

## Perinatal Exposure to Organochlorine Pesticides on Thyroid Hormone Status in Japanese Breast-Fed Infants

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### Introduction

Foods in Japan have been contaminated with some organochlorine pesticides<sup>1)</sup> and Japanese people have also been contaminated with these pesticides<sup>2)</sup>. Consequently, some pesticides such as hexachlorocyclohexanes (HCHs), DDT, dieldrin and heptachlor-epoxide (HCE) have been determined in Japanese breast milk and their mean concentrations on fat weight basis were about 1300, 950, 20 and 9ppb, respectively<sup>3)</sup>. Their levels were much higher than those of polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and coplanar polychlorinated biphenyls (Co-PCBs) in the breast milk of Japan<sup>3)</sup>. Therefore, we should give due attention to possible health consequences of these organochlorine pesticides in breast-fed infants.

In order to clarify the biological and/or biochemical effects of perinatal exposure to such pesticides, we investigated the thyroid hormone status in the peripheral blood of 101 breast-fed infants in relation to their levels.

### Material and Methods

One hundred and twenty four mothers volunteered to participate in all in this study. Pregnancy and delivery were completed without overt signs of serious illness or complications. Only babies born at term (37 to 42 weeks of gestation) without congenital anomalies or diseases were included.

Breast milk (50~100mℓ), sampled 2 to 4 months after the childbirth, was used to determine the concentrations of HCHs, dieldrin, DDT, HCE and chlordane by ECD gas chromatography method<sup>1)</sup>.

About 1 year after birth, 5 to 10mℓ of peripheral blood samples were individually obtained from 101 breast-fed infants. These blood samples were used to determine serum concentrations of triiodothyronine ( $T_3$ ), thyroxine ( $T_4$ ), thyroid stimulating hormone (TSH) and thyroxine binding globulin(TBG) by radioimmunoassay methods using commercially available kits<sup>4)</sup>.

In order to get more reliable results, the Spearman rank correlation coefficients were computed instead of the Pearson correlation and their statistical significances were evaluated. Each variable was transformed by natural logarithm and their scatter plots were given.

### Results

#### 1) Concentrations of the organochlorine pesticides in the breast milk

Among HCHs isomers, only  $\beta$ -HCH was detected and determined in the breast milk of 124 mothers. In DDT and its metabolites, only two congeners, namely, p,p'-DDE and p,p'-DDT were detected and p,p'-DDE was dominant. Therefore, in this study DDT indicates combined concentrations of p,p'-DDE and p,p'-DDT in the breast milk. In dieldrin and HCE, about 61% and 37% of 124 samples of the breast milk were less than the detection limit, respectively, so the Spearman rank correlation coefficients are not calculated. In this study, chlordane represents the total concentration of oxychlordane, trans-nonachlor and cis-nonachlor. Among them, the most minor component was cis-nonachlor and about 35% of 124 breast milk samples was less than the detection limit.

Respective mean concentrations of  $\beta$ -HCH, dieldrin, DDT, HCE and chlordane on the whole and fat weight bases are shown in Table 1, together with their standard errors of mean (s.e.m.). Order of their mean concentrations was  $\beta$ -HCH, DDT, chlordane, HCE and dieldrin. Concentrations of  $\beta$ -HCH and DDT were two orders of magnitude higher than those of HCE and dieldrin.

Table 1. Concentrations of the organochlorine pesticides in the breast milk of 124 mothers

Organochlorine Pesticide	Mean $\pm$ s.e.m. in ppb	
	Whole Basis	Fat Basis
$\beta$ -HCH	17.1 $\pm$ 1.3	419 $\pm$ 27
Dieldrin	0.17 $\pm$ 0.02	4.3 $\pm$ 0.4
DDT	13.9 $\pm$ 1.04	347 $\pm$ 23
HCE	0.18 $\pm$ 0.02	4.5 $\pm$ 0.4
Chlordane	3.22 $\pm$ 0.23	82 $\pm$ 5.5

2) Correlation between concentrations of the organochlorine pesticides and thyroid hormone status in breast-fed infants

Serum levels of T<sub>3</sub>, T<sub>4</sub>, TSH and TBG were determined in the peripheral blood of 101 breast-fed infants<sup>5)</sup> and their Spearman rank correlation coefficients with the concentrations of respective organochlorine pesticides on fat weight basis were calculated. The results are shown in Table 2.

Table 2. Spearman rank correlation of concentrations of the organochlorine pesticides on fat weight basis in the breast milk with the serum chemical levels related to thyroid function in the peripheral blood of breast-fed infants

	Correlation Coefficient			
	T <sub>3</sub>	T <sub>4</sub>	TSH	TBG
$\beta$ -HCH	0.017	-0.057	0.065	0.040
DDT	-0.101	-0.179*	0.271*	-0.147
Chlordane	-0.018	-0.167	-0.039	-0.078

\* : p<0.05

The concentration of DDT in the breast milk showed significant negative and positive correlations with the serum levels of T<sub>4</sub> and TSH, respectively. The relationship of the level of DDT to that of TSH in the serum is indicated in Fig. 1.

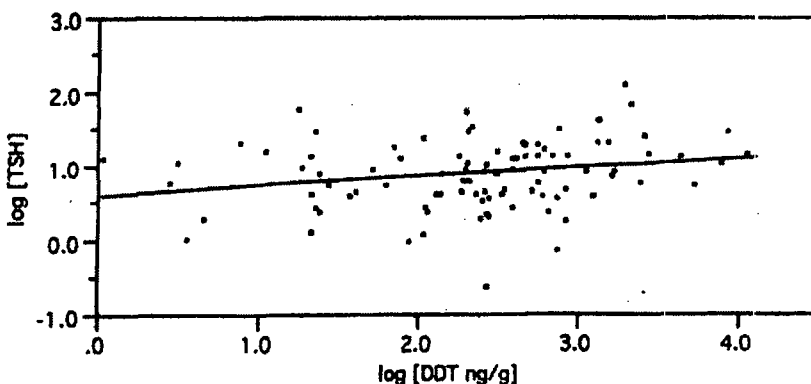


Fig. 1. Positive correlation between the concentration of DDT in the breast milk and the level of TSH in the serum of 97 breast-fed infants ( $p=0.03$ )

### Discussion

We have already determined these organochlorine pesticides in Japanese breast milk collected from 1990 to 1992<sup>3)</sup>. The breast milk in this study was collected from 1994 to 1996. The concentrations of these pesticides in our former study were 2 to 6 times higher than those in this study and in addition to p,p'-DDE and p,p'-DDT, p,p'-DDD and o,p'-DDT were also determined. At the present time, the reason of this marked decrease in their concentrations is unknown and maybe human contamination with these pesticides was truly decreased during such a short period.

Even in such decreased levels of the pesticides in the breast milk, their estimated daily intakes were 100 to 10,000 times greater than that of PCDDs, PCDFs and Co-PCBs in 2,3,7,8-TCDD TEQ value, and in particular DDT significantly decreased the serum level of  $T_4$  and increased that of TSH in the peripheral blood of breast-fed infants. Therefore, perinatal exposure to background levels of DDT may cause some effects on thyroid hormone status.

### References

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