SERIAL MEASUREMENTS OF DIOXINS, DIBENZOFURANS, PCBs, DDE, AND HCB WITH ESTIMATED DECREASE IN MATERNAL BODY BURDEN IN A MOTHER NURSING TWINS FOR OVER TWO YEARS

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ABSTRACT: Dioxins, dibenzofurans, dioxin-like PCBs, DDE, and HCB were repeatedly measured in milk and blood for 2.5 years in a mother nursing twins. Decreases in measured dioxin levels and TEQs in both milk and blood were found. Over this time period, the mother lost over 50% of her dioxin body burden.

INTRODUCTION: It has been noted that nursing leads to a decrease in maternal body burden of dioxins, dibenzofurans and PCBs, but at the nursing infant's expense.[1-6] In an attempt to quantitate the actual loss from the mother, to estimate her decrease in body burden, and to calculate infant intake, we collected and measured 16 milk and 4 blood samples over a 2.5 year period. In addition, this data was compared with previous dioxin measurements in the mother's milk just prior to conception of twins while the mother was nursing her first child.

METHODS: Milk and blood specimens were collected in chemically clean containers and stored frozen until shipped on dry ice for analysis at the dioxin laboratories in Canada and Germany. Analytic methodology has been previously described and will not be repeated here.[7,8] Both laboratories have been "certified" by the World Health Organization for analysis of dioxins in human blood and milk.

RESULTS: Table 1 provides a summary of measured PCDD/F levels and dioxin TEQs in blood from 1992 through 1994. Serial blood dioxin levels and TEQs decreased from 570 to 258 ng/kg (ppt) in 1992, and from 16 to 5 ppt TEQ in 1994, respectively. PCB, HCB, and DDE measurements taken over time are shown in Table 2. There is an approximate 5 fold decrease in total PCBs, 285 (1993) to 63 ng/g (ppb)(1995). HCB and DDE also decrease, from 10.7 to less than 1.80 ppb, and from 246 to 45.9 ppb, respectively. Table 3 presents congener-specific PCDD/F and coplanar PCB data for milk samples over time. Measured milk levels of total PCDD/F decreased from 316 (1992) to 182 ng/kg (ppt) (1995) and dioxin TEQs decreased from 17 to 4 ppt.

Assuming an average 65 kg weight, 30% of which is lipid, and that all dioxins and dibenzofurans are found in lipid, we estimate that total maternal dioxin body burden of TEQ decreased from 331 ng in 1992 to 78 ng in 1995 based on milk TEQ values; or from

312 ng to 98 ng based on blood TEQs, almost identical values. The mother's excretion of TEQs through breast milk by nursing is equivalent to the consumption of dioxin TEQ by the nursing twins. This represents a loss of approximately 234 ng of TEQs from nursing. Each infant's intake is 50% of the total amount excreted by the mother, or 117 ng of TEQs.

DISCUSSION AND CONCLUSIONS: A significant decrease in measured PCDD/F, PCB, HCB, and DDE levels can be noted over time. The mother's decrease of dioxins in milk is a direct result of the long-term nursing of twins. The values presented in this paper show that breast-feeding and possibly artificial milk extraction can be an effective means of reducing maternal xenobiotic body burden. Also, it is significant to note that the decrease in maternal body burden estimated from blood or milk TEQ is similar.

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Table 1. Decrease in Total PCDD/F and TEQ Levels in Whole Blood from a Mother Nursing Twins, 1992-1994 (ppt, lipid)

	BLOOD	
Year	Measured (ng)	TEQ (ng/kg (ppt))
2/92*	570	16
2/93**	693	16
1/94*	423	9
12/94**	258	5

* Analysis by Health Canada
** Analysis by ERGO Laboratory, Germany

HUM (po)

TABLE 2. Summary of PCB Levels Over Time in Milk for a Mother Nursing Twins ng/g (ppb), lipid basis

IUPAC #	Congener	MEASURED MILK LEVELS 3/93	6/93	9/93	12/93	9/95
18	22'5 Tri-PCB	4.67	5.45	2.47	2.39	ND(0.50)
28	244' Tri-PCB	13.09	ND(2.86)	4.42	ND(1.25)	ND(4.06)
44	22'35' Tetra-PCB	3.31	ND(0.36)	1.07	ND(0.16)	ND(0.52)
47	22'44' Tetra-PCB	2.21	ND(0.71)	0.69	1.75	ND(1.88)
49	22'45' Tetra-PCB	3.24	ND(0.98)	1.12	1.23	ND(1.33)
52	22'55' Tetra-PCB	6.59	1.66	2.14	0.73	ND(3.8)
60	2344' Tetra-PCB	5.14	1.21	1.80	0.53	ND(1.67)
66	23'44' Tetra-PCB	8.48	1.89	3.12	0.83	ND(1.12)
74	244'5 Tetra-PCB	14.38	6.85	6.24	3.01	1.22
99	22'44'5 Penta-PCB	10.63	6.26	5.02	2.75	1.49
101	22'455' Penta-PCB	7.43	ND(2.86)	2.24	ND(1.25)	ND(1.64)
105	233'44' Penta-PCB	4.20	1.77	2.03	0.78	ND(0.94)
110	233'4'6 Penta-PCB	7.69	2.32	3.72	1.02	ND(1.25)
114	2344'5 Penta-PCB	4.53	2.38	2.19	1.05	ND(0.96)
118	23'44'5 Penta-PCB	14.87	8.74	6.42	3.84	1.39
128	22'33'44' Hexa-PCB	4.28	2.88	2.32	1.26	ND(1.07)
137	22'344'5 Hexa-PCB	2.53	1.51	1.10	0.66	ND(2.34)
138	22'344'5' Hexa-PCB	36.33	24.51	20.84	10.76	7.09
153	22'44'55' Hexa-PCB	52.66	35.46	30.19	15.57	12.48
156	233'44'5 Hexa-PCB	9.33	6.38	5.38	2.80	1.93
157	233'44'5' Hexa-PCB	1.14	ND(0.96)	ND(0.63)	ND(0.43)	ND(1.09)
170	22'33'44'5 Hepta-PCB	14.48	9.09	8.14	3.99	4.49
180	22'344'55' Hepta-PCB	28.59	23.14	21.00	10.16	9.62
183	22'344'5'6 Hepta-PCB	4.70	3.53	2.96	1.55	1.35
187	22'34'55'6 Hepta-PCB	13.28	10.01	8.43	4.40	3.55
189	233'44'55' Hepta-PCB	ND(0.52)	ND(0.71)	ND(0.45)	2.47	ND(0.89)
194	22'33'44'55' Octa-PCB	4.51	3.68	3.54	1.62	2.08
195	22'33'44'56 Octa-PCB	2.31	1.63	1.61	0.72	ND(0.89)
203	22'344'55'6 Octa-PCB	5.43	3.82	3.72	1.68	2.18
206	22'33'44'55'6 Nona-PCB	ND(2.08)	ND(2.86)	ND(1.82)	ND(1.25)	ND(1.33)
207	22'33'44'566' Nona-PCB	ND(0.13)	ND(0.18)	ND(0.11)	ND(0.08)	ND(0.07)
209	22'33'44'55'66' Deca-PCB	ND(2.08)	ND(2.86)	ND(1.82)	ND(1.25)	ND(0.99)
TOTAL PCBs		**285**	**172**	**156**	**80**	**63**
HCB		**10.7**	**6.9**	**5.6**	**3.1**	**ND(1.80)**
DDE		**246**	**166**	**136**	**73**	**46**

Analysis by Health Canada

Table 3. Summary of Dioxin, Dibenzofurans, PCBs, and Dioxin Toxic Equivalents in Milk Samples Over Several Years from a Mother Nursing Twins ng/kg (ppt,), lipid basis

Congeners	TEF	MILK* Feb. 1992		MILK* Mar. 93 - Dec. 93		MILK# Feb. 1994		MILK# July 1994		MILK# Dec. 94		MILK* Sept. 95	
		ng/kg	TEQ	ng/kg	TEQ	ng/kg	TEQ	ng/kg	TEQ	ng/kg	TEQ	ng/kg	TEQ
2378-TCDD	1	3.3	3.3	1.93	1.93	2.4	2.4	0.7	0.7	0.5	0.53	ND (0.4)	0.2
12378-PnCDD	0.5	4.8	2.4	3.91	1.95	4.0	2.0	1.0	0.5	1.1	0.55	1.7	0.85
123478/123678-HxCDD	0.1	29	2.9	24.39	2.44	30.5	3.05	9.3	0.93	10.4	1.04	12.4	1.24
123789-HxCDD	0.1	4.5	0.45	3.0	0.30	2.9	0.29	0.93	0.09	1.0	0.10	2.4	0.24
1234678-HpPCDD	0.01	36	0.36	41.96	0.42	31.5	0.32	13.5	0.14	14.6	0.15	30.2	0.30
12346789-OCDD	0.001	147	0.15	139.7	0.14	151	0.15	72.2	0.07	85.9	0.09	126.3	0.13
2378-TCDF	0.1	1.7	0.17	1.29	0.13	ND(0.38)	0.02	ND(0.52)	0.026	ND(0.3)	0.015	ND (0.5)	0.025
12378-PnCDF	0.05	–	–	–	–	0.12	0.01	0.13	0.01	0.1	0.01	–	–
23478-PnCDF	0.5	4.4	2.2	3.49	1.74	2.8	1.40	0.79	0.40	0.68	0.34	1.6	0.80
123789-HxCDF	0.1	–	–	–	–	ND(0.10)	0.01	ND(0.10)	0.01	ND(0.10)	0.01	–	–
123478/123678-HxCDF	0.1	24	2.4	5.92	0.59	5.7	0.57	2.21	0.22	2.14	0.21	2.7	0.27
234678-HxCDF	0.1	21	2.1	1.16	0.12	0.76	0.08	0.37	0.04	0.43	0.04	1.1	0.11
1234678-HpCDF	0.01	40	0.4	4.71	0.05	3.2	0.03	1.9	0.02	2.2	0.02	3	0.03
1234789-HpCDF	0.01	–	–	–	–	0.17	0.002	0.21	0.002	0.16	0.002	–	–
Octa-CDF	0.001	–	–	–	–	ND(0.42)	0.0002	ND(0.59)	0.0003	ND(0.54)	0.0003	–	–
Coplanar PCBs													
77 3,3,4,4-Te-PCB	*0.0005*	6.9	*0.003*	71.9	*0.036*	–	–	5.8M	*0.003*	5.00M	*0.003*	ND(15.8)	*0.00395*
126 3,3,4,4,5-Pe-PCB	0.1	25	2.5	15.7	1.572	–	–	6.5	0.65	6.1	0.61	8.6	0.86
169 3,3,4,4,5,5-Hx-PCB	0.01	19	0.19	14	0.14	–	–	6.5	0.065	6.6	0.066	8.1	0.081
TOTAL PCDD		**224.6**	**9.6**	**214.9**	**7.2**	**222.3**	**8.2**	**97.6**	**2.4**	**113.5**	**2.5**	**173.4**	**3.0**
TOTAL PCDF		**91.1**	**7.3**	**16.6**	**2.6**	**13.7**	**2.1**	**6.8**	**0.7**	**6.7**	**0.6**	**8.9**	**1.2**
TOTAL PCDD/F		**315.7**	**16.8**	**231.4**	**9.8**	**236.0**	**10.3**	**104.5**	**3.1**	**120.2**	**3.1**	**182.3**	**4.2**
TOTAL PCBs		**50.9**	**2.7**	**101.7**	**1.7**	–	–	**18.8**	**0.7**	**17.7**	**0.7**	**32.5**	**0.9**
TOTAL PCDD/Fs and PCBs		**366.6**	**19.5**	**333.1**	**11.6**	**236.0**	**10.3**	**123.3**	**3.9**	**137.9**	**3.8**	**214.8**	**5.1**
Lipid %		**3.78**		**2.34****		**4.78**		**2.18**		**3.18**		**4.33**	

* Analysis by Health Canada, # Analysis by ERGO Laboratory, Germany
** Average of 10 samples taken in 1993
ND = one-half the detection limit used in calculation of TEQ, detection limit in ( )
M = Maximum value, possibile outside contamination
Date of Birth: 1st child 2/20/91; twins 12/15/92
Nursed 1st child until June/July 1992; twins until Sept. 1995