IRIS Bi-Monthly Public Science Meeting: PCBs

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Table 3
Concentration of PCB in plasma (μg/l) in differently aggregated groups according to exposure status. Statistics: Mann–Whitney *U* test.

PCB-aggregations	Non-exposed (n = 134)		Exposed (n = 139)		p
	Median (5–95 percentiles) (μg/l)	Mean (μg/l)	Median (5–95 percentiles) (μg/l)	Mean (μg/l)	
Sum 6 indicator[a]	0.805 (0.118–2.508)	0.954	2.715 (0.754–8.571)	3.454	<0.0001
Sum 27	1.256 (0.260–3.750)	1.520	4.902 (1.186–17.279)	6.816	<0.0001
Sum DL[b]	0.122 (0.065–0.357)	0.154	0.237 (0.088–0.760)	0.310	<0.0001
Sum_NDL[c]	1.138 (0.196–3.402)	1.366	4.700 (1.086–16.466)	6.505	<0.0001
Sum of tri/tetra chlorinated PCBs[d]	0.068 (0.036–0.388)	0.160	3.507 (0.549–13.28)	4.782	<0.0001
Sum of penta chlorinated PCBs[e]	0.080 (0.035–0.219)	0.103	0.337 (0.080–1.374)	0.467	<0.0001
Sum of hexa/hepta chlorinated PCBs[f]	1.052 (0.134–3.365)	1.253	1.268 (0.275–3.808)	1.562	0.02

[a] Sum of the 6 indicator congeners: PCB 28, 52, 101, 138, 153, 180.
[b] Sum of 12 dioxin-like PCB: PCB 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, 189.
[c] Sum of 15 non-dioxin-like PCB: PCB 28, 52, 66, 74, 99, 101, 138, 153, 170, 178, 180, 182, 183, 187, 190.
[d] Sum of tri-tetra chlorinated: PCB 28, 52, 66, 74, 77, 81.
[e] Sum of penta chlorinated: PCB 99, 101, 105, 114, 118, 123, 126.
[f] Sum of hexa–hepta chlorinated: PCB 138, 153, 156, 157, 167, 169, 170, 178, 180, 182, 183, 187, 189, 190.

Table 4
Air concentrations of PCB in dwellings (ng/m^3). 6 indicator congeners, PCB 118 and sums of PCB congeners. Statistics: Mann–Whitney *U*. <LOQ set to zero in calculations.

PCB-congener	Non-contaminated (n = 21)		Contaminated (n = 83)		p
	Median (min.–max.) (ng/m^3)	Mean (ng/m^3)	Median (min.–max.) (ng/m^3)	Mean (ng/m^3)	
PCB 28	<LOQ (<LOQ–19.8)	1.31	61.4 (14.9–296)	80.8	<0.001
PCB 52	<LOQ (<LOQ–28.3)	2.13	94.6 (16.5–426)	112	<0.001
PCB 101	<LOQ (<LOQ–2.64)	0.13	8.90 (1.78–47.1)	12.9	<0.001
PCB 118[d]	<LOQ (<LOQ–<LOQ)	<LOQ	1.18 (<LOQ–9.09)	1.75	<0.001
PCB 138	<LOQ (<LOQ–<LOQ)	<LOQ	<LOQ (<LOQ–<LOQ)	<LOQ	–
PCB 153	<LOQ (<LOQ–<LOQ)	<LOQ	<LOQ (<LOQ–1.48)	0.03	0.48
PCB 180	<LOQ (<LOQ–<LOQ)	<LOQ	<LOQ (<LOQ–<LOQ)	<LOQ	–
Sum 24	0.11 (<LOQ–64.5)	4.80	236 (43.3–1060)	285	<0.001
Sum_DL[a]	<LOQ (<LOQ–0.38)	0.02	2.19 (0.18–16.5)	3.21	<0.001
Sum_NDL[b]	0.11 (<LOQ–64.1)	4.78	234 (43.1–1043)	282	<0.001
Total PCB[c]	<LOQ (<LOQ–254)	17.8	859 (168–3843)	1030	<0.001

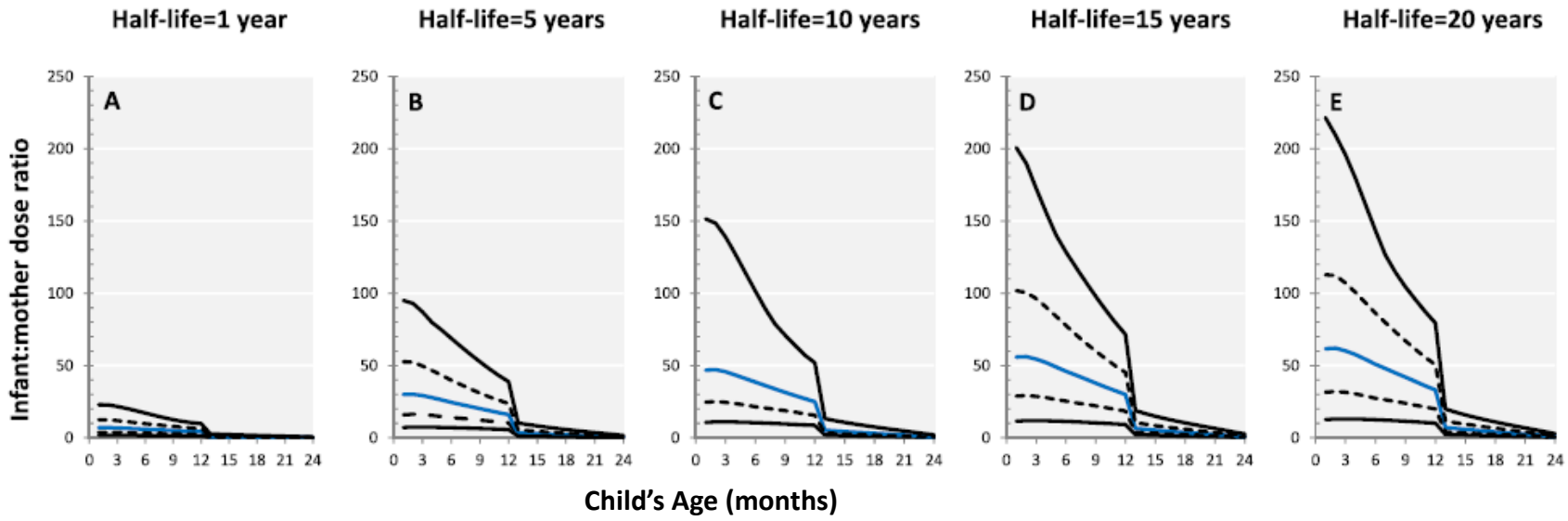
LOQ, limit of quantification.
[a] Sum of 12 dioxin-like PCB: PCB 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, 189.
[b] Sum of 12 non-dioxin-like PCB: PCB 28, 52, 66, 74, 99, 101, 138, 153, 170, 180, 183, 187.
[c] Total PCB calculated as sum of 6 indicator congeners × 5 (PCB 28, 52, 101, 138, 153 and 180).

Table 4-4. Approximate Weight Percent of PCB Homologs in Some Aroclors

Homolog	Aroclor 1016[a]	Aroclor 1221[b]	Aroclor 1232[c]	Aroclor 1242[d]	Aroclor 1248[e]
$C_{12}H_9Cl$	0.70	60.06	27.55	0.75	0.07
$C_{12}H_8Cl_2$	17.53	33.38	26.83	15.04	1.55
$C_{12}H_7Cl_3$	54.67	4.22	25.64	44.91	21.27
$C_{12}H_6Cl_4$	22.07	1.15	10.58	20.16	32.77
$C_{12}H_5Cl_5$	5.07	1.23	9.39	18.85	42.92
$C_{12}H_4Cl_6$	Not detected	Not detected	0.21	0.31	1.64
$C_{12}H_3Cl_7$	Not detected	Not detected	0.03	Not detected	0.02
$C_{12}H_2Cl_8$	Not detected	Not detected	Not detected	Not detected	Not detected
$C_{12}H_1Cl_9$	Not detected	Not detected	Not detected	Not detected	Not detected
Average molecular mass	262	206	240	272	300

Empirical Formula	Aroclor 1254[f]	Aroclor 1254[g]	Aroclor 1260[d]	Aroclor 1262[h]	Aroclor 1268
$C_{12}H_9Cl$	0.02	Not detected	0.02	0.02	No data
$C_{12}H_8Cl_2$	0.09	0.24	0.08	0.27	No data
$C_{12}H_7Cl_3$	0.39	1.26	0.21	0.98	No data
$C_{12}H_6Cl_4$	4.86	10.25	0.35	0.49	No data
$C_{12}H_5Cl_5$	71.44	59.12	8.74	3.35	No data
$C_{12}H_4Cl_6$	21.97	26.76	43.35	26.43	No data
$C_{12}H_3Cl_7$	1.36	2.66	38.54	48.48	No data
$C_{12}H_2Cl_8$	Not detected	0.04	8.27	19.69	No data
$C_{12}H_1Cl_9$	0.04	0.04	0.70	1.65	No data
Average molecular mass	334	334	378	395	453

Question 5. Breast Milk



Difference in Nursing Infant Dose Based Upon POP T½

Question 5: Breast Milk Exposure

Table 5. PCB half-lives in years (calculated using the geometric means of data expressed on a wet weight basis) for capacitor workers from archived cohort ($N = 45$)[a].

PCB Congener or summed score	Half-life men and women combined	Half-life men	Half-life women
Occupational PCBs			
PCB-28	4.6	4.2	6.6**
PCB-74	15.9	12.1	124.9*
PCB-105	13.7	10.9	46.5
PCB-118	13.8	11.6	29.2**
PCB-156	41.0	33.3	90.1
Occupational summed PCBs			
Occupational light[b]	9.6	8.2	18.2**
Occupational heavy[b]	17.8	14.9	37.2*
Occupational total[b]	10.5	9.0	19.8**

[a]Total $N = 45$ (33 men and 12 women) in 1976 and in 2004.
[b]Occupational light = PCB28 + PCB74. Occupational heavy = PCB105 + PCB118 + PCB156. Occupational Total = occupational light + occupational heavy.
*$P \leq 0.05$, significant rank transformation analysis of variance test between men and women.
**$P \leq 0.01$, significant rank transformation analysis of variance test between men and women.

Seegal et al. 2011 – Former capacitor workers in NYS (N=45)

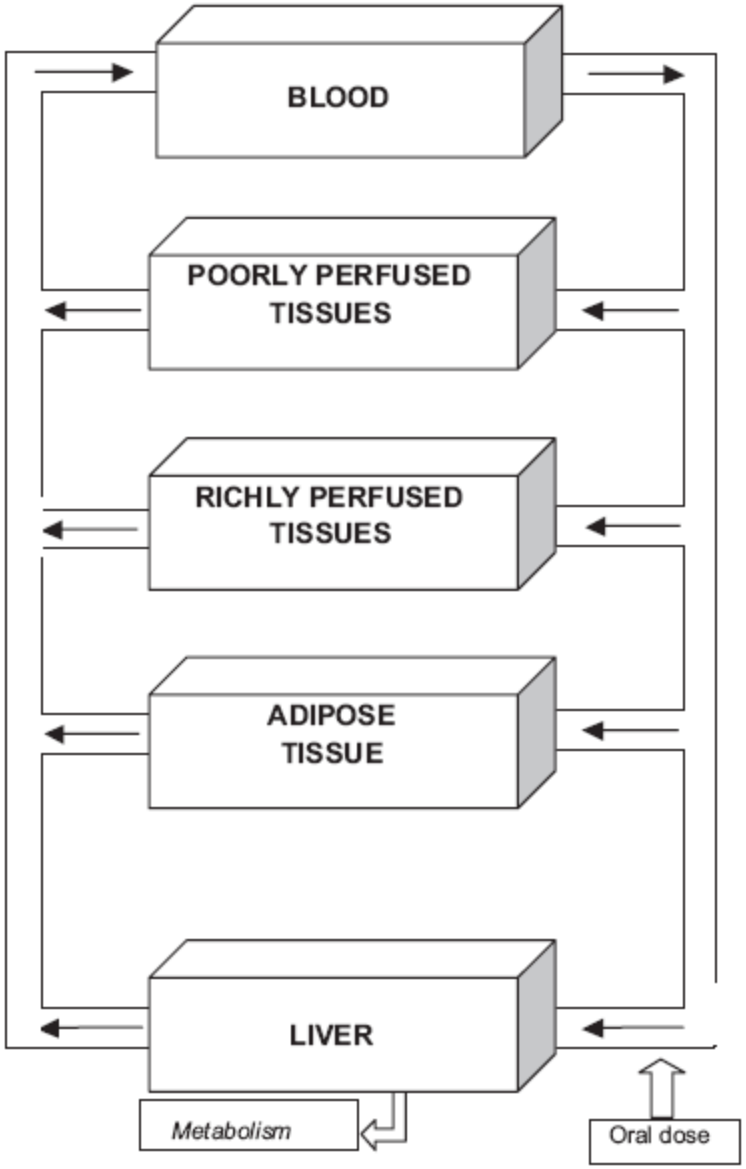
Question 5. PBPK for DRE

Table 2. Estimates of human intrinsic elimination half-lives at background concentration levels (years) for nine PCB congeners.

Data type	PCB-28	PCB-52	PCB-105	PCB-118	PCB-138	PCB-153	PCB-170	PCB-180	PCB-187	Reference
LD (children)			5.4	5.7	3.7	8.4	7.6	9.1	8	Grandjean et al. 2008
Single set of age–concentration CSD (adults)			5.2	6.3						Ogura 2004
Multiple sets of age–concentration CSD (adults; using OF_{CSD_Only})	5.6	2.6	4	9.5	8.4	13.8	7.4	5.5	7.8	Present study
Multiple sets of age–concentration CSD (adults; using OF_{CSD_Int})	5.5	2.6	5.2	9.3	10.8	14.4	15.5	11.5	10.5	Present study, recommended value

OF_{CSD_Only}, objective function using information only from empirical cross-sectional data (CSD); OF_{CSD_Int}, objective function using information from empirical CSD and empirical dietary intake data. Empty cells indicate that no value was reported for the congener.

Ritter et al. 2011: Crude plasma T½ Needs Adjustment Based Upon Changes in Intake Dose and Body Weight



Emond et al. 2005, PCB female rat model:

- 5 PCB hexa/hepta congeners
- Partitioning in tissue lipids
- Metabolism rates empirically determined
- Higher doses, faster metabolism

Question 4: PBPK for DRE

TABLE 1
Comparison of the Observed (Wolff *et al.*, 1982) and Predicted Adipose to Plasma Partition Coefficients (K_{fp}) on Log_{10} Scale

Congener	log(K_{fp}) Observed	log(K_{fp}) Predicted (formula (1))
4,4′	1.954	1.99883
2,5,2′,5′	1.903	1.85712
2,4,2′,5′	1.954	1.85712
2,4,2′,4′	2.491	2.35750
2,3,2′,5′	1.903	1.85712
2,4,5,4′	2.301	2.41542
2,4,3′,4′	2.204	2.17817
2,5,3′,4′	1.845	1.67778
2,3,6,2′,5′	1.778	1.91643
2,4,5,2′,5′	1.699	1.91643
2,4,5,2′,4′	2.380	2.41682
2,3,4,3′,4′	2.114	2.23748
2,4,5,3′,4′	2.255	2.23748
2,3,5,2′,4′,5′	2.477	2.35750
2,4,5,2′,4′,5′	2.431	2.35750
2,3,4,5,3′,5′	2.556	2.41542
2,3,4,5,3′,4′	2.491	2.41542
2,4,5,3′,4′,5′	2.079	2.17817
2,3,4,2′,4′,5′	2.041	2.35750
2,3,4,5,2′,3′,4′	2.556	2.41682
2,3,4,5,2′,4′,5′	2.431	2.41682
2,3,5,6,2′,4′,5′	2.568	2.41682
2,3,4,6,2′,4′,5′	2.204	2.41682
2,3,4,5,2′,3′,5′,6′	2.415	2.35750

Parham et al. 1997

Question 4. PBPK for DRE

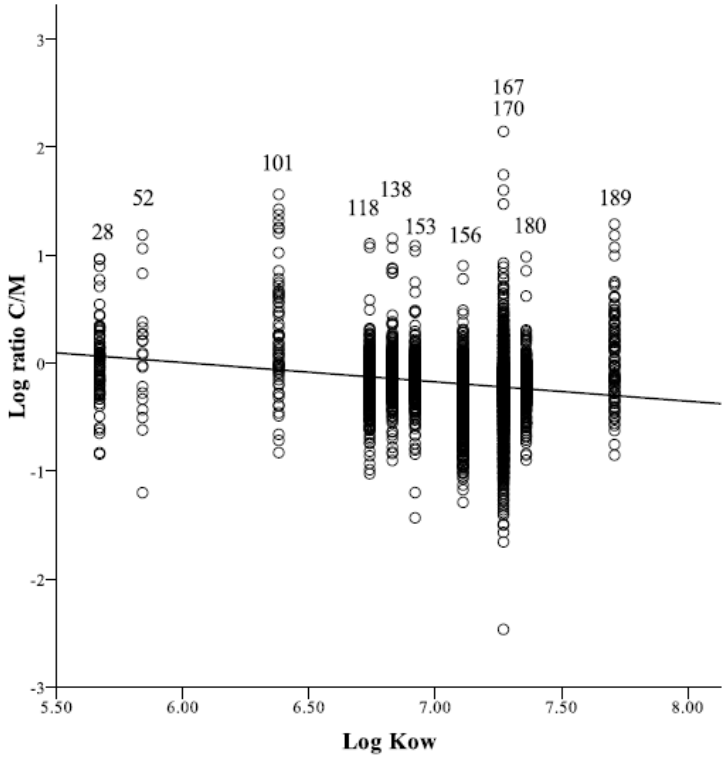


Fig. 1. Relationship between the logarithm of the ratio of cord/maternal PCB congener lipid adjusted serum concentration (C/M) and log octanol–water partition coefficient (K_{OW}). The numbers in the figure denote PCB congener. The relationship is characterized by slope = –0.179, $p < 0.001$, $R^2 = 0.039$ and. R^2 stands for coefficient of determination and p for significance.