

# The Survey on the Accumulation of Dioxins in Humans

## - A dioxin concentration of general environmental inhabitants in Japan and intake survey from food -

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### Abstract

The Environmental Risk Assessment Office of the Environmental Health Department of the Ministry of the Environment, Japan, carried out a survey, entitled "Survey on Accumulation of Dioxins in Humans", in order to obtain a general grasp of the state of the accumulation of dioxins in the Japanese people.

Whole blood for 1,656 general environmental inhabitants of all from 2002 to 2007, and dioxin intake from food for 450 subjects among 1,656 by duplicate portions study.

The average dioxin level in blood of 1,656 subjects as general environmental inhabitants of all was 20 pg-TEQ/g-fat, ranging from 0.64 to 120 pg-TEQ/g-fat. The level of blood dioxin concentration showed increasing trend with increasing age. In the district where inhabitants lived in, there was a difference to the dioxin density out of blood, and a fishery district was significantly high, and blood dioxin was significantly lower among females than males.

The average dioxin intake from food for the 450 subjects was 0.75 pg-TEQ/kg weight/day, ranging from 0.060 to 6.2 pg-TEQ/kg weight /day, and 8 subjects surpassed TDI (4pg-TEQ/kg weight/day). Significant correlation was observed between dioxin intake from food and dioxin concentration in blood. The average dioxin values of blood samples of the Follow-up Survey subjects were in the same order as survey results of the past.

### Introduction

Last decade, numbers of monitoring surveys have been conducted for dioxins in general environment in Japan, and it is thought that the present conditions of dioxin in general environment of our country are almost fully understood. On the other hand, some survey is performed in outskirts of municipal incineration facility, however, not much is yet known of general environment inhabitants at present.

Therefore, Ministry of the Environment Japan have been conducted surveys from 2002, in order to understand how much dioxin is accumulated (human exposure) in inhabitants of general environmental of our country and to accumulate data of a of dioxin in human body<sup>1</sup>.

### Materials and Methods

Nationwide Survey: Japan was divided into the five blocks (Hokkaido-Tohoku, Kanto-Koshin'etsu, Tokai-Hokuriku-Kinki, Chugoku-Shikoku and Kyushu-Okinawa). Single prefecture from each block was selected as the survey region. Three survey areas (Urban area, Agricultural area and Fishery area) were selected for each survey region. For each survey area, 50 subjects (20 from Urban area and 15 each from Agricultural and Fishery areas) meeting the conditions below, were recruited. The conditions were (1) ages 15 and under 69, (2) has been living within the area for more than 10 years, (3) seldom outside of the survey area, and (4) has no problem sampling blood (e.g. anemia). The age and gender ratio was considered when selecting the subjects.

A briefing session was held for each survey area, and investigating it was performed by drawing blood of 28 mL after having obtained informed consent from the subjects. Items analyzed besides dioxins were general biochemical, blood count, four unsaturated fatty acids (DGLA, AA, EPA, DHA) (**Table 1**). Also, an interviews on dietary and health conditions were performed on the subjects by community health nurses and nutritionist, to grasp the living and health conditions of the subjects.

Dietary survey collected by duplicate method were conducted on approximately five subjects from each area, in addition to the blood survey, The meals for a total of whole three days were collected, to measure the dioxin concentration and to calculate dioxin intake via daily meals. When collecting meals, details of seasonings and ingredients were measured and recorded by a nutritionist. Blood survey was performed in six years from 2002 to 2007 years for 1,656 subjects (the mean of age 43.8 years old, ranging from 15 to 73 years old) subjects in total, and dietary survey was performed for 450 people from the subjects of blood surveys.

The survey on dioxin in blood samples of subjects from 1998 to 2001 year survey was continued after 2002, and the secular change was studied (named "Follow-up Survey"). Scheme and design of the Follow-up Survey were

the same as Nationwide Survey but the dietary survey was not performed.

Blood analyses were performed by previous report <sup>2</sup>.

### Results and Discussion

The mean blood dioxin concentration of the 1,656 participants was 20 pg-TEQ/g-fat, ranging from 0.64 to 120 pg-TEQ/g-fat. There are relationship between dioxin concentration and age (**Figure 1**).

The concentration of a Fishery village area for age-calibrated concentrations exceeded the concentration of another two areas (**Table 2**), and the concentration of females was significantly lower than males.

The mean dioxin intake from food was 0.75pg-TEQ/kg/day, with the range of 0.060 to 6.2 pg-TEQ/kg/day. Dioxin intakes from food were thus calculated for the 450 subjects, resulting in eight instances exceeding the 4pg-TEQ/kg/day tolerable daily intake (TDI) of dioxins. Likewise, blood level of Fishery areas was higher than the other two areas.

Significant correlation was observed for dioxin intake from food and actual concentrations of dioxin in blood but not in a high correlation ( $r=0.20$ ). The mean dioxin concentrations of blood samples of the Follow-up Survey subjects were in the same order as survey results of the past.

The tables and figures presented in this paper are not shown by age-calibrated concentration, but the tendency of the results does not change even when shown by age-calibrated concentration.

### Relationship with other factors

(1)Correlation with age: The blood dioxin concentration showed increasing trend with increasing age (**Figure 1**). However, in “the Follow-Up Survey”, the increasing dioxin concentration with age of the same person was not observed (**Table 4**).

(2)Difference of area: “The blood dioxin concentration” and “dietary dioxin intake” in Fishery areas was high compared with the other two areas. Significant correlations were observed for dioxin concentration in blood and two kinds of fatty acids (EPA,DHA) (**Figure 2**).

(3)Gender difference: Dioxin in blood was significantly lower among females than males. In addition, the dioxin concentration of mothers who performed child care by breast milk was significantly lower than the those who took care of their babies by mixture milk and/or formula milk. Also, the dioxin concentrations of females with more delivery numbers were significantly low.

(4)Relationship with accumulation and intake: Significant correlation was observed for dioxin intake from food and actual concentrations of dioxin in blood, but the correlation was not high.

### Conclusions

(1)The mean dioxin in blood of 1,656 inhabitants of general environmental of all over Japan was 20 pg-TEQ/g-fat, ranging from 0.64 to 120 pg-TEQ/g-fat.

(2)Dioxin concentration in blood showed increasing trend with increasing age, but in the Follow-Up Survey, the dioxin concentration of the same person did not show increasing trend with increasing age.

(3)An area difference was recognized for the dioxin concentration. Dioxin concentration for subjects in Fishery areas was significantly high. It may be caused by the larger amount of the fish intake (**refer to Table 3**) of in which the unsaturated fatty acids are found in abundance.

(4)Dioxin in blood was significantly lower among females than males. It is thought that the dioxin was discharged at the time of delivery (birth) and breast-feeding for baby.

(5)Correlation was observed between dioxin intake from food and dioxin concentration in blood. The results were estimated from the three-day dietary survey.

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## Reference

1. Hasegawa et al., (2007) *Organohalogen Compounds*, **69**, 2001-2005
2. Matsumura et al., (2007) *Organohalogen Compounds*, **69**, 1154-1157

**Table 1. Items analyzed.**

Classification	Items	Sampling amount
Dioxins	PCDDs, PCDFs, Co-PCB (29 isomers; WHO's 2006 TEF)	8.5 mL test tube×2
Blood count	red blood cell, white blood cell, blood platelet, hemoglobin, hematocrit, Fe	2 mL test tube×1
Saccharo-metabolism	HbA1c	
Hepatic function	GOT, GPT, gamma-GTP	
Renal function	BUN, creatinine	
Blood lipids	Total cholesterol, HDL-cholesterol, triglyceride, fatty acid fractionation(DGLA,AA,EPA,DHA)	9 mL test tube×1

**Table 2. Dioxin concentrations in blood.**

Co-PCBs include 12 kinds of PCB compounds that have WHO's 2006 TEF. TEF used were based on WHO-TEF (2006), and measurements of concentrations in blood and food below the lower limit of quantification were treated as "zero" (also in Table 3, 4, Figure 1, 2).

TEQ	Statistics	Urban areas (n=669)	Agricultural areas (n=540)	Fishery areas (n=447)	Nationwide (n=1,656)
PCDDs+PCDFs (pg-TEQ/g-fat)	mean ± s.d. (median, range)	11 ± 7.1 (9.9,0.57-61)	11 ± 6.9 (9.7,0.40-53)	14 ± 9.4 (12,0.44-63)	12 ± 7.8 (10,0.40-63)
Co-PCBs (pg-TEQ/g-fat)	mean ± s.d. (median, range)	6.5 ± 5.1 (5.3,0.032-33)	7.4 ± 6.4 (5.4,0.013-51)	10 ± 9.0 (6.7,0.047-61)	7.8 ± 6.9 (5.7,0.013-61)
PCDDs+PCDFs +Co-PCBs (pg-TEQ/g-fat)	mean ± s.d. (median, range)	18 ± 11 (16,0.64-76)	19 ± 12 (16,0.96-97)	24 ± 17 (20,1.1-120)	20 ± 14 (16,0.64-120)

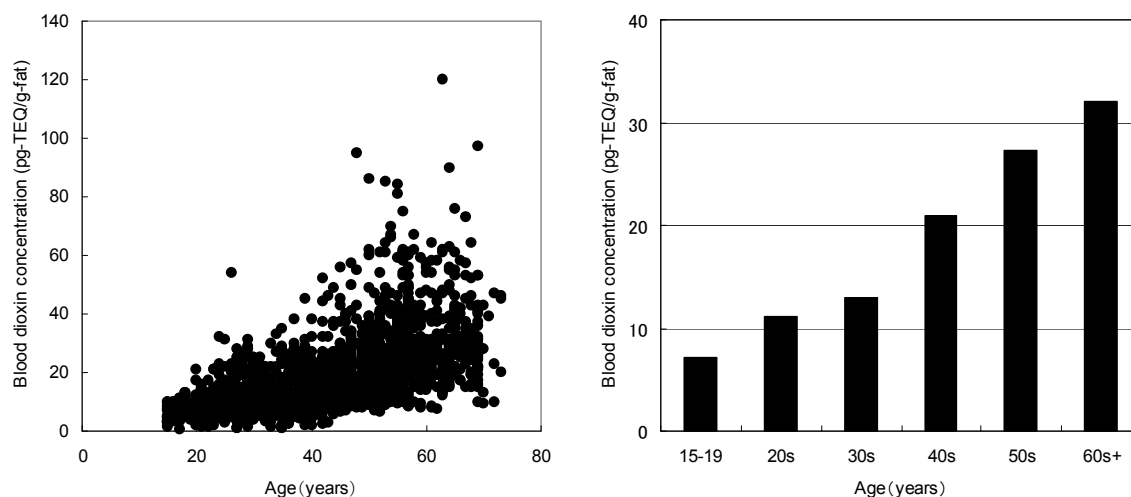
**Table 3. Dioxin intake from food.**

TEQ	Statistics	Urban areas (n=154)	Agricultural areas (n=161)	Fishery areas (n=135)	Nationwide (n=450)
PCDDs+PCDFs (pg-TEQ/g-fat)	mean ± s.d. (median, range)	0.33 ± 0.25 (0.26, 0.024-2.0)	0.37 ± 0.33 (0.27, 0.029-2.5)	0.49 ± 0.47 (0.37, 0.033-3.8)	0.39 ± 0.36 (0.29, 0.024-3.8)
Co-PCBs (pg-TEQ/g-fat)	mean ± s.d. (median, range)	0.43 ± 0.51 (0.26, 0.033-4.2)	0.48 ± 0.58 (0.30, 0.047-4.1)	0.60 ± 0.64 (0.43, 0.027-3.6)	0.50 ± 0.58 (0.32, 0.027-4.2)
PCDDs+PCDFs+ Co-PCBs (pg-TEQ/g-fat)	mean ± s.d. (median, range)	0.76 ± 0.71 (0.58, 0.058-6.2)	0.85 ± 0.86 (0.58, 0.080-5.6)	1.1 ± 0.98 (0.86, 0.060-5.2)	0.89 ± 0.86 (0.64, 0.058-6.2)

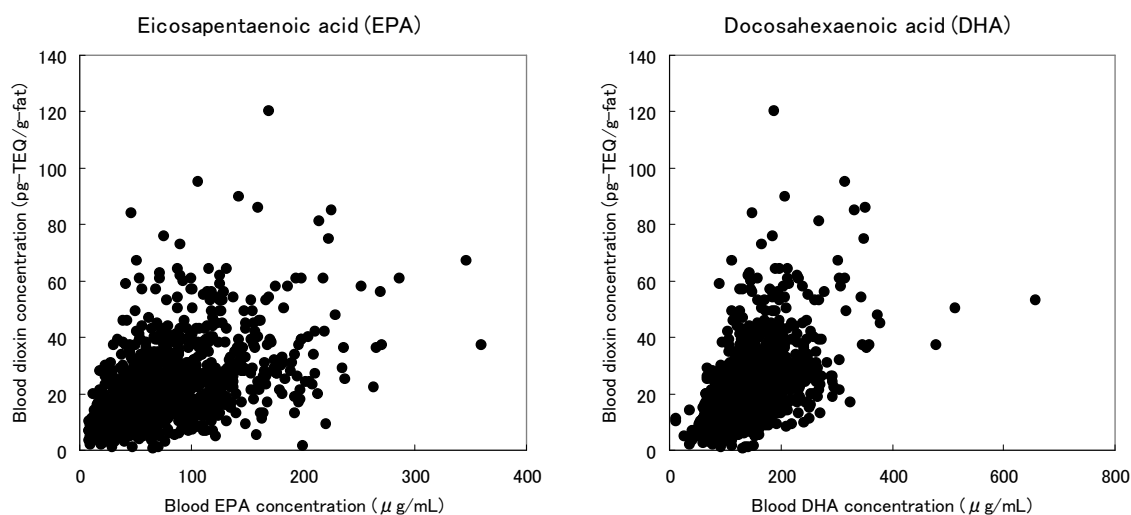
**Table 4. Chronological change of dioxin concentrations in blood.**

Statistical values are same in Table 2 and 3.

TEQ	2002 (n=43)	2003 (n=38)	2004 (n=51)	2005 (n=42)	2006 (n=46)	2007 (n=43)
PCDDs+PCDFs (pg-TEQ/g-fat)	18±9.1 (16, 4.6-50)	19±13 (17, 3.7-70)	17±9.3 (16, 1.3-53)	17±10 (17, 1.9-55)	16±10 (14, 1.1-59)	14±7.2 (13, 2.5-33)
Co-PCBs (pg-TEQ/g-fat)	9.4±6.6 (7.7, 1.8-32)	11±16 (8.2, 0.10-100)	8.6±5.2 (8.4, 0.10-24)	9.1±5.8 (8.0, 0.80-23)	11±6.9 (9.2, 0.10-32)	11±7.0 (9.2, 2.1-33)
PCDDs+PCDFs +Co-PCBs (pg-TEQ/g-fat)	27±15 (22, 7.3-83)	30±27 (25, 3.8-170)	26±14 (25, 1.4-77)	27±15 (26, 3.0-78)	26±16 (24, 2.0-91)	25±13 (24, 5.0-59)



**Figure 1. Relationship between age and dioxin concentrations in blood.**



**Figure 2. Relationship between fatty acids and dioxin concentrations in blood.**