CHE call on PFASs (aka PFCs)
20 December 2016

A brief discussion of exposure & human health effects of PFAS

Dr. Tom Webster
Dept Environmental Health
BU School of Public Health

I am an environmental epidemiologist & exposure scientist. Experience with this class of compounds, e.g.,
• C8 studies (WV/OH)
• a MA study of children of exposed mothers (birth cohort)
• indoor & water exposure
What are PFAS?

PFAS = “Per- and polyfluorinated alkyl substances” formerly called PFCs

- *large & complicated* class of compounds
- moving target (changing regulations & production -> shorter chain)
- PFOS & PFOA (“C8”) are the best known

- many are persistent organic pollutants (POPs)
- unusually for POPs, many are water soluble
Human serum levels

- widely found in human serum
- North America ~ Europe
- men > women
- time trends

**USA NHANES medians of 4 common PFAS (scales differ)**

- plus unidentified organofluorine compounds in human blood:
  Quantifiable PFAS accounted for 31-100% of total extractable organic fluorine, with a trend towards more unidentified compounds (German & Chinese samples)(Yeung & Mabury 2016)
Exposure

• PFAS used in manufacture of polymers, firefighting foams, stain/water resistant coatings, food packaging, etc.
• exposure pathways include ingestion (food, water, dust), inhalation
• Major complication: exposure to compounds & precursors, e.g. FTOH → PFOA in blood
  inhalation + metabolic conversion to stable PFOA

Boston office workers

*e.g.*, Fraser et al 2012
Exposure

• **IMPORTANT**: For most people, exposure is estimated to be predominantly via diet followed by indoor exposure with water small (e.g., Gebbink et al 2015)

• For some populations, water may be an important (or dominant) source of exposure.
Water contamination (early studies)

Elevated blood levels associated with elevated water levels for PFOA serum ~ 100 x water (e.g., Hoffman et al 2011)

WV/OH near Dupont facility

Germany, Moehne River “use of soil conditioner, which had been mingled with industrial waste”

Emmett et al 2006; Hölzer et al 2008
• Recent studies: water contamination more widespread than previously thought
• Related to waste water treatment plants, industrial sites, military fire training areas, textile mills, airports…
• CA: serum PFOA & PFOS higher where water had detected levels
Health effects of PFAS: toxicology

Effects seen in laboratory animals include

- neurobehavioral effects
- endocrine disruption
- effects on immune system
- tumors
- …

See reviews: Lau et al 2007, Post et al 2012…
Health effects of PFAS: human epidemiology

Environmental epidemiology is difficult! Often requires a substantial body of evidence

~100+ epidemiology studies of various design, outcomes, exposures, quality, often conflicting—difficult to summarize

C8 Science Panel “Probable Links” for PFOA—2011-2, court-related standard of evidence

• high cholesterol
• thyroid
• ulcerative colitis
• testicular cancer & kidney cancer
• pregnancy-induced hypertension

Not a probable link for many other outcomes, e.g., neuro-developmental disorders in children, birth defects, low birth weight…
thyroid

- Recent review: “Although there is a small number of studies with comparable data, we found some consistency of a positive association between maternal or teenage male exposure to some PFAS and TSH levels “ (Ballesteros et al 2016)

cholesterol

- One of the more interesting outcomes
- Several cross-sectional found increased cholesterol (LDL-”bad cholesterol”) associated with PFAS blood levels; other studies did not
- Longitudinal study (strong design) in WV/OH after intervention: reduced serum PFOA (& PFOS) associated with decreased LDL (Fitz-Simon et al 2013)

More epi underway
References


C8 Science Panel Probable Link Reports. http://www.c8sciencepanel.org/prob_link.html


