

Agency for Toxic Substances and Disease Registry (ATSDR): Investigating PFAS in the Environment

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PFAS (Per- and Polyfluoroalkyl substances) Information Session/Panel Discussion
Horsham/Warminster/Warrington Site Area
Horsham, PA

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Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations



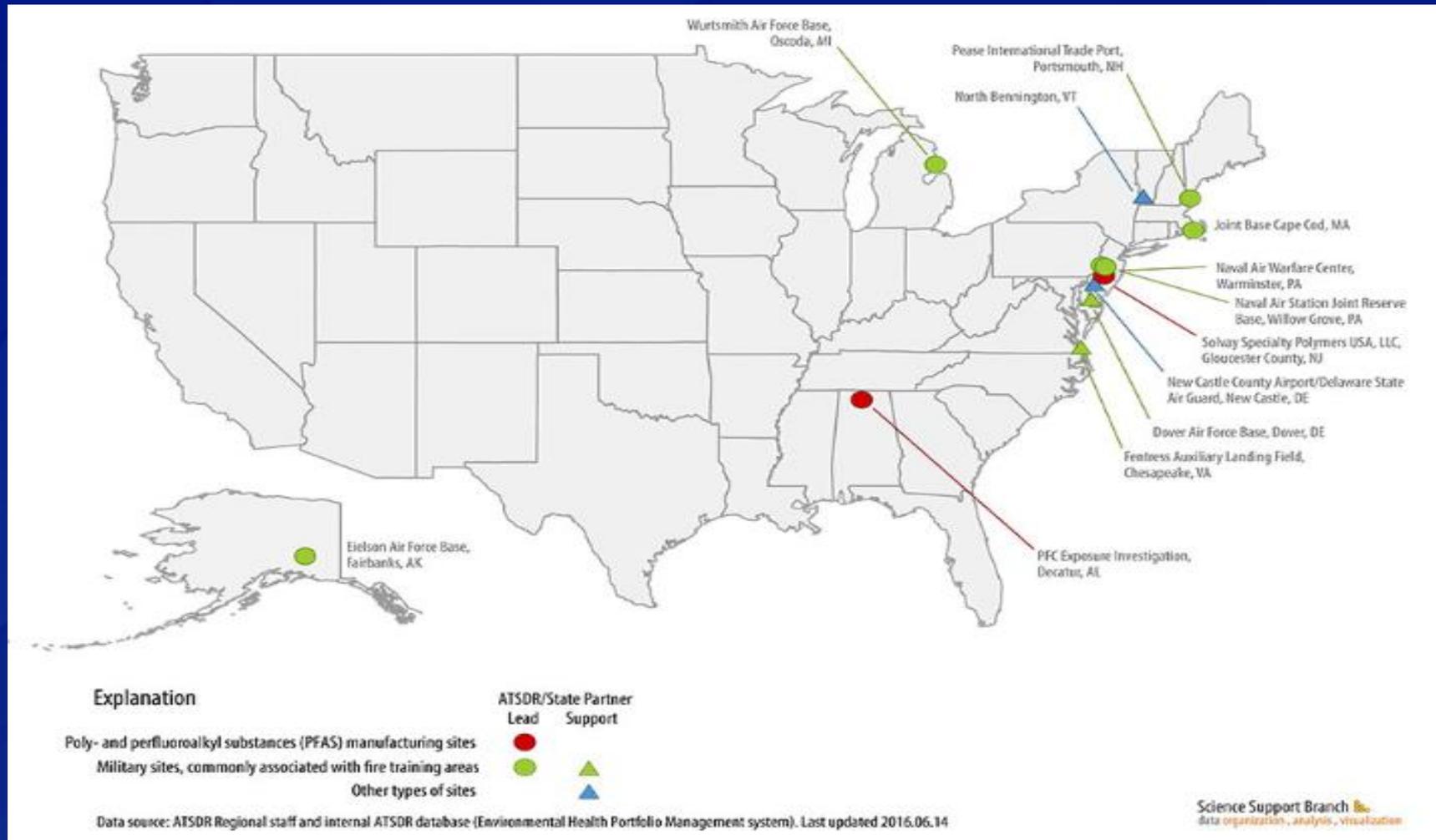
ATSDR: Our Mission and Our Role

ATSDR serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances by:

- Monitoring health and environmental factors
- Conducting research
- Developing guidance
- Building partnerships to support healthy decision making

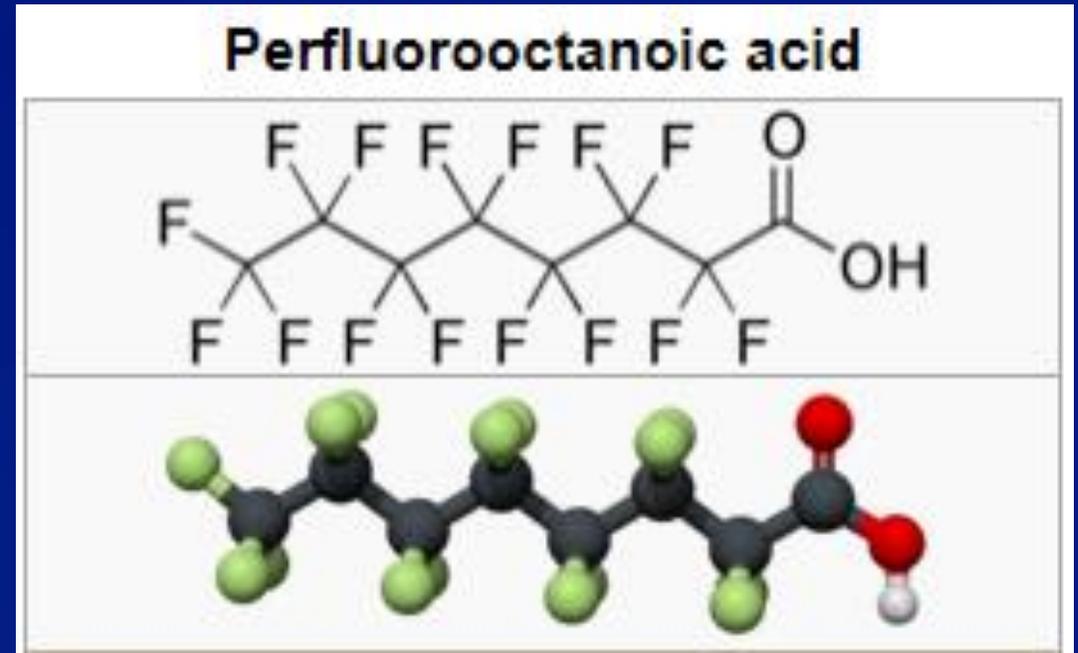


ATSDR investigating PFAS in the environment



What are PFAS?

- ❑ Per- and Polyfluoroalkyl substances
- ❑ PFOA, PFOS, PFBA, PFHpA, PFNA, PFDA, PFUA, PFDoA, PFHxS, PFBUA, PFOSA, Me-PFOSA-AcOH, Et-PFOSA-AcOH



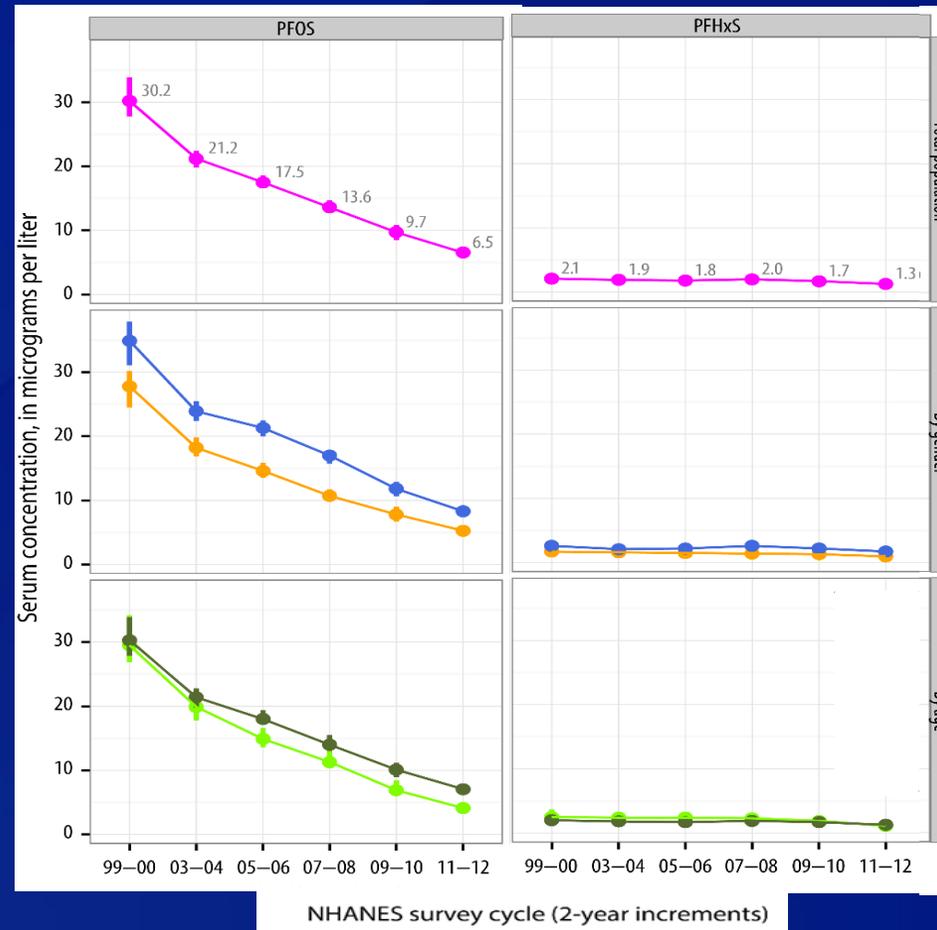
How can people be exposed to PFAS?

- ❑ **Ingestion is the primary exposure pathway.**
 - Water, food, breast milk
 - Consumer products
 - Dust, soil, and sediment
- ❑ **Dermal studies report very limited absorption of PFAS through the skin.**
 - Bathing or showering, washing dishes, and doing laundry is not expected to result in significant exposure to PFAS.
- ❑ **Living near a production facility can also include air (inhalation) exposures.**
- ❑ **In utero.**

National Biomonitoring

CDC/NCEH monitors PFAS concentrations in the general US population via the National Health and Nutrition Examination Survey (NHANES).

NHANES biomonitoring includes 12 different PFAS chemicals. More information at: https://www.cdc.gov/biomonitoring/PFCs_BiomonitoringSummary.html



Explanation

- 95% upper confidence level
- 30.2 Median value
- 95% lower confidence level

Category

- Total population
- Females
- Males
- Teens
- Adults

How can PFAS affect people's health?

- ❑ A growing body of scientific literature suggests that certain PFAS may affect a variety of systems in the body. Additional research is needed to better understand possible human health effects from exposure to PFAS in water and food.
- ❑ PFOS, PFOA, PFHxS and PFNA have been more widely studied than other PFAS.
- ❑ Carbon chain length may be related to toxicity (longer chain = more toxic).
- ❑ Long human biological $\frac{1}{2}$ life (up to 9 years depending on PFAS).
- ❑ There is no medically approved way to reduce the amount of PFAS in the body; typically levels decrease by natural excretion (in urine or feces).

EPA PFOA/PFOS Health Advisory Levels (HALs)

- ❑ Provisional Short-term HALs: PFOA = 400 ppt and PFOS = 200 ppt (*replaced by lifetime value in 5/16*)
- ❑ Lifetime HAL PFOA/PFOS = 70 ppt
- ❑ PFOA EPA cancer risk range ($10E-06$ to $E-04$) = 500 to 50,000 ppt

Comparison with maximum levels detected in public wells:

	Horsham	Warminster	Warrington
• PFOS -----	1,000 ppt	1,009 ppt	1,600 ppt
• PFOA -----	290 ppt	349 ppt	270 ppt

EPA PFOA/PFOS Health Advisory Levels (HALs)

- ❑ EPA LTHALs are not enforceable standards.
- ❑ EPA LTHALs are not health effect levels.
- ❑ Based on animal studies (rodents).
- ❑ **Uncertainty factors included:**
 - PFOA: $10 \times 3 \times 10 = 300$ (endpoint - reduced mouse pup ossification)
 - Human variability (10) x Animal to human (3) x LOAEL to NOAEL (10) = 300
 - PFOS: $10 \times 3 = 30$ (endpoint - decreased rat pup body weight)
 - Human variability (10) x Toxicodynamic Differences Animal to human (3) = 30
- ❑ **Drinking Water Equivalent Level (DWEL) = estimated 370 ppt for both PFOA and PFOS**
- ❑ **Lifetime Health Advisory = 74 ppt and rounded to 70 ppt for both PFOA and PFOS**

<https://www.epa.gov/ground-water-and-drinking-water/supporting-documents-drinking-water-health-advisories-pfoa-and-pfos>

Part per Trillion (ppt) Concentration Analogies:

- ❑ One second in nearly 32,000 years.
- ❑ 1 ounce in 7.5 billion gallons of water.
- ❑ One drop of detergent in enough dishwater to fill a string of railroad tank cars ten miles long.
- ❑ One square inch in 250 square miles.
- ❑ Less than half of a drop of oil in a super tanker containing six million gallons of oil.

Animal Studies

❑ Cancer

- Feeding PFOA and PFOS to rats caused them to develop tumors (liver, testes, pancreas).
- Humans and rodents react differently to PFOA and PFOS, and not all of the effects observed in rats and mice may occur in humans.

❑ Non-cancer

- Liver appears to be the most sensitive target in animals ingesting PFASs.
- Effects include increases in liver weight, changes in the liver cells, and changes in blood cholesterol and triglyceride levels.
- Studies in mice also found that the immune system is a sensitive target of PFOA and PFOS; effects include decreases in the size of the spleen and thymus and impaired immune function.

Human Studies

A growing body of scientific literature suggests that certain PFAS may affect a variety of systems in the body, including:

- ❑ Developmental delays in the fetus and child, including possible changes in growth, learning, and behavior**
- ❑ Decreased fertility and changes to the body's natural hormones**
- ❑ Increased cholesterol**
- ❑ Changes to the immune system**
- ❑ Increased uric acid levels**
- ❑ Changes in liver enzymes**
- ❑ Prostate, kidney, and testicular cancer**

Additional research is needed to better understand possible human health effects from exposure to PFAS in water and food.

West Virginia/Ohio Human Study (C8 Study)

- ❑ <http://www.c8sciencepanel.org/>
- ❑ Collected blood samples from about 69,000 people living near the Washington Works plant in West Virginia.
- ❑ Those who live or lived in any of six C8 contaminated water districts participated.
- ❑ Estimate historical serum concentrations for 28,541 community residents who had never worked at the DuPont plant.
- ❑ In addition, estimated combined residential and occupational exposure for 3,713 workers.
- ❑ 10,725 children (age: 1-17 years).
- ❑ Cancer study - community residents and workers were combined to form a final population of 32,254 people.

Human Health Effects “Probable” Links from C8 (PFOA) Study

- ❑ High cholesterol (n= ~32,000 participants)
- ❑ Ulcerative colitis (n =~32,000 participants)
- ❑ Thyroid disease (hypo and hyper) (n =~32,000 participants)
- ❑ Pregnancy-induced hypertension (n= ~1,500 participants)
- ❑ Testicular and kidney cancer (n =~32,254 participants)

http://www.c8sciencepanel.org/prob_link.html

C8 Science Panel Conclusion of “No Probable Link” for PFOA

- ❑ **Cancers other than testicular & kidney cancer**
- ❑ **Rheumatoid arthritis & other autoimmune diseases**
- ❑ **Osteoarthritis**
- ❑ **Common infections (cold & flu)**
- ❑ **ADHD & learning disabilities**
- ❑ **Asthma**
- ❑ **Stroke**
- ❑ **Diabetes (Types 1 & 2)**
- ❑ **Birth defects**
- ❑ **Miscarriage & stillbirth**
- ❑ **Premature birth & low birth weight**
- ❑ **Liver disease**
- ❑ **Kidney disease**
- ❑ **Parkinson’s disease**
- ❑ **Heart disease**
- ❑ **High blood pressure**

C8 Health Project (Frisbee et al. 2009)

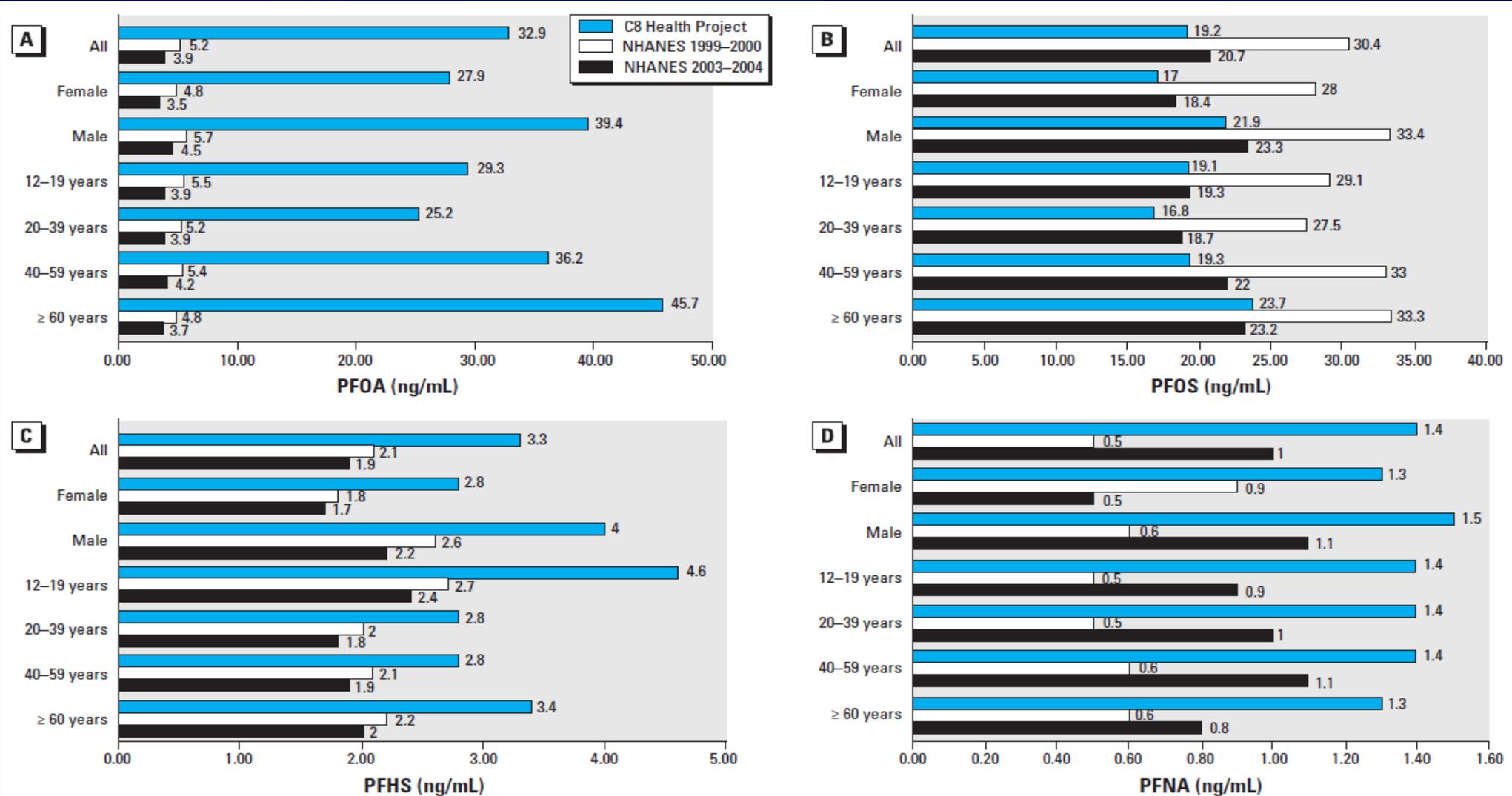


Figure 2. Geometric means (ng/mL) for PFC serum concentrations for C8 Health Project results [versus two NHANES samples (2003–2004; 1999–2000)]: PFOA (A), PFOS (B), PFHS (C), and PFNA (D).

C8 Health Project (Frisbee et al. 2009)

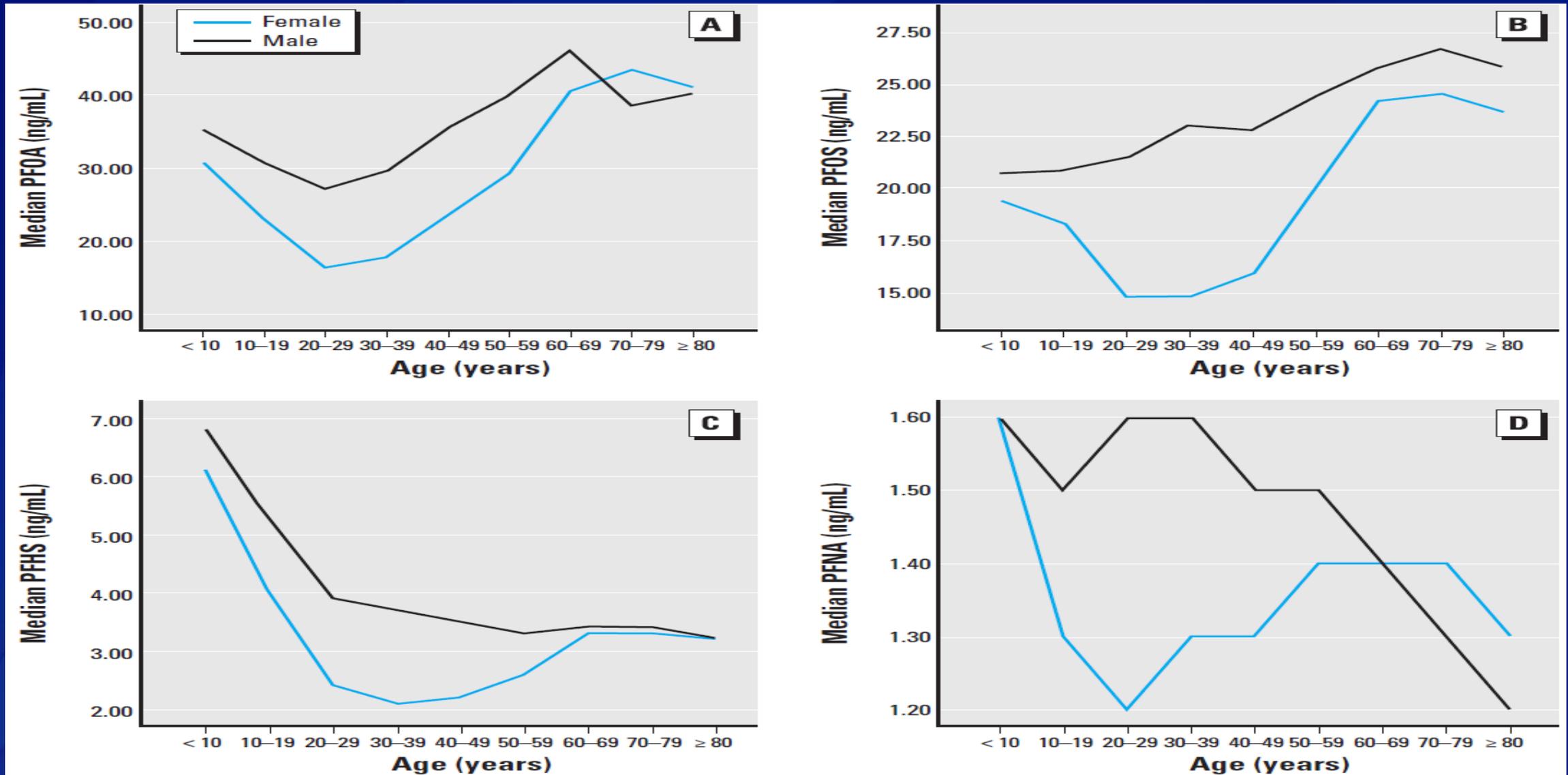


Figure 1. PFC concentrations stratified by age and sex: (A) PFOA, (B) PFOS, (C) PFHS, and (D) PFNA.

Pease, NH Biomonitoring Report (June 16, 2016)

<http://www.dhhs.nh.gov/dphs/documents/pease-pfc-blood-testing.pdf>

Levels in 1 production well (below provisional HALS in other 2 wells)

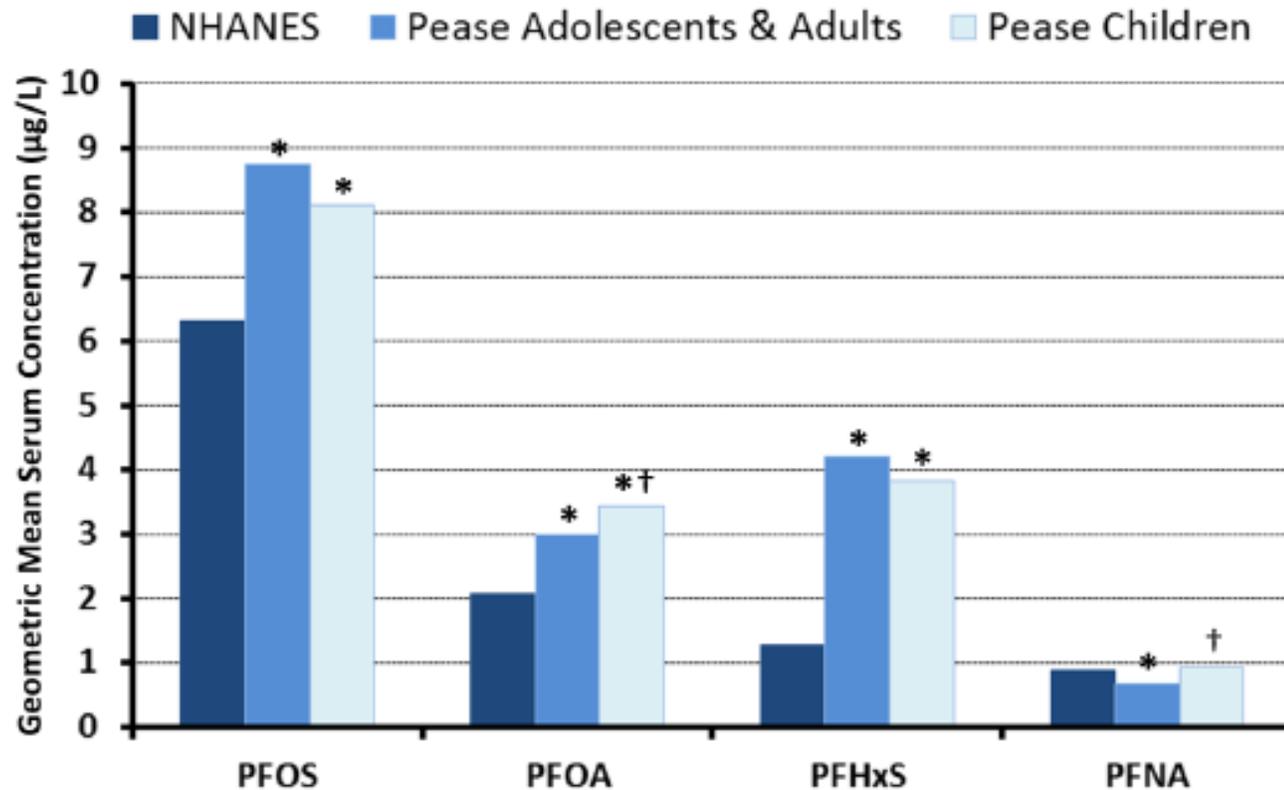
- ❑ PFOS up to 2,500 ppt
- ❑ PFOA up to 350 ppt
- ❑ PFHxS up to 830 ppt
- ❑ Water blended from 3 wells so dilution expected
- ❑ Population: 1,578 individuals; ~25% 11 years old or younger

Comparison with maximum levels PFOS/PFOA detected in public wells:

	Horsham	Warminster	Warrington
• PFOS -----	1,000 ppt	1,009 ppt	1,600 ppt
• PFOA -----	290 ppt	349 ppt	270 ppt

Pease, NH Biomonitoring Report, continued

Figure 2. Comparison of geometric means by serum PFC concentrations, Pease Tradeport, Portsmouth, NH, 2015–2016



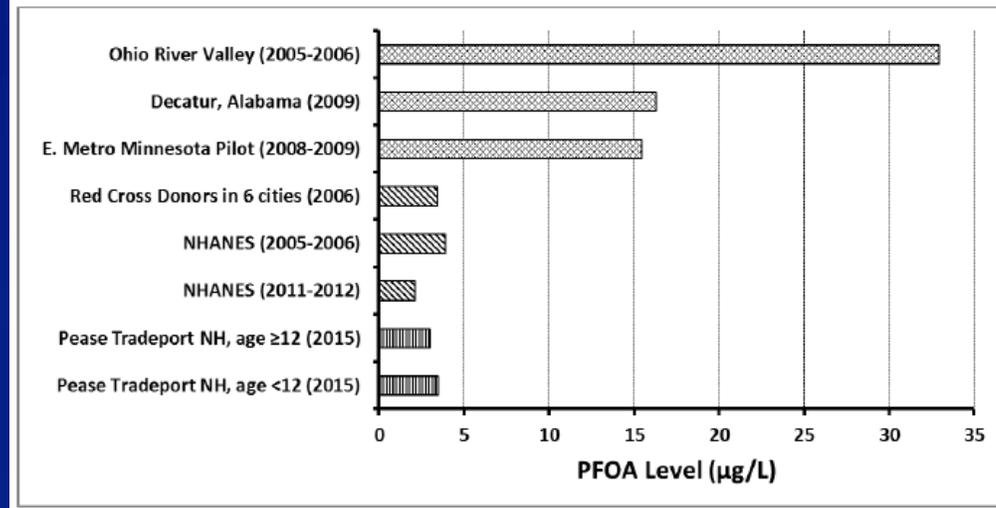
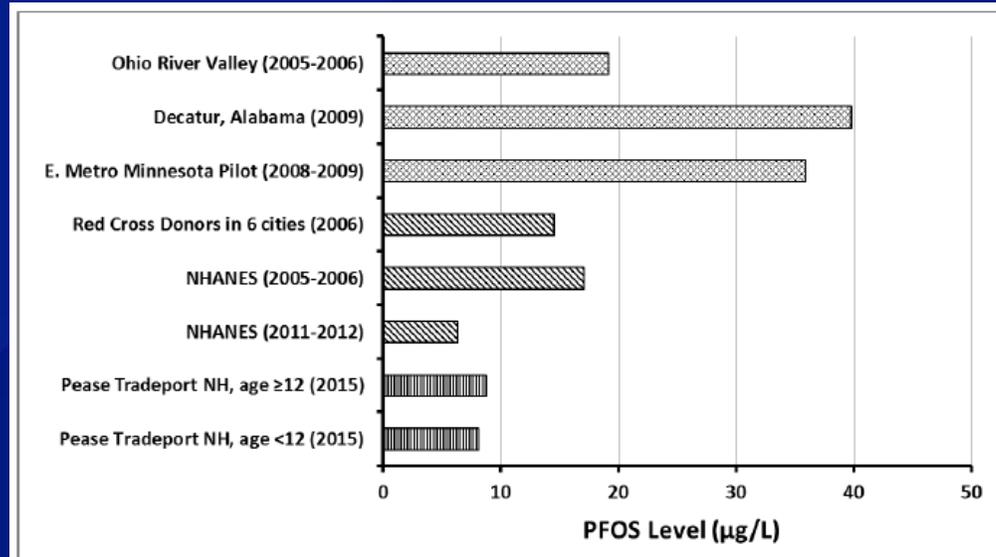
NHANES=National Health and Nutrition Examination Survey, 2011-2012 data

* Indicates a statistically significant difference compared with NHANES

† Indicates a statistically significant difference comparing Pease children with Pease adolescents and adults

Pease, NH Biomonitoring Report, continued

Comparison of Geometric Mean PFAS Serum Levels Among Populations



Pease, NH Biomonitoring Report, continued

- ❑ The serum PFAS test results likely represent exposure from multiple sources, including drinking water contamination related to Pease.
- ❑ Daily water consumption appeared to be a non-significant contributor to PFAS levels, with the exception of PFHxS, when stratified by age.
- ❑ Age, sex, and time spent on Pease appeared to be more consistently associated with PFAS level.
- ❑ Serum levels of PFOS, PFOA, and PFHxS were found at higher levels in the Pease population compared with the general U.S. adolescent and adult population (compared to NHANES 2011-2012).
- ❑ Absolute difference in the mean PFAS levels between Pease population and national results is small, and on a population level these small changes have unclear health implications.

CDC/ATSDR

We'll be available after this meeting if you'd like to discuss further or you can reach us after the meeting at:

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- ❑ Christine - 215-814-3142 or hjn7@cdc.gov
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