FLEMISH SERUM VALUES OF ORGANOCHLORINATED COMPOUNDS: WHERE ARE WE NOW?

FIRST RESULTS OF FLEMISH ENVIRONMENT & HEALTH SURVEY (FLEHS) 2002-2006

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Introduction

To collect data on health effects in relation to different environmental loads, a five years Environmental Health Action Program (2002-2006) for systematic biomonitoring of residents from different geographical areas in Flanders is being established. The measurements of organochlorinated compounds in 1196 cord blood samples and 1679 teenagers are presented in this paper.

Material and Methods

Design. The campaign was approved by the ethical committee of the University of Antwerp. Mothers and their newborns were enrolled via 25 maternities and 42 schools. They recruited participants out of eight regions in Flanders. They were representative for 20% of Flanders area. Inclusion criteria were living for at least five years in the area of interest, giving informed consent, being able to fill out Dutch questionnaires and in case of the youngsters, being between 14 en 15 years old. The sampling period of the mothers was between October 2002 and December 2003. The adolescents were recruited between October 2003 and July 2004 The blood collection methods were tested on contamination and/or adhesion of the measured compounds. Cord blood was alliquoted and plasma was separated by centrifugation within one day in either the maternity or blood bank laboratories or by the field workers in the schools. The alliquoted samples were kept in the refrigerator maximal one week. Afterwards they were put at -20°C until analysis.

Measurements. In cord blood plasma, marker polychlorinated biphenyls (PCB 28, 52, 101, 138, 153, 180), chlorinated pesticides (p,p'-DDE and HCB), and dioxin-like compounds (CALUX® assay) were analyzed. In serum of the youngsters only marker PCBs and chlorinated pesticides were determined. The PCB and chlorinated pesticides were analyzed with GC/ECD in 2 mL of serum. The method was similar to that used by Gomara et al.[1]. The analyses were performed by two labs. Both laboratories participated in the AMAP proficiency testing scheme (Institut National de Santé Publique, Quebec, Canada). The measurement uncertainty (sum of systematic error and two times the reproducibility) was estimated from the results of the ClinChek and AMAP samples, and ranged between 21% and 34% for all the compounds except for HCB (64%). The detection limit of all chlorinated compounds in serum was 0.02 µg/L. Exposure to dioxin-like compounds was assessed via the CALUX® assay, based on *in vitro* activation of the aryl hydrocarbon receptor (AhR) of cultured H4IIE rat hepatoma cells by the dioxin-like compounds present in 5 mL cord plasma (BioDetection Systems BV, Amsterdam, The Netherlands). The extraction and clean-up procedures were performed as described in elsewhere[2]. The limit of detection was calculated as the light signal measured from the dimethyl sulfoxide-control plus 3 times its standard deviation on each well plate, viz. 0.13 ± 0.04 pg/mL extract (= 16 pg CALUX-TEQ/g cord plasma fat).

Results and Discussion

Description of mother-newborn pairs: The total group included 1196 baby's and 1186 mothers with a mean age of 29.6 (range: 18.1-44.0) years and a pre-pregnancy body mass index of 23.3 (15.4-44.6) kg/m².

Sixteen % of the mothers smoked during pregnancy and 36 % ever smoked. The mean duration of pregnancy was 39.2 (31-42) weeks, with 41 % deliveries of the first child and 52% boys. The age distribution, pregnancy duration and sex of the babies were comparable to the record data of the Belgian Centre of Perinatal Epidemiology. In our study there were however more women having their first child i.e. 61% vs. 47% in general.

*Description of the adolescents:*892 boys and 787 girls were included with a mean age of 14.9 years and a body mass index of 20.8 and 20.3 kg/m^2 for boys and girls respectively. This was comparable to the Flemish average determined in a study on growth curve measurements[3]. The group included 13.6 % regular smokers.

Levels in mother- newborn pairs

In the current Flemish Environment and Health Study (FLEHS 2002-2006) mother-child pairs were one of the groups, where the focus was put on. Former measurements of organochlorine compounds showed that Belgian levels were around the highest in Europe. Belgian mother milk levels of dioxins/furans and marker PCBs of the third WHO coordinated campaign ('01-'02) were around 15 to 19 pg WHO-TEQ/g fat and ca. 200 ng/g fat, respectively[4,5]. These levels were as high as other industrialized countries like The Netherlands, Italy and Spain. In cord blood, a limited number of Belgian results are available from the past. In the current campaign dioxin-like compounds were measured in cord blood for the first time. The average plasma concentration was 23 pg CALUX-TEQ/g fat. The current cord blood concentrations of marker PCBs, pp'-DDE and HCB, were at the lower level compared to results of recent studies performed in Western countries after the year 1993 (Table 1).

Table 1. Levels of marker PCBs (PCB 28+52+101+138+153+180), pp'-DDE and HCB levels in ng/g cord plasma fat determined in **newborns** of the current campaign, compared to newborns examined in other Western countries (after the year 1993).

	Country	Date	N	Mean	Ref.
PCB	Germany (Düsseldorf)	'93	180	272	6
	Canada (Québec)	'93-'95	656	62*	7
	Germany (Düsseldorf+Fulda)	'98	200	P_{95}= 700	8
	Spain (Catalonia**)	'97-'99	69	105	9
	Belgium (Antwerp)	'99	44	P_{50}=150	10
	The Netherlands (Groningen)	'98-'00	51	229	11
	current campaign	'02-'03	1054	**64***	/
pp'-DDE	Canada (Québec)	'93-'95	656	206*	7
	Spain (Catalonië**)	'97-'99	69	415	9
	Belgium (Antwerp)	'99	44	P_{50}=245	10
	current campaign	'02-'03	1054	**110***	/
	Canada (Québec)	<'03	30	P_{50}= 80	12
	The Netherlands (Groningen)	'04	27	P_{50}=145	13
HCB	Canada (Québec)	'93-'95	656	20*	7
	Germany (Düsseldorf)	'98	100	P_{50}= 130	8
	Germany (Fulda)	'98	100	P_{50}= 80	8
	Belgium (Antwerp)	'99	44	P_{50}=35	10
	current campaign	'02-'03	1054	**19***	/
	The Netherlands (Groningen)	'04	27	P_{50}=35	13

* geometric mean, ** rural area, *** urban area, *NB: if concentration was expressed per mL serum, it was recalculated on fat base, using a theoretical fat content of 200 mg/dL for cord serum.*

Levels in adolescents

In 1999 some 200 Flemish adolescents of 17 to 18 years old were examined for marker PCBs. The levels were comparable to German adolescents at that time. In the current campaign marker PCBs were measured

in a total of 1679 slightly younger teenagers. Not considering the age difference a decline of 32% from 97 ng/g fat (‘99) to 66 ng/g fat (’02-’03) was observed (Table 2). Data on organochlorinated compounds in adolescents are spares. Flemish teenagers appeared to have comparable concentrations to international values (Table 2).

Table 2. Levels of marker PCBs (PCB 28+52+101+138+153+180), pp’-DDE and HCB in ng/g serum fat determined in **adolescents** of the current campaign, compared to study results from other countries.

	Country	**Date**	**N**	**Age (y)**	**Geometric mean**	**Ref.**
PCB	Germany	‘98	355	18-25	112**	[14]
	Flanders	‘99	200	17-18	97	[15]
	Germany	‘01	163	11-17	38**	[16]
	current campaign	‘03-‘04	1679	14-15	**66**	/
	Russia	‘05	30	14-17	42*	[17]
pp’-DDE	USA	‘99	686	12-19	124	[18]
	USA	‘01	758	12-19	118	[18]
	Germany	‘01	163	11-17	100**	[16]
	current campaign	’03-‘04	1679	14-15	**94**	/
HCB	Germany	‘98	358	18-25	28**	[14]
	USA	‘99	591	12-19	8	[18]
	USA	‘01	747	12-19	8	[18]
	Germany	‘01	163	11-17	37**	[16]
	current campaign	’03-‘04	1679	14-15	**21**	/

* arithmic mean, ** in whole blood

Conclusion

The present campaign showed that Flemish levels of PCBs, pp’-DDE and HCB in newborns and adolescents were moderate to low compared to recent international available data. Measuring persistent (chlorinated) compounds in newborns offers the advantage to study exposure at the start of life. Adolescents’ levels give the possibility to study the effectiveness of environmental hygiene strategies aiming at the reduction of exposure of these compounds. Taking this in mind, these age groups are ideal to take up in a biomonitoring campaign, even for persistent compounds accumulating with age.

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