PCBs AND DIOXINS IN BREAST MILK - LEVELS AND TRENDS IN SWEDEN 1996-2001

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Introduction

Breast milk has been used for monitoring of human body burdens of polychlorinated biphenyls (PCBs), polychlorinated dibenzo-*p*-dioxins (PCDDs) and dibenzofurans (PCDFs) for many decades. Some of the advantages with breast milk in exposure monitoring are that no invasive sampling techniques are needed and that the lipid level is high enough to facilitate analysis of lipid-soluble compounds. Moreover, PCB and PCDD/DF levels in breast milk estimates the body burden of the compounds during pregnancy, when the critical exposure of the fetus occurs. In Sweden (Stockholm), time trends of PCBs and PCDD/DFs have been studied since the early 1970s[1]. During the period 1972 to 1997, total PCB levels declined 3.3-fold and the levels of total toxic equivalents (total TEQ) of dioxin-like PCBs and PCDD/DFs declined 3.2-fold. Time trend studies were performed on pooled milk samples, making it impossible to account for factors influencing the PCB and PCDD/DF levels, such as age of the women and parity[2,3]. In 1996 the Swedish National Food Administration (NFA) started a time trend study of PCBs and PCDD/DFs in breast milk from primiparous women living in Uppsala County. Analysis of the compounds were made in individual samples, making it possible to statistically adjust for life-style/medical factors affecting the levels in breast milk. Here we present preliminary results from the period 1996-2001.

Study participants and methods

Primiparas from the general population in Uppsala County (age 21-41 years) were recruited annually between 1996 and 2001. Mothers sampled breast milk during the third week after delivery, using a manual breast pump and/or a passive breast milk sampler. Milk was sampled both in the beginning and at the end of each breast-feeding session. The goal was to sample 500 ml milk during 7 days. Breast milk was kept frozen in hexane-washed glass bottles and the newly sampled milk was poured on top of the frozen milk.

The PCBs were analyzed at the NFA and the PCDD/DFs at the National Institute of Public Health and Environment (RIVM), the Netherlands, using methods described in Glynn et al.[2]. So far individual mono- and di-ortho PCB congeners (CBs 28, 52, 105, 118, 138, 153, 156, 167, 180) have been analyzed in 211 samples. Non-ortho PCBs (CBs 77, 126, 169) and PCDD/DFs (17 congeners) have been analyzed in 77 samples. Statistical analysis was performed using simple or multiple linear regression analysis.

Results

Median CB 153 concentration was approx. 60 ng/g lipid with a 9.6-fold difference between highest and lowest concentrations (Table 1). Median CB 180 concentrations was lower but the variation in concentrations was similar. Dioxin-like PCBs contributed about 50% to the total TEQ concentrations. The average level of total TEQ was below 20 pg/g lipid and a 5.7-fold difference between minimum and maximum concentrations was observed.

Among women which had their breast milk analyzed for di-ortho and mono-ortho PCBs (N=211), the average age was not significantly different between 1996 and 2001 (median age: 29.3-30.3 years). Among women with breast milk analyzed for non-*ortho* PCBs and PCDD/DFs (N=77), however, simple linear regression showed that age of the participating women increased 0.56±0.26 years/sampling year (p=0.037).

Simple linear regression showed that the concentrations of CB 153, CB 180, mono-ortho TEQ, non-ortho TEQ, PCDD/DF TEQ and total TEQ increased with the age of the participating women (Table 2). Concentrations of CB 153 and CB 180 increased 2-4 ng/year of age. Total TEQ concentration increased 1 pg/year of age.

Multiple linear regression analysis showed that there was a negative association between sampling year and concentrations of di- or mono-*ortho* PCBs (ln-transformed data) when age was included in the regression model (Table 3, Fig. 1). Negative associations were found between sampling year and non-ortho, PCDD/DF and total TEQ with age in the model, but only the association for total TEQ was statistically significant (Table 3, Fig 1).

Discussion

Earlier studies in the Stockholm/Uppsala area have shown declining PCB and dioxin concentrations in breast milk during the time period 1972 to 1997[1,3]. These studies have, however, not been able to account for possible differences in age of the participating women between sampling year. Our study indicates that the average concentrations of mono- and di-*ortho* PCBs have declined about 30%, among primiparas from Uppsala County, during the period 1996 to 2001, after age-adjustment. This is in line with the earlier reported decline in PCB concentration in food, such as meat and fish[4,5].

Age-adjusted non-ortho PCB and PCDD/DF concentrations did not show a significant decline during the study period. A negative trend was, however, found for total TEQ, which could partly be due to the decline in mono-*ortho* TEQ concentrations. The results are, however, uncertain and more analyses have to be performed before more certain conclusions can be made about time trends.

In certain areas along the East Coast of Sweden the decrease in PCB and dioxin concentrations appears to be leveling off in certain commercially important fish species[5]. Future studies will show if this will result in a slower decline in PCB and dioxin body burdens among women, as reflected by the concentrations in breast milk.

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Table 1. PCB and PCDD/DF concentrations in breast milk from primiparas living in Uppsala County 1996-2001.

Congener	N	Mean±SD (pg/g lipid)	Median (min-max)	1st quartile	3rd quartile
CB 153[a]	211	64.6±28.8	60.1 (19.4-186.0)	42.0	82.9
CB 180[a]	211	30.6±13.6	28.8 (8.0-83.8)	20.1	39.2
Mono-*ortho* TEQ	211	4.0±2.1	3.6 (1.1-17.9)	2.6	4.8
Non-*ortho* TEQ	77	5.2±2.4	5.1 (1.2-11.3)	3.6	6.7
PCDD/DF TEQ	77	9.1±3.6	8.3 (4.2-21.4)	6.6	11.0
Total TEQ	77	18.2±7.2	16.5 (7.0-39.6)	13.0	22.6

[a]ng/g lipid

Table 2. Association between concentrations of PCBs and dioxins in breast milk and age

Congener	N	Regression coeff. (pg/year)	p
CB 153[a]	205	4.29±0.43	<0.001
CB 180[a]	205	2.46±0.18	<0.001
Mono-*ortho* TEQ	205	0.28±0.03	<0.001
Non-*ortho* TEQ	77	0.31±0.06	<0.001
PCDD/DF TEQ	77	0.55±0.08	<0.001
Total TEQ	77	1.12±0.16	<0.001

[a]ng/year

Table 3. Time trends (1996-2001) of PCB and dioxin in breast milk from primiparas living in Uppsala County, Sweden, adjusted for age

Congener	N	Regression coeff.[a]	P
CB 153	205	-0.0882±0.0212	<0.001
CB 180	205	-0.0941±0.0184	<0.001
Mono-*ortho* TEQ	205	-0.0982±0.0219	<0.001
Non-*ortho* TEQ	77	-0.1901±0.1384	0.174
PCDD/DF TEQ	77	-0.3757±0.1913	0.053
Total TEQ	77	-0.9824±0.3714	0.010

[a]Concentrations of di- and mono-*ortho* PCBs ln-transformed