THE DUTCH PCB/DIOXIN STUDY
Relation Between PCB and Dioxin Congeners in Human Blood and Human Milk Samples of 400 Dutch Women and Their Children

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Introduction:
To estimate the adverse health effects of PCBs and dioxins in utero and in human milk a study was designed comparing breast fed with formula fed infants. Growth and neurodevelopmental parameters are recorded during the first eighteen months of life and compared with PCB levels in human plasma and with PCB and dioxin levels in human milk. This study is part of a large collaborative survey on PCBs and dioxins in the Netherlands, which is funded by the Dutch Toxicology and Dutch Health Research Promotion Program (SGO and PCT). In this abstract we present the correlations between PCB and dioxin congeners in maternal plasma, cord plasma and human milk.

Methods:
In Rotterdam as well as in Groningen 200 healthy Dutch women and their term children (100 breast fed /100 formula fed) take voluntary part in the study. Maternal plasma is collected in the 36th week of pregnancy, child's plasma at birth, 10 days, 3 and 18 months after birth. Human milk is collected as a representative 24 hours sample at 10 days, 6 weeks and if possible 3 months after delivery. PCB and dioxin congeners are measured by capillary gas chromatography with electron capture and mass spectrometric detection[1]. The outline of the study is summarized in table 1 and 2. Mean levels of PCB congeners in maternal, cord plasma and human milk are summarized in table 3. Correlations between PCB and dioxin congeners in maternal plasma, cord plasma and human milk are summarized in table 4 to 7. The available levels of Rotterdam (R) and Groningen (G) are presented separately.

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Results:

Table I Study design of the collected Biochemical parameters.

	Human Milk	Maternal Plasma	Cord Plasma	Child Plasma
PCB 118,138,153,180	+	+	+	-
PCB (22 congeners)	+	-	-	-
Dioxins (17 congeners)	+	-	-	-
Thyroid functions (TT3, TT4, TSH, FT4)	-	+	+	+
Vitamin A	+	+	+	+

Table II Study design of the Neurodevelopmental follow-up.

	10 days	3 months	7 months	18 months
Neurological Examination Prechtl/Touwen	+	-	-	+
Psychomotor Development Bayley Scales of Infant Development	-	+	+	+
Visual Recognition Memory Fagan Infantest	-	+	+	-
Weight, Height, Head, circumference	+	+	+	+

Table III Mean levels of PCB 118, 138, 153, 180 (^{ng}/ml) in plasma and human milk (10 days after delivery). R = Rotterdam, G = Groningen.

	PCB 118		PCB 138		PCB 153		PCB 180	
	Mean R (SD)	Mean G (SD)	Mean R (SD)	Mean G (SD)	Mean R (SD)	Mean G (SD)	Mean R (SD)	Mean G (SD)
Maternal plasma R (n=205)	0.17	0.18	0.61	0.62	0.93	0.94	0.55	0.56
G (n=151)	0.09	0.08	0.26	0.26	0.40	0.37	0.29	0.22
Cord plasma R (n=192)	0.05	0.04	0.14	0.13	0.19	0.18	0.11	0.10
G (n=111)	0.03	0.02	0.09	0.06	0.13	0.08	0.08	0.04
Human milk R (n=105)	1.03	1.03	3.71	3.78	5.36	5.34	2.19	2.28
G (n=95)	0.53	0.43	1.65	1.49	2.35	2.04	1.16	0.95

Table IV Correlations between PCB congener levels in maternal blood samples. PCB concentrations in ^{ng}/ml plasma. All correlations have a significance of $p < 0.001$.
R = Rotterdam(n = 205), G = Groningen(n = 138).

Maternal plasma	PCB 138		PCB 153		PCB 180	
	R	G	R	G	R	G
PCB 118	0.81	0.83	0.77	0.83	0.57	0.76
PCB 138			0.95	0.97	0.80	0.90
PCB 153					0.89	0.94

Table V Correlations between PCB congener levels in cord blood samples. PCB concentrations in ^{ng}/ml plasma. All correlations have a significance of $p < 0.001$.
R = Rotterdam(n = 192), G = Groningen(n = 111).

Cord plasma	PCB 138		PCB 153		PCB 180	
	R	G	R	G	R	G
PCB 118	0.78	0.71	0.77	0.75	0.64	0.66
PCB 138			0.97	0.96	0.88	0.84
PCB 153					0.93	0.91

Table VI Correlations between PCB congener levels in maternal plasma and cord plasma samples. PCB concentrations in ^{ng}/ml plasma. All correlations have a significance of $p < 0.001$.
R = Rotterdam(n = 192), G = Groningen(n = 108).

Cord plasma	Maternal plasma							
	PCB 118		PCB 138		PCB 153		PCB 180	
	R	G	R	G	R	G	R	G
PCB 118	0.67	0.67	0.43	0.55	0.44	0.56	0.34	0.53
PCB 138	0.54	0.50	0.60	0.68	0.61	0.67	0.56	0.61
PCB 153	0.54	0.54	0.61	0.67	0.64	0.69	0.61	0.66
PCB 180	0.44	0.38	0.59	0.51	0.67	0.55	0.76	0.61

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Table VII Correlations between PCB concentrations in human milk (^{ng}/ml milk) and PCB concentrations in maternal blood (^{ng}/ml plasma). All correlations have a significance of p ≤ 0.01. R = Rotterdam(n = 95), G = Groningen(n = 79).

Human milk	Maternal plasma							
	PCB 118		PCB 138		PCB 153		PCB 180	
	R	G	R	G	R	G	R	G
PCB 118	0.69	0.67	0.59	0.59	0.51	0.56	0.24	0.45
PCB 138	0.51	0.46	0.67	0.66	0.64	0.59	0.40	0.53
PCB 153	0.49	0.45	0.65	0.65	0.66	0.61	0.46	0.57
PCB 180	0.30	0.35	0.54	0.52	0.63	0.49	0.63	0.51

The mean TEQ dioxin (pg/g fat) in human milk on 10 days is 31.0(R) and 29.4(G), the mean TEQ PCB is 16.1(R) and 16.0(G) (n = 95(R), 99(G)).
In 43 paired samples of the same mothers on 10 days and 6 weeks after birth, the mean TEQ dioxin was 32.1 resp. 30.1 pg/g fat. The mean TEQ PCB was 16.6 resp. 16.5 pg/g fat so that we couldn't find a decline in mean PCB and dioxin levels over a 4-5 weeks period.
There is a correlation of 0.55(R) resp. 0.48(G) (p < 0.001) between PCB 153 level in maternal plasma and the total TEQ of 17 dioxin and 3 PCB congeners in human milk (n = 95(R), 90(G)).
Until now we could not find differences in PCB and/or dioxin levels in blood and human milk samples from persons living in Rotterdam city, the highly industrialized suburbans of Rotterdam (Vlaardingen and Spijkenisse), the rural suburbans of Rotterdam and Groningen.

Conclusions:
Considerable levels of PCB and dioxin congeners are found in human milk and blood samples of 400 Dutch women and their children. There is a good correlation between different congener levels in maternal plasma, cord plasma and human milk. If we find adverse health effects of PCB and/or dioxin contamination in utero or via breastfeeding in our neurodevelopmental study of 400 children, risk groups can be detected by measuring PCB congeners in maternal plasma before birth.

References:
1 Tuinstra LGMTh, Driessen JJM, Keukens HJ, Van Munsteren TJ, Roos AH, Traag WA Quantitative determination of specified chlorobiphenyls in fish with capillary gas chromatography and its use for monitoring and tolerance purposes. Int J Environ Anal Chem 1983; 14: 147-157.