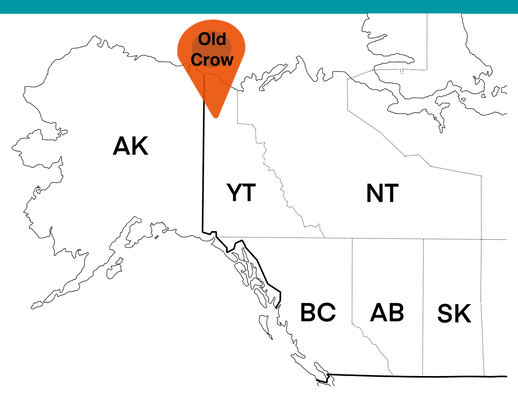
Human Biomonitoring of Dioxins, Furans, and Dioxin-like PCBs in Blood Plasma from Old Crow, Yukon, Canada (2019)

Ashlyn Simpson, Mallory Drysdale, Mary Gamberg, Ken Froese, Jeremy Brammer, Mylene Ratelle, Kelly Skinner, and Brian D. Laird

UNIVERSITY OF WATERLOO
FACULTY OF HEALTH

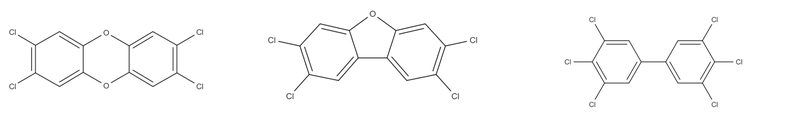
LOCATION



ABSTRACT

- Biobanked blood plasma samples from Old Crow, YT, were used to measure blood dioxins and dioxin-like congeners.
- Most dioxins, furans, and dioxin-like PCBs were lower than the respective levels in the general Canadian population.
- PCB 169 levels appeared to be two-fold elevated in participants aged 20 to 39 years and 60 to 79 years when compared to the general Canadian population.
- The cultural and health benefits of eating traditional foods continue to outweigh the risks of environmental contaminant exposures in Old Crow.

INTRODUCTION



- Dioxins, furans, and dioxin-like polychlorinated biphenyls (PCBs) [herein referred to as dioxins and dioxin like-congeners) are a group of persistent and toxic chemicals that are known to have human health effects at low levels.
- These chemicals have been produced by industrial emissions or natural sources. Additionally, dioxin-like PCBs were formerly used in electrical applications before being banned internationally (2004). These chemicals are widespread in the environment as they can contaminate air and travel distances hundreds to thousands of kilometers from any known source of emission.
- Polar regions are particularly vulnerable to persistent organic pollutants (POPs) because the cold conditions promote the global distillation of these semi-volatile chemicals. This process can result in contamination of traditional foods from both aquatic and terrestrial food chains.
- Vuntut Gwitchin residents of Old Crow have diets with high proportions of traditional foods (such as wild meat, fish, and plants) in comparison to other Yukon communities, and the average of other First Nation communities across Canada.
- Traditional foods are integral to food security, food sovereignty, and culture in Old Crow. The safety of traditional foods is a community research priority. This prompted a human biomonitoring project in Old Crow (2019).

Purpose

- To report on the dioxin and dioxin-like congener (DLC) exposure levels in Old Crow and compare these to the Canadian national averages.
- To investigate the relationships of lifestyle and demographic determinants such as sex, age, and BMI to biomarkers.

METHODS

Study Design:
- Cross-sectional

Recruitment:
- Anyone in Old Crow, four years of age and older, who was able to provide free and informed voluntary consent was eligible to participate in the biomonitoring study.

Plasma Samples:
- Biobanked blood plasma samples (n=54, representing 44% of residents) which were collected as a part of a contaminant biomonitoring project conducted in Old Crow, YT (2019).

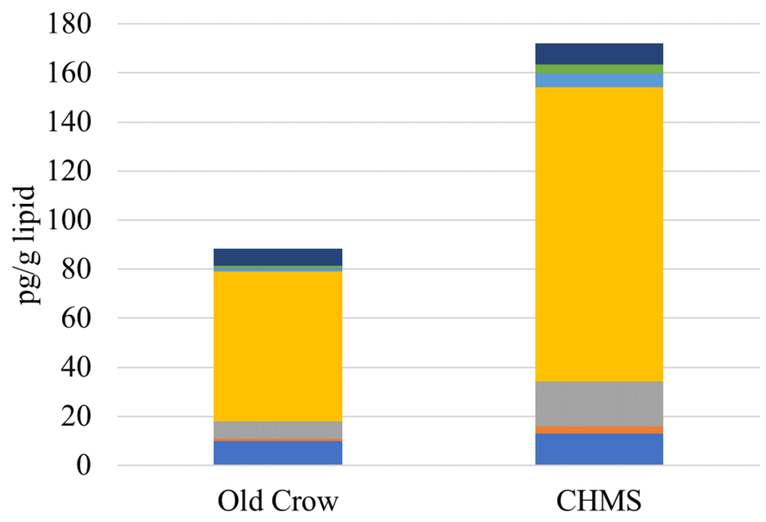
Target Analytes:
- Seven dioxins, ten furans, and four dioxin-like PCBs.

Analysis:
- Completed at the Centre de Toxicologie du Québec within the Institut National de Santé Publique du Québec, Canada.

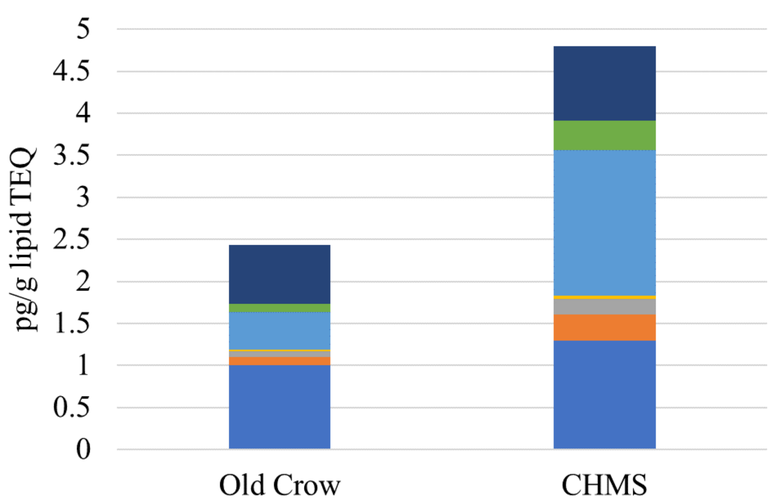
Comparison Group:
- CHMS arithmetic means from the Cycle 5 (2016-2017) pooled analysis served as the Canadian national averages.

RESULTS

Arithmetic mean dioxins, furans, and dioxin-like PCBs detected in >50% of samples from Old Crow (13-74 years of age) plasma relative to CHMS (6-79 years of age) levels in serum*

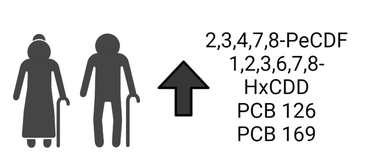


Arithmetic mean dioxins, furans, and dioxin-like PCBs detected in >50% of samples from Old Crow (13-74 years of age) plasma relative to CHMS (6-79 years of age) levels in serum adjusted for toxicity equivalence*



*PCB 169 is excluded from these plots because CHMS data for all ages is not available.

KEY FINDINGS



Some dioxins and DLCs were found to increase with age.

On average, those who were 20 to 39 and 60 to 79 years of age had 2-fold elevated PCB 169 levels compared to CHMS.

DISCUSSION

- These results serve as a first baseline measurement of dioxins and DLCs in Old Crow.
- When compared to CHMS, most dioxins, and DLCs appeared to be equal or lower than the levels observed in CHMS.
- An exception to this general observation is PCB 169, which appeared two-fold elevated in Old Crow in comparison to the Canadian national averages.
- Notably, CHMS Cycle 5 data for PCB 169 had high variability and was limited to those in the 20 to 39 and 60 to 79 age groups.
- Since diet is often a main driver of dioxin and DLC exposures, it is important to consider the dietary differences between people living in Old Crow, and those living across the provinces of Canada; most people living in Old Crow consume traditional foods harvested from traditional Vuntut Gwitchin lands and neighboring areas.
- Alternatively, PCB 169 may be of pyrogenic origin, potentially from smoking or other burning activities. It is noteworthy that municipal waste continues to be openly burned near the community.
- Community partners expressed concern that the source of this elevated exposure remains unknown at a community meeting (February 2023).

CONCLUSIONS

- Since most of the congeners measured in Old Crow were below the Canadian national average, this work supports existing messaging that **the cultural, social, and nutritional benefits of consuming traditional foods continue to outweigh the risks of contaminant exposure in this area.**
- Additional investigation into exposure from traditional foods, local airborne emissions, and historical environmental emissions may help to understand the reason for the elevated appearance of PCB 169.

ACKNOWLEDGEMENTS

In collaboration with:
Researchers at the University of Waterloo (Brian Laird, Heidi Swanson, Mylene Ratelle, Kelly Skinner, Rhona Hanning, Shannon Majowicz, Ken Stark), Trent University (Chris Furgal), University of Montréal (Michèle Bouchard), Washington State University (Amanda Boyd), INSPQ, and Gamberg Consulting (Mary Gamberg).

Vuntut Gwitchin Government

We would like to thank all community leaders, participants, and local coordinators in Old Crow for making this work possible. Mahsi' cho!

With Funding Granted By:

Northern Contaminants Program
Programme de lutte contre les contaminants dans le Nord
Crown-Indigenous Relations and Northern Affairs Canada
Relations Couronne-Autochtones et Affaires du Nord Canada
NSERC CRSNG
GLOBAL WATER FUTURES
SOLUTIONS TO WATER THREATS IN AN ERA OF GLOBAL CHANGE
NSTP PFSN
UNIVERSITY OF WATERLOO

and the the Canada Research Chairs in Nutritional Lipidomics.

Created with BioRender Poster Builder