

Per- and polyfluoroalkyl substances (PFAS) in Canadians

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To obtain additional information, please contact:

Health Canada
Address Locator 0900C2
Ottawa, ON K1A 0K9
Tel.: 613-957-2991
Toll free: 1-866-225-0709
Fax: 613-941-5366
TTY: 1-800-465-7735
E-mail: hc.publications-publications.sc@canada.ca

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BACKGROUND



What are per- and polyfluoroalkyl substances (PFAS)?

PFAS are structurally related organic compounds that have a fluorinated carbon chain structure. They are synthetic chemicals with high chemical and thermal stability that can repel water and oils. PFAS persist in the environment and can accumulate over time. Below is a list of PFAS that are detected in the Canadian population.

Abbreviation	Chemical Name	CASRN
PFOA	Perfluorooctanoic acid	335-67-1
PFNA	Perfluorononanoic acid	375-95-1
PFDA	Perfluorodecanoic acid	335-76-2
PFHxS	Perfluorohexane sulfonate	355-46-4
PFOS	Perfluorooctane sulfonate	1763-23-1



Where are PFAS found?

PFAS are used in a wide range of products and industrial processes, such as surfactants, lubricants and repellents (for dirt, water and grease). They can also be found in products as diverse as firefighting foams, cosmetics, food packaging and textiles (such as carpets, furniture and clothing).



How are people exposed to PFAS?

People are exposed to PFAS mainly through food, drinking water and house dust. For infants, toddlers and children, hand-to-mouth contact with consumer textile products may be a significant source of exposure.



How are PFAS measured in people?

Some PFAS are well absorbed in the body and not extensively metabolized. PFAS are commonly measured in blood, including whole blood, blood serum and blood plasma. Serum levels of PFAS, especially PFOA and PFOS, can reflect cumulative exposure over several years. The presence of these substances in serum may also result from exposure to other PFAS that can be metabolized to PFOS and PFOA.



What are the potential health impacts of PFAS?

Studies in laboratory animals show that exposure to certain PFAS is associated with reproductive, developmental, endocrine, liver, kidney and immunological effects. Studies in people have found that exposure to PFOA and PFOS can affect the liver, birth weight, metabolism and immune system. The International Agency for Research on Cancer has classified PFOA as possibly carcinogenic to humans.



What is the Government of Canada doing to lower human exposures to PFAS?

PFOA, PFOS, long-chain perfluoroalkyl carboxylic acids (such as PFNA and PFDA) and their salts and precursors are identified as toxic under the *Canadian Environmental Protection Act, 1999*. Health Canada, in collaboration with the Federal-Provincial-Territorial Committee on Drinking Water, has developed guidelines for PFOA and PFOS. It has also developed screening values for 9 other PFAS (including PFNA and PFHxS) in drinking water. The *Prohibition of Certain Toxic Substances Regulations, 2012* prohibits PFOA, PFOS, long-chain perfluoroalkyl carboxylic acids, and their salts and precursors in Canada. The Government of Canada continues to monitor and assess a subset of PFAS.

DATA SOURCES

Table 1. Biomonitoring initiatives and their target populations

Initiative	Target population
Canadian Health Measures Survey (CHMS)	General Canadian population living in the 10 provinces
First Nations Biomonitoring Initiative (FNBI)	First Nations people living on-reserve south of the 60° parallel
Maternal-Infant Research on Environmental Chemicals (MIREC) study	Pregnant women and their infants recruited from obstetric and prenatal clinics in 10 cities across Canada
Nutaratsaliit qanungisiarningit niqituinnanut (NQN) Pregnancy Wellness with Country Foods project	Pregnant Inuit women in 14 communities of Nunavik
U.S. National Health and Nutrition Examination Survey (NHANES)	General U.S. population

This fact sheet presents nationally representative data from the CHMS. These data are compared with data from the FNBI, the MIREC study, the NQN project and the U.S. NHANES.

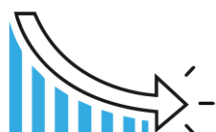
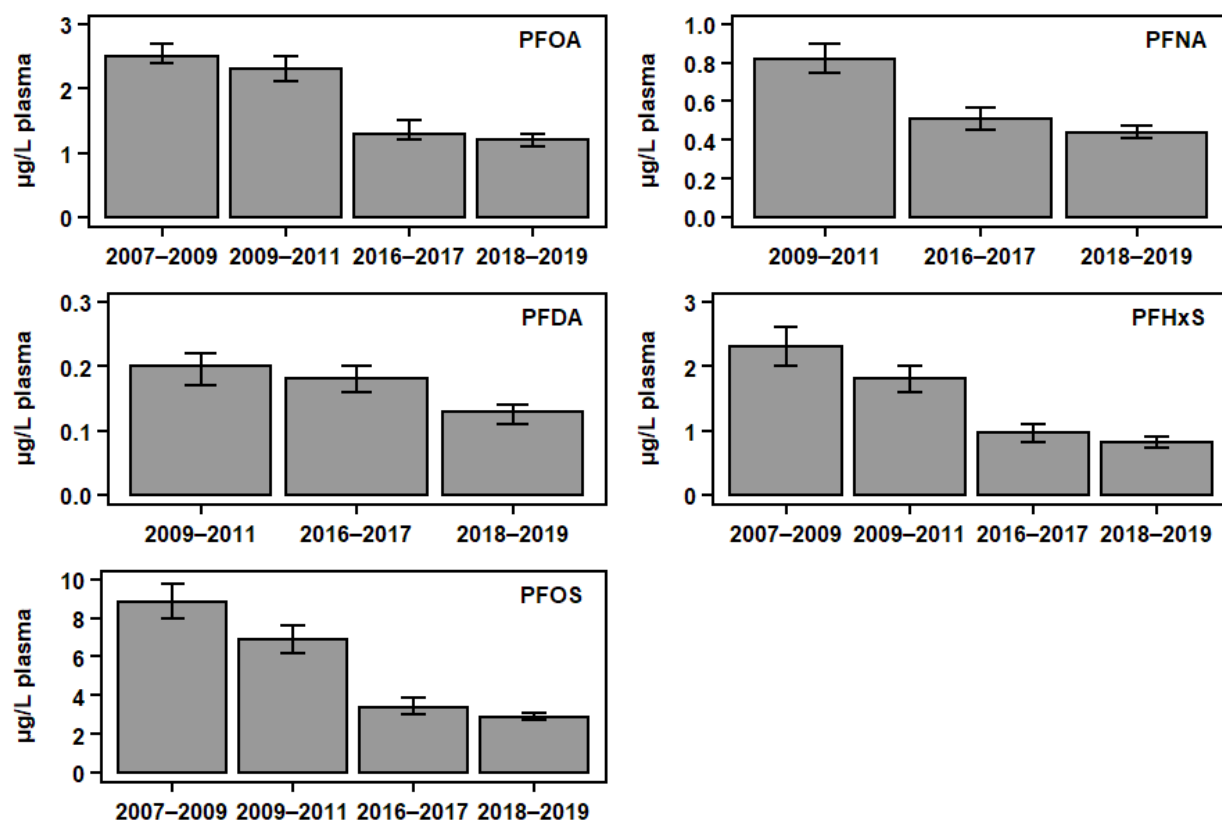
Table 2. Biomonitoring initiatives and their collection periods, participant age ranges, matrices sampled and biomarkers measured

Collection period	Age range (years)	Matrix	Biomarkers
CHMS			
2007–2009	20 to 79	Plasma	PFOA, PFHxS, PFOS
2009–2011	12 to 79	Plasma	PFOA, PFNA, PFDA, PFHxS, PFOS
2016–2017	3 to 79	Plasma	PFOA, PFNA, PFDA, PFHxS, PFOS
2018–2019	3 to 79	Plasma	PFOA, PFNA, PFDA, PFHxS, PFOS
FNBI			
2011	20+	Plasma	PFOA, PFNA, PFDA, PFHxS, PFOS
MIREC study			
2008–2011	18+	Plasma	PFOA, PFHxS, PFOS
NQN project			
2016–2017	16 to 40	Serum	PFOA, PFNA, PFDA, PFHxS, PFOS
U.S. NHANES			
2007–2008	12+	Serum	PFOA, PFNA, PFDA, PFHxS, PFOS
2009–2010	12+	Serum	PFOA, PFNA, PFDA, PFHxS, PFOS
2011–2012	12+	Serum	PFOA, PFNA, PFDA, PFHxS, PFOS
2013–2014	12+	Serum	PFOA, PFNA, PFDA, PFHxS, PFOS
2015–2016	12+	Serum	PFOA, PFNA, PFDA, PFHxS, PFOS

RESULTS

Canadian population

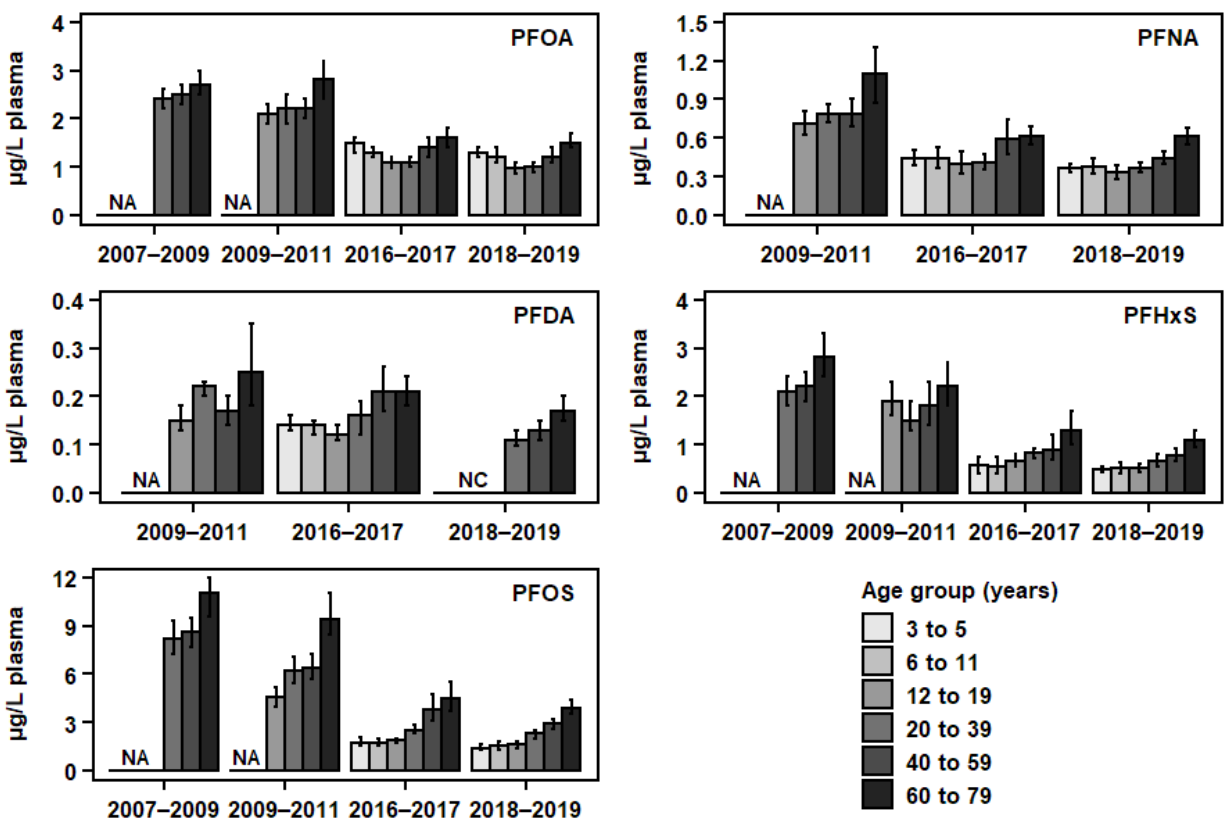
Figure 1. PFAS concentrations in the Canadian population. This figure shows the geometric mean concentrations of PFOA, PFNA, PFDA, PFHxS and PFOS in blood plasma ($\mu\text{g/L}$) in the Canadian population from the CHMS (2007–2019). Concentrations of PFOA, PFHxS and PFOS represent Canadians aged 20 to 79; those of PFNA and PFDA represent Canadians aged 12 to 79. PFNA and PFDA were not measured in 2007–2009.



There was a statistically significant decreasing trend ($P < 0.001$) in PFOA, PFNA, PFDA, PFHxS and PFOS concentrations in the Canadian population aged 12 or 20 to 79. Between 2007–2009 and 2018–2019, PFOA concentrations declined by 52%, PFHxS concentrations declined by 64% and PFOS concentrations declined by 67%. Between 2009–2011 and 2018–2019, PFNA concentrations declined by 47% and PFDA concentrations declined by 36%.

Canadian population, by age group

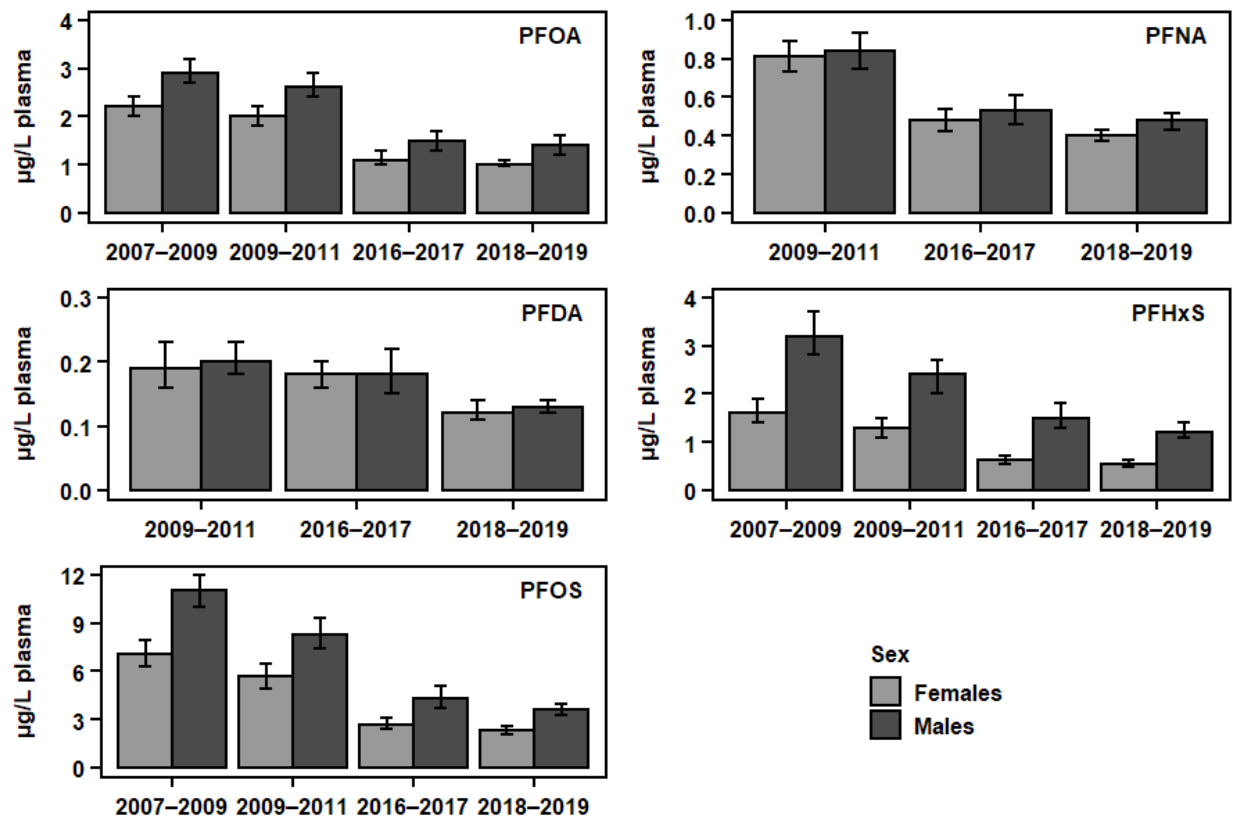
Figure 2. PFAS concentrations in the Canadian population, by age group. This figure shows the geometric mean concentrations of PFOA, PFNA, PFDA, PFHxS and PFOS in blood plasma ($\mu\text{g/L}$) in the Canadian population by age group from the CHMS (2007–2019). PFAS were measured in individuals aged 20 to 79 in 2007–2009, aged 12 to 79 in 2009–2011 and aged 3 to 79 in 2016–2017. Concentrations were therefore not available (NA) for individuals aged 3 to 19 in 2007–2009 or for individuals aged 3 to 11 in 2009–2011. PFNA and PFDA were not measured in 2007–2009. Geometric mean PFDA concentrations could not be calculated (NC) for individuals aged 3 to 19 in 2018–2019. This was because too many samples were below the analytical limit of detection.



Concentrations of PFAS were generally higher in adults than in children in the Canadian population.

Canadian population, by sex

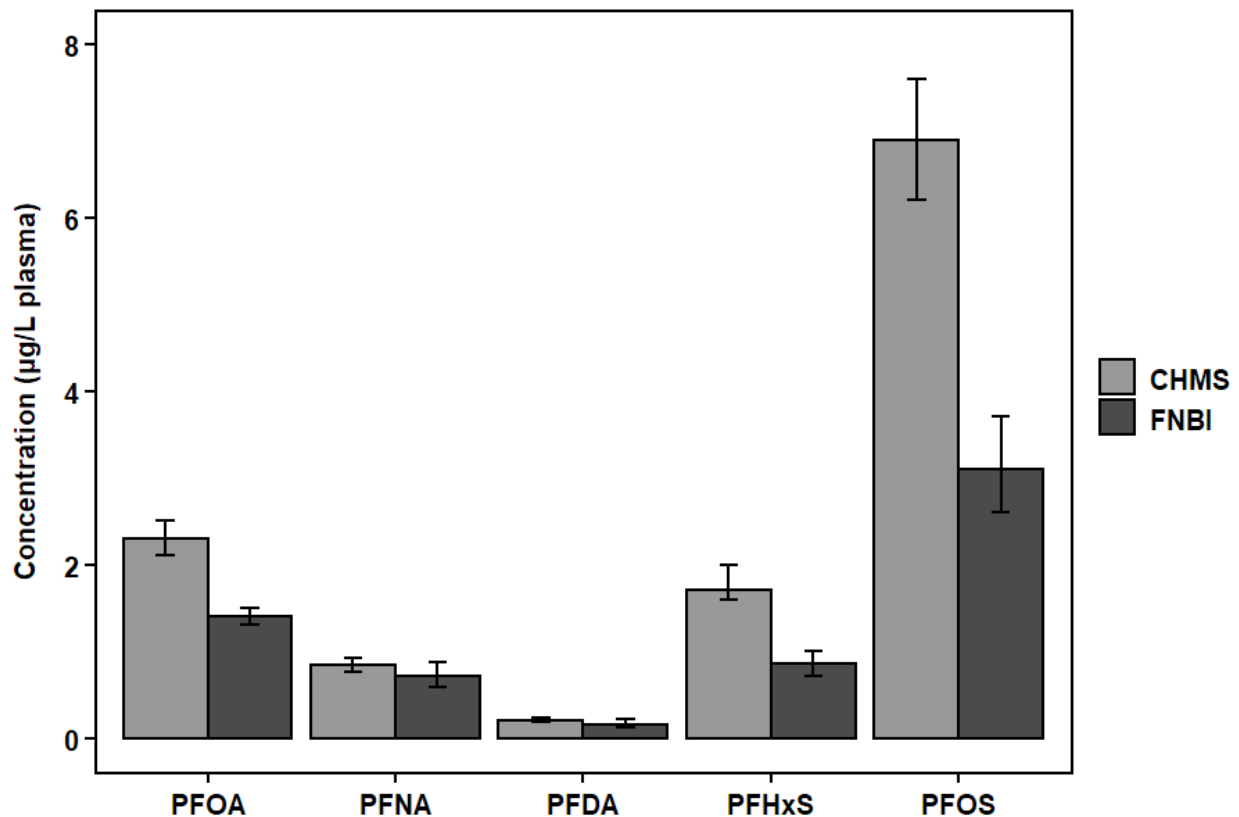
Figure 3. PFAS concentrations in the Canadian population, by sex. This figure shows the geometric mean concentrations of PFOA, PFNA, PFDA, PFHxS and PFOS in blood plasma ($\mu\text{g/L}$) in the Canadian population by sex from the CHMS (2007–2019). Concentrations of PFOA, PFHxS and PFOS represent Canadians aged 20 to 79. Concentrations of PFNA and PFDA represent Canadians aged 12 to 79. PFNA and PFDA were not measured in 2007–2009.



Concentrations of PFOA, PFHxS and PFOS were higher in males than in females in the Canadian population. Concentrations of PFNA and PFDA were similar between sexes.

Comparison of the general population and First Nations on-reserve population in Canada

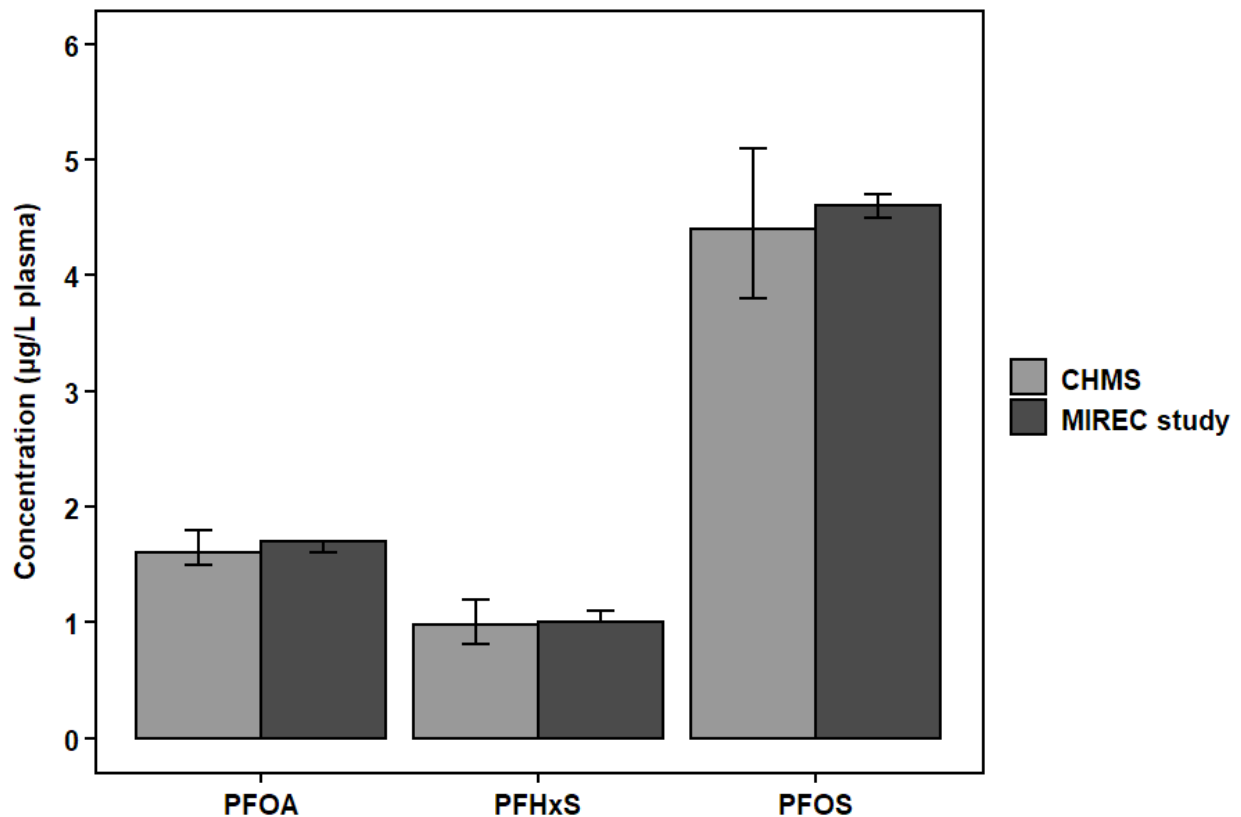
Figure 4. PFAS concentrations in the general population and First Nations on-reserve population in Canada. This figure shows the geometric mean concentrations of PFOA, PFNA, PFDA, PFHxS and PFOS in blood plasma ($\mu\text{g/L}$) in the general population aged 20 to 79 from the CHMS (2009–2011) and in the First Nations on-reserve population aged 20 and older from the FNBI (2011).



Concentrations of PFOA, PFHxS and PFOS were higher in the general population than in the First Nations on-reserve population in Canada. Concentrations of PFNA and PFDA were similar between the two populations.

Comparison of women of child-bearing age and pregnant women in Canada

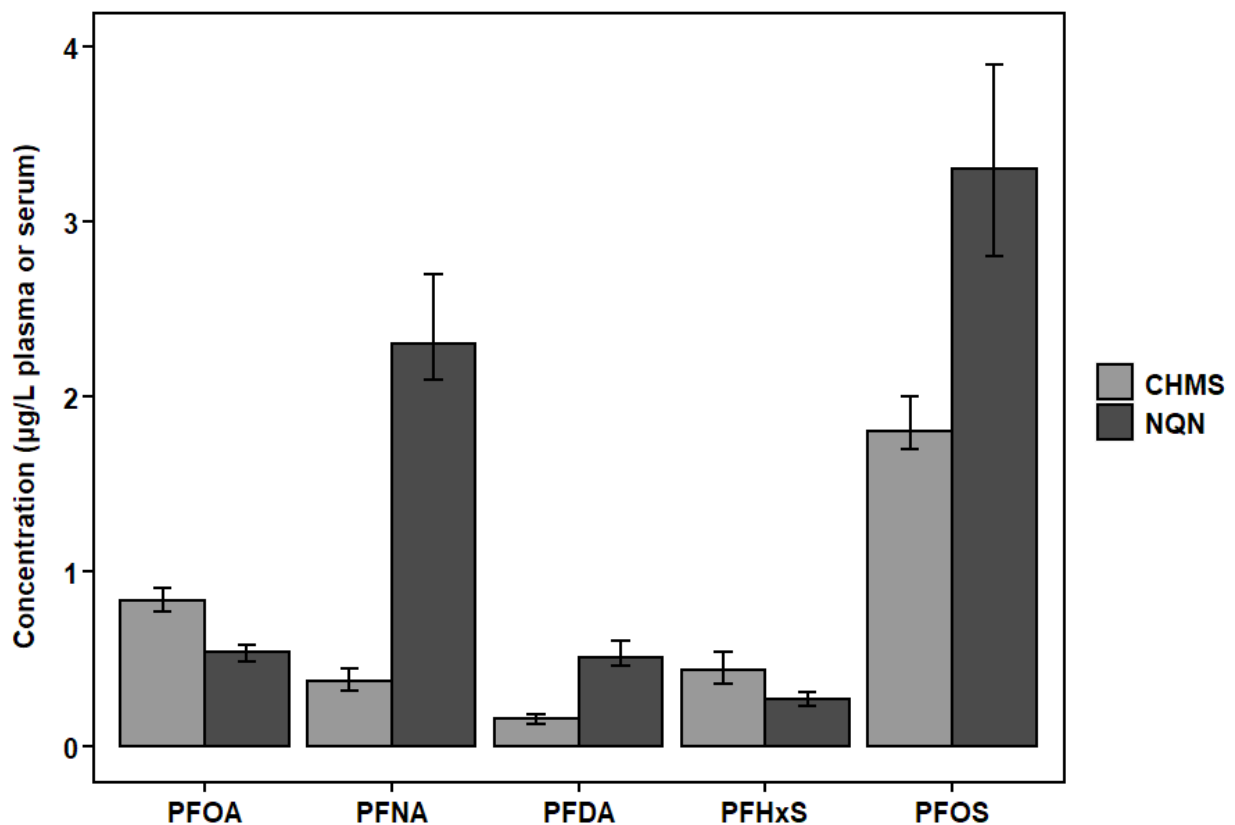
Figure 5. PFAS concentrations in women of child-bearing age and women in the first trimester of pregnancy in Canada. This figure shows the geometric mean concentrations of PFOA, PFHxS and PFOS in blood plasma ($\mu\text{g/L}$) in women of child-bearing age (18 to 49) in the general population from the CHMS (2009–2011) and for women in the first trimester of pregnancy from the MIREC study (2008–2011).



Concentrations of PFOA, PFHxS and PFOS were similar between women of child-bearing age and women in the first trimester of pregnancy in cities across Canada.

Comparison of women of child-bearing age and pregnant women from Nunavik Inuit communities in Canada

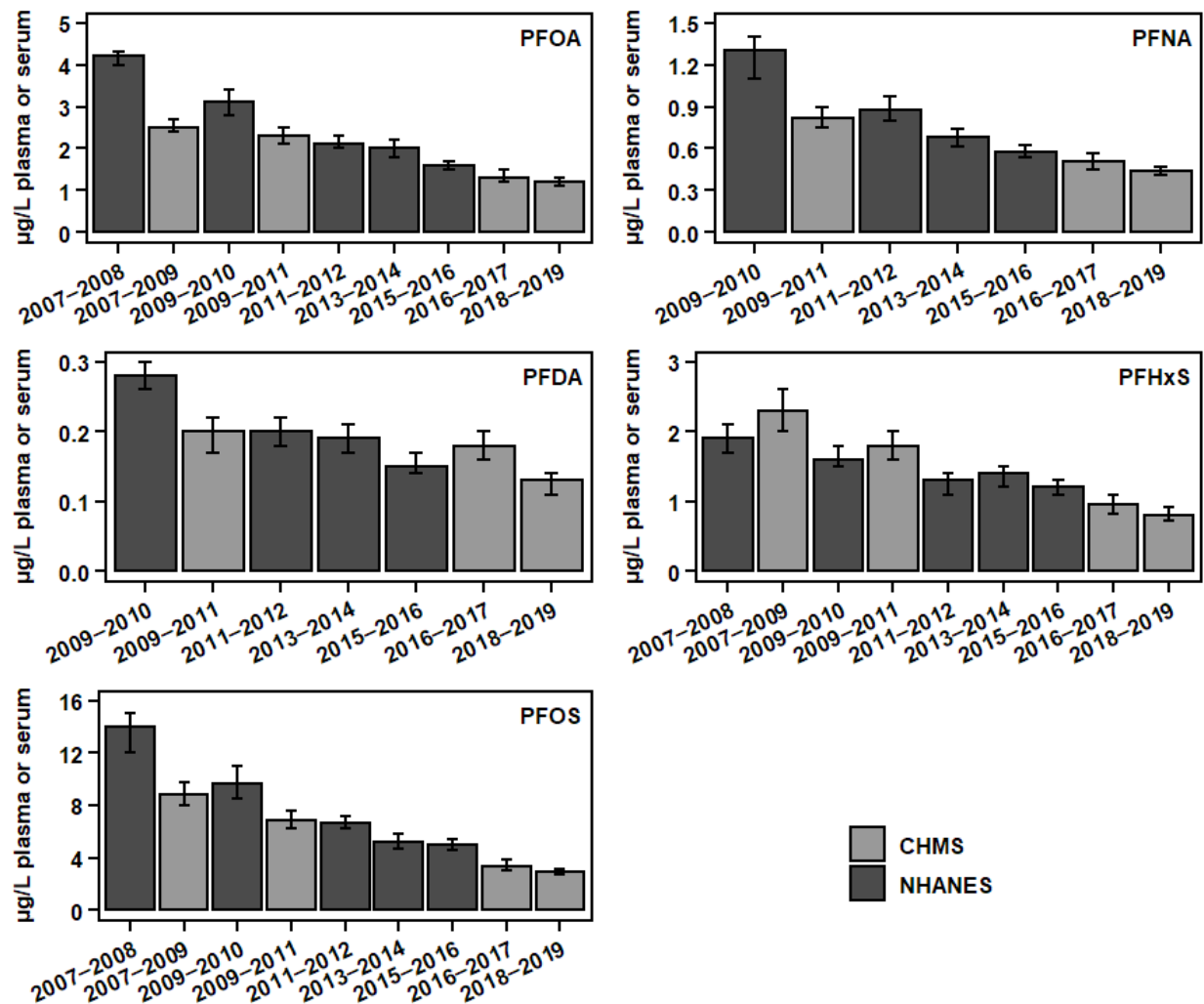
Figure 6. PFAS concentrations in women of child-bearing age and pregnant women from Nunavik Inuit communities in Canada. This figure shows the geometric mean concentrations of PFOA, PFNA, PFDA, PFHxS and PFOS in women of child-bearing age (18 to 40) in the general population from the CHMS (2016–2017) and in pregnant women (age 16 to 40) from 14 Inuit communities in Nunavik from the NQN project (2016–2017). PFAS were measured in blood plasma ($\mu\text{g/L}$) in the CHMS and in blood serum ($\mu\text{g/L}$) in the NQN project.



Concentrations of PFOA and PFHxS were higher in women of child-bearing age in the general Canadian population. Concentrations of PFNA, PFDA and PFOS were higher in pregnant women from Inuit communities in Nunavik.

Comparison of the Canadian and U.S. populations

Figure 7. PFAS concentrations in the Canadian and U.S. populations. This figure shows the geometric mean concentrations of PFOA, PFNA, PFDA, PFHxS and PFOS in the Canadian population from the CHMS (2007–2019) and in the U.S. population from the NHANES (2007–2016). PFAS were measured in blood plasma ($\mu\text{g/L}$) in the CHMS and in blood serum ($\mu\text{g/L}$) in NHANES. Note that there are slight differences between the surveys in sampling (such as the age ranges of participants) and analysis (such as the limits of detection).



Concentrations of PFAS were similar between the Canadian and U.S. populations.

ADDITIONAL INFORMATION

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