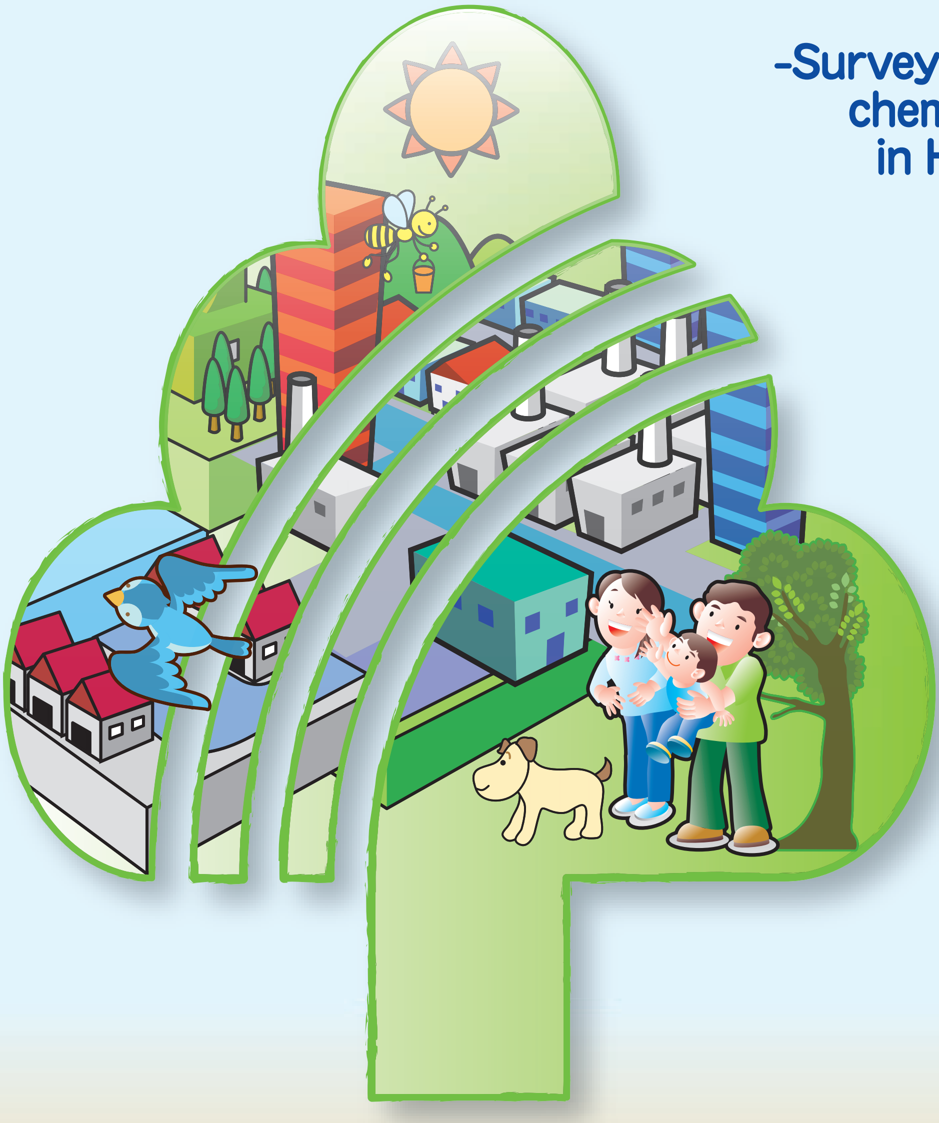
The Exposure to chemical compounds in the Japanese People

-Survey of the Exposure to chemical compounds in Human (2011～)-



2013

Environmental Risk Assessment Office
Environmental Health Department
Ministry of the Environment, Japan

Introduction

The Office of Environmental Risk Assessment of the Environmental Health Department of the Ministry of the Environment, Japan, carried out a project entitled "Survey of the Exposure to Dioxins and other chemical compounds in Humans,"(renamed to "Survey of the Exposure to chemical compounds in Human" from FY 2012) to obtain the state of accumulation and the amount of intake of dioxins and other chemical compounds, starting from FY 2011.
The OERA compiled the results of two years of survey conducted in FY 2011 and in FY 2012.

Summary of Survey of the Exposure of chemical compounds in Humans

Objective of the survey

- To obtain the state of exposure of dioxins and other chemical compounds in the Japanese people.
- Conduct a follow-up survey and obtain chronological change in the levels of chemical compounds in people who had participated in surveys carried out in the past.
- To conduct a monitoring survey on POPs (Persistent Organic Pollutants) in biological samples, as required by each parties to Stockholm Convention on Persisting Organic Pollutants.

Scope and methods of the survey

- Three areas were selected from survey regions of "Survey on the Accumulation of Dioxins and other chemical compounds (FY 2002 to FY 2010)" for this survey.
- Within each survey area, residents aged 40 ～ 59, who had lived in the area for a long period, were recruited and designated as survey subjects.
- Dioxin and other chemical compounds were measured in blood and urine of survey subjects.
- Survey on lifestyles of the subjects was conducted by questionnaire.
- Food samples were collected over a period of three days from some survey subjects. Levels of chemical compounds in food were measured and the amount of intake was calculated.

Results of dioxins survey

- The average concentration of dioxins in the blood in 170 people (86 in FY 2011 and 84 in FY 2012) was 14 pg-TEQ/g-fat, with a range of 0.42 ～ 56 pg-TEQ/g-fat. This result is similar to those reported in other surveys.
- Among 26 people who had participated in past studies (8 ～ 9 years had passed from the previous survey),dioxin levels in blood of 24 people had decreased.
- The average dioxin intake from food by 30 people (15 in FY 2011 and 15 in FY 2012) was 0.68 pg-TEQ/kg body weight/day with a range of 0.035 - 2.4 pg-TEQ/kg body weight/day. No survey subjects exceeded the tolerable daily intake (TDI) of 4 pg-TEQ/kg body weight/day.

Results of fluorine compounds survey

- The average of PFOS and PFOA in blood of 86 people was 5.8 ng/mL and 2.2 ng/mL, respectively. The range of PFOS and PFOA was 1.6 ～ 17 ng/mL and 0.66 ～ 9.6 ng/mL, respectively. This result is similar to those reported in other surveys.
- The average intake of PFOS and PFOA from food by 15 people was 0.57 ng/kg body weight/day and 0.69 ng/kg body weight/day, respectively. The range of intake of PFOS and PFOA was N.D. ～ 1.7 ng/kg body weight/day and N.D. ～ 2.9 ng/kg body weight/day, respectively.

Results of heavy metals survey

- The average concentration of total mercury in blood of 170 people (86 in FY 2011 and 84 in FY 2012) was 11 ng/mL with a range of 1.7 ～ 41 ng/mL. In addition, lead, cadmium, arsenic, copper, selenium, and zinc measurement in blood were conducted.
- The average concentration in cadmium in urine of 99 people (15 in FY 2011 and 84 in FY 2012) was 0.89 μg/g cr with a range of 0.20 - 3.9 μg/g cr. In addition, measurement of arsenic speciation in urine was conducted.
- Intake of total mercury, methyl mercury, lead, cadmium, arsenic, copper, selenium, and zinc from food was measured for 30 people (15 in FY 2011 and 15 in FY 2012).

Results of pesticides, plasticizers, and others survey

- Chemical compounds such as pesticides (including their metabolites) and plasticizers in urine of 99 people (15 in FY 2011 and 84 in FY 2012) were measured.

Results of POPs survey

- The concentration of POPs and candidates specified by Stockholm Convention in blood of 86 people was measured. In addition, amount of intake from food was calculated for 15 people. (Conducted only in FY 2011)

Results of radioactive substances survey

- The concentration of radioactive substances (cesium 134, cesium 137, potassium 40, and iodine 131) and in blood and urine of 84 people was measured. In addition, amount of intake of radioactive substances from food was calculated for 15 people. (Conducted starting from FY 2012)

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1. Overview of the Survey of the Exposure to chemical compounds in Human

The Environmental Risk Assessment Office of the Environmental Health Department of the Ministry of the Environment, Japan, carried out a survey entitled "Survey on the Accumulation of Dioxins and other chemical compounds in Humans" from FY 2002 to FY 2010. In this survey, blood dioxin concentrations were measured in 2,264 people living in general environment in Japan. In addition, dioxin concentration in food was measured for 625 people, and the amount of intake from food was calculated (see Supplementary Information).

The "Survey of the Exposure to Dioxins and other chemical compounds in Humans" was newly-launched in FY 2011. In this survey, the survey regions were selected from that of the surveys carried out in the past. The blood and urine was sampled from the participating residents, and the accumulation of dioxins and other chemical compounds and so forth was studied.

Furthermore, a food study (duplicate portions study) was conducted for a part of the survey subjects. The chemical compound level in food was measured, and the amount of chemical compounds ingested into the body from food (intake) was estimated.

In FY 2011 and FY 2012, chemical compound concentration in blood of 170 people from 6 survey regions was measured. In addition, the chemical compound intake from food was estimated for 30 people.

Survey of the Exposure to chemical compounds in Humans

Organization responsible for the survey	Environmental Risk Assessment Office, Environmental Health Department, Ministry of the Environment, Japan
Survey period	From FY 2011
Survey regions	Three regions
Survey specimen	-Blood study (to ascertain the accumulation of chemical compounds in the body) -Urine study (to ascertain the excretion of rapidly-metabolizing compounds) -Food study (to ascertain the amount of intake of chemical compounds)
Number of subjects	170 people (FY 2011, 86 people; FY 2012, 84 people) (30 people also participated in Food study)

2. Methods of Survey

2-1 Target regions and subjects

In "Survey on the Accumulation of Dioxins and other chemical compounds in Humans" conducted from FY 2002 to FY 2010, Japan was divided into five regions, and one prefecture was selected for each region for each fiscal year. In each prefecture, three areas classifiable as urban, agricultural, or fishery area were selected on a city, town or village unit.

In FY 2011 survey, three regions were selected from the survey regions of the past studies.

Study subjects were recruited in survey regions according to the criteria shown below, through local administrative authorities.

Furthermore, study subjects who meet the criteria below and who had participated in the past studies were recruited as well.

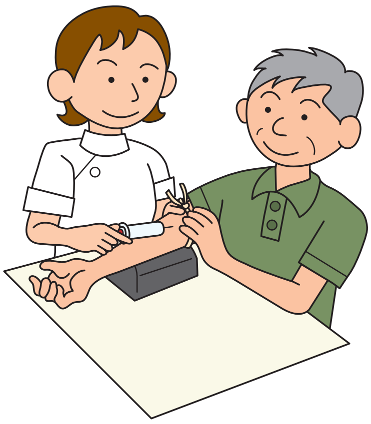
Study subject criteria

- Age : 40 – 59
- Residential period in the survey region: 10 years or more
- Infrequent leaves from the study regions for work or other reasons
- Having no problem in blood sampling owing to anemia or other reasons

2-2 Methods

● Blood study (all subjects)

Blood was sampled from survey subjects by a nurse in the presence of a physician. As a general rule, fasting blood samples were taken from the subjects.



Analysis item

Analysis item	FY 2011	FY 2012
• Chlorinated Dioxins	○	○
• Brominated Dioxins		○
• Organofluorine Compounds	○	
• Heavy metals	○	○
• Hydroxylated PCB		○
• POPs	○	
• Radioactive substances		○
• General health checkup items(blood count, hepatic function, renal function, glucose metabolism, etc.)	○	○
• Healthy influence index items (Thyroidalfunction, allergic function, fatty acids etc.)	○	○

● Urine study (sampled from all subjects; measurement conducted for a part of the subjects)

Urine was sampled in urine receptacle, early in the morning of the same day of blood sampling.

Analysis item

Analysis item	FY 2011	FY 2012
• Pesticides and other (organophosphorus pesticide metabolites, pyrethroid pesticide metabolites, etc.)	○	○
• Plasticizers and other (phthalate metabolites, bisphenol A)	○	○
• Heavy metals (cadmium, arsenic)	○	○
• Other chemical substances (PAH, cotinine, caffeine, etc.)		○
• Hydroxylated PCB		○
• POPs	○	
• Radioactive substances		○
• General health examination items (urine specific gravity, urinary sugar, uric protein, etc.)	○	○

● Food study (a part of the subjects)

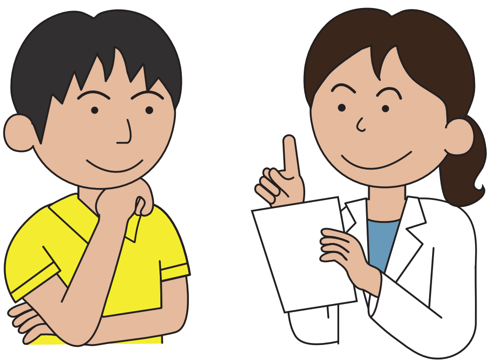
The food study was conducted by "duplicate portions study" over three days during the survey period, in which duplicates of the subjects' meals for the three days were stored in containers and collected afterwards. Upon collection, a nutritionist checked the types and weight of the food commodities.
The three days' portion of collected food was homogenized. Then, the chemical compounds measured and the intake of chemical compounds (kg body weight/day) was estimated.

Analysis item

Analysis item	FY 2011	FY 2012
• Chlorinated Dioxins	○	○
• Organofluorine Compounds	○	
• Heavy metals	○	○
• POPs	○	
• Radioactive substances		○

● Lifestyle survey (questionnaire)

The lifestyle of survey subjects were investigated through individual interviews by a health nurse or a nutritionist, based on the questionnaire sent to the subjects prior to the interview.



Analysis item

• Personal medical history, residential history, occupational history, smoking habit, dietary history, lifestyle, birth history, etc.

3. Results and Discussion

3-1 Dioxins survey

3-1-1 Blood study (chlorinated dioxins)

● Result summary

The blood dioxin concentrations found in this study are shown in Table 1. The average concentration in the 170 survey subjects was 14 pg-TEQ/g-fat. The range of the concentration was 0.42 ～ 56 pg-TEQ/g-fat.

□ Table 1 Statistics of blood dioxin concentration

(unit: pg-TEQ/g-fat)

	FY 2011 (n=86)	FY 2012 (n=84)	Total (n=170)
PCDDs+PCDFs +Co-PCBs			
Average	17	10	14
Standard deviation	10	6.9	9.6
Median	14	9.0	11
Range	0.83 ～ 56	0.42 ～ 40	0.42 ～ 56

● Comparison with past survey results

Table 2 summarizes the comparison with the results of "Survey on the Accumulation of Dioxins and other chemical compounds (FY 2002 to FY 2010) ", conducted on 2,264 subjects. While it is difficult to compare in a simplified manner since the average age and the number of subjects differ by surveys, the blood dioxin concentrations obtained in this survey are considered to fall generally within the range of the past surveys.

□ Table 2 Comparison with past survey results

(unit: pg-TEQ/g-fat)

Survey name	Survey on the Accumulation of Dioxins and other chemical compounds	This survey
Survey year	FY 2002 to FY 2010	FY 2011, 2012
Subjects	People living in the general envionment	People living in the general envionment
The number of subject	2,264	170
Age		
Average(yeas)	44.5	49.7
Range	15 ～ 76	36 ～ 63
PCDDs+PCDFs +Co-PCBs		
Average	19	14
Standard deviation	14	9.6
Median	16	11
Range	0.10 ～ 130	0.42 ～ 56

● Comparison for the same subjects

Among the subjects of this survey, 26 people had participated in the past surveys (FY 2002 and FY 2004).
The comparison of blood dioxin results of the past studies and this survey for these 26 people are shown in Table 3. The dioxin concentrations in blood have decreased in most of the subjects.

□ Table 3 Comparison of blood dioxin concentration in the same subjects

(unit: pg-TEQ/g-fat)

Survey name	Past survey (n=26)	This study (n=26)
Survey year	FY 2002,2003,2004	FY 2011, 2012
PCDDs+PCDFs +Co-PCBs		
Average	25	14
Standard deviation	22	11
Median	23	11
Range	0.96 ～ 95	3.0 ～ 56

3-1-2 Food study (chlorinated dioxins)

● Result summary

Table 4 summarizes the dioxin intake from food. The average intake was 0.68 pg-TEQ/kg bw/day with a range of 0.035 ～ 2.4 pg-TEQ/kg bw/day.
In Japan, the tolerable daily intake (TDI; a value indicating the maximum intake of a given chemical substance per kg of body weight per day, below which humans may not show adverse health effects even when the chemical is ingested at this amount over a long period of time) for dioxins is 4 pg-TEQ/kg/day as stipulated by the Law Concerning Special Measures against Dioxins. No subjects exceeded this TDI value in this survey.

□ Table 4 Statistics of Dioxins intake from food

(unit: pg-TEQ/kg/day)

	FY 2011 (n=15)	FY 2012 (n=15)	Total (n=30)
PCDDs+PCDFs +Co-PCBs			
Average	0.65	0.72	0.68
Standard deviation	0.71	0.55	0.62
Median	0.39	0.57	0.48
Range	0.035 ～ 2.4	0.071 ～ 2.3	0.035 ～ 2.4

● Comparison with past survey results

Table 5 summarizes the comparison with the results of "Survey on the Accumulation of Dioxins and other chemical compounds (FY 2002 to FY 2010) " , conducted on 625 subjects. The results of this survey are considered to fall generally within the range of the past surveys.

☐ Table 5 Comparison with past survey results

(unit: pg-TEQ/kg/day)

Survey name	Survey on the Accumulation of Dioxins and other chemical compounds	This survey
Survey year	FY 2002 to FY 2010	FY 2011, 2012
Subjects	People living in the general envionment	People living in the general envionment
The number of subject	625	30
PCDDs+PCDFs +Co-PCBs		
Average	0.82	0.68
Standard deviation	0.86	0.62
Median	0.56	0.48
Range	0.031 ～ 6.2	0.035 ～ 2.4

3-1-3 Blood study (brominated dioxins)

● Result summary

The result of brominated dioxins concentrations in blood for FY 2012 survey is shown in Table 6. The brominated dioxins concentrations in blood of 84 subjects were all N.D. (below determination limit).

☐ Table 6 Statistics of brominated dioxins in blood

(unit: pg/g-fat)

	FY 2012 (n=84)
PBDDs+PBDFs	
Average	All N.D.
Standard deviation	
Median	
Range	

3-2 Fluorine compounds survey

3-2-1 Blood study

● Result summary

The result of fluorine compound concentrations in blood is shown in Table 7. The average of 86 survey subjects for PFOS was 5.8 ng/mL and 2.2 ng/mL for PFOA. The concentration range for PFOS was 1.5 ～ 17 ng/mL and 0.66 ～ 9.6 ng/mL for PFOA.

☐ Table 7 Statistics of blood fluorine compound concentration

(unit: ng/mL)

	FY 2011 (n=86)
PFOS	
Average	5.8
Standard deviation	3.1
Median	4.8
Range	1.5 ～ 17
PFOA	
Average	2.2
Standard deviation	1.4
Median	1.8
Range	0.66 ～ 9.6

● Comparison with past survey results

The comparison with the results of "Survey on the Accumulation of Dioxins and other chemical compounds in Humans" conducted from FY 2008 to FY 2010 for 609 subjects is shown in Table 8. While it is difficult to compare in a simplified manner since the average age and the number of subjects differ by surveys, the blood dioxin concentrations obtained in this survey are considered to fall generally within the range of the past surveys.

☐ Table 8 Comparison with past survey results

(unit: ng/mL)

Survey name	Survey on the Accumulation of Dioxins and other chemical compounds	This survey
Survey year	FY 2008 to FY 2010	FY 2011, 2012
Subjects	People living in the general envionment	People living in the general envionment
The number of subject	609	86
PFOS		
Average	7.8	5.8
Standard deviation	9.2	3.1
Median	5.8	4.8
Range	0.73 ～ 150	1.5 ～ 17
PFOA		
Average	3.0	2.2
Standard deviation	2.9	1.4
Median	2.1	1.8
Range	0.37 ～ 25	0.66 ～ 9.6

3-2-2 Food study

The intake of fluorine compounds from food for the 15 subjects is shown in Table 9. The average was 0.57 ng/kg body weight/day with a range of N.D. ～ 1.7 ng/kg body weight/day for PFOS. Tolerable daily intake (TDI) is not established for fluorine compounds in Japan.

☐ Table 9 Statistics of fluorine compounds intake from food

(unit: ng/kg/day)

	FY 2011 (n=15)
PFOS	
Average	0.57
Standard deviation	0.51
Median	0.53
Range	N.D. ～ 1.7
PFOA	
Average	0.69
Standard deviation	0.70
Median	0.62
Range	N.D. ～ 2.9

3-3 Heavy metals survey

3-3-1 Blood study

● Result summary

Heavy metals such as total mercury, lead, cadmium, arsenic, copper, selenium, and zinc concentration in blood were studied (lead, cadmium, arsenic, copper, selenium, and zinc was studied starting from FY 2012). The blood heavy metals concentration is shown in Table 10.

□ Table 10 Statistics of blood heavy metal concentration

(unit: ng/mL)

	FY 2011 (n=86)	FY 2012 (n=84)	Total
Total mercury			
Median	9.1	9.0	9.0
Range	2.4 ～ 29	1.7 ～ 41	1.7 ～ 41
Lead			
Median	―	12	12
Range	―	5.0 ～ 28	5.0 ～ 28
Cadmium			
Median	―	1.6	1.6
Range	―	0.38 ～ 5.4	0.38 ～ 5.4
Arsenic			
Median	―	5.2	5.2
Range	―	1.4 ～ 35	1.4 ～ 35
Copper			
Median	―	800	800
Range	―	590 ～ 1,100	590 ～ 1,100
Selenium			
Median	―	260	260
Range	―	150 ～ 750	150 ～ 750
Zinc			
Median	―	6,300	6,300
Range	―	4,700 ～ 7,800	4,700 ～ 7,800

3-3-2 Urine study

● Result summary

In this survey, cadmium and arsenic speciation (As (V), As (III), monomethylarsonic acid, dimethylarsinic acid, and arsenobetaine) in urine were measured. The results are shown in Table 11.

□ Table 11 Statistics of urine heavy metal concentration

(unit: μg/g cr)

Chemical compounds		Statistics	FY 2011 (n=15)	FY 2012 (n=84)	Total (n=99)
Cadmium		Median	0.97	0.89	0.90
		Range	0.25 ～ 3.9	0.20 ～ 3.8	0.20 ～ 3.9
Arsenic	As(V)	Median	0.30	N.D.	N.D.
		Range	N.D. ～ 2.5	N.D. ～ 2.9	N.D. ～ 2.9
	As(III)	Median	1.5	1.7	1.7
		Range	N.D. ～ 6.2	N.D. ～ 6.6	N.D. ～ 6.6
	MMA (monomethylarsonic acid)	Median	2.0	2.1	2.1
		Range	0.89 ～ 5.1	0.38 ～ 8.5	0.38 ～ 8.5
	DMA (dimethylarsinic acid)	Median	42	33	36
		Range	12 ～ 170	6.7 ～ 110	6.7 ～ 170
	AB (arsenobetaine)	Median	73	40	42
		Range	15 ～ 300	2.8 ～ 640	2.8 ～ 640

3-3-3 Food study

● Result summary

Heavy metals such as total mercury, methyl mercury, lead, cadmium, arsenic, copper, selenium, and zinc in food was measured (arsenic, copper, selenium, and zinc was studied starting from FY 2012). The results are shown in Table 12.
Among the heavy metals studied, Tolerable Daily Intake (TDI) is established for methyl mercury (0.29 μg/kg body weight/day) and cadmium (7 μg/kg body weight/week) in Japan. In this survey, no subject exceeded the TDI.

□ Table 12 Statistics of heavy metal intake from food

(unit：μg/kg/day)

	FY 2011 (n=15)	FY 2012 (n=15)	Total
Total mercury			
Median	0.063	0.079	0.071
Range	N.D. ～ 0.16	0.025 ～ 0.30	N.D. ～ 0.30
Methyl mercury			
Median	0.063	0.078	0.066
Range	N.D. ～ 0.14	0.022 ～ 0.29	N.D. ～ 0.29
Lead			
Median	0.094	0.11	0.097
Range	0.024 ～ 0.17	0.031 ～ 0.28	0.024 ～ 0.28
Cadmium			
Median	0.24	0.25	0.25
Range	0.059 ～ 0.39	0.11 ～ 0.57	0.059 ～ 0.57
Arsenic			
Median	─	2.8	2.8
Range	─	1.0 ～ 14	1.0 ～ 14
Copper			
Median	─	16	16
Range	─	8.2 ～ 26	8.2 ～ 26
Selenium			
Median	─	1.3	1.3
Range	─	0.90 ～ 1.8	0.90 ～ 1.8
Zinc			
Median	─	140	140
Range	─	80 ～ 170	80 ～ 170

3-4 Pesticides, plasticizers, and others survey

3-4-1 Urine study

Pesticides (including metabolites), plasticizers, and others in urine were studied. The results are shown in Tables 13-1 and 13-2.

□ Table 13-1 Statistics of pesticide, plasticizer, and others in urine (1)

(unit：μg/g cr)

Classification	Chemical compound		Statictics	FY 2011 (n=15)	FY 2012 (＊)	Total
Pesticides	Organophosphorous pesticide metabolites	DMP	Median	5.6	2.4	3.3
Pesticides	Organophosphorous pesticide metabolites	DMP	Range	1.8 ～ 14	0.60 ～ 11	0.60 ～ 14
Pesticides	Organophosphorous pesticide metabolites	DEP	Median	5.8	5.6	5.7
Pesticides	Organophosphorous pesticide metabolites	DEP	Range	N.D. ～ 32	N.D. ～ 520	N.D. ～ 520
Pesticides	Organophosphorous pesticide metabolites	DMTP	Median	12	7.7	8.1
Pesticides	Organophosphorous pesticide metabolites	DMTP	Range	N.D. ～ 62	N.D. ～ 82	N.D. ～ 82
Pesticides	Organophosphorous pesticide metabolites	DETP	Median	N.D.	N.D.	N.D.
Pesticides	Organophosphorous pesticide metabolites	DETP	Range	N.D. ～ 2.7	N.D. ～ 8.3	N.D. ～ 8.3
Pesticides	Pyrethroid pesticide metabolites	PBA	Median	0.22	0.22	0.22
Pesticides	Pyrethroid pesticide metabolites	PBA	Range	N.D. ～ 3.4	N.D. ～ 1.6	N.D. ～ 3.4
Pesticides	Pyrethroid pesticide metabolites	DCCA	Median	N.D.	N.D.	N.D.
Pesticides	Pyrethroid pesticide metabolites	DCCA	Range	N.D. ～ 13	N.D. ～ 3.1	N.D. ～ 13
Pesticides	Carbamate pesticide metabolite	Ethylenethiourea	Median	N.D.	N.D.	N.D.
Pesticides	Carbamate pesticide metabolite	Ethylenethiourea	Range	N.D. ～ 0.23	N.D. ～ 0.50	N.D. ～ 0.50
Pesticides	Imidachloprid metabolite	6-Chloronicotinic acid	Median	－	N.D.	N.D.
Pesticides	Imidachloprid metabolite	6-Chloronicotinic acid	Range	－	N.D. ～ 1.8	N.D. ～ 1.8
Pesticides	Fenitrothion metabolite	3-methyl-4-nitrophenol	Median	－	N.D.	N.D.
Pesticides	Fenitrothion metabolite	3-methyl-4-nitrophenol	Range	－	N.D. ～ 2.8	N.D. ～ 2.8
Pesticides	Parathion metabolite	p-nitrophenol	Median	－	0.67	0.67
Pesticides	Parathion metabolite	p-nitrophenol	Range	－	0.23 ～ 4.6	0.23 ～ 4.6
Pesticides	Acephate		Median	－	N.D.	N.D.
Pesticides	Acephate		Range	－	N.D. ～ 0.30	N.D. ～ 0.30
Pesticides	Methamidophos		Median	－	N.D.	N.D.
Pesticides	Methamidophos		Range	－	N.D. ～ 0.058	N.D. ～ 0.058
Plasticizers	Phthalate metabolites	MBP	Median	20	17	18
Plasticizers	Phthalate metabolites	MBP	Range	11 ～ 670	6.6 ～ 540	6.6 ～ 670
Plasticizers	Phthalate metabolites	MEHP	Median	4.2	2.9	3.0
Plasticizers	Phthalate metabolites	MEHP	Range	0.98 ～ 8.1	0.61 ～ 21	0.61 ～ 21
Plasticizers	Phthalate metabolites	MEHHP	Median	15	9.9	10
Plasticizers	Phthalate metabolites	MEHHP	Range	5.7 ～ 44	2.7 ～ 59	2.7 ～ 59
Plasticizers	Phthalate metabolites	MEOHP	Median	9.6	6.3	6.6
Plasticizers	Phthalate metabolites	MEOHP	Range	4.6 ～ 18	1.6 ～ 31	1.6 ～ 31
Plasticizers	Phthalate metabolites	MBzP	Median	0.59	0.68	0.67
Plasticizers	Phthalate metabolites	MBzP	Range	0.25 ～ 10	N.D. ～ 38	N.D. ～ 38

＊ In FY 2012, the number of subjects was 84 for phthalate metabolites and 30 for other chemical compounds.

□ Table 13-2 Statistics of pesticide, plasticizer, and others in urine (2)

(unit：μg/g cr)

Classification	Chemical compound		Statictics	FY 2011 (n=15)	FY 2012 (＊)	Total
Others	Iodine		Median	—	310	310
			Range	—	110 ～ 3,000	110 ～ 3,000
	Perchloric acid		Median	—	3.5	3.5
			Range	—	1.2 ～ 10	1.2 ～ 10
	Triclosan		Median	1.3	1.3	1.3
			Range	0.27 ～ 79	0.15 ～ 120	0.15 ～ 120
	Bisphenol A		Median	0.76	0.44	0.47
			Range	0.23 ～ 1.4	N.D. ～ 31	N.D. ～ 31
	Deet		Median	—	All N.D.	All N.D.
			Range	—		
	PAHs	1-Hydoroxypyrene	Median	—	0.19	0.19
			Range	—	0.045 ～ 0.76	0.045 ～ 0.76
		1&9-Hydroxyphenanthrene	Median	—	0.15	0.15
			Range	—	0.038 ～ 0.60	0.038 ～ 0.60
		2-Hydroxyphenanthrene	Median	—	0.14	0.14
			Range	—	0.031 ～ 0.39	0.031 ～ 0.39
		3-Hydroxyphenanthrene	Median	—	0.24	0.24
			Range	—	0.077 ～ 0.65	0.077 ～ 0.65
		4-Hydroxyphenanthrene	Median	—	N.D.	N.D.
			Range	—	N.D. ～ 0.20	N.D. ～ 0.20
	Parabens	Methylparaben	Median	—	55	55
			Range	—	1.3 ～ 870	1.3 ～ 870
		Ethylparaben	Median	—	2.5	2.5
			Range	—	N.D. ～ 120	N.D. ～ 120
		Propylparaben	Median	—	1.0	1.0
			Range	—	N.D. ～ 71	N.D. ～ 71
		Butylparaben	Median	—	N.D.	N.D.
			Range	—	N.D. ～ 25	N.D. ～ 25
		Benzylparaben	Median	—	All N.D.	All N.D.
			Range	—		
	Benzophenone-3		Median	—	N.D.	N.D.
			Range	—	N.D. ～ 120	N.D. ～ 120
	Cotinine		Median	—	0.92	0.92
			Range	—	0.060～1,600	0.060～1,600
	Caffeine		Median	—	1,100	1,100
			Range	—	0.36 ～ 9,100	0.36 ～ 9,100
	Phytoestrogens	Genistein	Median	—	1,700	1,700
			Range	—	360 ～ 5,700	360 ～ 5,700
		Daidzein	Median	—	2,700	2,700
			Range	—	240 ～ 7,800	240 ～ 7,800
		Equol	Median	—	690	690
			Range	—	6.1 ～ 28,000	6.1 ～ 28,000

＊ In FY 2012, the number of subjects was 84 for bisphenol A and 30 for other chemical compounds.

3-5 POPs survey

3-5-1 Blood and food study

The results of POPs concentrations in blood and POPs intake from food in FY 2011 survey are shown in Tables 14-1 and 14-2.

☐ Table 14-1 Statistics of blood POPs concentration and POPs intake from food (1)

Classification	Chemical compounds	Statictics	Blood concentration FY 2011(n=86)	Intake from food FY 2011(n=15)
		Unt	pg/g-fat	pg/kg/day
PCB	MoCBs	Median	N.D.	7.4
		Range	N.D. ～ 430	3.0 ～ 89
	DiCBs	Median	100	200
		Range	N.D. ～ 800	100 ～ 620
	TrCBs	Median	920	400
		Range	210 ～ 3700	180 ～ 1400
	TeCBs	Median	6400	750
		Range	650 ～ 33000	230 ～ 4100
	PeCBs	Median	18000	930
		Range	1900 ～ 140000	130 ～ 8200
	HxCBs	Median	87000	980
		Range	12000 ～ 670000	100 ～ 14000
	HpCBs	Median	62000	420
		Range	10000 ～ 520000	37 ～ 7500
	OcCBs	Median	13000	71
		Range	2600 ～ 110000	4.1 ～ 1100
	NoCBs	Median	1300	11
		Range	370 ～ 6600	1.1 ～ 91
	DeCB	Median	630	6.0
		Range	220 ～ 2500	0.74 ～ 50
	Total PCB	Median	190000	5100
		Range	31000 ～ 1400000	820 ～ 35000
DDT	o,p'-DDD	Median	N.D.	39
		Range	N.D. ～ 500	4.1 ～ 550
	p,p'-DDD	Median	730	380
		Range	N.D. ～ 5000	19 ～ 4900
	o,p'-DDE	Median	200	27
		Range	N.D. ～ 1100	4.8 ～ 210
	p,p'-DDE	Median	120000	1600
		Range	17000 ～ 1000000	240 ～ 8200
	o,p'-DDT	Median	600	66
		Range	N.D. ～ 4500	8.5 ～ 1400
	p,p'-DDT	Median	6100	300
		Range	1100 ～ 29000	28 ～ 7600
Chlordane	*cis*-Chlordane	Median	100	490
		Range	N.D. ～ 800	63 ～ 1400
	trans-Chlordane	Median	N.D.	170
		Range	N.D. ～ 400	41 ～ 800
	Oxychlordane	Median	10000	95
		Range	1600 ～ 43000	22 ～ 340
	cis-Nonachlor	Median	3700	130
		Range	600 ～ 29000	10 ～ 950
	trans-Nonachlor	Median	23000	440
		Range	3000 ～ 110000	59 ～ 2100
Drins	Aldrin	Median	All N.D.	N.D.
		Range		N.D. ～ 5.2
	Dieldrin	Median	3200	510
		Range	1300 ～ 40000	71 ～ 1800
	Endrin	Median	All N.D.	69
		Range		N.D. ～ 200
Hexachlorobenzene(HCB)		Median	14000	630
		Range	3400 ～ 39000	160 ～ 2100

☐ Table 14-2 Statistics of blood POPs concentration and POPs intake from food (2)

Classification	Chemical compounds	Statictics	Blood concentration FY 2011(n=86)	Intake from food FY 2011(n=15)
		Unt	pg/g-fat	pg/kg/day
Hptachlor	Heptachlor	Median	All N.D.	13
		Range		4.5 ～ 47
	cis-Heptachlorepoxide	Median	1800	110
		Range	600 ～ 6500	63 ～ 430
	trans-Heptachlorepoxide	Median	All N.D.	All N.D.
		Range		
Toxaphene	parlar-26	Median	790	52
		Range	N.D. ～ 3500	N.D. ～ 340
	parlar-50	Median	1100	98
		Range	N.D. ～ 4300	1.5 ～ 550
	parlar-62	Median	0	73
		Range	N.D. ～ 3400	N.D. ～ 430
Mirex		Median	1800	14
		Range	400 ～ 6600	2.2 ～ 190
PBDE	TeBDEs	Median	520	290
		Range	180 ～ 1100	160 ～ 1500
	PeBDEs	Median	210	150
		Range	N.D. ～ 870	63 ～ 710
	HxBDEs	Median	800	36
		Range	N.D. ～ 2600	8.9 ～ 510
	HpBDEs	Median	All N.D.	N.D.
		Range		N.D. ～ 40
	OcBDEs	Median	300	25
		Range	N.D. ～ 3400	N.D. ～ 110
	NoBDEs	Median	N.D.	36
		Range	N.D. ～ 2000	N.D. ～ 120
	DeBDEs	Median	700	230
		Range	N.D. ～ 5100	72 ～ 980
	Total PBDEs	Median	2600	780
		Range	500 ～ 8600	530 ～ 3000
Pentachlorobenzene		Median	300	63
		Range	40 ～ 1500	31 ～ 220
HCH	α -HCH	Median	120	160
		Range	N.D. ～ 1200	64 ～ 1000
	β -HCH	Median	27000	250
		Range	2800 ～ 240000	48 ～ 2000
	γ -HCH	Median	N.D.	47
		Range	N.D. ～ 1000	23 ～ 430
	δ -HCH	Median	All N.D.	14
		Range		3.7 ～ 29
Chlordecone		Median	N.D.	All N.D.
		Range	N.D. ～ 1.0	
Hexabromobiphenyl		Median	N.D.	N.D.
		Range	N.D. ～ 700	N.D. ～ 6.3
Endosulfan	α - Endosulfan	Median	1300	570
		Range	N.D. ～ 3700	390 ～ 1300
	β - Endosulfan	Median	N.D.	280
		Range	N.D. ～ 1200	130 ～ 810
HBCD	α -HBCD	Median	N.D.	N.D.
		Range	N.D. ～ 10	N.D. ～ 9.0
	β -HBCD	Median	All N.D.	All N.D.
		Range		
	γ -HBCD	Median	N.D.	All N.D.
		Range	N.D. ～ 3.4	
	δ -HBCD	Median	All N.D.	All N.D.
		Range		
	ε -HBCD	Median	All N.D.	All N.D.
		Range		

3-6 Radioactive substances survey

3-6-1 Blood, urine, and food study

The results of radioactive substances concentrations for FY 2012 survey are shown in Table 15.

☐ Table 15 Statistics of radioactive substances concentrations

（unit：Bq/kg）

Classification	Chemical compounds	Statictics	Blood concentration FY 2012(n=84)	Urine concentration FY 2012(n=84)	Diet concentration FY 2012(n=15)
Cesium	Cesium-134	Average	All N.D.	All N.D.	All N.D.
		Standard deviation			
		Median			
		Range			
	Cesium-137	Average	All N.D.	0.027	All N.D.
		Standard deviation		0.18	
		Median		N.D.	
		Range		N.D. ～ 1.2	
Iodine	Iodine -131	Average	All N.D.	All N.D.	All N.D.
		Standard deviation			
		Median			
		Range			
Potassium	Potassium -40	Average	67	42	32
		Standard deviation	12	20	8.0
		Median	67	41	29
		Range	41 ～ 95	12 ～ 120	22 ～ 48

＊ Cesium-137 was detected from 2 out of 84 urine samples. Potassium-40 was detected from all blood, urine, and diet samples.

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Supplementary Information

Overview of the Survey on Accumulation of Dioxins in Humans (FY2002 ～ FY2010)

(1) Nationwide survey

● Blood dioxin concentrations

☐ Table 16 Blood dioxin concentrations by fiscal year

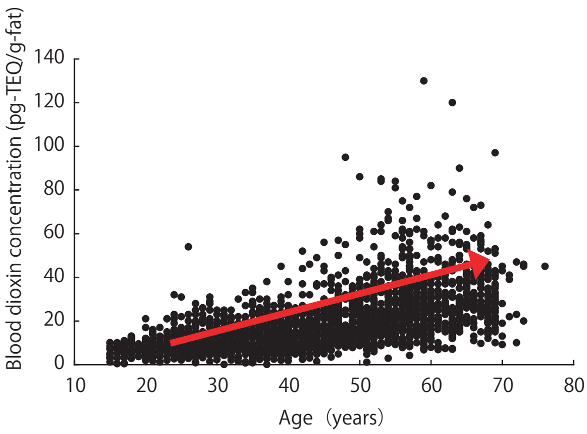
(unit: pg-TEQ/g-fat)

Survey year	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	Nine-year average
Subjects (N)	259	272	264	288	291	282	257	178	175	Total:2,264
Age (years)										
Average	44.4	41.7	45.2	44.3	43.0	44.2	47.6	46.3	44.4	44.5
Range	16～72	15～69	15～70	15～70	15～72	15～69	17～70	18～76	16～70	15～76
PCDDs+PCDFs Co-PCBs										
Average	22	19	19	22	17	20	21	17	14	19
Standard deviation	14	12	13	15	12	15	15	12	13	14
Median	19	17	16	17	14	16	17	14	11	16
Range	0.96～95	2.7～97	0.64～85	1.5～75	0.82～67	1.6～120	0.43～130	1.1～59	0.10～82	0.10～130

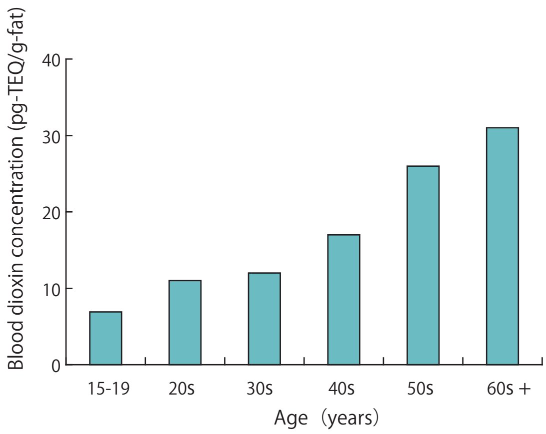
(According to WHO 2006 TEFs)

● Relationship to age

☐ Figure 1 Relationship between age and blood dioxin concentrations



☐ Figure 2 Blood dioxin concentrations by age group



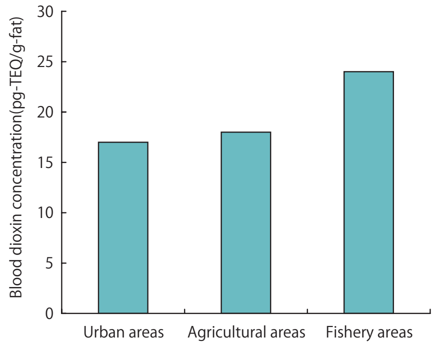
(According to WHO 2006 TEFs)

Differences in blood dixin concentrations by area

☐ Table 17 Blood dioxin concentrations by types of survey area

	Urban areas	Agricultural areas	Fishery areas
Subjects (N)	938	675	651
Average age (years)	43.5	45.4	44.8
Blood dioxin concentration (pg-TEQ/g-fat)			
Average	17	18	24
Standard deviation	11	12	17
Median	15	15	19
Range	0.11～77	0.10～97	0.43～130

(According to WHO 2006 TEFs)



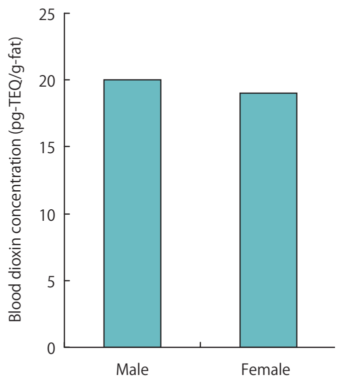
(According to WHO 2006 TEFs)

Difference in blood dioxin concentrations by gender

☐ Table 18 Blood dioxin concentrations by gender

	Male	Female
Subjects (N)	1,063	1,201
Average age (years)	43.5	45.3
Blood dioxin concentration (pg-TEQ/g-fat)		
Average	20	19
Standard deviation	15	13
Median	16	16
Range	0.64～130	0.10～95

(According to WHO 2006 TEFs)



Dioxin intake from food

☐ Table 19 Dioxin intake from food by fiscal year

Study year	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	Nine-year average
Subjects (N)	75	75	75	75	75	75	75	50	50	Total: 625
Dioxin intake from food (pg-TEQ/kg/day)										
Average	1.1	1.1	0.89	0.89	0.57	0.75	0.68	0.79	0.44	0.82
Standard deviation	1.1	0.92	0.66	0.89	0.44	0.90	0.75	1.2	0.42	0.86
Median	0.75	0.91	0.68	0.59	0.41	0.46	0.39	0.43	0.34	0.56
Range	0.058～5.6	0.14～5.6	0.16～3.7	0.13～5.2	0.099～2.2	0.060～6.2	0.054～4.8	0.055～6.2	0.031～2.0	0.031～6.2

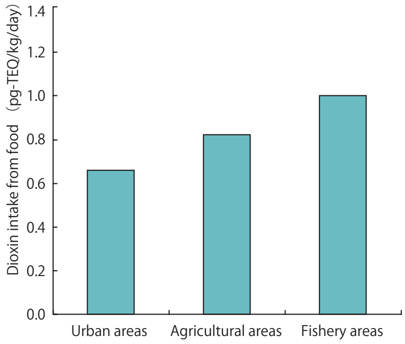
(According to WHO 2006 TEFs)

Differences in dioxin intake from food by area

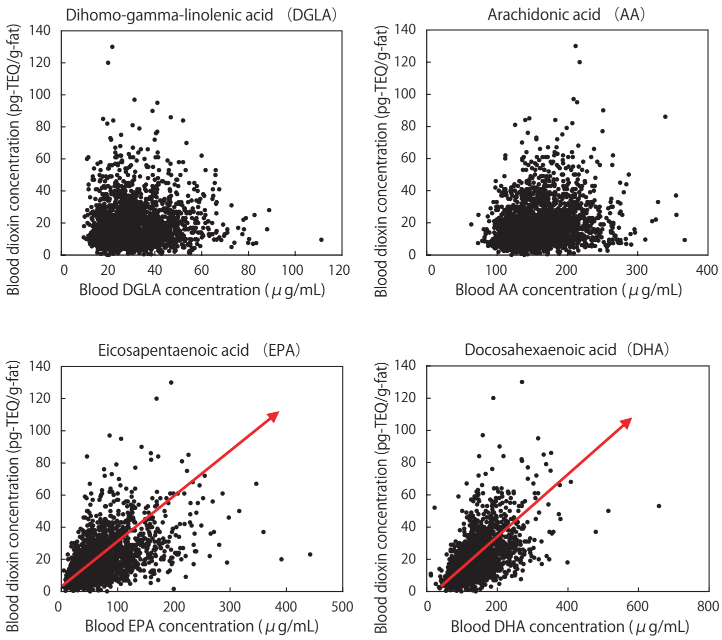
☐ Table 20 Dioxin intake from food by area

	Urban areas	Agricultural areas	Fishery areas
Subjects (N)	229	201	195
Dioxin intake from food (pg-TEQ/kg/day)			
Average	0.66	0.82	1.0
Standard deviation	0.65	0.86	1.0
Median	0.46	0.53	0.71
Range	0.031〜6.2	0.080〜5.6	0.054〜6.2

(According to WHO 2006 TEFs)

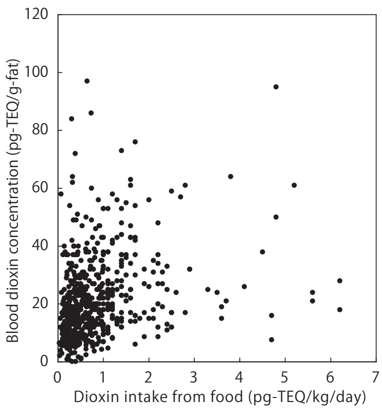


☐ Figure 3 Relationship between fatty acids and blood dioxin concentrations



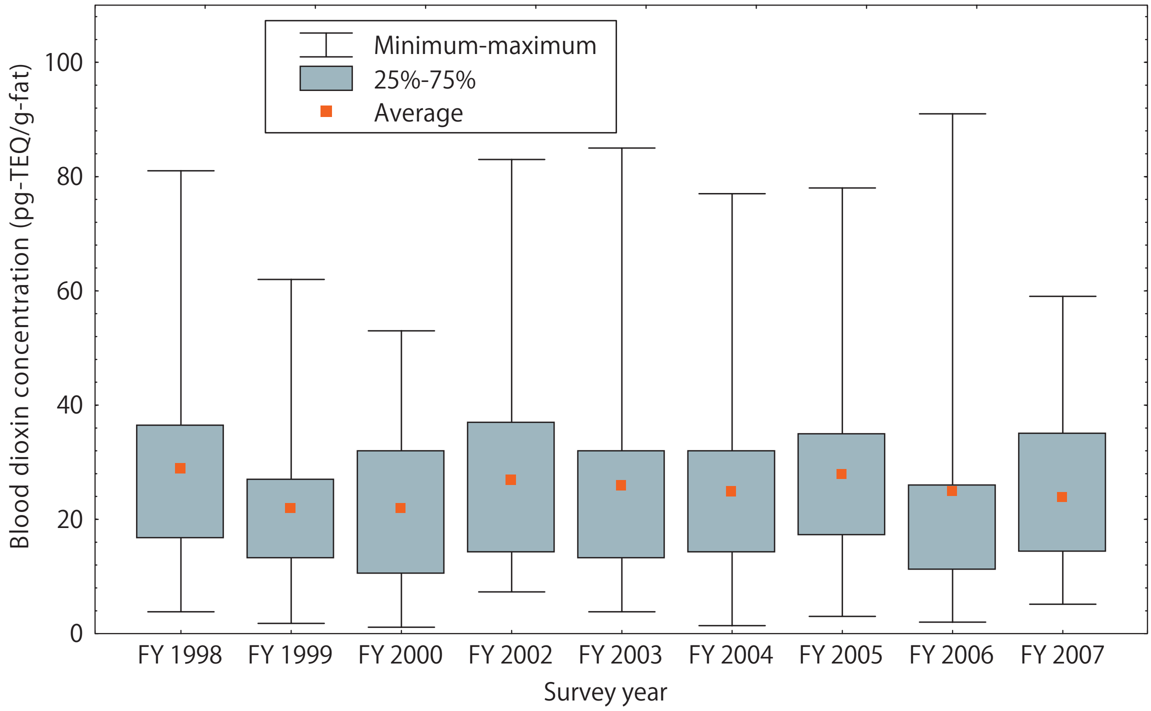
Relationship to blood dioxin concentrations

☐ Figure 4 Relationship between dioxin intake from food and blood dioxin concentrations

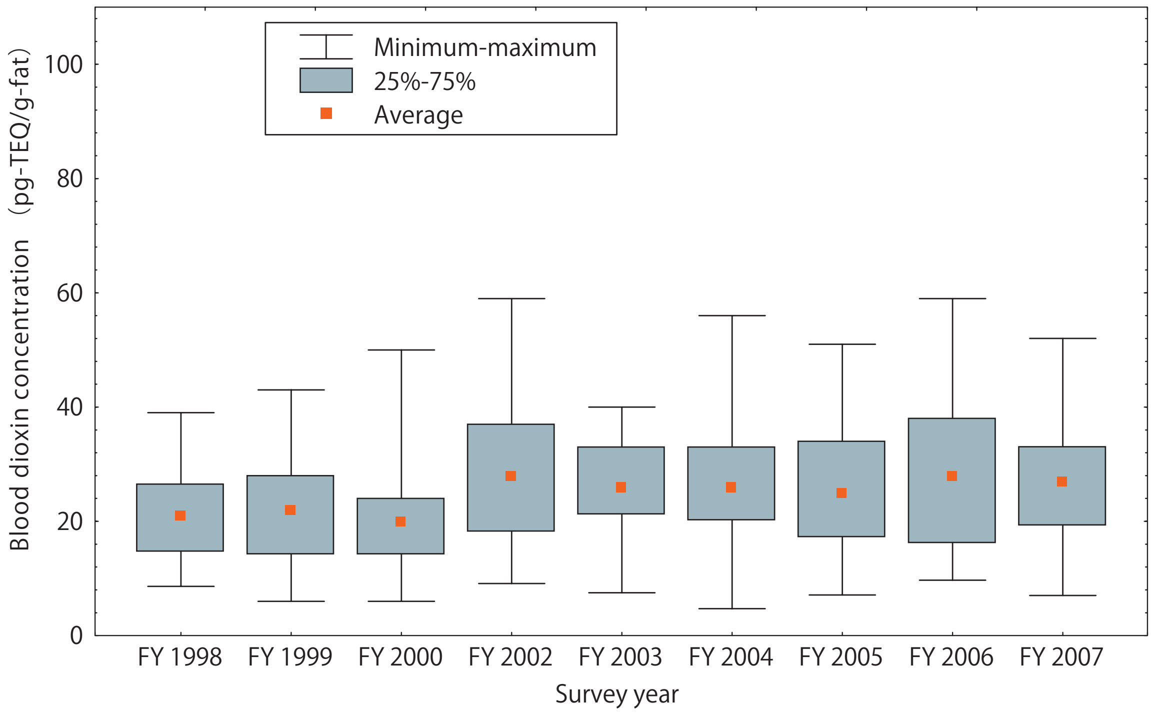


(2) Follow-up survey

☐ Figure 5 Chronological change in blood dioxin concentrations in Nose, Osaka Prefecture



☐ Figure 6 Chronological change in blood dioxin concentrations in Saitama Prefecture



Chemical compounds which measured it in this survey

1． Dioxins

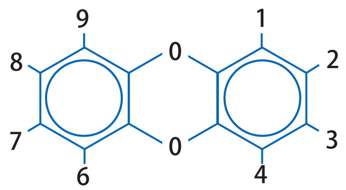
1.1 Structure of dioxins

Polychlorodibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are collectively called dioxins. Co-planar polychlorinated biphenyls (co-planar PCBs or dioxin-like PCBs) possess toxicity similar to those of dioxins and are called dioxin-like compounds.

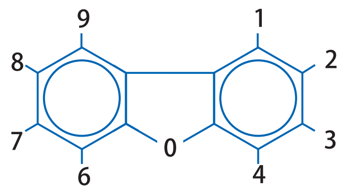
"Dioxins" are defined to include PCDDs, PCDFs and co-planar PCBs in Japan's Law Concerning Special Measures against Dioxins, promulgated on July 16, 1999.

Accordingly, throughout this report, the term "dioxins" will be used to refer to PCDDs, PCDFs, and co-planar PCBs.

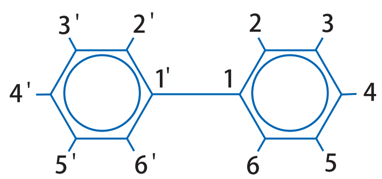
The chemical structure of a dioxin molecule is generally composed of two rings of six carbon atoms (benzene rings, shown as in the figure below) bound by oxygen atom(s) (shown as O in the figure below) with chlorine or hydrogen atoms attached (the numbered positions: 1-9 and 2'-6' in the figure below). There are 75 types of PCDDs, 135 types of PCDFs and 12 types of co-planar PCBs, depending on the numbers and locations of the attached chlorine atoms (among these dioxins, 29 types have toxicities similar to 2,3,7,8-TCDD toxicity).



PCDDs



PCDFs



PCBs※

※ PCB compounds in which the two benzene rings are on the same plane, thereby giving the compound a flat structure, are known as co-planar PCBs. Some PCBs, which do not have the planar structure but possess dioxin-like toxicity, are classified for practical reasons as co-planar PCBs in current documents of the Government of Japan.

1.2 Properties of dioxins

Dioxins in general are colorless solids of very low water solubility and low vapor pressure. On the other hand, dioxins characteristically exhibit a high degree of solubility in fats and oils. They are generally stable, not reacting easily with other compounds, acids, and alkalis, but are considered to gradually decompose in the presence of solar ultraviolet light.

1.3 Toxicity of dioxins

Carcinogenicity and chronic toxicity have long been used to assess the health risks posed by the toxicities of dioxins. Dioxins have been reported to show carcinogenicity in rats, producing hepatocellular carcinoma, follicular adenoma of the thyroid, lymphoma, and other tumors. As for the carcinogenic mechanism of dioxins, they are considered to act as a promoter—that is, dioxins do not act directly on genes; rather, they promote the carcinogenic activity of other carcinogens. At present, the International Agency for Research on Cancer (IARC) of the World Health Organization (WHO) has classified 2,3,7,8-TCDD as a human carcinogen. In terms of hepatotoxicity, it is recognized to cause elevated liver enzymes and hyperlipidemia. When the WHO reevaluated the risk assessment of dioxins and related compounds in 1998, and whenever risk assessments in and outside Japan have been conducted thereafter, reproductive organ toxicity, central nervous system toxicity and immune system toxicity were identified as adverse effects observed after birth following dioxin exposure during the fetal stage, and these toxicities have been used as endpoints of dioxins. Shortened anogenital distance in males, congenital abnormalities in the vagina, diminished learning ability, diminished resistance to viral infection and other outcomes in laboratory animals are used as endpoints. At present, the effects of dioxins are widely recognized to develop as a result of endocrine disruption through the arylhydrocarbon receptor (AhR) within cells. However, further studies are required, since there is very little understanding of why these diverse toxicities appear.

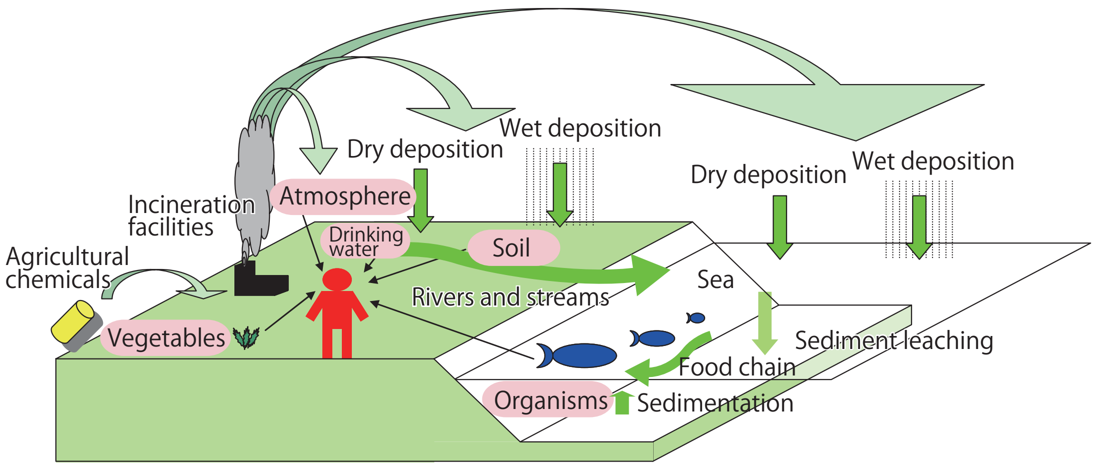
1.4 Generation and behavior of dioxins in the environment

Dioxins are not produced intentionally, except for research purposes, *i.e.*, production of a standard material for dioxin analysis. Dioxins are by-products generated during the processes that occur when heat is applied to substances containing carbon, oxygen, hydrogen and chlorine.

The major source of dioxins at present is waste incineration, particularly the incineration of plastic waste and other products made from fossil fuels. Dioxins are formed in combustion processes and emitted into the air without being fully captured by waste-gas treatment equipment. Other sources exist, such as emissions from electric steel-making furnaces, cigarette smoke, and automobile exhaust. Some reports indicate that dioxins may have accumulated in bottom sediment in aquatic environments owing to the past use of PCBs and some types of agricultural chemicals, which contain dioxins as impurities.

The behavior of dioxins in the environment is not fully known. For example, dioxins in the air may stick to particulate matter, fall to the ground, and pollute soil and water. It is considered that over long period of time, these dioxins, together with those released into the environment via various other pathways, ultimately accumulate in aquatic sediments and enter the food chain when ingested by plankton and fish, thereby accumulating in various organisms in the biota.

While dioxins are mostly anthropogenically made, small amounts are generated in the nature. For instance, dioxins are said to be produced through forest fires and volcanic activity.



1.5 Brominated dioxins

Brominated dioxins have similar structure as chlorinated dioxins, where a part of chlorines of chlorinated dioxins are substituted by bromines.

Like chlorinated dioxins, brominated dioxins are not produced intentionally except for research purposes and are by-products that occur when heat is applied to organobromine compounds and combustion processes. It is said to be produced especially through heating processes during production and processing of plastics including Brominated Flame Retardants.

The toxicity and health effects are not as much known as chlorinated dioxins.

2. Fluorine compounds

PFOS (perfluorooctanesulfonic acid) and PFOA (perfluorooctanoic acid) are organofluorine compounds, whose fluoride is bound to carbon. The carbon and fluoride are strongly bound to each other, and the compounds are highly resistant to heat and chemicals.

These compound have been used widely as "surfactants" readily soluble to oil and water in water-repellent sprays, foam fire extinguishers, and coatings of nonstick frying pans until very recently.

However, studies have been reported that they are difficult to decompose in environment and within living organisms, and that they have substantial bioaccumulation properties.

PFOS is listed as POPs in Stockholm Convention

In this survey, PFOS and PFOA measurements were conducted for blood and food.

□ Table 21 Fluorine compounds

Chemical compound	Usage	Measurement case in Japan (average)	Standard; Tolerable intake
PFOS PFOA	Used in water-repellent sprays and foam fire extinguishers as surfactants.	＜ Blood ＞ PFOS：6.3 ng/mL PFOA：2.1 ng/mL （N-609 Ministry of the Environment, Japan 2008-2010） ＜ Food ＞ PFOS: 0.98 ng/kg/day（ND and/or below＝0） 12.1 ng/kg/day（ND and/or below＝1/2 ND） （Maitani et al,. 2007 market-basket system） PFOA： 0.06 ng/kg/day（ND and/or below＝0） 11.5 ng/kg/day（ND and/or below＝1/2 ND） （Maitani et al,. 2007 market-basket system）	※Tolerable intake is not established.

3. Heavy metals

Heavy metals are widely distributed on Earth and are used for various purposes. However, some heavy metals are potentially toxic within organisms.

In the past, Japan have experienced pollution-related health damage due to heavy metals, such as Minamata Disease caused by methyl mercury and Itai-Itai Disease caused by cadmium.

☐ Table 22 Heavy metals studied in this survey

Chemical compound	Usage	Case study in Japan (average)	Standard; Tolerable intake
Total mercury Methyl mercury	Metal mercury is used in fluorescent lights, amalgam, batteries, catalysts, and others. Merhyl mercury is produced by methylation of metal mercury. Methyl mercury is highly toxic.	＜ Total mercury / blood ＞ 5.4 ng/mL (600 mothers, Shimada et al., 2008) 5.18 ng/mL (115 mothers, Sakamoto et al., 2007) 18.2 ng/mL (56 females, Yamauchi et al., 1994) ＜ Total mercury / food ＞ 0.225 μg/kg body weight/day (Tokyo, 2005 10 samples by duplicated portion method) 0.238 μg/kg body weight/day (Tokyo, 2010 market-basket system) ＜ Methyl mercury / food ＞ 0.198 μg/kg/day (Tokyo, 2005 10 samples by duplicated portion method) 0.152 μg/kg/day (Tokyo, 2010 market-basket method)	＜ Methyl mercury ＞ 0.29 μg/kg body weight/day 2.0 μg/kg body weight/week
Cadmium	Used in watch batteries, plating materials, and others. Cadmium is produced with zinc and is recovered in the process of zinc refinery.	＜ Urine ＞ 3.46 μg/g cr* (1243 females, Kayama et al., 2000 – 2001) 1.26 μg/g cr* (10753 females, Ikeda et al., 2000 – 2001) ＜ Food ＞ 0.320 μg/kg body weight/day (Tokyo, 2005 10 samples by duplicated portion method) 0.317 μg/kg body weight/day (Tokyo, 2010 market-basket method)	7 μg/kg/week (Japan)
Arsenic	In the past, arsenic compounds were used in rat poisons. Organic arsenic is found in seafood (seaweeds, shrimps, crabs) but are basically non-toxic. Inorganic arsenic is highly toxic.	＜ Arsenic speciation / urine ＞ MMA: 2.01 μg/g cr DMA: 40 μg/g cr (248 residents near metropolitan area Chiba et al., 2001) As (III) 4.0 μg/g cr As (V) 0.2 μg/g cr MMA: 3.2 μg/g cr DMA: 38.5 μg/g cr AB: 71.4 μg/g cr (142 males Nakajima et al., 2001)	※ Tolerable intake is not established.
Lead	Used widely in electrodes, weight, glass products, solder, and others.	＜ Food ＞ 0.154 μg/kg body weight/day (Tokyo, 2010 market-basket system) 4.5 μg/kg body weight/week (Ministry of Health, Labour and Welfare, Japan, 2007 market-basket system)	※ Tolerable intake is not established.

* The result of urine cadmium concentration are geometric mean.

4. Pesticides, plasticizers, and others

For those pesticides having harmful effects and are easily decomposed in bodies of organisms, it is general to measure their metabolites in biological samples. Because these metabolites are excreted through urine, metabolites of organophosphorous pesticides, pyrethroid pesticides, and carbamate pesticides in urine was measured in this survey.

In addition, triclosan, used as disinfectant in medicated soaps and shampoos, was measured.

□ Table 23 Pesticide metabolites studied in this survey

Chemical compound	Usage	Case study in Japan (average)
Organophosphorous compound metabolites	Used in pesticides, disinfectant, wood preservatives, and others (metabolites were measured)	＜ Urine ＞ DMP ：1.5 μg/L（73 subjects, Toyama） ：3.1 μg/L（60 subjects, Tokyo） DMTP：3.2 μg/L（73 subjects, Toyama） ：5.8 μg/L（60 subjects, Tokyo） DEP ：0.8 μg/L（73 subjects, Toyama） ：1.2 μg/L（60 subjects, Tokyo） DETP ：<0.5 μg/L（73 subjects, Toyama） ：<0.5 μg/L（60 subjects, Tokyo） （Toyama Institute of Health）
Pyrethroid pesticide metabolites	Used in pesticides, insecticides, and others (metabolites were measured)	＜ Urine ＞ PBA：0.40 μg/g cr （42 males Toshima et al., 2010） PBA：0.73 μg/g cr （448 subjects Ueyama et al, 2009）
Carbamate pesticide metabolites	Used in pesticides, insecticides, and others (metabolites were measured)	—
Triclosan	Used as disinfectant	—

Phthalate ester and bisphenol A are used in the process of plastic manufacturing. These compounds are suspected to be endocrine disruptors (showing hormonal effects within bodies or obstructing hormone action).

Either compounds excrete from bodies in a short period of time. Therefore, concentration in urine was studied in this survey.

☐ Table 24 Plasticizers studied in this survey

Chemical compound	Usage	Case study in Japan (average)
Phthalate monoesters	Used as plasticizer in plastic, adhesive agents, and others	< Urine > MBP : 52.2 μg/g cr (48.1 ng/mL) MEHP : 5.84 μg/g cr (4.44 ng/mL) MEHHP : 10.1 μg/g cr (8.61 ng/mL) MEOHP : 11.0 μg/g cr (9.2 ng/mL) MBzP : 4.70 μg/g cr (3.46 ng/mL) } median 149 pregnant women Suzuki et al., 2010
Bisphenol A	Used as monomer or ingredients in plastic manufacturing	< Urine > 24.1 μg/L (University students 1992) 21.5 μg/L (University students 1999) (Kawamoto et al., 1999)

5. POPs and POPs candidates

Pops is the abbreviation of Persistent Organic Pollutants and has following properties:

○ remain intact for exceptionally long period of time;

○ accumulate in bodies of organisms and are highly bioaccumulative;

○ have long range transport and are widely distributed on Earth; and

○ Have toxic effects within bodies of organisms, etc.

The Stockholm Convention on Persistent Organic Pollutants is a global treaty. Initially, twelve POPs have been recognized, and nine new POPs were amended.

These compounds include those produced and used intentionally as pesticides and others. On the other hand, there are compounds like dioxins, which could be produced in the process of combustion or manufacturing of other chemicals.

In the Convention, each party is to prohibit the production, use, and import and export of POPs, and to take every appropriate measure possible in eliminating and reducing the unintentionally produced compounds. Furthermore, each party is encouraged and/or to undertake measures for POPs under Stockholm Convention. Thus, considering this, monitoring surveys of the environment and biological samples are conducted by MOE of Japan.

In this survey, all POPs, listed in Stockholm Convention, in blood and food was measured.

☐ Table 25 POPs studied in this survey

Chemical compound	Usage
Dioxins	Produced unintentionally due to combustion, as well during the manufacture of chlorinated substances
PCBs	Used as heat exchange fluids, in electric transformers, and as additives in carbonless copy papers and such
DDT	Used as hygiene pesticides and insecticides
Chlordane	Used to control termites and as pesticides
Aldrin	Used as pesticides
Dieldrin	Used as pesticides, insecticides, and termite control
Endrin	Used as pesticides
Hexachlorobenzen (HCB)	Used as material for herbicide manufacturing
Heptachlor	Used as pesticide and termite control
Toxaphene	Used as pesticides overseas
Mirex	Used as pesticides overseas
PBDE	Used as fire-retardant
Pentachlorobenzene	Used as chemical intermediate of agricultural fungicides
HCH	Used as pesticides
Chlordecone	Used as insecticides overseas
Hexabromobiphenyl	Used as fire-retardant
Endosulfan	Used as pesticides and insecticides
HBCD	Used as fire-retardant

6. Radioactive substances

Radioactive substances emit radiation with radioactive decay over time. These substances are present in nature but are also emitted into the environment through explosion of atomic bombs and nuclear power plant accidents. In FY 2012, potassium 40 which is present in nature, and cesium 134, cesium 137, and iodine 131 which are emitted into the environment through explosion of atomic bombs and nuclear power plant accidents were studied.

7. Dioxin intake

In Japan, the tolerable daily intake (TDI) of dioxins was set at 4 pg-TEQ/kg/day in June 1999, based on the latest available scientific information. Safety of the total amount of dioxins ingested by humans is evaluated by comparing with this value.

On the average, the total daily intake of dioxins by the Japanese people is estimated to be approximately 0.69 pg-TEQ/kg/day.

A similar figure has been reported in Western countries.

Conceivable routes of intake include food and the ambient air and soil, but the intake from food is estimated to account for the largest portion. A survey by the Ministry of Health, Labour and Welfare, Japan (FY 2011 Survey on the Daily Intake of Dioxins from Food) estimated the daily intake at approximately 0.68 pg-TEQ/kg/day. A survey by the Ministry of the Environment (FY 2011 Environmental Survey of Dioxins) estimated the intake from the ambient air at approximately 0.0082 pg-TEQ/kg/day and the intake from soil at approximately 0.0039pg-TEQ/kg/day. These levels are below the TDI and thereby considered to be below the level which can cause adverse effects on human health.

Once dioxins are absorbed into the body, they remain mostly in the adipose tissue. The rate of decomposition and excretion of dioxins is very slow. It is reported to take approximately seven years for dioxin concentrations to be reduced by one half (half life) in humans.

☐ Figure 7 Specification of the average daily intake of dioxins by the Japanese people (FY 2011) Note 1

■ Converted to amount per kg of body weight

Total approx. 0.69 pg-TEQ/kg/day

Ambient air	0.0082 pg-TEQ/kg/day	0.0121 pg-TEQ/kg/day	Ambient air Note 2
Soil	0.0039 pg-TEQ/kg/day		Soil Note 3
Seafood	0.6308 pg-TEQ/kg/day	0.6774pg-TEQ/kg/day	Food Note 4
Meat and eggs	0.0416 pg-TEQ/kg/day		
Milk and dairy products	0.0008 pg-TEQ/kg/day		
Highly pigmented vegetables	0.0002 pg-TEQ/kg/day		
Grains and potatoes	0.0006 pg-TEQ/kg/day		
Others	0.0034 pg-TEQ/kg/day		

Estimated intake

Tolerable daily intake (TDI) 4 pg-TEQ/kg/day

(According to WHO 2006 TEFs)

Table 26 and Figure 8 show chronological change of estimated total daily intake of dioxins by the Japanese people using the results of "Survey on the Daily Intake of Dioxins from Food (Ministry of Health, Labour and Welfare, Japan)" and "Environmental Survey of Dioxins (the Ministry of the Environment, Japan)".
Enforcement of the "Act on Special Measures against Dioxins (Jan,2000)" has decreased emission of dioxins to environment greatly.
Dioxin concentration of food and environment (ambient air and soil) have also decreased.
As a result, trend of total daily intake of dioxins by the Japanese people has decreased.
Further decreases in intake are

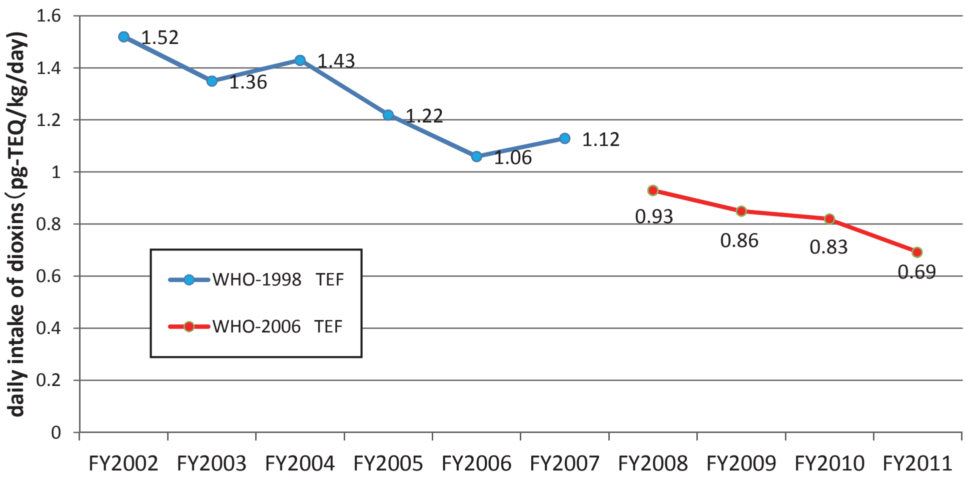
□ Table 26 Chronological change in of the average daily intake of dioxins by Japanese people Note 1, Note 5

pg-TEQ/kg/day

		FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Ambient air Note 2		0.028	0.019	0.018	0.015	0.015	0.012	0.011	0.0093	0.0093	0.0082
Soil Note 3		0.0068	0.0052	0.0044	0.0040	0.0038	0.0054	0.0056	0.0042	0.0042	0.0039
Food Note 4	Seafood	1.290	1.147	1.245	1.090	0.9400	1.033	0.8634	0.7840	0.7626	0.6308
	Meat and eggs	0.150	0.141	0.101	0.0686	0.0704	0.0422	0.0396	0.0398	0.0416	0.0416
	Milk and dairy products	0.0346	0.0322	0.0468	0.0328	0.0212	0.0226	0.0076	0.013	0.0028	0.0008
	Highly pigmented vegetables	0.0030	0.002	0.0028	0.0028	0.001	0.0006	0.0008	0.0004	0.0006	0.0002
	Grains and potatoes	0.001	0.001	0.0026	0.0022	0.0054	0.001	0.0008	0.001	0.0004	0.0006
	Others	0.010	0.0070	0.010	0.0064	0.0064	0.0058	0.0030	0.0042	0.0054	0.0034
Total approx.		1.52	1.36	1.43	1.22	1.06	1.13	0.93	0.86	0.83	0.69

(According to WHO 1998 TEFs from FY2002 to FY2007, WHO 2006 TEFs from FY2008 to FY2011)

□ Figure 8 Chronological change in the average daily intake of dioxins by Japanese people Note 1, Note 5



Note 1 :Created by MOE based on "Environmental Survey of Dioxins [MOE] " and "Survey on the Daily Intake of Dioxins from Food [MHLW] - Health and Labour Sciences Research"
Note 2 :Values used for statistical analysis were derived as follows :average the general environmental monitoring data and the roadside monitoring data, respectively, multiply each average value by the number of monitoring points, add the multiplied values, and divide this value by the total number of monitoring points.
Note 3 :Values are average of the general environmental monitoring data.
Note 4 :The significant figures are based on the daily intake values of dioxins from each food groups and total food.
Note 5 :As handling of significant figures, etc. had changed after FY 2009, there were cases in which values including the last digit differed from results of previous fiscal year.

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