

## POP exposure among native people of Uelen, Chukotka, Russia

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### Introduction

High intake of blubber from marine mammals, by humans from Greenland, northern-Canada and the Faeroe Island have been found to lead to elevated blood levels of persistent organic pollutants (POPs) in humans, especially PCBs and the metabolite *p,p'*-dichlorodiphenylethylene (*p,p'*-DDE)<sup>1-4</sup>. In men from Scoresbysund in Greenland, the average amount of sum PCBs and sum DDTs in plasma was found to be 41 µg/L and 11.1 µg/L, respectively<sup>1</sup>. However, high levels of *p,p'*-dichlorodiphenyltrichloroethane (*p,p'*-DDT) and  $\beta$ -HCH have been found in human plasma from residents of the town of Nikel and city of Arkhangelsk indicating the presence of *de nova* local sources at these sites in western Russia<sup>2,5</sup>; their exact origin have thus far not been identified. Pentachlorophenol (PCP) and hydroxylated-PCBs are also found in high levels in human plasma<sup>6</sup>. The information on plasma levels of POPs, and diet in northeast Russia is very limited in comparison to other Arctic countries. This was also highlighted in the 1998 AMAP report and Chukotka Peninsula is now one of the key areas in the future work of AMAP<sup>2,7</sup>. In Uelen, situated by the Bering Strait and Chukotka Sea, the intake of marine mammals was known to be considerable.

Thus the aim of this paper was to report levels of PCBs and pesticides in plasma from the native population of Uelen, Chukotka Peninsula, Russia. These levels were related to dietary intake through the use of a semi quantitative dietary questionnaire. The levels of OH-PCBs and PCP were also determined in a high exposed subgroup.

### Materials and Methods

A total of 250 adults were interviewed and who donated blood. The 250 participants were all the people available, from an adult population of 374, at the time of the fieldwork. Of these 250 samples, 50 were selected at random (corresponding to every 5<sup>th</sup> donor) and analysed to get a first indication of the human levels of POPs among the general population of Uelen. The samples were collected in July and August of 2001 and the weight and the height of the participants were measured at the time of the interview.

PCBs (17 congeners), DDTs, chlordanes (CDs), HCHs, HCB, Mirex, Tox 26 and Tox 50 were determined in all samples. OH-PCBs and PCP were determined in 15 high exposed individual. The method for extraction and clean up of plasma samples for determination of neutral organohalogen is described elsewhere<sup>8</sup>. The method for the OH-PCB and PCP was a slight modification of this including a derivatisation step.

#### GC/MS investigations of plasma extracts

Quantification was carried out with low resolution Finnigan MD800 quadrupole mass spectrometry (LRMS) as detector in selected ion monitoring mode (SIM). Electron impact (EI) was used as ionisation method for the determination of PCBs, DDTs, and organochlorine pesticides; and ECNI was used for the analyses of toxaphenes. For the determination of OH-PCBs and PCP, a Hewlett Packard 5890 Series II Plus GC connected to a Hewlett Packard 5890B (Engine) mass spectrometer, was employed. The mass spectrometer was used in electron capture negative ionisation (ECNI) mode with methane (99.97 %) as the reagent gas.

#### Results and Discussion

The intake of marine mammals was high and the combined intake of blubber from walrus, seal and whale was a significant predictor ( $p < 0.01$ ) of plasma concentrations of sum PCBs and borderline for sum CDs ( $p = 0.02$ ) and sum DDTs ( $p = 0.04$ ). There was a significant gender difference in the levels of POPs, and among women there was a significant increase with age. Extensive breastfeeding and lower blubber intake among women could be possible explanations for this gender difference. Despite the high intake of blubber the plasma levels of PCBs and DDTs were lower than some of those reported for the East Coast of Greenland. The levels of the main compound groups are listed in Table 1. The geometric mean values for sum PCBs (17 congeners) and sum DDTs were 1316 ng/g lipids and 563 ng/g lipids, respectively. PCB 163, which partly co-eluted with PCB 138, was found in high concentrations (40 % of PCB 138). The geometric mean of sum CDs was 518 ng/g lipids. Concentrations of  $\beta$ -HCH (geometric mean; 410 ng/g lipids) were higher than observed for other native populations depending on marine mammals. Transportation of  $\beta$ -HCH by ocean currents through the Bering Strait into the Arctic Ocean, or regional point sources might explain these elevated levels.

**Table 1:** Lipid weight levels of POPs in 50 plasma samples from the native population of Uelen, Chukotka.

Compound	Average (ng/g lipids)	stdev	Median (ng/g lipids)	Geomean (ng/g lipids)	Range (ng/g lipids)
HCB	211.4	130.4	204.0	167.7	19.7 - 531.4
$\beta$ -HCH	524.3	319.5	519.7	409.6	51.1 - 1281.5
Mirex	41.1	41.0	28.6	27.0	3.1 - 228.7
Sum CDs	736.4	592.1	683.0	518.1	56.2 - 2734.6
Sum DDTs	657.5	344.7	607.7	563.3	106.8 - 1726.0
Sum PCBs	1755.3	1262.7	1606.2	1316.4	175.2 - 5614.1
Tox 26 + tox 50	85.9	61.6	75.5	62.7	10.3 - 279.0

In the PCB exposed plasma samples from the native population of Uelen ( $n = 15$ ), the median ratio of sum OH-PCBs to sum PCBs was as high as 0.4 and the sum values were significantly correlated

( $r=0.7$ ,  $p<0.01$ ). The median sum OH-PCBs (10 congeners) was 5916 pg/g plasma with 4-OH-CB107 as the dominating congener (median: 1673 pg/g plasma) (Table 2). The PCP levels were moderate (median: 642 pg/g plasma). The high OH-PCB concentrations clearly indicate the need for further research on the levels and the behaviour of these compounds in humans.

**Table 2:** Wet weight and lipid weight levels of OH-PCBs and PCP in plasma of selected high PCB exposed samples from Chukchi people from Uelen, Chukotka Peninsula (n=15). Recovery rates:  $^{13}\text{C}_6\text{PCP} = 64\%$  (range 43 – 83 %),  $^{13}\text{C}_{12}4\text{-OH-CB 187} = 72\%$  (range 41 – 90 %).

Compound	Median (pg/g wet weight)	Range (pg/g wet weight)	Median (ng/g lipid weight)	Range (ng/g lipid weight)
PCP	642	369-1197	117	51-252
4-OH-CB107	1673	697-3948	275	203-917
4'-OH-CB130	33	10-100	6	1-20
3'-OH-CB138	859	536-1469	174	92-341
4-OH-CB146	841	452-2105	191	87-346
3-OH-CB153	1313	558-2100	194	104-488
4-OH-CB162	85	48-251	18	8-58
4'-OH-CB172	188	90-439	37	17-82
3'-OH-CB180	92	46-227	18	9-53
4-OH-CB187	786	447-1967	136	74-457
4-OH-CB193	71	18-356	15	4-83
Sum OH-PCBs	5916	3304-12215	1098	707-2838

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