STEEP
Sources, Transport, Exposure & Effects of PFASs
UNIVERSITY OF RHODE ISLAND SUPERFUND RESEARCH PROGRAM

Let's Talk About PFAS
Monthly Webinar Series
March 11, 2021

Taking Action to Protect Your Health

Welcoming remarks	Cheryl Osimo, Mass. Breast Cancer Coalition Mark Ells, Barnstable Town Manager
Presentations	Carmen Messerlian and Philippe Grandjean Harvard T.H. Chan School of Public Health
Q&A	Moderated by Cheryl Osimo Panelists: Dr. Messerlian, Dr. Grandjean, and Amanda Hernandez, Silent Spring Institute

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Let's Talk About PFAS: Per- and Polyfluoroalkyl Substances and Immune Function in Children

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THE UNIVERSITY OF RHODE ISLAND

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Department of Environmental Health

SILENT SPRING INSTITUTE
Researching the Environment and Women's Health

I have no conflicts of interest to declare.

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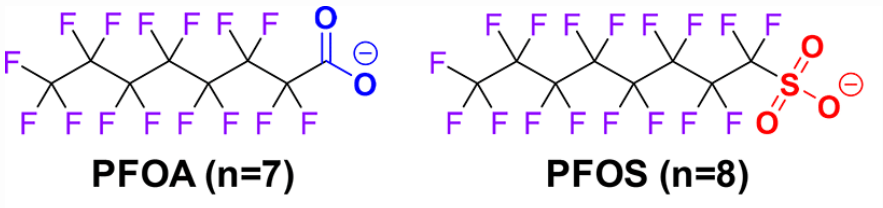
BACKGROUND



Manmade Persistent Chemicals

Class of over 9000 compounds

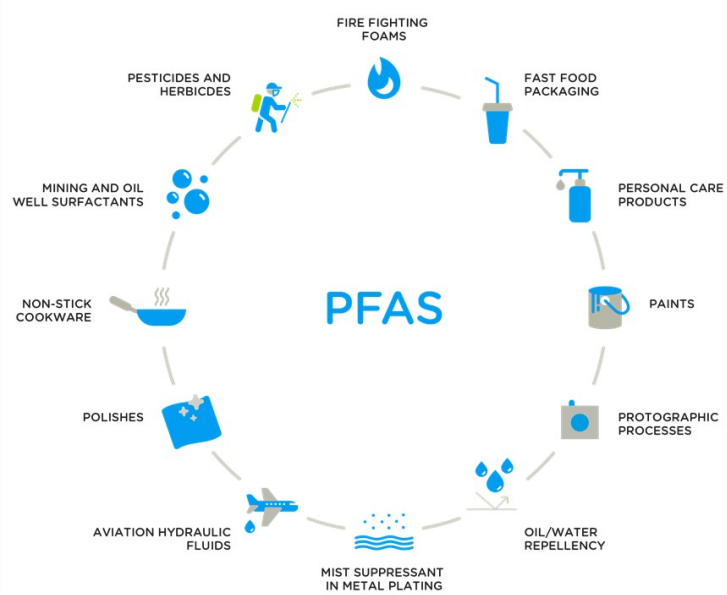
Persistent, long half lives (2-9 years)

Resistant to degradation

Mobile in the environment

Drinking water pollutant

“Forever chemicals”



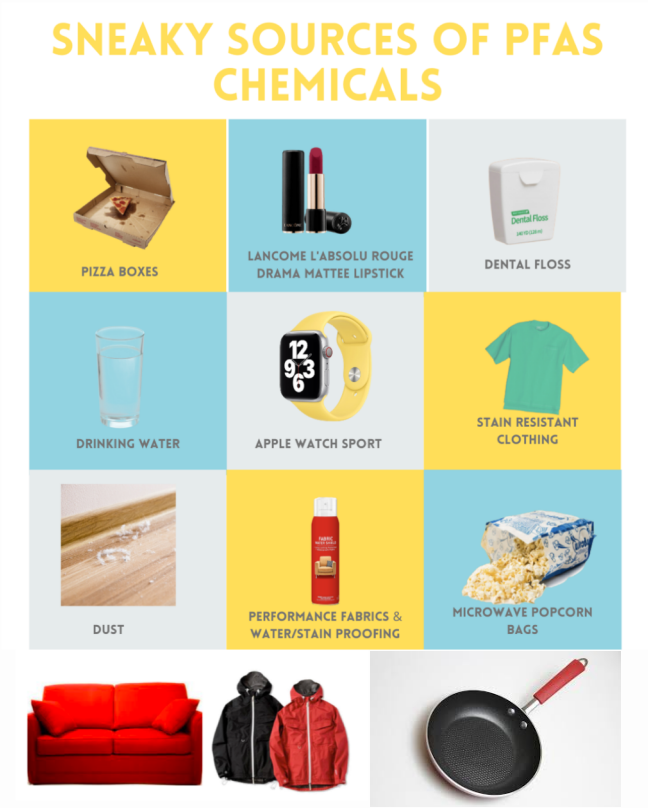
Widespread Applications

Used in products since 1950s

Heat, oil, stain, and water resistant

Diverse commercial applications

- textiles, furniture
- non-stick cookware, food packaging
- fire-fighting foam



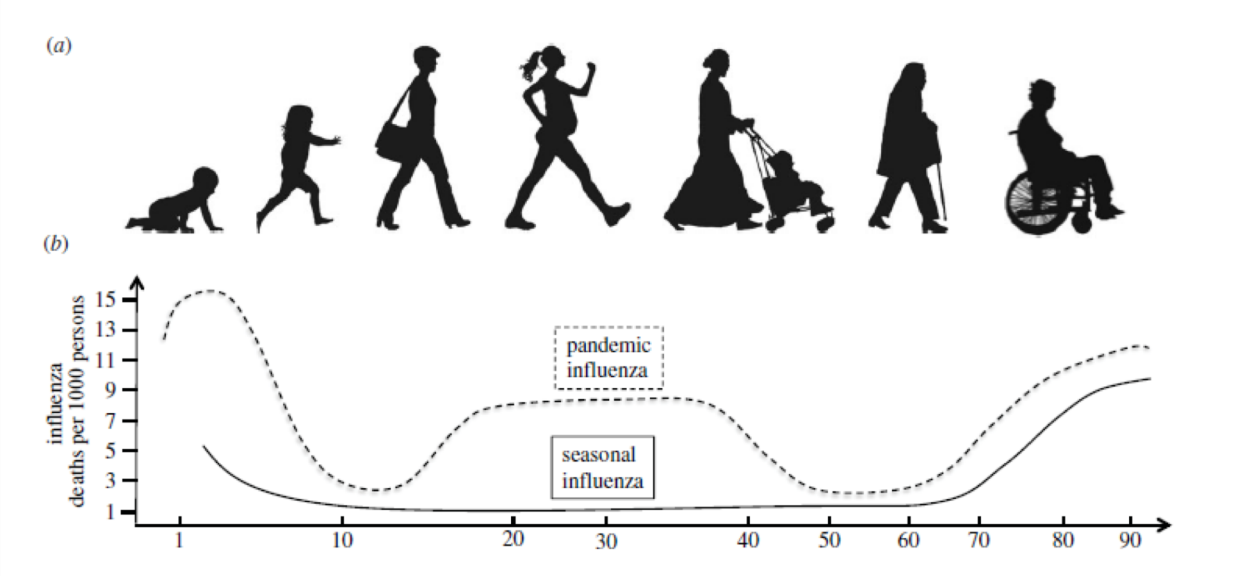
PFAS in Everyday Products

- Carpets and upholstery
- Waterproof apparel
- Waxes (floors, skis)
- Non-stick cookware
- Grease proof food packaging
- Dental Floss
- Cosmetics
- Paints

Children: Higher Body Burden of PFAS

Routes: oral, dermal, inhalation, placental
Mouthing behaviors
Different body size to surface area/intake ratios
Placental transfer
Breastfeeding

Early Childhood as a Critical Window for Immune System Maturation



Mother-Fetus-Infant

Highly Interdependent

Fetus: placental transfer IgG antibodies

Neonate: breastmilk transfer of antibodies

Adaptive immune system: antigen specific and immune memory based

Variation in response and immune maturation

Acquisition of innate and adaptive immune system in infancy may be influenced by exposure to PFAS in pregnancy and early infancy

02

PFAS and Immune Function

Experimental Studies in Rodents

Most studies on PFOS and PFOA
Some studies for PFNA and PFDA
Very limited evidence for other compounds

Immunotoxic Effects

Decreased spleen and thymus weights
Reduction in circulating immune cells
Reduction in antibody levels
Altered cytokine production

Epidemiologic Evidence

Immunosuppression

Antibody level: prenatal or childhood PFAS exposure is negatively associated with specific antibody levels in childhood **(Most robust evidence)**

Other lab markers of the immune function: reduced C-reactive protein response, increased basophil counts among children

Immune morbidity: increased risks of common cold, infections, upper and lower respiratory airway infections among children

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PFAS AND COMMON COLD in NHANES

National Health and Nutrition Examination Study (NHANES)

A national survey

Measures health and nutritional status every two years

Questionnaire interview, physical examination, and specimen collection for environmental and biomarker measurements

We included children 3 to 11 and adolescents 12-19

Cycle: 2013-2014

Exposure

Serum concentrations of the following PFAS compounds:
PFOA, PFOS, perfluorohexane sulfonic acid (PFHxS), perfluorononanoic acid (PFNA)

Outcome

Common cold obtained by:
“Did your child have a head cold or chest cold that started during the previous 30 days?”

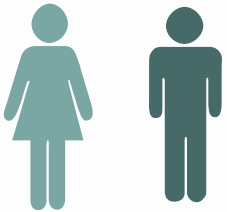
Children
3-11 years

N=517
Mean age 7

52% non-Hispanic white
14% non-Hispanic black

Prevalence of common cold 23%

Adolescents
12-19 years



N=394
Mean age 16

55% non-Hispanic white
15% non-Hispanic black

Prevalence of common cold 17%

Multivariate Model

Adjusted Odds Ratio of Common Cold per Doubling of Biomarker Concentrations

Biomarkers	3-11 years	12-19 years
PFOA	1.32 (0.83, 2.10)	1.18 (0.71, 1.97)
PFOS	1.06 (0.76, 1.48)	1.16 (0.76, 1.78)
PFHxS	1.31 (1.06, 1.62)	1.23 (0.96, 1.59)
PFNA	1.36 (1.03, 1.80)	0.68 (0.46, 1.00)

Covariates: Age (continuous), sex (dichotomous), races (Non-Hispanic White, Non-Hispanic Black, Hispanic, Other), and income-poverty ratio (<1, =1< and <2, 2=<) which is the ratio of family income to poverty guidelines

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Conclusions

Robust association for serum **PFHxS** concentration and increased odds of common cold among **children and adolescents**

Positive association between serum **PFNA** concentration and common cold in **children** while a possible negative association among adolescents

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Associations between PFAS and common cold most evident during childhood

Early childhood: more critical period for PFAS-related immune effects compared to adolescence

Adolescent PFAS exposure: prone to confounding by dietary, personal care product use, and other exposure sources or behaviors (e.g. smoking/alcohol)

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THANK YOU

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More information about STEEP is available at: https://web.uri.edu/steep/

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Multivariate Model

Adjusted Odds Ratio of Common Cold per Doubling of Biomarker Concentrations

Stratified by Sex

Biomarkers	3-11 years			12-19 years		
	Male	Female	Test of Heterogeneity p	Male	Female	Test of Heterogeneity p
PFOA	1.28 (0.71, 2.29)	1.43 (0.63, 3.25)	0.84	0.69 (0.32, 1.50)	1.55 (0.77, 3.10)	0.19
PFOS	1.03 (0.67, 1.58)	1.14 (0.65, 1.99)	0.65	0.76 (0.30, 1.90)	1.42 (0.89, 2.24)	0.54
PFHxS	1.61 (1.20, 2.18)	0.96 (0.67, 1.37)	**0.09**	1.14 (0.79, 1.63)	1.37 (0.94, 2.02)	0.54
PFNA	1.41 (0.99, 2.01)	1.27 (0.80, 2.01)	0.75	0.33 (0.15, 0.72)	0.96 (0.59, 1.56)	**0.03**

Covariates: Age (continuous), sex (dichotomous), races (Non-Hispanic White, Non-Hispanic Black, Hispanic, Other), and income-poverty ratio (<1, =1< and <2, 2=<) which is the ratio of family income to poverty guidelines

PFAS Biomarker Distribution

Biomarkers	3-11 years		12-19 years	
	Detection Rate	GM (ng/ml)	Detection Rate	GM (ng/ml)
PFOA	100%	1.90	100%	1.70
PFOS	100%	3.87	100%	3.62
PFHxS	99.81%	0.85	100%	1.29
PFNA	99.81%	0.80	100%	0.61