First Data on Background Levels of Non-Ortho and Mono-Ortho PCBs in Blood of Residents from Southern Germany

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1. Introduction

Polychlorinated biphenyls (PCBs) represent a group of various congeners with different toxicity. According to present data-base especially for the non-ortho and the mono-ortho substituted PCBs a dioxin-like toxicity is discussed.

2. Objectives

There is only limited information about the background concentrations of non-ortho and mono-ortho PCBs in human blood especially for children. Therefore we investigated selected PCB congeners in adults and children from Southern Germany. Additionally PCDD/PCDF were investigated.

3. Material and Methods

PCDD/PCDF and PCB blood fat concentrations in children were measured in pooled samples. Individual samples were obtained from fourth-graders in three different areas of Baden-Württemberg, whose parents had given informed consent to participate in a survey of various environmental exposures(142 boys, 144 girls, mean age 10 years, range 9 - 12 years). Survey areas included an urban industrial area, an industrial area within a rural setting, and a rural area. Two pooled blood samples were prepared for each region. The first sample consisted of blood aliquots from a random selection of participating children who had been resident in the survey area for a minimum of two years. A second pooled blood sample referred to a selection of children who, in addition to a two-year minimum residence period, were born in Germany.
The adult study population consisted of 15 volunteers (11 males, 4 females, age 24 to 58 years) from among a reference group of a study on fish consumption. Persons with a history of probable occupational or environmental exposure to PCDD/PCDF and PCB, as

determined by a standardized questionnaire, had been excluded from the investigation.
PCDD/PCDF were determined by analytic methods nearly identical to those applied for the successful participation in the WHO inter-laboratory validation studies (round II and III) on human blood [1,2,3]. Mono-ortho substituted (no. 105, 118, 156), non-ortho substituted (no. 77, 126, 169) and PCB congeners no. 28, 52, 101, 138, 153 and 180 were determined as described elsewhere [4]. TEQ values for PCDD/PCDF have been calculated as proposed by NATO-CCMS and the German Federal Helth Office (FHO).

4. Results

Table 1 summarizes blood fat standardized PCB congener concentrations for 15 adults. Table 2 contains the equivalent data for six pooled blood samples from children in three different areas. The PCDD/PCDF concentrations among children are shown in Table 3.

Table 1: PCB blood fat concentrations in 15 adults from Southern Germany

PCB-congener (ng/g) lipid based		min	max	mean	median
2,4,4'-Tri-CB	(PCB-28)	n.d.	8.7	3.4	2.1
2,2',5,5'-Tetra-CB	(PCB-52)	n.d.	6.3	0.6	n.d.
2,2',4,5,5'-Penta-CB	(PCB-101)	n.d.	6.3	2.6	2.0
2,2',3,4,4',5-Hexa-CB	(PCB-138)	91.2	410	190	183
2,2',4,4',5,5'-Hexa-CB	(PCB-153)	114	522	272	244
2,2',3,4,4',5,5-Hepta-CB	(PCB-180)	77.2	346	198	189
Mono-ortho-substituted PCB (ng/g) lipid based					
2,3,3',4,4'-Penta-CB	(PCB-105)	2.6	19.4	6.16	5.2
2,3',4,4',5-Penta-CB	(PCB-118)	12.6	109	34.19	30.7
2,3,3',4,4',5-Hexa-CB	(PCB-156)	6.2	63.2	32.54	30.7
Non-ortho-substituted (coplanar) PCB (pg/g) lipid based					
3,3',4,4'-Tetra-CB	(PCB-77)	8.3 (M)	40.8 (M)	23.2 (M)	22.0 (M)
3,3',4,4',5-Penta-CB	(PCB-126)	28.7	171.1	67.27	59.0
3,3',4,4',5,5'-Hexa-CB	(PCB-169)	46.6	214	116.15	105.6

M = maximum value due to possible contribution of a contaminant
n.d. = not detectable

The PCDD/PCDF concentrations expressed in I-TEQ of the adult group varied from 11.7 - 31.9 pg/g blood fat, median 18.3 pg/g. Detailed information for PCDD/PCDF will be presented at the meeting.

Table 2: PCB blood fat concentrations in 6 pooled blood samples from children of different areas in Southern Germany

area		urban industrial area		industrial area within rural setting		rural area	
sample condition		1	2	1	2	1	2
number of pooled blood samples		n=45	n=79	n=39	n=44	n=43	n=32
PCB-congener (ng/g) lipid based							
2,4,4'-Tri-CB	(PCB-28)	2.6	n.d.(3)	n.d.(3)	n.d.(3)	n.d.(3)	5.9
2,2',5,5'-Tetra-CB	(PCB-52)	n.d.(3)	n.d.(3)	n.d.(3)	n.d.(3)	n.d.(3)	n.d.(3)
2,2',4,5,5'-Penta-CB	(PCB-101)	5.3	n.d.(3)	n.d.(3)	n.d.(3)	n.d.(3)	n.d.(3)
2,2',3,4,4',5-Hexa-CB	(PCB-138)	50.0	68.6	55.9	52.6	71.1	73.5
2,2',4,4',5,5'-Hexa-CB	(PCB-153)	63.2	91.4	79.4	73.7	86.8	85.3
2,2',3,4,4',5,5-Hepta-CB	(PCB-180)	34.2	42.9	41.2	34.2	42.1	38.2
Mono-ortho-substituted PCB (ng/g) lipid based							
2,3,3',4,4'-Penta-CB	(PCB-105)	n.d.(3)	n.d.(3)	n.d.(3)	n.d.(3)	n.d.(3)	n.d.(3)
2,3',4,4',5-Penta-CB	(PCB-118)	13.2	14.6	11.8	7.9	18.4	20.6
2,3,3',4,4',5-Hexa-CB	(PCB-156)	7.9	11.4	8.8	5.3	10.5	8.8
Non-ortho-substituted (coplanar) PCB (pg/g) lipid based							
3,3',4,4'-Tetra-CB	(PCB-77)	< 19.6 (M)	< 16.7 (M)	< 24.5 (M)	< 19.1 (M)	< 20.5 (M)	< 24.4 (M)
3,3',4,4',5-Penta-CB	(PCB-126)	37.6	41.9	52.6	44.8	49.4	45.2
3,3',4,4',5,5'-Hexa-CB	(PCB-169)	24.6	29.4	37.4	30.3	36.7	34.0

1 ≙ children who had been resident in the area for a minimum of 2 years

2 ≙ children who had been resident in the area for a minimum of 2 years and were born in Germany

M = maximum value due to possible contribution of a contaminant

n.d. = not detectable

( ) = detection limit

Table 3: PCDD/PCDF concentrations and TEQ values from 6 pooled blood samples from children of different areas in Southern Germany (pg/g blood fat)

area	urban industrial area		industrial area within rural setting		rural area	
sample conditions	1	2	1	2	1	2
number of pooled blood samples	n = 45	n = 79	n = 39	n = 44	n = 43	n = 32
Σ PCDD	302,7	290,1	273,2	230,6	246,3	303,1
Σ PCDF	24,0	28,0	30,2	30,0	42,7	30,7
Σ PCDD/PCDF	326,7	318,1	303,4	260,6	289,0	333,8
I-TEQ (NATO/CCMS)	7,3	8,2	10,0	9,0	9,3	10,1
TEQ (BGA/UBA)	4,7	5,2	6,3	5,8	5,8	6,5

1 ≙ children who had been resident in the area for a minimum of 2 years

2 ≙ children who had been resident in the area for a minimum of 2 years and were born in Germany

5. Conclusions

Due to the limited number of samples and the selection process our results have to be interpreted with caution. With regard to the TEQ values for PCDD/PCDF our results are in good agreement with earlier investigations [5,6]. Concentrations of the investigated PCBs and the TEQs were lower in children than in adults. An age dependance of the PCDD/PCDF body burden has been discussed [7]. There was no clear-cut association between blood levels in children and the areas under study. This corresponds with earlier data for human milk [8]. While not necessarily representative for the target population, our data suggest a range of values which could be anticipated from a representative population sample.

6. References

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