

Level in Contamination of Chlorinated Dioxins and Related Compounds and Their Genotoxicity in Japanese Young Women

Junya Nagayama^a, Mayumi Nagayama^a, Takao Iida^b, Hironori Hirakawa^b, Takahiko Matsueda^b, Takashi Yanagawa^c, Hiroshi Tsuji^d, Kayo Sato^e and Yoko Okamoto^f

a : Laboratory of Environmental Health Sciences, School of Health Sciences, Kyushu University, Higashi-ku, Fukuoka 812, Japan

b : Department of Environmental Sciences, Fukuoka Institute of Health and Environmental Sciences, Dazaifu-shi, Fukuoka 818-01, Japan

c : Department of Mathematical Statistics, Faculty of Science, Kyushu University, Higashi-ku, Fukuoka 812, Japan

d : 2nd Department of Internal Medicine, Faculty of Medicine, Kyushu University, Higashi-ku, Fukuoka 812, Japan

e : Department of Midwifery, School of Health Sciences, Kyushu University, Higashi-ku, Fukuoka 812, Japan

f : Department of Nursing, School of Health Sciences, Kyushu University, Higashi-ku, Fukuoka 812, Japan

OBJECTIVES

It has been noticed that our human bodies are already contaminated with various chemicals including the highly toxic organochlorine compounds such as polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and coplanar polychlorinated biphenyls (Co-PCBs)¹⁾. We have determined the level of PCDDs, PCDFs and Co-PCBs in human breast milk samples obtained from healthy Japanese mothers and daily intakes of these chemicals as 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) toxic equivalent (TEQ) value were estimated to be 93 to 197 pg/kg/day for breast-feeding babies of these mothers²⁾. These TCDD TEQ values are much higher than the acceptable daily intake (ADI) of 1~10 pg/kg/day for TCDD. Therefore, we should give due attention to the possible health effects of sucklings due to these highly toxic chemicals.

Our previous studies¹⁾²⁾ indicate that their concentrations in human milk samples are about 10 times greater than those in human blood samples in terms of TCDD TEQ value on whole weight basis, so it is useful to determine their concentrations in the blood of unmarried Japanese young women in order to clarify their contamination levels in the

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blood and to estimate their levels in the breast milk when they will become mothers. We have already reported that these chemicals are also very potent genotoxic compounds and 50% effective concentration for the inductions of sister chromatid exchanges (SCEs) and micronuclei are 210 to 560 ppt as TCDD TEQ value, which are only about 3 to 8 times higher than the average contamination level in Japanese people, in cultured human lymphocytes³⁾. Therefore, we also examined the frequency of SCEs in cultured lymphocytes obtained from the same blood samples and statistically analyzed the relationship between the blood level of these chemicals and the frequency of SCEs to evaluate whether PCDDs, PCDFs and Co-PCBs in the blood was able to elicit the genotoxicity or not.

APPROACH AND METHODS

Sixty to 80 ml of peripheral blood samples were individually obtained from 40 unmarried healthy Japanese women (mean age : 20 years old and range : 18~29 years old). Concentrations of PCDDs, PCDFs and Co-PCBs in the blood samples were determined by ordinary gas chromatography/mass spectrometry (GC-MS) method²⁾. Frequencies of SCEs in the lymphocytes of individual whole-blood cultures were counted and analyzed as described before⁴⁾. Chemicals, experimental procedures and statistical analysis were previously mentioned in detail^{2,4)}.

RESULTS

Respective mean concentrations of PCDDs, PCDFs and Co-PCBs in the 40 blood samples and their concentrations as a whole are given in Table 1 as TCDD TEQ values

Table 1. Concentrations of PCDDs, PCDFs and Co-PCBs in the blood of 40 Japanese young women

Organohalogen Compound	Concentration as TCDD TEQ value (ppt) *	
	Whole Weight Basis	Fat Weight Basis
PCDDs	0.0295 ± 0.0014	10.29 ± 0.53
PCDFs	0.0201 ± 0.0009	6.95 ± 0.29
Co-PCBs	0.0166 ± 0.0013	5.70 ± 0.44
Total	0.0663 ± 0.0031	22.93 ± 1.04

* : mean ± S.E.

on both the whole and fat weight bases. Mean total concentrations on the whole and fat weight bases are 0.0663 ppt and 22.93 ppt respectively. Distributions in the total concentration of these chemicals are shown in Fig. 1 as TCDD TEQ value and the range of the total concentrations is 0.030 to 0.117 ppt on the whole weight basis and 9.1 to 35.1 ppt on the fat weight basis.

Frequencies of SCEs in the blood lymphocytes of Japanese young women are summarized in Table 2. Mean frequency of SCEs in the absence of 7,8-benzoflavone (ANF), $SCE_{baseline}$, is 9.69/cell and the range is 7.24 to 11.32/cell. In the presence of ANF ($8 \times 10^{-5}M$), SCE_{ANF} , it is 14.14/cell and the range is 11.32~16.16/cell. We also calculated

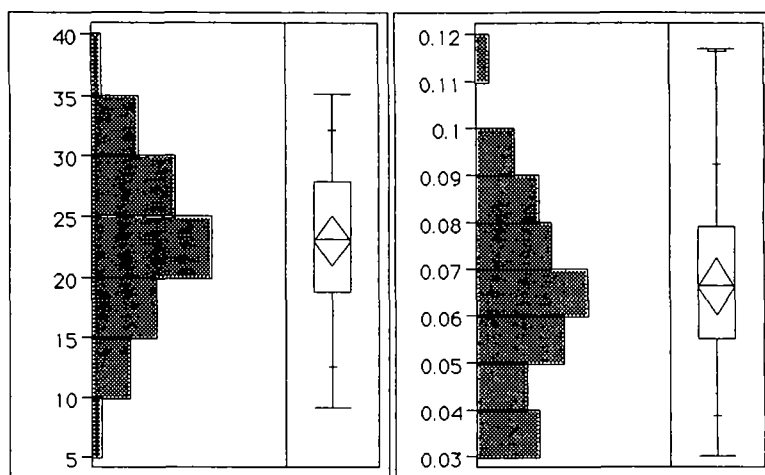


Fig. 1. Distributions in total concentration of PCDDs, PCDFs and Co-PCBs as TCDD TEQ value on fat (left) and whole (right) weight bases in the blood of 40 Japanese young women

Table 2. Frequency of SCEs in the lymphocytes of 40 Japanese young women

Category	SCEs/Cell* (min.~max.)
ANF(-) : $SCE_{baseline}$	9.69 ± 0.15 (7.24~11.32)
ANF(+) : SCE_{ANF}	14.14 ± 0.21 (11.32~16.16)
ΔSCE : $SCE_{ANF} - SCE_{baseline}$	4.45 ± 0.19 (2.72~6.56)

* : mean \pm S.E.

ANF : 7,8-benzoflavone

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the ΔSCE ($\text{SCE}_{\text{ANF}} - \text{SCE}_{\text{baseline}}$) and the range of ΔSCE is 2.72 to 6.56/cell with the mean value of 4.45/cell. Distributions in frequencies of $\text{SCE}_{\text{baseline}}$, SCE_{ANF} and ΔSCE are shown in Fig. 2.

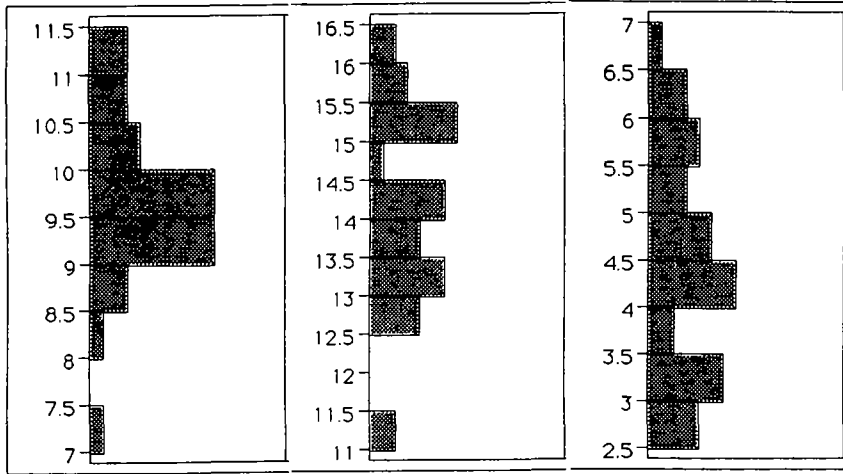


Fig. 2. Distributions of $\text{SCE}_{\text{baseline}}$ (left), SCE_{ANF} (middle) and ΔSCE (right) in the blood lymphocytes of 40 Japanese young women

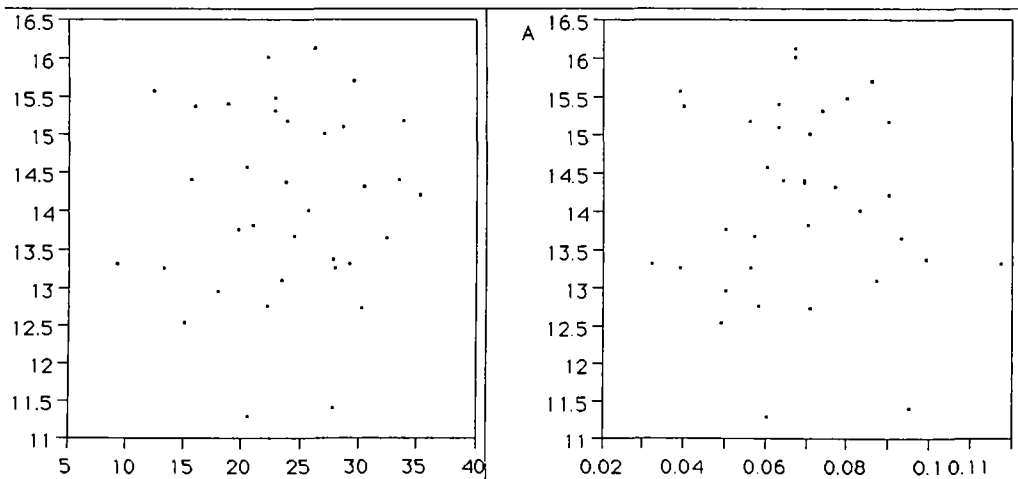


Fig. 3. Frequency of SCE_{ANF} in the blood lymphocytes of 40 Japanese young women plotted in relation to total concentration of PCDDs, PCDFs and Co-PCBs as TCDD TEQ value on fat (left) and whole (right) weight bases in the same blood samples

Lastly, we examined the relationship between the concentrations of PCDDs, PCDFs and Co-PCBs and the frequency of SCEs and do not find any significant correlation between them probably due to their low levels in the blood. As an example, frequency of SCE_{ANF}/cell in the lymphocytes of 40 healthy Japanese women is plotted in relation to the total concentration of PCDDs, PCDFs and Co-PCBs as TCDD TEQ value in Fig. 3.

CONCLUSIONS

- 1) Total levels of PCDDs, PCDFs and Co-PCBs in the blood of Japanese young women (mean age : 20 years old) are about a half of those in Japanese people aged about 40 years as TCDD TEQ value.
- 2) These levels of PCDDs, PCDFs and Co-PCBs in the blood do not enhance the frequencies of any kind of SCEs examined in this study, probably due to the low concentration.

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