BIOMONITORING OF HALOGENATED PERSISTENT ORGANIC POLLUTANTS (POPs) IN THE POOLED SERUM OF PREGNANT WOMEN AND CHILDREN LIVING IN ALBERTA, CANADA

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Introduction

Many persistent organic pollutants (POPs) transfer between the mother and fetus through the placenta during pregnancy as well as between the mother and the infant through maternal milk.[1,2] Relatively high maternal body burdens of some of these chemicals are known to cause adverse effects on fetal development and birth outcomes. Biomonitoring data from adults cannot be extrapolated to children as they differ greatly in diet, physiology, and activity patterns. As a result children have different and often higher exposures to environmental chemicals than adults.[3]

The main objective of these studies is to quantify the level of exposure of pregnant women and children to various emerging and established environmental chemicals. The influence of age and geography on detected levels was examined.

Materials and methods

Prenatal serum samples were selected from those leftover from routine infectious disease marker screening in 2005 at the Provincial Public Health Laboratory in Edmonton, Alberta. Equal volumes of serum from each sample were placed in pools stratified by age and geography. The pool volume was determined based on the volume of serum required to analyze all chemicals of interest. Children's samples were obtained from leftover samples from normal, healthy children presenting for elective surgeries between 2004 and 2006. Equal volumes of serum from each sample were placed in pools stratified by age. The persistent organic pollutants analyzed in the pregnant women's and children's samples included perfluorinated chemicals (PFCs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), dioxins and furans, organochlorine pesticides, and polybrominated biphenyls (PBBs) (pregnant women only). Compound classes were analyzed in separate analytical methods. Analytical methods included gas chromatography (GC) with electron capture detection (ECD), GC-mass spectrometry (MS), high resolution GC-MS, and liquid chromatography tandem mass spectrometry (LC-MSMS).

Results and discussion

PFCs, PCBs, PBDEs, dioxins and furans, and organochlorine pesticides were detected in the serum samples of pregnant women and children. The percentage of pregnant women's pools with detectable levels of an individual chemical ranged from 0 – 100%. The number of children's pools with detectable concentrations of POPs ranged from 0 of 6 to 6 of 6 pools. The percentage of analytes detected per chemical class ranged from 9 - 100% (Table 1). Mean concentrations and confidence intervals are only calculated if ≥25% of the pools had POP

levels above the limit of detection (LOD). The median number of chemicals per class detected in more than 25% of the pools was 7 (of 9 PFCs) for the pregnant women and 5 (of 38 PCBs) for the children (Table 1).

Chemical Class	Number of POPs detected (one or more pools)		Number of POPs detected (≥25% of pools)	
	Pregnant Women	Children	Pregnant Women	Children
Polychlorinated Dibenzo-P-Dioxins and Dibenzofurans	17 (17)[a]	12 (17)	8 (17)	8 (17)
Polychlorinated Biphenyls	32 (38)	6 (38)	5 (38)	5 (38)
Organochlorine Pesticides	17 (22)	2 (23)	3 (22)	1 (23)
Polybrominated Diphenyl Ethers	12 (12)	6 (12)	8 (12)	6 (12)
Perfluorinated Compounds	9 (9)	6 (9)	7 (9)	4 (9)

[a] Values in brackets are the total number of analytes per chemical class

Table 1: Number of POPs detected per chemical class in at least one and in more than 25% of pregnant women's and children's serum pools

Age and geography did have a significant effect on the concentrations of some of the POPs detected in the serum. Levels of all PFCs detected in the children's serum were significantly higher than levels detected in the pregnant women's serum (Figure 1). Some studies have noted higher concentrations of PFCs in children than in adults[4,5] while others have not observed this trend.[6] In agreement with studies in various other countries, PFOS was detected at the highest levels of all PFCs in the pregnant women and children.[7] In general, concentrations of PFCs in pregnant women from the southern region were lower than PFCs detected in pregnant women from the northern and central regions.

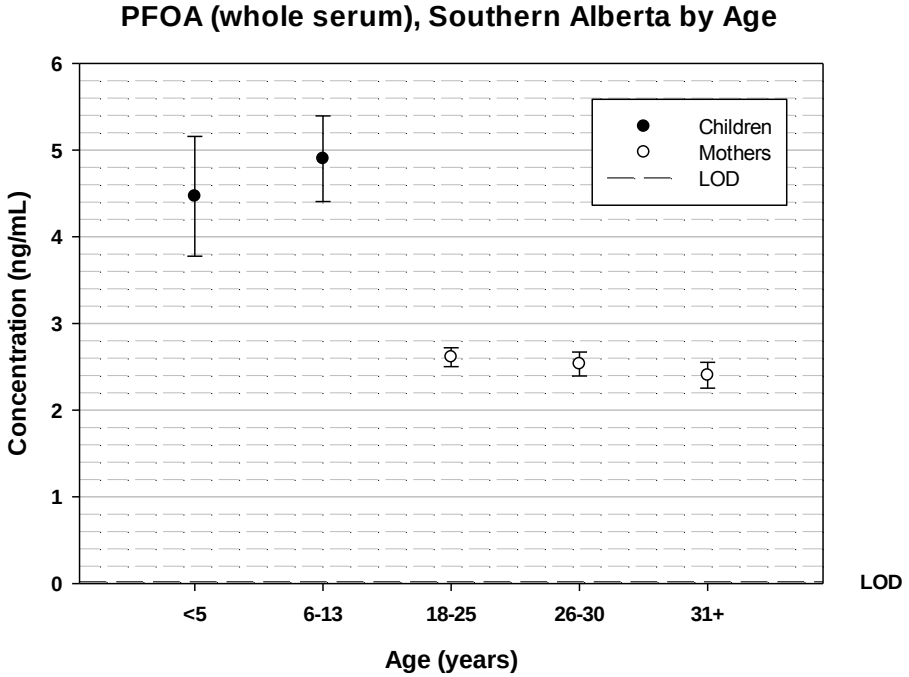

Figure 1: Concentration of PFOA in whole serum of children and pregnant women from Southern Alberta

Levels of PCBs detected in the pregnant women's serum generally increased with age of the women (Figure 2). This trend with age has been noted in another Canadian biomonitoring study.[8] PCB levels in the oldest group of women are generally higher in the south than in the north and central regions. PCB levels do not differ significantly between the children's age groups. Concentrations of PCBs detected in the pregnant women's serum in this study are lower than concentrations detected in adult female's serum in the most recent National Health and Nutrition Examination Survey (NHANES).[9]

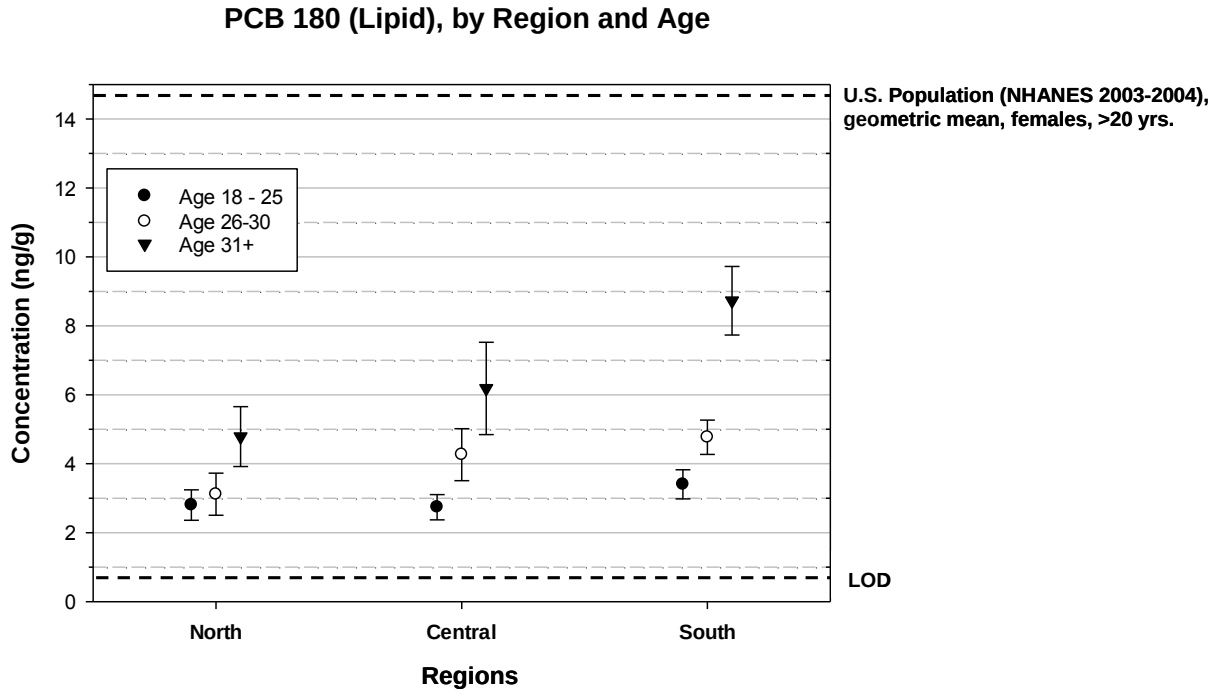

Figure 2: Concentrations of PCB 180 in lipid adjusted serum of pregnant women stratified by age and geography

Dioxin and furan serum levels are not significantly different among age groups of the pregnant women. Some of the dioxin and furan congeners have higher concentrations in at least one age group of the children than in the pregnant women (Figure 3). In the current study some congeners have higher serum concentrations in the south than in the north while others are higher in the south than both the northern and central regions.

4,4'-dichlorodiphenyldichloroethylene (DDE) was detected in the serum of children and pregnant women. Concentrations in pregnant women's serum were generally higher in the south than in the northern and central regions. Concentrations of 4,4'-DDE did not differ significantly between the children's age groups.

PBDEs did not differ significantly by age category overall. However, the serum concentrations of three congeners (PBDE 47, 100 and 153) are higher in one age group of children than in one or more of the age categories of the pregnant women.

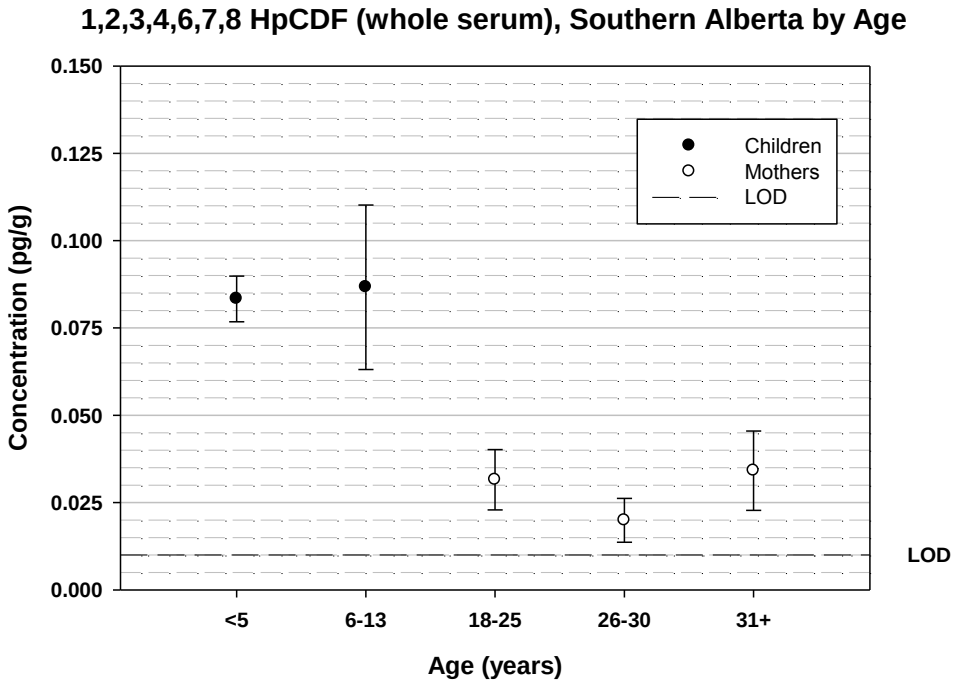

Figure 3: Concentration of 1,2,3,4,6,7,8-HpCDF in whole serum in children and pregnant women in Southern Alberta

In comparison to other biomonitoring studies around the world, concentrations of POPs are typically similar or lower in the current study. At the time these samples were collected there were no systematic biomonitoring measurements in Alberta or Canada. The Alberta Biomonitoring Program continues to monitor chemicals of interest in the Alberta population. The data collected in this study determined baseline concentrations of POPs in pregnant women and children on a regional basis within Alberta. This information can serve as a benchmark to track future exposures, a starting point to assess health risks, indicate exposure sources and prioritize future research.

Acknowledgements
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