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PFC FACT SHEET: PFOS/PFOA in Blood

How do PFCs get into blood?
Perfluorinated Compounds (PFCs) such as Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctonoic acid (PFOA) are manmade chemicals used in a number of products, most notably firefighting foams such as Aqueous Film Forming Foam (AFFF) and stain resistant sprays as well as in the production of nonstick cookware and stain- or water-resistant fabric.[1,2] PFCs have also been found in food packaging.[3]

Human exposure to PFCs has been very widespread and has resulted primarily from ingesting contaminated drinking water[1,3,5] and from fish consumption,[3,4] and breast milk.[4,5] PFCs build up and remain in the body for years. Body burden levels are reduced slowly over time.[3,4,5]

According to the Agency for Toxic Substances and Disease Registry (ATSDR), PFCs are present in the blood of most people in the U.S.[5] PFCs in drinking water[1,6,7] as well as canned and packaged food[8] directly contribute to higher PFC concentrations in people. In addition, the frequency and amount at which people are exposed to these sources have been shown to influence the levels of PFCs in the blood.[7] PFCs are measured in blood because they bind to proteins, which are then distributed throughout the body by blood.[6] Therefore, measuring PFC levels in blood serum accurately represents levels of PFCs in the body as a whole.

What patterns have been observed for PFC concentrations in people?
Studies have found that men tend to have higher PFC concentrations than women.[9,10] This difference could be due to differences in exposure to PFCs or PFC loss in women through menstruation, childbirth, and breastfeeding.[8,9,11] Some studies have also found that PFC serum concentration increases with age in adults,[9,12] but this correlation has been found less frequently than the relationship between sex and PFC levels.[13] In some cases children have been found to have higher PFC serum concentrations than adults.[2]

What do we know about exposure to PFCs in drinking water at the Pease Air Force Base in Portsmouth, NH?
In May 2014 the New Hampshire Department of Health and Human Services (DHHS) alerted the Portsmouth community that one of three wells that provides drinking water for the Pease Air Force Base was contaminated with high levels of PFCs. The use of firefighting foam for Air Force training in the 1970s allowed the PFCs to leach from the soil to the wells, which in turn exposed the community to PFCs. In 1991, portions of the base were converted into commercial and retail office space called Tradeport that included two daycare centers. DHHS compared the results of the Pease children's blood tests to the PFOA and PFOS serum concentrations found in a study of Texas children[14] while the adult Portsmouth results were compared to concentrations found in adults in the National Health and Nutrition Examination Survey (NHANES).[15] These values are included in the reports that each individual received with their blood test results.

The Texas and NHANES studies are reputable and have been cited numerous times by other

researchers; the participants in these studies were representative of the broader population in that they have been exposed to "everyday" levels of PFCs. Additional studies have been done to examine PFC concentrations in people who have been occupationally or environmentally exposed to PFCs.[9,10,12] The Portsmouth community is considered "environmentally exposed" because the main source of their PFC exposure is likely to be contaminated water from the three wells at Pease Tradeport in Portsmouth, NH. According to the EPA Public Health Advisory, only one of three wells, the Haven Well (2.5 ug/L), exceeded the permissible levels of PFOS (0.2ug/L) and PFOA (0.4 ug/L).[16,17] However, water from the other two wells also showed trace amounts of PFCs, and water from all three wells was mixed before distribution. As an environmentally exposed population, Portsmouth has higher levels of PFCs in blood than the general population, but much lower levels than occupationally exposed populations (See Tables 1 and 2).

The summary tables below list the PFOS and PFOA serum concentrations found in adults and children as well as the type of exposure that occurred in each study population. The current averages from the Portsmouth blood samples are included in the last row of each chart. More data will be available after the completion of the second round of testing in October, 2015.

SUMMARY TABLES FOR PFC VALUES FOUND IN SCIENTIFIC STUDIES*

Table 1. PFOS and PFOA Serum Concentrations in Adults

Adult or Total Population Study	PFOS serum concentration	PFOA serum concentration	Type of Exposure
Olsen, GW et al. 2003[18]	910 ug/L	1130 ug/L	occupational
Olsen, GW et al. 2007[19]	799 ug/L** → 403 ug/L**	691 ug/L** → 262 ug/L**	occupational
Sakr, CJ et al. 2007[7]	Not measured	354 ug/L (median)	occupational
Olsen, GW et al. 2008[13]	14.5 ug/L	3.4 ug/L	general population
CDC 2015 (NHANES)[15]	6.31 ug/L (2011-2012 value)	2.08 ug/L (2011-2012 value)	general population
ATSDR 2013[9]	39.8 ug/L	16.3 ug/L	environmental
Minnesota Dept. of Health 2009[12]	35.9 ug/L	15.4 ug/L	environmental
Frisbee et al. 2009[10]	19.2 ug/L	32.91 ug/L	environmental
Adult Data from Portsmouth, NH[16]	7.5 ug/L	3.0 ug/L	environmental

* Concentrations in both tables are geometric means unless otherwise noted. Concentrations have been converted to micrograms/Liter (ug/L) for ease of comparison.

** This is an arithmetic mean. Additionally, the values connected by an arrow represent a decrease over about 4-5 years.

Table 2. PFOS and PFOA Serum Concentrations in Children

Pediatric Study	PFOS serum concentration	PFOA serum concentration	Type of Exposure
Olsen et al. 2004[20]	37.5 ug/L	4.9 ug/L	general population
Pinney, SM et al. 2014[11]	13.2 ug/L	6.7 ug/L	general population
Wu et al. 2015[8]	6.28 ug/L	4.46 ug/L	general population
Schecter et al. 2012[14]	4.10 ug/L (median)	2.85 ug/L (median)	general population
Frisbee et al. 2009[10]	20.6 ug/L	36.9 ug/L	environmental
Pediatric Data from Portsmouth, NH[16]	8.9 ug/L	4.0 ug/L	environmental

* Concentrations in both tables are geometric means unless otherwise noted. Concentrations have been converted to micrograms/Liter (ug/L) for ease of comparison.

**An exact value was not given. However, we know that PFOA was still present in the serum of children at lower levels than PFOS.

Should residents of Portsmouth, NH be concerned?

The New Hampshire Department of Human Health and Services' (NH DHHS) September 10th, 2015 presentation stated that although Portsmouth levels of PFOS and PFOA are elevated compared to the Texas and NHANES studies, the current levels are lower than they were in the past before PFCs were regulated. PFC concentration levels have been decreasing over the past decade as a result of manufacturing phase-outs of these chemicals.[12,13] The NH DHHS implies that a lack of clear evidence of PFC-related health problems at past elevated PFC levels demonstrates that the current levels in Portsmouth are not a cause for concern. However, there has been no systematic study that we are aware of designed to evaluate whether PFC levels found in the general population were related to any increase in adverse health problems. Furthermore, uncertainty is not a reason to ignore the potential health threats posed by PFCs; not knowing does not mean proof of no harm.

What do higher levels of PFCs mean for health?

Scientists are still working to better understand exactly how PFCs can affect human health. Some population-based studies have linked PFC exposure to adverse health effects such as higher cholesterol, hypertension, decreased physiological functionality, and certain cancers (particularly kidney and testicular). For more information please see the PFC FACT SHEET: PFOS/PFOA TOXICITY prepared by CHEJ.

Sources

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