

PFAS AND PLACENTAL TOXICITY

Rebecca Fry Environmental Sciences and Engineering UNC-Chapel Hill

October 23, 2019 Environmental Health Collaborative 2019 Summit PFAS: Integrating Science and Solutions in NC





THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL Human studies suggest PFAS exposure may...

increase risk of thyroid disease

increase blood cholesterol levels

decrease the body's response to vaccines

decrease fertility in women

increase risk of high blood pressure & preeclampsia

> lower infant birth weight

in adults

Information sourced from Agency for Toxic Substances and Disease Registry



in children in pregnant women

Human studies suggest PFAS exposure may... PFAS Testing Network

increase risk of thyroid disease

increase blood cholesterol

Do PFAS in drinking water pose a risk to pregnant women and could they affect the health and function of her placenta?



Information sourced from Agency for Toxic Substances and Disease Registry

Do PFAS in drinking water pose a risk to pregnant women and could they affect the health and function of her placenta?

Human



What are the levels of PFAS in the placenta??





What is the effect of PFAS on placental health and function?

What are the levels of PFAS in the placenta?

	PFPeS	PFHxS	PFHpS	PFOS	PFHxA	PFOA	PFNA	PFDA	PFUnA	PFTriA	PFTA
Chain length	5	6	7	8	6	8	9	10	11	13	14
%> LOD	31.1	74.6	54.9	99.2	1.6	27.0	21.3	39.3	49.2	29.5	6.6
Maximum	0.035	0.446	0.063	4.87	5.87	1.23	0.494	0.465	0.24	0.336	0.111
Minimum	< 0.005	< 0.033	< 0.008	< 0.001	< 1.32	< 0.290	< 0.148	< 0.030	< 0.033	< 0.050	< 0.049
Median	< 0.005	0.067	0.009	0.48	< 1.45	< 0.315	< 0.163	< 0.031	< 0.031	< 0.057	< 0.054
n	122	122	122	122	122	122	122	122	122	122	122

- 122 placentas from high-risk pregnancies at UNC Hospitals
- Pre-Term Birth cohort
- Monitored for a total of 26 PFAS
- Including GenX, Nafion BP2 previously seen in Wilmington serum
- 11 legacy PFAS found above limit of detection (LOD)





What are the levels of PFAS in the placenta?



PFAS results are presented as ng/g wet weight

Risk factors associated with elevated PFAS in PTB placenta

PFOS, PFHxS, PFHps, and PFUnA were investigated for associations with risk factors including:

- Maternal age
- Maternal smoking status
- Maternal race/ethnicity
 - Child's gender
- Maternal pre-pregnancy BMI
- Maternal medical insurance
 - Maternal education
 - Marital status

Risk factors associated with elevated PFAS in PTB placenta

• PFOS, PFHxS, PFHps, and PFUnA were investigated for associations with risk factors including:



PFAS in relation to pregnancy outcomes and birth outcomes

PFOS, PFHxS, PFHps, and PFUnA in relation to adverse outcomes:

- Preeclampsia
 - Birthweight
- Gestational age at delivery



PFAS and adverse outcomes



PFAS and adverse outcomes



No significant associations were observed between PFAS and any investigated adverse outcome for this study



Examining the effects of PFAS in cell culture





Perfluorooctanoic acid

(PFOA)

Perfluorooctanoic sulfate (PFOS)





2,3,3,3-tetrafluoro-2-(hepta fluoropropoxy) propanoate (GenX)

- Late in the first trimester, cells of the placenta known as trophoblast cells migrate to invade and remodel the arteries of the uterine wall.
- Remodeling allows for increased blood flow to the placenta and growing fetus.
- When this migration and invasion of trophoblast is compromised, pregnancy complications develop like Preeclampsia.



PFAS reduce migration in SVneo/HTR8



Time



N = mean of 3 experiments * p < .05 compared to control



Immune regulation of trophoblast migration



- Trophoblast-immune crosstalk
 - Prevents maternal immune cells from attacking fetal tissue
 - Protects fetus against pathogens
 - Controls trophoblast invasion/ migration
- PFAS modulate immune signaling in other tissues



https://www.rndsystems.com/resources/articles/chemokines-pregnancy

Chemokine expression





N = mean of 4 experiments * p < .05 compared to control

PFAS (ng/mL)





OUR TEAM: UNC at Chapel Hill



Dr. Rebecca Fry



Dr. Tracy Manuck



Dr. Jackie Bangma



Dr. Martha Scott Tomlinson



Dr. John Szilagyi



Eaves



Kirsi Oldenburg





Discussion Questions

- Who needs to know about this research?
- How can these results inform clinical practice?
- Can we use these data to drive in vivo work?

EXTRA SLIDES