BODY BURDEN OF POLYCHLORINATED DIBENZO-P-DIOXINS, DIBENZOFURANS AND BIPHENYLS IN PREGNANT WOMEN AND THEIR INFANTS – CORRELATION BETWEEN PRENATAL AND POSTNATAL EXPOSURE TO INFANTS

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Introduction

Polychlorinated dibenzo-p-dioxins, dibenzofurans (PCDD/Fs) and Polychlorinated biphenyls (PCBs) are ubiquitous toxic compounds in environment, which cause many important health effects including cancer and hormonal, neuro-cognitive dysfunctions. For high population density country such as Taiwan, the increase in emission of dioxins and PCBs is one of major concerns for largely increased numbers of solid waste incinerators. Dioxins and PCBs are lipophilic compounds with half-life as long as 7-10 years, which accumulate in human bodies and pass to babies placentally and lactationally. This is the first study in Taiwan aiming at measuring body burden of PCDD/Fs and PCBs in pregnant women and their infants. We measured 17 PCDD/Fs and 12 PCBs with WHO-TEF and 6 marker PCBs for perinatal venous serum, placenta, cord serum and breast milk. Correlations of the TEQ levels between the four specimens were evaluated. Placenta level was utilized to predict levels in the others. This may help unfold current internal dose in child bearing aged women from the general population without large amount of blood drawing (i.e. 40-50 ml), and towards understanding of the compound transport to next generation.

Methods and Materials

Subjects are pregnant women without clinical complications aged between 25 and 35 years, who delivered babies in a medical center during 1 December 2000 - 30 November 2001. This medical center serves local residents in southern part of Taichung, in between urban and rural, area of middle Taiwan, where there is one solid waste incinerator and not heavy industry. Each of the pregnant woman over 18 weeks of gestation in Obstetric clinic for routine check-up was asked whether they will have their babies delivered in the same hospital. The subject name list was based on those with positive answer. A total number of 438 subjects were interviewed. Those with completed specimen and data collection were set the first priority for dioxins/PCBs analyses.

Congener-specific PCDD/Fs and PCBs analysis was done by High Resolution Gas Chromatography/High Resolution Mass Spectrometry in ERGO laboratory, Hamburg, German. Collected data at interview included demographics, living history, pre-pregnant and post-pregnant

dietary habits, medical and reproductive history. In addition, health check information on subjects was collected including blood pressures, body weight and height, obesity indexes, blood lipids, glucose and hormones. Pearson correlation analysis, analysis of variance and linear regression model were utilized to examine the association of the exposure levels between the 4 kinds of specimens by SAS software.

Results and Discussion

Table 1 shows general characteristics of study population. This is a relative young and healthy population with mean age of 28.92 and pre-pregnant Body Mass Index of 21.99. Mean of baby weight is 3004 gram with 38 weeks of gestational age, with 58 % of them being the first parity. Fat percentage was as high as 3.63 % in breast milk followed by placenta (0.81 %), venous serum (0.58 %) and cord serum (0.23 %).

Table 1. General characteristics of the pregnant women and their infants

Subject characteristics	Mean (n=12)	Standard error
Age	28.92	4.96
Pre-pregnant BMI (kg/m^2)	21.99	4.17
Baby gender male (%)	42	—
Gestational age (weeks)	38	1.87
Baby birth weight (g)	3004.2	503.38
Baby birth length (cm)	51	3.66
Baby head circumference (cm)	33	1.32
Age at milk collection (days)	14.5	10.6
Parity 1	58 %	—
2	25 %	—
3	17 %	—
Placenta weight (g)	597.33	233.13
Fat content:		
Cord serum (%)	0.23	0.04
Breast milk (%)	3.63	0.36
Placenta (%) 0.81	0.04	
Venous serum (%)	0.58	0.06

Figure 1 shows TEQ levels for PCDD/Fs and PCBs with standard errors, and percentage of samples over detection limit in figure legend. Those laboratory results under detection limits were assigned as zero. We found a lower percentage of detectable samples for cord and venous serum. In general, PCDD/Fs levels tended to be higher in venous serum; whereas for PCBs including marker PCBs, the levels were higher in breast milk. These levels for the relative young and healthy population were generally lower than previous studies for general population with compatible age [1,2,3].

For total PCDD/Fs and PCBs, venous serum (14.77 pg WHO-TEQ/g lipid) had the highest level followed by milk (13.09), placenta (11.33) and cord serum (6.34). This is in accordance with comparison between the various specimens for New York women[4]. To compare with these 5 women with mean age of 27 years, total PCDD/F TEQ were slightly lower in the present study except cord serum. In per-gram specimen, breast milk (48.43 pg WHO-TEQ/g) had the highest level, followed by placenta (9.16), venous serum (8.29) and cord serum (1.68).

PCB levels in placenta correlated with levels in milk and venous blood was reported for 36 women from central Japan [5]. The present study further demonstrated good correlation of PCDD/F levels

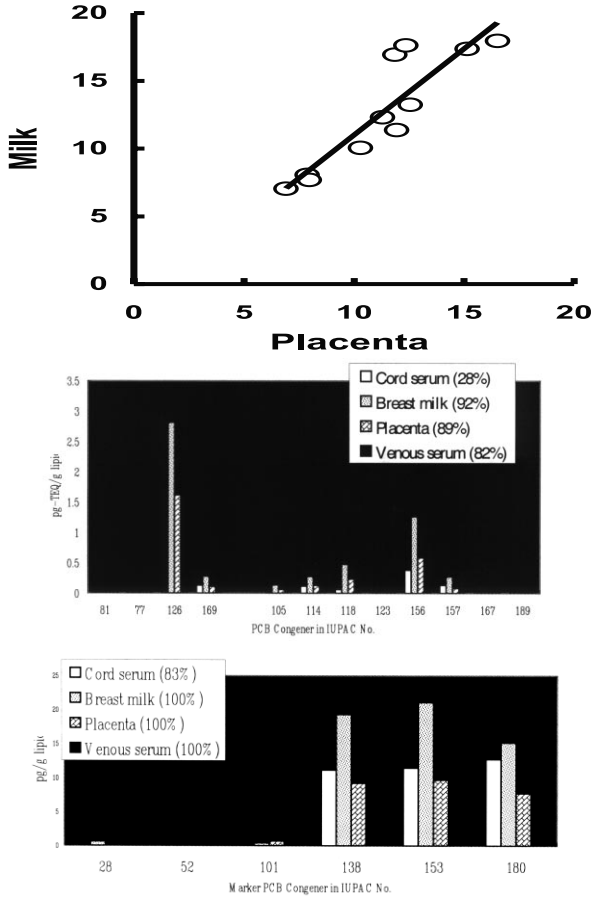


Figure 1. The pg-WHO TEQ levels per gram lipid for PCDD/F(upper panel), PCB(middle panel) and marker PCB(lower panel) congers with standard errors and percentage of samples over detection limit in figure legend.

between placenta, milk and venous serum (Table 2). Cord level did not correlate well with the others. This might be because of low fat content in cord serum resulting in low percentage of detectable samples. There were 34.2 % of all congener-specific tests over detection limit for cord serum. Placenta level can significantly predicted milk and venous levels well through a linear function, whereas for cord serum a curly relation was recommended (Figure 2). Similar pattern was found for specific congers. More data with larger sample size are being analyzed and will be presented. The related health effects will be discussed.

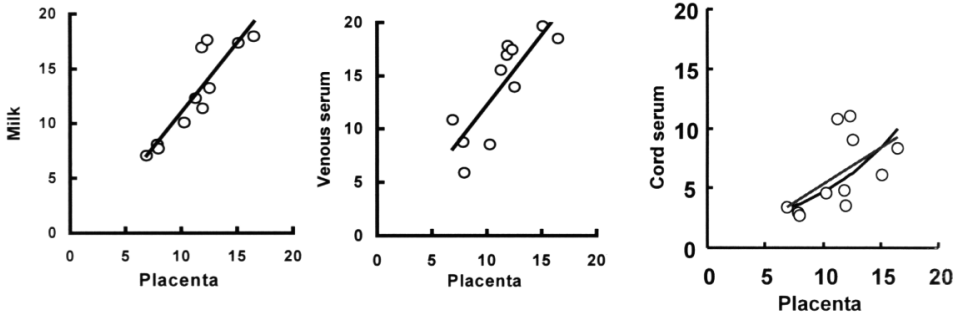
Acknowledgments

This study was funded by the National Health Research Institutes, Taiwan. We are grateful to Professors P.-C. Liao in NCKU, Taiwan and O. Päpke in ERGO Lab, German for their generous technique support.

Table 2. Correlation coefficients of important and high level congeners between placenta, breast milk, venous and cord serum

Dioxin and PCB congeners	P vs. M	P vs. V	P vs. C	M vs. V	M vs. C	V vs. C
2.3.7.8-Tetra-CDD	0.821**	0.120	0.009	-0.116	0.0961	-0.018
1.2.3.7.8-Penta-CDD	0.846***	0.767**	0.505	0.819**	0.484	0.451
1.2.3.6.7.8-Hexa-CDD	0.938***	0.980***	0.903***	0.937***	0.897***	0.920***
2.3.4.7.8-Penta-CDF	0.854***	0.839**	0.486	0.915***	0.644*	0.631*
PCB 126	0.771**	0.809**	—	0.805**	—	—
Total non-ortho PCB	0.767**	0.819**	0.425	0.808**	0.648*	0.666*
PCB 114	0.874***	0.889***	0.839**	0.989***	0.910***	0.873***
PCB 156	0.729*	0.754**	0.525	0.766**	0.391	0.549
PCB 138	0863***	0.601*	0.574	0.247	0.794**	0.303
PCB 153	0.870***	0.553	0.634*	0.311	0.756**	0.293
PCB 180	0.841**	0.540	0.880***	0.401	0.884***	0.346
Total WHO-TEQ (PCDD/Fs)	0.884***	0.803**	0.541	0.805**	0.591*	0.574
Total WHO-TEQ (PCBs)	0.799**	0.896***	0.613*	0.869***	0.433	0.596*

P: Placenta
M: breast Milk
C: Cord serum
V: Venous serum
P-value < 0.05 ** P-value < 0.01 *** P-value < 0.001



Milk=-1.76+1.27 Placenta (P=0.0002)

Venous =-1.05+1.33 Placenta (P=0.0014)

Cord=-0.72+0.60 Placenta (P=0.0671)
Ln(Cord)=0.36+0.12 Placenta (P=0.0256)

Figure 2. Plots of total pg WHO-TEQ/g lipid levels for placenta to milk, venous and cord levels with linear regression models shown below.

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