THE FLEMISH HEALTH AND ENVIRONMENT BIOMONITORING PROGRAM: RELATION BETWEEN PCB LEVELS IN CORD BLOOD AND DIETARY HABITS

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Introduction

Biomonitoring is a population based laboratory analysis of blood, urine, breast milk, hair, saliva or tissue (such as body fat) for the purpose of identifying the presence of certain chemicals, or effects of these chemicals, in the human body. This technique takes advantage of the knowledge that chemicals that have entered the human body leave markers reflecting this exposure. The marker may be the chemical itself. It may also be a breakdown product of the chemical or some change in the body that is a result of the action of the chemical on the individual.

Information on the presence and the amount of toxic substances accumulating in the human body is needed to understand more about if and how these chemicals can cause health effects in humans, and to make decisions on environmental and public health issues.

In order to study the relation between environmental exposure and health effects in Flanders (the Northern, Dutch-speaking part of Belgium), the Flemish Health and Environment Biomonitoring Program was established by the Flemish Ministries of Public Health and Environment.

The results presented in this paper focus on the relationship between the dietary habits of the mother and the PCB levels found in cord blood.

Materials and Methods

Between October 2002 and December 2003, several biomarkers of exposure have been measured in cord blood samples of women residing in eight areas with different pollution pressure. Participants were recruited from maternity hospitals. The inclusion criteria were: (1) living for at least five years in the respective area, (2) being able to complete questionnaires in Dutch and (3) giving informed consent. The study was approved by the Ethical Committee of the University of Antwerp, Belgium.

The sum of three marker PCBs (mPCBs) (PCB138, 153 and 180) was determined in cord blood (ng/g fat). The PCBs were analysed with GC/ECD in 2 mL of serum. The method was similar to that used by B. Gomara et al. (2002)[1].

The participating mothers completed an extensive questionnaire on residence history, education, occupation and lifestyle. Body mass index (BMI) was calculated, based on self-reported height and weight (before pregnancy). Dietary habits were questioned via a semi quantitative Food Frequency Questionnaire (FFQ), focussing on the year before giving birth. This questionnaire was based on the Dutch ANI-questionnaire[2], and adapted to Flemish dietary habits. The FFQ was used to estimate the daily consumption of (animal) fat containing food items.

Non-parametric tests (Kruskal-Wallis, Spearman rank correlation) and regression models were used to study the relation between dietary intake of fat containing food items and PCB concentrations. Data were analysed using the SPSS® software package (version 12.0). The level of statistical significance was set at $p \leq 0.05$.

Results and Discussion

In total, 1196 mothers have been included. The sum of the three mPCBs could be analysed in blood samples of 1032 women, 1172 mothers completed the FFQ. The mean age of the mothers was 29.6 (± 4.3) years. The mean BMI was 23.3 (± 4.2) kg/m^2. Data on PCB concentrations in the cord blood and on dietary intake of the mothers can be found in Table 1 and Table 2.

For humans, the diet is considered to be the main source of exposure (for persons who are not exposed occupationally). Fatty food of animal origin is known to contain relatively high levels of PCBs due to their lipophilic character and their possibility to bioaccumulate.

Table 1: PCB concentrations in cord blood (ng/g fat)

	PCB138	PCB153	PCB180	Sum of 3 mPCBs
N	1044	1055	1060	1032
Mean (SD)	21.4 (18.0)	37.8 (30.9)	26.1 (18.2)	84.2 (64.2)
Median	17.4	31.3	22.7	69.1
P25 – P75*	7.5 – 28.9	14.9 – 52.9	14.0 – 33.3	39.0 – 113.2

*P25 – P75 = interquartile range

Table 2: Dietary intake of selected food items and total fat (g/d)

	meat & meat products	fish & seafood	milk	eggs	total fat
N	1171	1172	1172	1172	1171
Mean (SD)	101 (60)	20 (17)	174 (193)	11 (12)	76 (39)
Median	96	16	115	8	68
P25 – P75*	60 – 131	10 – 27	56 – 236	3 – 14	52 – 92

P25 – P75 = interquartile range

Since serum concentrations rise with age, age is a relevant factor to consider. Women above the age of 35 (N=102) had significantly higher PCB levels than younger women (younger than 25; N=145) (129.9 vs 44.6 ng/g fat respectively; $p < 0.001$). The Spearman rank correlation coefficient between age and the sum of 3 mPCBs is 0.426 ($p < 0.001$).

BMI is also known to influence PCB levels in blood. In our population, PCB levels were significantly higher for women with a BMI below 20 (N=206) in comparison with overweight women (BMI > 25; N=262) (93.6 vs 69.7 ng/g fat respectively; $p < 0.001$). The Spearman rank correlation coefficient for BMI and the sum of the 3 mPCBs is -0.149 ($p < 0.001$).

Therefore, Spearman rank correlations between dietary intake and cord blood levels of the sum of 3 mPCBs were considered after correction for age and BMI (Table 3).

Table 3: Correlation between cord blood levels of the sum of 3 mPCBs (ng/g fat) and dietary intake (g fat/day), after correction for age and BMI of the mother.

	Spearman rank correlation	p value
fish & seafood	0.035	0.273
fatty fish	0.026	0.405
meat & meat products	0.020	0.524
chicken	0.107	< 0.001
dairy products	0.056	0.075
milk	0.079	0.013
egg	0.016	0.613

The linear regression model confirmed these findings (Table 4). PCB levels in cord blood are positively associated with consumption of fat from chicken and milk, even after controlling for age, BMI and number of weeks of breastfeeding given. Intake of other food items (fish & seafood, meat & meat products, dairy products, eggs) did not show a statistically significant relationship.

Table 4: Coefficient of determination (R^2), slope (B) and significance level (p value) for the relationship between explanatory variables and concentration of the sum of 3 mPCBs.

	R^2	B	p value
age (years)	0.178	6.66	< 0.001
BMI (kg/m²)	0.015	-1.87	< 0.001
chicken (g fat/d)	0.008	10.84	0.002
breastfeeding (weeks)	0.005	-0.232	0.008
milk (g fat/d)	0.005	0.98	0.021

Previous studies, performed in Belgium, have also shown that poultry meat and milk & dairy products are relevant sources of lipophilic contaminants.[3,4] It is also known that the consumption of fish and seafood can contribute significantly. However, consumption levels in this population are rather low.

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