The survey on the Accumulation of Dioxins in Humans －A dioxin concentration of general environmental inhabitants in Japan and intake survey through diet

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Abstract

Ministry of the Environment Japan carried out survey of the dioxin density of the whole blood for 1,374 general environmental inhabitants of all from 2002 to 2006.and, dioxin intake through diet for 375 subjects among 1,374 by duplicated meal method. The average dioxin level in blood of 1,374 subjects as general environmental inhabitants of all was 24 pg-TEQ/g-fat, ranging from 0.98 to 110 pg-TEQ/g-fat. The level of dioxin in blood 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 fishing district was significantly high. and dioxin in blood was significantly lower among females than males. The average dioxin intake through diet for 375 subjects among 1,374 was 1.1 pg-TEQ/kg weight/day, ranging from 0.067 to 6.7 pg-TEQ/kg weight /day, 8 subjects surpassed TDI(（4pg-TEQ/kg weight/day）. Significant correlation was observed for dioxin intake through diet and actual values of dioxin 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. Toxic equivalency factors used were based on WHO-TEF(1998).

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 outskirt of municipal incineration facility, however, not much is yet known of general environment inhabitants at present.

Therefore, the 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.

Toxic equivalency factors used were based on WHO-TEF(1998),and measurements of concentrations in blood and food below the lower limit of quantification were treated as “zero”.

Materials and Methods

Nationalwide 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, Agriculture area and Fishing area) were selected for each survey region. For each survey area, 50 participants (20 from Urban area and 15 each from Agriculture and Fishing areas) meeting the conditions below, were recruited. The conditions were (1) ages 15 and above and below 70, (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 participants.

A briefing session was held for each survey area, and investigating it was performed by drawing blood of 25mL after having obtained informed consent from the participants. Items analyzed besides dioxins were general biochemical, blood count, four unsaturated fatty acids (DHLA, AA, EPA, DHA). Also, an interviews on dietary and health conditions were performed on the participants by community health nurses and dieticians, to grasp the living and health conditions of the participants.

Dietary survey collected by duplicate method were conducted on approximately five participants 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 dieticians. Blood survey was performed in five years from 2002 to 2006 years for 1,374 participants (the mean of age 43.7 years old, ranging from 15 to 73 years old) participants in total, and dietary survey was performed for 375 people from the participants of blood surveys.

(Follow-up Survey)

The survey on dioxin in blood samples of participants from 1998 to 2001 year survey was continued after 2002, and the secular change was studied. Quantity of drawing blood and a measurement item of follow-up survey were the same as national survey but the dietary survey was not performed.

Results and Discussion

The mean concentration of dioxin in blood for 1,374 participants was 24 pg-TEQ/g-fat, ranging from 0.98 to 110 pg-TEQ/g-fat. There are relationship between dioxin concentrations and age.

The concentration of a Fishing village area for age-calibrated concentrations exceeded the concentration of an other two areas, and the concentration of females was significantly lower than males.

The mean dioxin intake through diet was 1.1pg-TEQ/kg/day, with the range of 0.067 to 6.7 pg-TEQ/kg/day. Dioxin intakes through diet were thus calculated for the 375 participants, resulting in eight instances exceeding the 4pg-TEQ/kg/day tolerable daily intake (TDI) of dioxins. Likewise, blood level of Fishing area was higher than the other two areas.

Significant correlation was observed for dioxin intake through diet and actual concentrations of dioxin in blood but not in a high correlation（r=0.24）. The mean dioxin concentrations of blood samples of the Follow-up Survey participants 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 and age: The dioxin concentration in blood showed increasing trend with increasing age. However, in “the Follow-Up Survey”, the increasing dioxin concentration with age of the same person was not observed.

(2) Difference of area: “Dioxin concentration in blood” and “dietary dioxin intake” in Fishing Area 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).

(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 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 through diet and actual concentrations of dioxin in blood, but the correlation was not high

Conclusions

(1) The mean concentration of dioxin in blood for 1,374 inhabitants of general environmental of all over Japan was 24 pg-TEQ/g-fat, ranging from 0.98 to 110 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 dioxin concentration. Dioxin concentration for participants in Fishing Area was significantly high. It may be caused by the larger amount of the fish intake 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 through diet and dioxin concentration in blood. The results were estimated from the three-day dietary survey.

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Table 1. Dioxin concentration in blood.

Classification	Items	Sampling amount
Dioxins	PCDDs, PCDFs, Co-PCB (29 isomers, WHO-1998,)	7 mL test tube×2
Blood component	red blood cell count, leukocyte count, number of platelet, number of hemoglobin, hematocrit, Fe	2 mL test tube×1
Saccharo-metabolism	HbA1c	
Liver function	GOT, GPT, γ-GTP	9 mL test tube×1
Kidney function	BUN, creatinine	
Blood lipid	total cholesterol, HDL-cholesterol, triglyceride, fatty acid fractionation(DHLA,AA,EPA,DHA)	

Table 2. Dioxin concentration in blood.

		Urban district (n=552)	Agriculture district (n=440)	Fishing district (n=382)	Nationwide (n=1,374)
PCDDs+PCDFs	mean±s.d. (median, range)	13±8.2 (12,0.76～63)	13±7.7 (11,0.39～55)	16±10 (14,0.61～56)	14±8.7 (12,0.39～63)
Co-PCBs(1)	mean±s.d. (median, range)	6.9±6.9 (7.2,0.21～44)	9.7±8.1 (7.5,0.087～63)	13±10 (8.6,0.26～72)	10±8.5 (7.6,0.087～72)
PCDDs+PCDFs+ Co-PCBs	mean±s.d. (median, range)	22±14 (19,0.95～90)	23±15 (18,1.6～110)	29±19 (24,1.9～110)	24±16 (20,0.98～110)

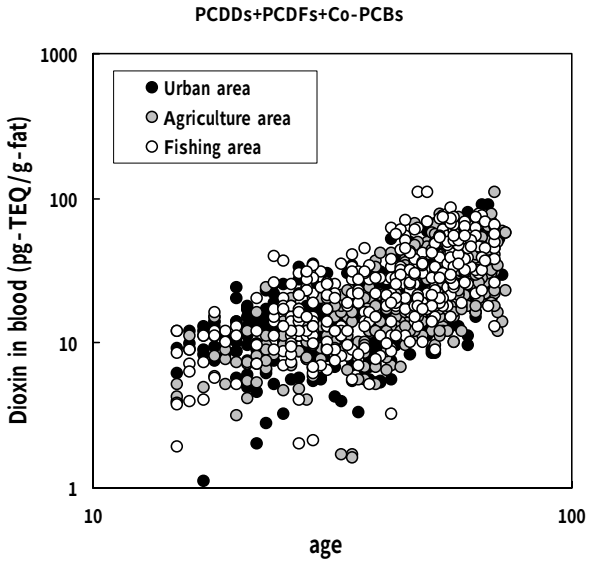

Figure 1. Age and dioxin in blood.

Table 3. Dioxin intake through diet.

		Urban district (n=129)	Agriculture district (n=131)	Fishing district (n=115)	Nationwide (n=375)
PCDDs+PCDFs	mean±s.d. (median, range)	0.38±0.26 (0.30, 0.029～1.3)	0.46±0.40 (0.33, 0.059～2.8)	0.57±0.53 (0.43, 0.086～4.1)	0.46±0.41 (0.34, 0.029～4.1)
Co-PCBs	mean±s.d. (median, range)	0.49±0.48 (0.32, 0.038～2.3)	0.59±0.73 (0.35, 0.051～4.8)	0.71±0.75 (0.50, 0.052～4.5)	0.59±0.66 (0.39, 0.038～4.8)
PCDDs+PCDFs+ Co-PCBs	mean±s.d. (median, range)	0.87±0.68 (0.68, 0.067～3.2)	1.0±1.1 (0.71, 0.11～6.7)	1.3±1.1 (1.0, 0.15～5.9)	1.1±0.99 (0.78, 0.067～6.7)

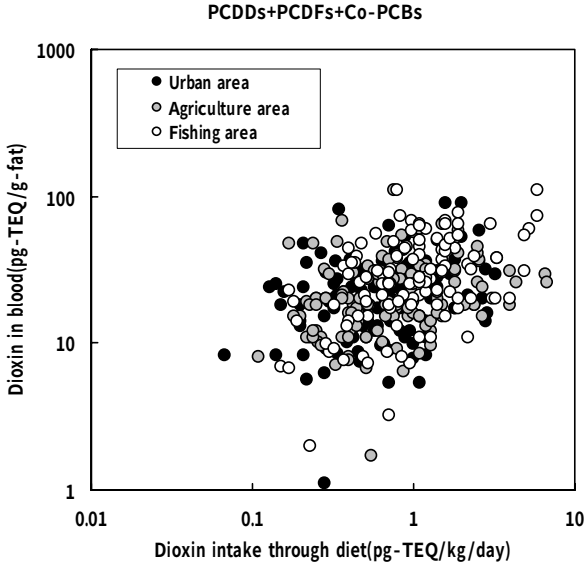

Figure 2. Relationship between dioxin in blood and dioxin intake through diet.

Table 4. The secular change of dioxin concentration in blood.

		2002 (n=43)	2003 (n=38)	2004 (n=51)	2005 (n=42)	2006 (n=46)
PCDDs+PCDFs	mean±s.d. (median, range)	20±11 (18, 5.1～60)	22±15 (19, 4.0～82)	20±11 (18, 1.7～53)	20±12 (19, 2.1～66)	18±12 (17, 1.1～71)
Co-PCBs	mean±s.d. (median, range)	13±8.5 (10, 3.1～43)	15±20 (12, 0.69～130)	12±6.8 (11, 0.69～32)	13±7.6 (12, 1.6～31)	14±8.8 (14, 0.71～42)
PCDDs+PCDFs+ Co-PCBs	mean±s.d. (median, range)	33±18 (27, 8.5～100)	36±34 (32, 4.7～210)	32±17 (30, 2.4～94)	33±18 (31, 3.9～96)	32±20 (29, 2.8～110)