Per and polyfluoroalkyl substances (PFAS) and our health

What are PFAS?

The use of per and polyfluoroalkyl substances (PFAS) in industrial and consumer products is increasing due to their surface protection properties, which are exploited in products such as stain- and oil-resistant coatings, but also in floor polishes and fire extinguishers. The group comprises several chemicals, e.g. perfluorooctanoic acid (PFOA) as well as perfluorooctane sulfonate (PFOS). PFAS are persistent in the environment.

Where can we find PFAS?

PFOS is commonly used as a salt or incorporated into larger polymers via amide or acrylate substituents. PFOS-based polymers were incorporated into stain repellents and other surface coating agents. PFOS salts continue to be used in fire-fighting foams and in the semiconductor and photolithographic industry. PFOS is restricted in the production by Annex B of Stockholm Convention on Persistent Organic Pollutants (POPs).

PFOA has been manufactured since the 1940s for industrial applications. The major application is as an emulsifier in the production of fluoropolymers, but it is also used as an industrial surfactant in a variety of other processes. PFOA is also formed by the transformation of precursors such as polyfluorotelomers and by polyfluoroalkyl phosphates and phosphonates. PFOA is newly listed in Annex A of Stockholm Convention on POPs in 2019.

Perfluorohexane sulfonic acids (PFHxS) is widely utilized in a variety of consumer goods such as carpets, leather, apparel, textiles, firefighting foam, papermaking, printing inks, sealants, non-stick cookware. PFHxS have been proposed for listing under the Stockholm Convention on POPs.

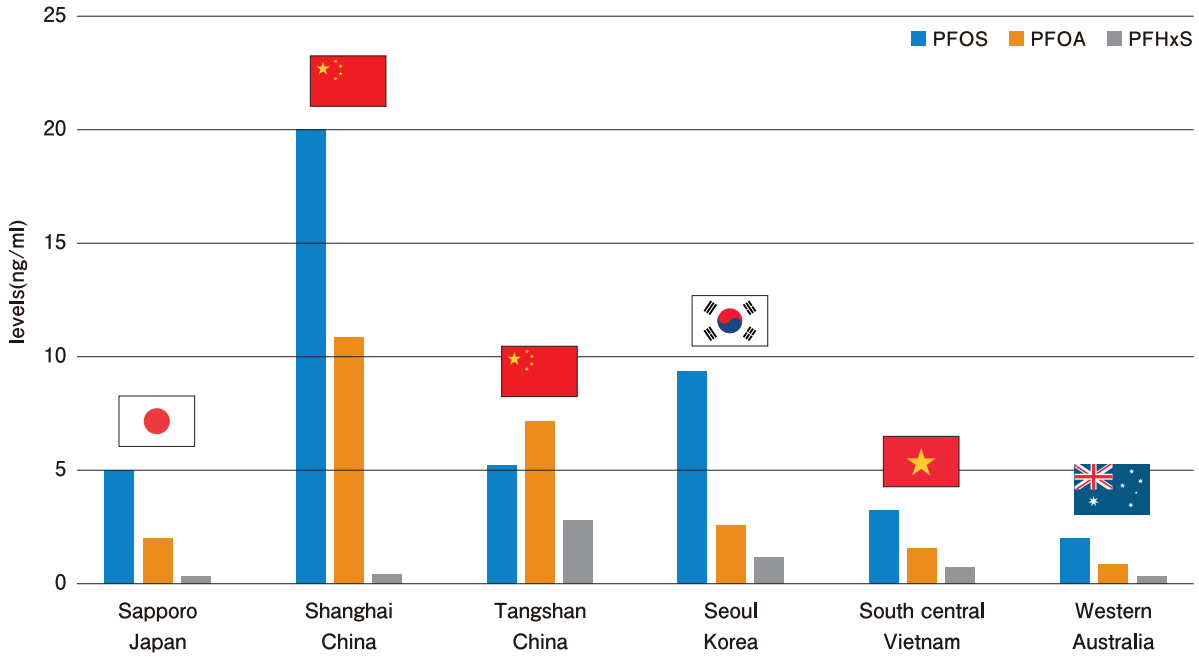
How we are exposed to PFAS?

PFAS are frequently found in meat, seafood, and dairy products.

The major exposure pathways for PFOS for general population are contaminated food and water ingestion, dust ingestion, and hand-to-mouth transfer from mill-treated carpets and house-dust.

For PFOA, major exposure pathways are oral exposure from PFAS coated paper packing and wrapping, contaminated food and water ingestion, inhalation from impregnate clothes and dust ingestions. Because of the hand-to-mouth behavior, exposure to children is expected to be higher.

PFAS levels in pregnant women in Asia and Pacific



(Sapporo: Tsai et al. 2018, n=2123; Shanghai: Tian et al. 2018, n=981; Tangshan: Yang et al. 2019, n=534; Seoul: Lee et al. 2013, n=70; South central Vietnam: Rylander et al. 2009, n=91; Western Australia: Callen et al. 2016, n=98)

*Levels shown in median

What are the known health effects?

In general, little is studied and very limited evidence on PFAS exposure and human health. More epidemiological studies are necessary. Up to now the following findings have been reported from epidemiological studies.

- High levels of PFOS exposure may interfere with human thyroid function.
- Occupational exposure may lower female fecundity and altered menstrual cyclicity.
- Exposure to PFOA may link to kidney cancer, testicular cancer, thyroid disease, pregnancy-induced hypertension, high cholesterol
- Exposure to PFHxS may link to nervous system, brain development, endocrine system, thyroid hormone, and immune function.

What can we do to reduce exposures?

Families may choose to use products that do not contain pre-treated stain repellent product or grease resistant food packaging. Avoid multiple use of paper cups can reduce PFAS exposure.

Using an alternative water source for drinking, food preparation, cooking, brushing teeth or any activity that might result in ingestion of contaminated water may be one way to reduce exposure from contaminated water source. Use of activated carbon water filters can reduce the levels of PFAS as well.

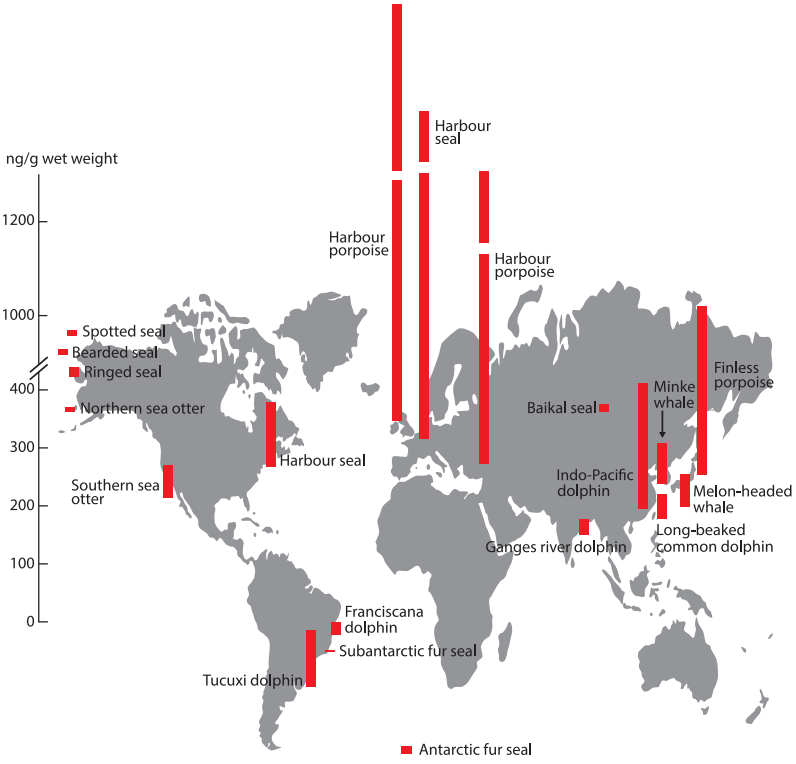
Levels in environmental samples

PFAS are released into the air, water, soil and solid waste and degrade into the environment and in organisms.

Worldwide surveys of PFAS concentrations in water environment reported that PFOS and PFOA were detected in all 41 cities where surveys conducted not only in industrialized areas but also in non-industrialized areas indicating that PFAS undergo long-range transportation in the environment. The industrialized areas show higher contamination in both PFOS and PFOA concentrations than non-industrialized areas. Industrial activities are some of the major sources of PFAS contamination in rivers close by.

PAFS and wild animals

Even though PFOS was added to Annex B of Stockholm Convention on POPs in 2009, PFOS remains the predominant PFAS found in all species, tissues, and locations analyzed around the world. The bioaccumulation potential of PFOA seems to be low in fish, but the presence of detectable concentrations in higher trophic levels (polar bear, caribou, walrus) has generated concerns regarding the biomagnification potential of PFAS in food webs.



PFOS concentrations in liver of marine mammals worldwide
(figure in State of the science of endocrine disrupting chemicals - 2012)

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