
Recruited from the UCSF system (n = 302)

- 43% (n = 130) White; 32% (n= 96) Latina; 15% (n = 15) Asian

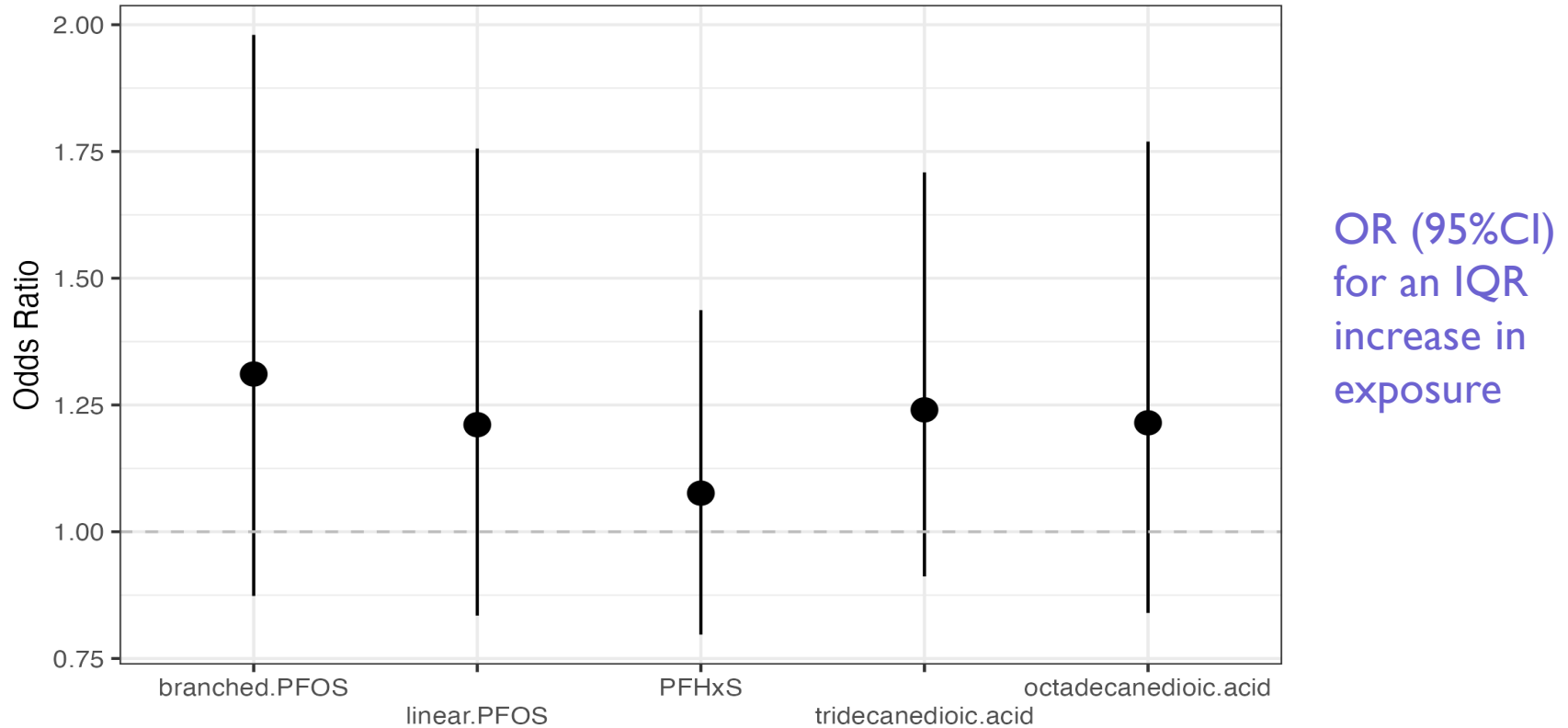
Outcomes evaluated from medical record:

- 19% (n = 57) with GDM or were “at risk” for GDM
- 17% (n = 50) with hypertensive disorders of pregnancy
Includes pre-eclampsia and pregnancy related hypertension

Chemicals identified in both maternal and cord blood

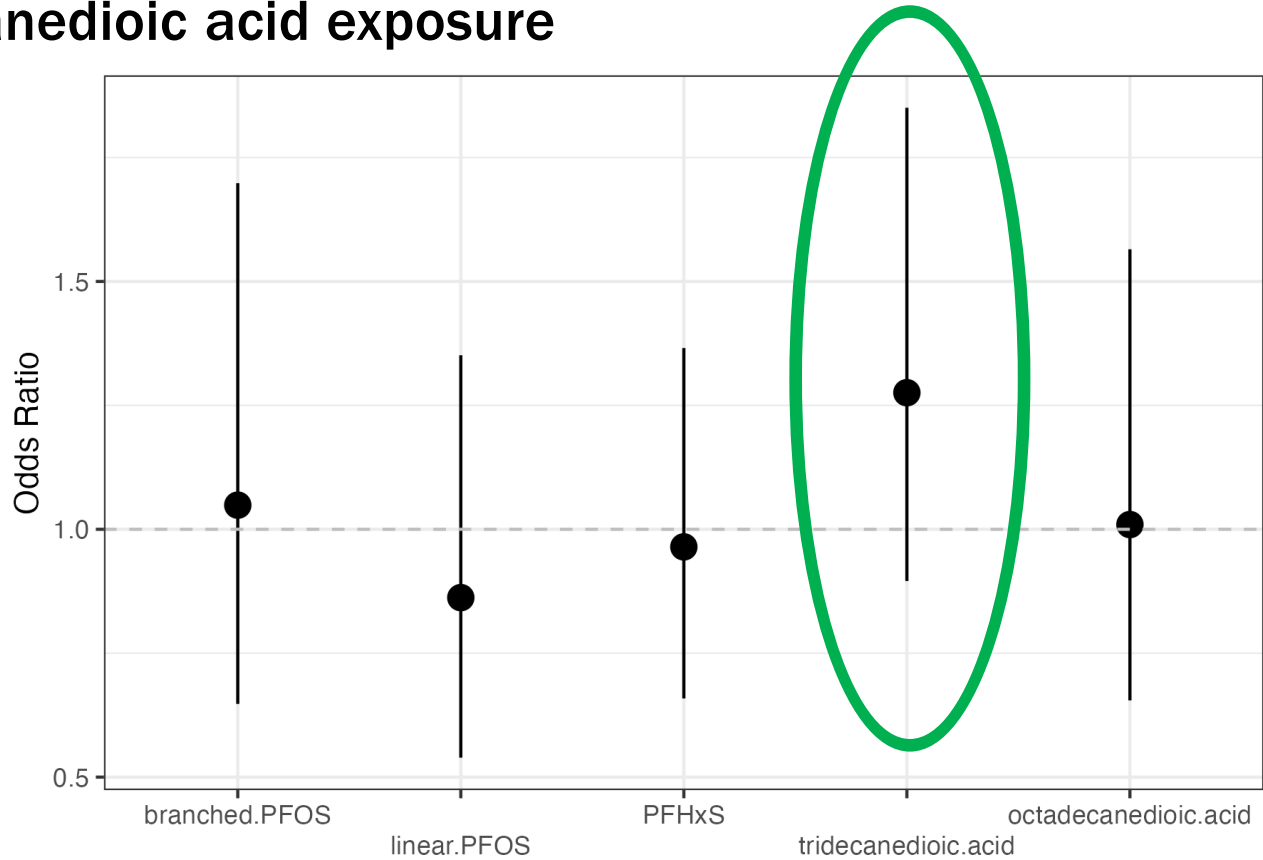


Chemical exposures associated with increased odds of Gestational Diabetes Mellitus (GDM)



Adjusted for maternal age, hospital of delivery and race/ethnicity

Increased odds of hypertensive disorders for an IQR increase in tridecanedioic acid exposure



OR (95%CI)
for an IQR
increase in
exposure

Adjusted for maternal age, hospital of delivery and race/ethnicity

Conclusions

- First time tridecanedioic acid and octadecanedioic acid measured in pregnant people and cord blood or evaluated for associations with pregnancy complications
- Found chemical exposure in all study participants and found chemicals in cord blood
- Provide further support to relationship PFAS and GDM

Thank you



Study participants of CIOB

Co-authors: D. Abrahamsson, G. Bland, T. Jiang, M. Wang, JS Park, R. Morello-Frosch, M. Sirota, H. Lee, D. Goin, M. Zlatnik, TJ Woodruff.

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