The Exposure to chemical compounds in the Japanese People

-Survey of the Exposure to chemical compounds in Human (2018～)-

2025

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

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1. Overview of "Survey of the exposure to chemical compounds in humans (Pilot Survey)"

The Ministry of the Environment, Japan, has been conducting continuous monitoring surveys to assess the exposure of chemical substances to humans in our country.

From fiscal year 2002 to 2010, a survey on the accumulation of chemical substances, including dioxins, in humans was carried out. In this survey, the blood dioxin levels of 2,264 individuals residing in typical environments across Japan were measured. Additionally, dioxin levels in the diet of 625 of these individuals were measured to estimate the intake of dioxins through food.

In fiscal year 2011, "Survey of the Exposure to chemical compounds in Humans, including Dioxins" was conducted, followed by "Survey of the Exposure to chemical compounds in Humans" from fiscal year 2012 to 2016. In these surveys, blood samples were collected from 490 people and urine samples from 491 people across 18 regions. The concentrations of chemicals such as metals, organic fluorine compounds, and pesticides were measured, and the intake of chemicals through diet was calculated for 90 individuals.

In fiscal year 2017, after reviewing for a more efficient and effective surveys, issues such as the recruitment method for survey participants and improvements to questionnaires were identified. Based on this, the "Survey of the exposure to chemical compounds in Humans (Pilot Survey)" was started in fiscal year 2018 to examine the issues mentioned above.

This brochure summarizes the Pilot Survey results from fiscal year 2018 to fiscal year 2024. However, it should be noted that the methods for selecting participants and the age distribution of the survey subjects are not uniform, making it difficult to make direct comparisons with past measurements or with other suveys.

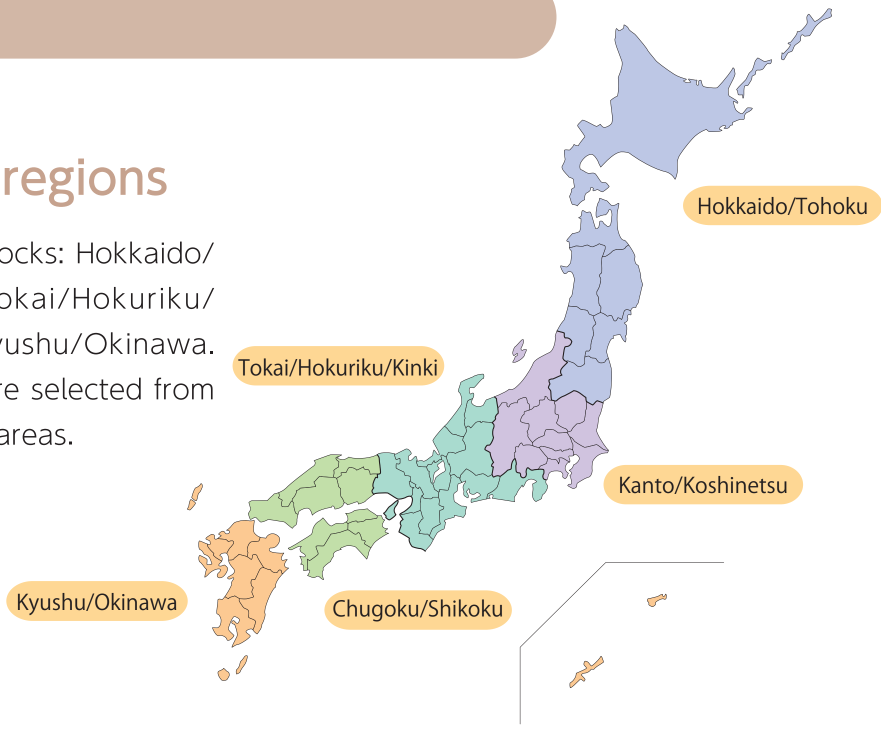
"Survey of the exposure to chemical compounds in Humans (Pilot Survey)"

Survey entity	Environmental Risk Assessment Office, Environmental Health Department, Ministry of the Environment, Japan
Survey period	From FY 2018
Survey regions	21 regions
Survey details	Blood/Hair (to assess chemical substance internal dose) ※Hair : FY 2024～ Urine (to assess the excretion of rapidly metabolized substances) Lifestyle survey (to assess the lifestyle conditions)
Number of participants	606 people (FY 2018・FY 2019, 90 people; FY 2020, 80 people; FY 2021, 121 people; FY 2022, 89 people; FY 2023, 108 people; FY 2024, 118 people)

2. Survey method

2-1 Survey target regions

Japan was divided into five blocks: Hokkaido/Tohoku, Kanto/Koshinetsu, Tokai/Hokuriku/Kinki,Chugoku/Shikoku, and Kyushu/Okinawa. For each fiscal year, regions were selected from different blocks as survey target areas.



2-2 Participant recruitment

In the survey target areas, recruitment of participants was conducted using various methods as shown below, and the effectiveness of these recruitment methods was also evaluated.

Recruitment method of the participants

Survey FY	Recruitment method
2018	・Recruitment of registered monitors ・Recruitment of fishing cooperative members
2020	・Recruitment via community magazines ・Recruitment of registered monitors ・Recruitment at universities (posters on bulletin boards)
2021	・Recruitment via community magazines ・Recruitment of registered monitors ・Recruitment at universities (mailing lists within the university)
2022	・Recruitment through newspaper flyers ・Recruitment through municipal newsletters ・Recruitment at universities (mailing lists within the university)
2023	・Survey participation was requested through mails sent to selected local residents based on their gender and age ・Survey participant was requested by directly visiting the selected local residents based on their gender and age. ・Recruitment through newspaper flyers
2024	・Survey participation was requested through mails sent to selected local residents based on their gender and age ・Survey participation was requested through mails sent to all households in the area.

The criteria of survey participants are as shown below.

Criteria of survey participants	・Age 20 and above (age 18 and above in FY 2024) ・Blood collection can be performed without restrictions (*e.g.* anemia).

Additionally, when the number of applicants exceeded the expected number, selection was made based on factors such as age distribution and gender ratio.

2-3 Methods

The methods are as shown below.

● Blood (all participants)

Blood was collected from survey participants by a nurse or a clinical laboratory technician in the presence of a physician. Generally, fasting blood samples were taken.

Analytes for blood

Analytes	FY 2018 FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Chlorinated dioxins				○		
Organofluorine compounds		○	○	○	○	○
Metals		○	○	○	○	○
General health checkup items (such as blood cell count, liver function, kidney function, glucose metabolism, blood lipids, etc.)	○	○	○	○	○	○
Health effect marker items (such as thyroid function, allergy function, fatty acid profile, etc.)	○	○	○	○	○	○

● Urine (all participants)

An early morning urine sample was collected in a container on the day of the blood test.

Analytes for urine

Analytes	FY 2018 FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Metals	○	○	○	○	○	○
Plasticizers	○	○	○	○	○	
Pesticides and their metabolites	○	○	○	○	○	○
Other chemical compounds	○	○	○	○	○	
General health checkup items (urine specific gravity, urine glucose, urine protein, urine creatinine, etc.)	○	○	○	○	○	○

● Hair (Only the desired participants)

Hair samples were collected by nurses and clinical laboratory technicians, who collected about 10 samples using scissors.

Analytes for hair

Analytes	FY 2018 FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Mercury						○

● Lifestyle survey (questionnaire)

Based on the questionnaire filled out in advance by the participants, public health nurses, nutritionists, and nurses conducted one-on-one interviews with the participants to assess their living conditions.

Items of the questionnaire

Medical history, residential history, occupational history, smoking habits, dietary habits, lifestyle, obstetric history, etc.

3. Results

3-1 Chlorinated dioxins

3-1-1 Blood

● Results summary

The blood dioxin concentrations for FY 2022 survey are shown in Table 1.

Table 1 Statistics for blood dioxin concentrations (unit: pg-TEQ/g-fat)

Chemical compounds	Statistics	FY 2022 (n=89)
Blood dioxin concentration (PCDDs+PCDFs+Co-PCBs)	Average	5.6
	Standard deviation	4.2
	Median	5.4
	Range	0.093 ～ 18

(According to WHO-TEF2006)

● Comparison with previous surveys

Table 2 shows a comparison between the measurement results of 2,264 individuals from the 'Survey on the accumulation of dioxins and other chemical substances in humans' conducted from fiscal years 2002 to 2010, and the measurement results from the 'Survey of the Exposure to chemical compounds in Human' conducted from fiscal years 2011 to 2016.

Table 2 Comparison of blood dioxin concentrations with previous surveys (unit: pg-TEQ/g-fat)

	FY 2002 ～ 2010	FY 2011 ～ 2016	FY 2022
Number of participants	2,264	490	89
Age			
Average	44.5	49.9	44.7
PCDDs+PCDFs+Co-PCBs			
Average	19	11	5.6
Stanadard deviation	14	7.9	4.2
Median	16	9.4	5.4
Range	0.10～130	0.39～56	0.093～18

(According to WHO-TEF2006)

Survey : FY 2002-2007 : Survey on accumulation of dioxins in humans
FY 2008-2010 : Survey on accumulation of dioxins and other chemical compounds in humans
FY 2011 : Survey of the exposure to dioxins and other chemicals in humans
FY 2012-2016 : Survey of the exposure to chemical compounds in humans
FY 2022 : Survey of the exposure to chemical compounds in humans (pilot survey)

Note 1 : This survey began in fiscal year 2017 with a review of the survey methodology and the design of specific surveys. Starting from fiscal year 2018, it has been conducted as a pilot survey aimed to identify and to address issues related to the feasibility of participant recruitment methods. Therefore, it is important to note that the participant selection methods and their ages are not consistent, making comparisons with previous years' measurement results and other surveys difficult.

3-2 Organofluorine compounds

3-2-1 Blood

● Summary results

The statistical results of organofluorine compound concentrations in the blood (whole blood) are shown in Table 3.

Table 3 Statistics for organofluorine compound concentrations in the blood (whole blood) (unit：ng/mL)

Chemical compounds		FY 2020 (n=80)	FY 2021 (n=119)	FY 2022 (n=89)	FY 2023 (n=108)	FY 2024 (n=117)	FY 2020～2024 (n=513)
PFHxA (Perfluorohexanoic acid)							
	Average	All N.D.	All N.D.	All N.D.	All N.D.	All N.D.	All N.D.
	Standard deviation						
	Median						
	Range						
PFHpA (Perfluoroheptanoic acid)							
	Average	0.0019	0.0028	All N.D.	0.0016	0.0018	0.0017
	Standard deviation	0.017	0.021		0.016	0.019	0.017
	Median	N.D.	N.D.		N.D.	N.D.	N.D.
	Range	N.D.～0.15	N.D.～0.18		N.D.～0.17	N.D.～0.21	N.D.～0.21
PFOA (Perfluorooctanoic acid)							
	Average	0.86	1.2	1.1	1.2	1.2	1.1
	Standard deviation	0.45	0.56	0.44	0.67	0.81	0.63
	Median	0.77	1.1	1.0	1.0	1.1	1.0
	Range	N.D.～3.4	0.23～3.5	0.23～2.2	N.D.～3.9	N.D.～6.4	N.D.～6.4
PFNA (Perfluorononanoic acid)							
	Average	0.64	0.89	0.85	0.88	0.83	0.83
	Standard deviation	0.39	0.46	0.44	0.52	0.51	0.48
	Median	0.53	0.80	0.77	0.83	0.70	0.71
	Range	0.21～2.1	0.26～3.0	0.21～2.5	N.D.～3.2	N.D.～2.5	N.D.～3.2
PFDA (Perfluorodecanoic acid)							
	Average	0.21	0.28	0.25	0.24	0.25	0.25
	Standard deviation	0.18	0.19	0.16	0.25	0.20	0.20
	Median	0.21	0.24	0.24	0.21	0.25	0.23
	Range	N.D.～0.85	N.D.～1.1	N.D.～0.73	N.D.～1.2	N.D.～1.0	N.D.～1.2
PFUdA (Perfluoroundecanoic acid)							
	Average	0.65	0.79	0.85	1.0	0.77	0.83
	Standard deviation	0.35	0.51	0.46	0.78	0.49	0.56
	Median	0.57	0.66	0.78	0.83	0.66	0.68
	Range	0.16～1.8	0.20～3.2	0.23～2.7	N.D.～4.0	N.D.～3.6	N.D.～4.0
PFDoA (Perfluorododecanoic acid)							
	Average	All N.D.	0.020	0.0040	0.0046	0.0018	0.0067
	Standard deviation		0.078	0.027	0.028	0.019	0.043
	Median		N.D.	N.D.	N.D.	N.D.	N.D.
	Range		N.D.～0.58	N.D.～0.18	N.D.～0.18	N.D.～0.21	N.D.～0.58
PFTrDA (Perfluorotridecanoic acid)							
	Average	0.062	0.081	0.11	0.26	0.13	0.13
	Standard deviation	0.11	0.15	0.15	0.32	0.15	0.21
	Median	N.D.	N.D.	N.D.	0.20	N.D.	N.D.
	Range	N.D.～0.42	N.D.～0.80	N.D.～0.67	N.D.～1.4	N.D.～0.57	N.D.～1.4

(Table 3 Continued)

Chemical compounds	FY 2020 (n=80)	FY 2021 (n=119)	FY 2022 (n=89)	FY 2023 (n=108)	FY 2024 (n=117)	FY 2020～2024 (n=513)
PFTeDA (Perfluorotetradecanoic acid)						
Average	All N.D.	0.0039	All N.D.	All N.D.	All N.D.	0.00092
Standard deviation		0.032				0.016
Median		N.D.				N.D.
Range		N.D.～0.32				N.D.～0.32
PFHxS (Perfluorohexanesulfonic acid)						
Average	0.22	0.56	0.30	0.27	0.52	0.39
Standard deviation	0.17	0.79	0.22	0.27	0.62	0.52
Median	0.21	0.41	0.27	0.25	0.38	0.30
Range	N.D.～0.81	N.D.～6.3	N.D.～1.2	N.D.～1.6	N.D.～6.0	N.D.～6.3
PFOS (Perfluorooctanesulfonic acid)						
Average	1.4	2.1	1.8	2.2	1.8	1.9
Standard deviation	0.84	1.4	0.98	1.6	1.1	1.3
Median	1.2	1.8	1.7	1.9	1.6	1.6
Range	0.48～4.2	0.65～8.5	0.49～5.9	0.22～10	0.14～6.4	0.14～10
PFDS (Perfluorodecanesulfonic acid)						
Average	All N.D.	All N.D.	All N.D.	All N.D.	All N.D.	All N.D.
Standard deviation						
Median						
Range						

Note 1 : N.D.: below limit of detection (when calculating the mean and standard deviation, N.D. was considered as 0.)
Note 2 : Linear isomers of each substance were analyzed.

Table 4 shows the statistical values of plasma concentration, estimated from whole blood concentration adjusted using hematocrit.

Table 4 Statistics for organofluorine compound concentrations in the blood (adjusted by hematocrit: estimated concentrations in plasma)

(unit: ng/mL)

Chemical compounds	FY 2020 (n=80)	FY 2021 (n=119)	FY 2022 (n=89)	FY 2023 (n=108)	FY 2024 (n=117)	FY 2020～2024 (n=513)
PFHxA (Perfluorohexanoic acid)						
Average	All N.D.	All N.D.	All N.D.	All N.D.	All N.D.	All N.D.
Standard deviation						
Median						
Range						
PFHpA (Perfluoroheptanoic acid)						
Average	0.0034	0.0050	All N.D.	0.0026	0.0028	0.0029
Standard deviation	0.030	0.039		0.027	0.031	0.029
Median	N.D.	N.D.		N.D.	N.D.	N.D.
Range	N.D.～0.27	N.D.～0.32		N.D.～0.28	N.D.～0.33	N.D.～0.33
PFOA (Perfluorooctanoic acid)						
Average	1.5	2.2	2.0	2.1	2.2	2.1
Standard deviation	0.82	1.0	0.87	1.2	1.5	1.2
Median	1.4	2.0	1.9	1.8	2.0	1.9
Range	N.D.～6.4	0.41～6.2	0.41～4.2	N.D.～6.5	N.D.～12	N.D.～12
PFNA (Perfluorononanoic acid)						
Average	1.2	1.6	1.6	1.6	1.5	1.5
Standard deviation	0.71	0.82	0.87	0.92	0.93	0.87
Median	0.97	1.5	1.4	1.4	1.3	1.3
Range	0.38～3.8	0.49～4.9	0.40～5.1	N.D.～5.9	N.D.～4.6	N.D.～5.9

(Table 4 Continued)

Chemical compounds	FY 2020 (n=80)	FY 2021 (n=119)	FY 2022 (n=89)	FY 2023 (n=108)	FY 2024 (n=117)	FY 2020～2024 (n=513)
PFDA (Perfluorodecanoic acid)						
Average	0.38	0.52	0.47	0.42	0.47	0.45
Standard deviation	0.32	0.35	0.31	0.45	0.37	0.37
Median	0.38	0.44	0.46	0.38	0.46	0.41
Range	N.D.～1.6	N.D.～2.0	N.D.～1.5	N.D.～2.2	N.D.～1.8	N.D.～2.2
PFUdA (Perfluoroundecanoic acid)						
Average	1.2	1.4	1.6	1.8	1.4	1.5
Standard deviation	0.60	0.92	0.88	1.4	0.89	1.0
Median	1.0	1.2	1.4	1.5	1.3	1.3
Range	0.33～3.0	0.38～5.9	0.41～5.4	N.D.～6.7	N.D.～6.3	N.D.～6.7
PFDoA (Perfluorododecanoic acid)						
Average	All N.D.	0.037	0.0081	0.0080	0.0032	0.012
Standard deviation		0.14	0.054	0.047	0.034	0.079
Median		N.D.	N.D.	N.D.	N.D.	N.D.
Range		N.D.～1.1	N.D.～0.38	N.D.～0.30	N.D.～0.37	N.D.～1.1
PFTrDA (Perfluorotridecanoic acid)						
Average	0.11	0.15	0.20	0.46	0.25	0.24
Standard deviation	0.19	0.28	0.29	0.57	0.28	0.37
Median	N.D.	N.D.	N.D.	0.36	N.D.	N.D.
Range	N.D.～0.72	N.D.～1.4	N.D.～1.4	N.D.～2.8	N.D.～1.1	N.D.～2.8
PFTeDA (Perfluorotetradecanoic acid)						
Average	All N.D.	0.0072	All N.D.	All N.D.	All N.D.	0.0017
Standard deviation		0.059				0.029
Median		N.D.				N.D.
Range		N.D.～0.59				N.D.～0.59
PFHxS (Perfluorohexanesulfonic acid)						
Average	0.40	1.0	0.56	0.49	0.95	0.72
Standard deviation	0.31	1.4	0.42	0.48	1.1	0.97
Median	0.38	0.76	0.51	0.44	0.72	0.55
Range	N.D.～1.5	N.D.～11	N.D.～2.4	N.D.～2.9	N.D.～11	N.D.～11
PFOS (Perfluorooctanesulfonic acid)						
Average	2.5	3.9	3.4	3.9	3.3	3.5
Standard deviation	1.5	2.5	1.9	2.9	2.1	2.3
Median	2.2	3.4	3.2	3.3	2.9	2.9
Range	0.79～7.6	1.1～14	0.80～12	0.39～19	0.25～11	0.25～19
PFDS (Perfluorodecanesulfonic acid)						
Average	All N.D.	All N.D.	All N.D.	All N.D.	All N.D.	All N.D.
Standard deviation						
Median						
Range						

Note 1 : N.D.: below limit of detection (when calculating the mean and standard deviation, N.D. was considered as 0).
Note 2 : Linear isomers of each substance were analyzed.
Note 3 : Hematocrit adjusted concentrations were calculated using formula as shown below:

Hematocrit adjusted concentration=whole-blood concentration/(100-hematocrit)/100

● Comparison with previous survey

The measurement results of the 'Survey on the accumulation of dioxins and other chemical substances in humans' conducted from fiscal years 2008 to 2010 and the 'Survey on exposure to chemical compounds in humans' conducted from fiscal years 2011 to 2016, are compared in Table 5 (whole blood concentration) and Table 6 (hematocrit-adjusted value: estimated plasma concentration).

Table 5　Comparison of blood organofluorine compound concentrations (whole blood)

(unit: ng/mL)

Chemical substances	FY 2008～2010 (n=609)	FY 2011～2016 (PFOS,PFOA:n=406) (others :n=320)	FY 2020～2024 (n=513)
PFHxA (Perfluorohexanoic acid)			
Average	–	All N.D.	All N.D.
Standard deviation	–		
Median	–		
Range	–		
PFHpA (Perfluoroheptanoic acid)			
Average	–	0.018	0.0017
Standard deviation	–	0.085	0.017
Median	–	N.D.	N.D.
Range	–	N.D.～1.2	N.D.～0.21
PFOA (Perfluorooctanoic acid)			
Average	3.0	2.2	1.1
Standard deviation	2.9	1.8	0.63
Median	2.1	1.8	1.0
Range	0.37～25	0.27～13	N.D.～6.4
PFNA (Perfluorononanoic acid)			
Average	–	1.5	0.83
Standard deviation	–	0.96	0.48
Median	–	1.3	0.71
Range	–	0.30～7.7	N.D.～3.2
PFDA (Perfluorodecanoic acid)			
Average	–	0.60	0.25
Standard deviation	–	0.37	0.20
Median	–	0.51	0.23
Range	–	N.D.～2.7	N.D.～1.2
PFUdA (Perfluoroundecanoic acid)			
Average	–	1.4	0.83
Standard deviation	–	0.95	0.56
Median	–	1.2	0.68
Range	–	0.13～6.4	N.D.～4.0
PFDoA (Perfluorododecanoic acid)			
Average	–	0.16	0.0067
Standard deviation	–	0.14	0.043
Median	–	0.14	N.D.
Range	–	N.D.～0.89	N.D.～0.58

(Table 5 Continued)

Chemical substances	FY 2008～2010 (n=609)	FY 2011～2016 (PFOS,PFOA：n=406) (others ：n=320)	FY 2020～2024 (n=513)
PFTrDA (Perfluorotridecanoic acid)			
Average	－	0.46	0.13
Standard deviation	－	0.36	0.21
Median	－	0.38	N.D.
Range	－	N.D.～2.7	N.D.～1.4
PFTeDA (Perfluorotetradecanoic acid)			
Average	－	0.012	0.00092
Standard deviation	－	0.052	0.016
Median	－	N.D.	N.D.
Range	－	N.D.～0.41	N.D.～0.32
PFHxS (Perfluorohexanesulfonic acid)			
Average	－	0.41	0.39
Standard deviation	－	0.31	0.52
Median	－	0.35	0.30
Range	－	N.D.～1.8	N.D.～6.3
PFOS (Perfluorooctanesulfonic acid)			
Average	7.8	4.1	1.9
Standard deviation	9.2	2.7	1.3
Median	5.8	3.5	1.6
Range	0.73～150	0.29～17	0.14～10
PFDS (Perfluorodecanesulfonic acid)			
Average	－	0.00055	All N.D.
Standard deviation	－	0.0057	
Median	－	N.D.	
Range	－	N.D.～0.065	

Surveys : FY 2008～2010 : Survey on accumulation of dioxins and other chemical compounds in humans
FY 2011 : Survey on accumulation of dioxins and other chemical compounds in humans
FY 2012～2016 : Survey of the exposure to chemical compounds in humans
FY 2020～2024 : Survey of the exposure to chemical compounds in humans (pilot survey)

Note 1 : N.D.: below limit of detection (when calculating the mean and standard deviation, N.D. was considered as 0).

Note 2 : Linear isomers of each substance were analyzed.

Note 3 : Among the FY 2011 to 2016 surveys, organofluorine compounds were not analyzed in FY 2012. In FY 2011, only PFOA and PFOS were analyzed.

Note 4 : This survey began in fiscal year 2017 with a review of the survey methodology and the design of specific surveys. Starting from fiscal year 2018, it has been conducted as a pilot survey aimed to identify and to address issues related to the feasibility of participant recruitment methods. Therefore, it is important to note that the participant selection methods and their ages are not consistent, making comparisons with previous years' measurement results and other surveys difficult.

Table 6 Comparison of blood organofluorine compound concentrations
(hematocrit-adjusted values: estimated plasma concentrations) (unit: ng/mL)

Chemical substances	FY 2008～2010 (n=609)	FY 2011～2016 (PFOS,PFOA：n=406) (others ：n=320)	FY 2020～2024 (n=513)
PFHxA (Perfluorohexanoic acid)			
Average	–	All N.D.	All N.D.
Standard deviation	–		
Median	–		
Range	–		
PFHpA (Perfluoroheptanoic acid)			
Average	–	0.032	0.0029
Standard deviation	–	0.14	0.029
Median	–	N.D.	N.D.
Range	–	N.D.～2.0	N.D.～0.33
PFOA (Perfluorooctanoic acid)			
Average	5.6	4.1	2.1
Standard deviation	5.4	3.3	1.2
Median	3.9	3.3	1.9
Range	0.66～46	0.41～28	N.D.～12
PFNA (Perfluorononanoic acid)			
Average	–	2.8	1.5
Standard deviation	–	1.9	0.87
Median	–	2.4	1.3
Range	–	0.53～17	N.D.～5.9
PFDA (Perfluorodecanoic acid)			
Average	–	1.1	0.45
Standard deviation	–	0.67	0.37
Median	–	0.93	0.41
Range	–	N.D.～4.7	N.D.～2.2
PFUdA (Perfluoroundecanoic acid)			
Average	–	2.6	1.5
Standard deviation	–	1.7	1.0
Median	–	2.1	1.3
Range	–	0.23～11	N.D.～6.7
PFDoA (Perfluorododecanoic acid)			
Average	–	0.28	0.012
Standard deviation	–	0.26	0.079
Median	–	0.26	N.D.
Range	–	N.D.～1.7	N.D.～1.1
PFTrDA (Perfluotridecanoic acid)			
Average	–	0.85	0.24
Standard deviation	–	0.65	0.37
Median	–	0.70	N.D.
Range	–	N.D.～5.1	N.D.～2.8
PFTeDA (Perfluorotetradecanoic acid)			
Average	–	0.021	0.0017
Standard deviation	–	0.094	0.029
Median	–	N.D.	N.D.
Range	–	N.D.～0.71	N.D.～0.59

(Table 6 Continued)

Chemical substances		FY 2008～2010 (n=609)	FY 2011～2016 (PFOS,PFOA：n=406) (others ：n=320)	FY 2020～2024 (n=513)
PFHxS (Perfluorohexanesulfonic acid)				
	Average	－	0.75	0.72
	Standard deviation	－	0.57	0.97
	Median	－	0.66	0.55
	Range	－	N.D.～3.2	N.D.～11
PFOS (Perfluorooctanesulfonic acid)				
	Average	14	7.5	3.5
	Standard deviation	17	4.9	2.3
	Median	11	6.4	2.9
	Range	1.3～280	0.48～33	0.25～19
PFDS (Perfluorodecanesulfonic acid)				
	Average	－	0.00098	All N.D.
	Standard deviation	－	0.010	
	Median	－	N.D.	
	Range	－	N.D.～0.12	

Surveys : FY 2008～2010: Survey on accumulation of dioxins and other chemical compounds in humans
FY 2011 : Survey on accumulation of dioxins and other chemical compounds in humans
FY 2012～2016 : Survey of the exposure to chemical compounds in humans
FY 2020～2024 : Survey of the exposure to chemical compounds in humans (pilot survey)

Note 1 : N.D.: below limit of detection (when calculating the mean and standard deviation, N.D. was considered as 0).
Note 2 : Linear isomers of each substance were analyzed.
Note 3 : Among the FY 2011 to 2016 surveys, organofluorine compounds were not analyzed in FY 2012.In FY 2011, only PFOA and PFOS were analyzed.
Note 4 : This survey began in fiscal year 2017 with a review of the survey methodology and the design of specific surveys. Starting from fiscal year 2018, it has been conducted as a pilot survey aimed to identify and to address issues related to the feasibility of participant recruitment methods. Therefore, it is important to note that the participant selection methods and their ages are not consistent, making comparisons with previous years' measurement results and other surveys difficult.
Note 5 : Hematocrit adjusted concentrations were calculated using formula as shown below:

Hematocrit adjusted concentration=whole-blood concentration/(100-hematocrit)/100

3-3　Metals

3-3-1　Blood

● Results summary

Table 7 shows the statistical values of blood metal concentrations by survey year.

Table 7　Statistics for blood metal concentrations.　(unit: ng/mL)

Chemical substances	FY 2020 (n=80)	FY 2021 (n=119)	FY 2022 (n=89)	FY 2023 (n=108)	FY 2024 (n=117)	FY 2020~2024 (n=513)
Total mercury						
Average	6.7	6.4	6.2	9.0	7.3	7.2
Standard deviation	3.5	4.8	4.8	7.4	4.7	5.4
Median	6.4	5.2	5.3	7.4	6.3	6.0
Range	1.5~18	0.77~29	0.28~34	0.72~53	1.2~26	0.28~53
Lead						
Average	8.6	8.7	7.9	8.4	7.6	8.2
Standard deviation	4.5	4.3	3.5	3.8	3.7	3.9
Median	7.6	7.7	7.3	7.9	6.7	7.5
Range	3.3~31	3.6~27	2.7~18	1.8~26	2.4~24	1.8~31
Cadmium						
Average	0.77	0.64	0.94	1.0	0.95	0.86
Standard deviation	0.47	0.38	0.57	0.68	0.65	0.58
Median	0.68	0.54	0.80	0.83	0.83	0.73
Range	0.17~3.0	0.16~2.2	0.17~2.7	0.19~3.9	0.19~3.3	0.16~3.9
Total arsenic						
Average	4.4	3.9	3.4	6.9	4.5	4.7
Standard deviation	3.5	3.1	1.9	6.3	3.1	4.1
Median	3.2	3.1	2.9	4.9	3.8	3.4
Range	0.91~23	0.52~18	0.37~9.7	0.82~33	0.95~22	0.37~33
Copper						
Average	810	850	760	870	830	830
Standard deviation	120	150	140	130	140	140
Median	790	810	740	850	810	800
Range	640~1,200	660~1,500	560~1,400	680~1,400	620~1,700	560~1,700
Selenium						
Average	190	180	180	180	180	180
Standard deviation	26	28	33	30	36	31
Median	180	180	170	170	180	180
Range	140~270	130~330	120~350	130~290	120~370	120~370
Zinc						
Average	6,200	6,200	5,700	6,400	5,800	6,100
Standard deviation	740	750	700	740	750	780
Median	6,300	6,200	5,700	6,400	5,800	6,100
Range	4,700~8,300	4,200~9,600	3,600~7,300	4,600~8,500	3,300~7,600	3,300~9,600
Managanese						
Average	14	13	13	12	13	13
Standard deviation	4.9	4.0	4.3	3.8	3.8	4.1
Median	12	12	12	12	12	12
Range	7.2~41	5.6~28	6.5~28	6.0~23	5.4~26	5.4~41

● Comparison with previous surveys

Table 8 shows a comparison with results of the 'Survey of the exposure to chemical compounds on humans' conducted from fiscal years 2011 to 2016.

Table 8　Comparison of blood metal concentrations (unit: ng/mL)

Chemical substances		FY 2011～2016 (Total mercury：n=490) (Manganese：n=320) (Others：n=404)	FY2020～2024 (n=513)
Total mercury			
	Average	9.7	7.2
	Standard deviation	5.8	5.4
	Median	8.3	6.0
	Range	1.3～41	0.28～53
Lead			
	Average	13	8.2
	Standard deviation	5.6	3.9
	Median	11	7.5
	Range	4.3～54	1.8～31
Cadmium			
	Average	1.2	0.86
	Standard deviation	0.69	0.58
	Median	1.0	0.73
	Range	0.25～6.2	0.16～3.9
Total arsenic			
	Average	7.6	4.7
	Standard deviation	8.9	4.1
	Median	5.4	3.4
	Range	0.70～110	0.37～33
Copper			
	Average	850	830
	Standard deviation	120	140
	Median	840	800
	Range	550～1,500	560～1,700
Selenium			
	Average	190	180
	Standard deviation	35	31
	Median	190	180
	Range	110～480	120～370
Zinc			
	Average	6,300	6,100
	Standard deviation	820	780
	Median	6,300	6,100
	Range	3,700～8,600	3,300～9,600
Managanese			
	Average	14	13
	Standard deviation	4.7	4.1
	Median	13	12
	Range	5.8～53	5.4～41

Survey : FY 2011 : Survey of the exposure to dioxins and other chemical compounds in humans
FY 2012～2016 : Survey of the exposure to chemical compounds in humans
FY 2020～2024 : Survey of the exposure to chemical compounds in humans (Pilot survey)

Note 1 : N.D.: below limit of detection (when calculating the mean and standard deviation, N.D. was considered as 0).
Note 2 : For some items, measurements were not conducted in certain fiscal years.
Note 3 : This survey began in fiscal year 2017 with a review of the survey methodology and the design of specific surveys. Starting from fiscal year 2018, it has been conducted as a pilot survey aimed to identify and to address issues related to the feasibility of participant recruitment methods. Therefore, it is important to note that the participant selection methods and their ages are not consistent, making comparisons with previous years' measurement results and other surveys difficult.

3-3-2 Urine

● Results summary

Table 9 shows the statistical values of urine metal concentrations by survey year.

Table 9 Statistics for urine metal concentrations. (unit: μg/g Cr)

Chemical substances		FY 2018 FY 2019 (n=87)	FY 2020 (n=80)	FY 2021 (n=121)	FY 2022 (n=89)	FY 2023 (n=108)	FY 2024 (n=118)	FY 2018 ~FY 2024 (n=603)
Cadmium								
	Average	0.62	0.60	0.57	0.81	1.1	0.91	0.78
	Standard deviation	0.45	0.46	0.45	0.69	0.99	0.70	0.69
	Median	0.52	0.48	0.43	0.55	0.80	0.72	0.59
	Range	N.D.~2.4	0.066~1.9	0.042~2.1	0.093~3.4	0.11~5.8	0.10~3.9	N.D.~5.8
Arsenic	As (V)							
	Average	0.43	0.47	0.22	0.44	0.46	0.46	0.41
	Standard deviation	0.77	1.7	0.34	0.82	0.31	0.80	0.85
	Median	0.22	0.21	0.16	0.28	0.37	0.25	0.25
	Range	N.D.~6.5	N.D.~15	N.D.~2.9	N.D.~7.5	0.11~1.8	N.D.~7.0	N.D.~15
	As (III)							
	Average	0.92	1.6	1.2	1.2	1.3	1.8	1.3
	Standard deviation	0.74	1.3	0.73	1.3	0.76	1.5	1.1
	Median	0.87	1.2	1.1	0.95	1.2	1.4	1.1
	Range	N.D.~4.5	0.30~9.8	N.D.~5.0	N.D.~12	N.D.~5.2	N.D.~9.5	N.D.~12
	MMA (monomethylarsonic acid)							
	Average	1.3	2.0	1.4	1.6	1.9	2.4	1.8
	Standard deviation	0.74	1.5	0.77	1.1	1.2	1.8	1.3
	Median	1.2	1.6	1.2	1.4	1.6	2.0	1.5
	Range	0.14~3.8	0.33~9.4	0.24~5.7	N.D.~10	N.D.~7.6	N.D.~11	N.D.~11
	DMA (dimethylarsinic acid)							
	Average	22	26	23	26	32	37	28
	Standard deviation	18	18	19	18	24	27	22
	Median	18	19	20	20	28	31	22
	Range	2.9~140	6.4~94	4.7~140	4.7~88	5.6~160	5.6~180	2.9~180
	AB (arsenobetaine)							
	Average	75	55	58	37	110	49	65
	Standard deviation	230	120	150	55	250	60	160
	Median	22	19	21	19	30	27	22
	Range	1.6~1,700	1.1~820	0.28~1,400	1.1~350	1.2~1,400	1.5~340	0.28~1,700

Note1 : N.D.: below limit of detection (when calculating the mean and standard deviation, N.D. was considered as 0.)

● Comparison with previous surveys

Table 10 shows a comparison with results of the 'Survey of the exposure to chemical compounds on humans' conducted from fiscal years 2011 to 2016.

Table 10 Comparison of urine metal concentrations (unit: μg/g Cr)

Chemical substances		FY 2011～2016 (n=420)	FY 2018～2024 (n=603)
Cadmium			
	Average	0.94	0.78
	Standard deviation	0.63	0.69
	Median	0.74	0.59
	Range	0.11～4.7	N.D.～5.8
Arsenic	As (V)		
	Average	0.16	0.41
	Standard deviation	0.39	0.85
	Median	N.D.	0.25
	Range	N.D.～2.9	N.D.～15
	As (III)		
	Average	1.5	1.3
	Standard deviation	1.2	1.1
	Median	1.4	1.1
	Range	N.D.～15	N.D.～12
	MMA (monomethylarsonic acid)		
	Average	2.0	1.8
	Standard deviation	1.4	1.3
	Median	1.8	1.5
	Range	N.D.～13	N.D.～11
	DMA (dimethylarsinic acid)		
	Average	37	28
	Standard deviation	25	22
	Median	29	22
	Range	6.2～170	2.9～180
	AB (arsenobetaine)		
	Average	110	65
	Standard deviation	210	160
	Median	44	22
	Range	2.1～2,300	0.28～1,700

Survey : FY 2011 : Survey of the exposure to dioxins and other chemical compounds in humans
FY 2012～2016 : Survey of the exposure to chemical compounds in humans
FY 2018～2024 : Survey of the exposure to chemical compounds in humans (Pilot survey)

Note 1 : N.D.: below limit of detection (when calculating the mean and standard deviation, N.D. was considered as 0).
Note 2 : For some items, measurements were not conducted in certain fiscal years.
Note 3 : This survey began in fiscal year 2017 with a review of the survey methodology and the design of specific surveys. Starting from fiscal year 2018, it has been conducted as a pilot survey aimed to identify and to address issues related to the feasibility of participant recruitment methods. Therefore, it is important to note that the participant selection methods and their ages are not consistent, making comparisons with previous years' measurement results and other surveys difficult.

3-3-3 Hair

● Results summary

Table 11 shows the statistical values of hair mercury concentrations. Measurement of hair mercury concentrations began in fiscal year 2024.

Table 11 Statistics for hair mercury concentrations. (unit: μg/g)

	Chemical substances	FY 2024 (n=113)
Mercury	Total mercury	
	Average	1.7
	Standard deviation	1.0
	Median	1.5
	Range	0.31～5.2
	Methylmercury	
	Average	1.6
	Standard deviation	0.94
	Median	1.4
	Range	0.27～4.7

3-4 Plasticizers・pesticides・pesticide metabolites・others

3-4-1 Urine

● Results summary

Tables 12 and 13 show concentrations of chemical substances in urine by survey year.

Table 12 Statistics of urine plasticizer and pesticide concentrations. (unit: μg/g Cr)

	Chemical substances			FY 2018 ·FY 2019 (n=87)	FY 2020 (n=80)	FY 2021 (n=121)	FY 2022 (n=89)	FY 2023 (n=108)	FY 2024 (n=118)	FY 2018 ~2024 (※)
Plasticizers	Phthalate monoesters	MBP (monobutyl phthalate)	Median	12	12	10	11	15	–	12
			Range	2.5~180	3.4~58	2.0~200	2.9~46	3.1~89		2.0~200
		MEHP (mono(2-ethylhexyl) phthalate)	Median	1.9	3.0	1.2	1.3	1.9	–	1.7
			Range	N.D.~13	0.47~11	N.D.~7.8	0.26~8.2	0.39~9.3		N.D.~13
		MEHHP (mono(2-ethyl-5-hydroxyhexyl) phthalate)	Median	6.8	4.8	4.4	4.5	6.2	–	5.1
			Range	0.74~22	0.96~18	1.5~25	1.1~51	1.1~28		0.74~51
		MEOHP (mono(2-ethyl-5-oxohexyl) phthalate)	Median	4.3	3.8	2.6	2.5	3.3	–	3.1
			Range	0.36~13	1.3~16	0.94~11	0.77~20	0.59~11		0.36~20
		MBzP (monobenzyl phthalate)	Median	0.51	0.54	0.23	0.23	0.21	–	0.29
			Range	N.D.~9.2	N.D.~27	N.D.~21	N.D.~5.8	N.D.~23		N.D.~27
	Bisphenol A		Median	0.25	0.19	0.16	0.18	0.20	–	0.19
			Range	N.D.~30	N.D.~1.8	0.027~4.8	N.D.~3.5	N.D.~3.1		N.D.~30
	Bisphenol S		Median	–	–	–	0.092	0.084	–	0.086
			Range				N.D.~5.8	N.D.~1.4		N.D.~5.8
	Bisphenol F		Median	–	–	–	N.D.	N.D.	–	N.D.
			Range				N.D.~14	N.D.~15		N.D.~15
Pesticides	Neoniconinoid pesticides	Acetamiprid	Median	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
			Range	N.D.~0.32	N.D.~0.82	N.D.~0.63	N.D.~1.0	N.D.~0.34	N.D.~0.69	N.D.~1.0
		Imidacloprid	Median	N.D.	0.020	0.016	0.013	0.017	0.0093	0.014
			Range	N.D.~0.51	N.D.~0.42	N.D.~0.24	N.D.~0.32	N.D.~0.50	N.D.~0.58	N.D.~0.58
		Thiacloprid	Median	N.D.	All N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
			Range	N.D.~0.083		N.D.~0.035	N.D.~0.35	N.D.~0.021	N.D.~0.090	N.D.~0.35
		Thiamethoxam	Median	0.058	0.041	0.074	0.084	0.093	0.14	0.083
			Range	N.D.~2.5	N.D.~18	N.D.~2.3	N.D.~3.6	N.D.~1.3	N.D.~5.8	N.D.~18
		Clothianidin	Median	0.17	0.16	0.18	0.23	0.27	0.44	0.23
			Range	N.D.~3.9	N.D.~6.7	0.023~6.3	0.027~5.1	0.048~5.5	N.D.~28	N.D.~28
		Dinotefuran	Median	0.30	0.73	0.76	0.91	0.67	0.81	0.74
			Range	N.D.~23	0.0079~23	0.0077~40	0.034~21	N.D.~29	0.034~49	N.D.~49
		Nitenpyram	Median	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
			Range	N.D.~1.9	N.D.~0.050	N.D.~0.0058	N.D.~0.36	N.D.~2.0	N.D.~11	N.D.~11
	Phenylpyrazole pesticides	Fipronil	Median	N.D.	All N.D.	All N.D.	All N.D.	All N.D.	All N.D.	N.D.
			Range	N.D.~0.027						N.D.~0.027

(※) Pesticides: n=603; phthalate monoesters, bisphenol A: n=485; bisphenol S, bisphenol F: n=197
Note 1 : N.D. : below limit of detection

Table 13 Statistics for urine pesticide metabolites and other chemical substances concentrations. (unit: μg/g Cr)

	Chemical substances		Statistics	FY 2018 ･FY 2019 (n=87)	FY 2020 (n=80)	FY 2021 (n=121)	FY 2022 (n=89)	FY 2023 (n=108)	FY 2024 (n=118)	FY 2018 ~2024 (※)
Pesticide metabolites	Organophosphorus pesticide metabolites	DMP (dimethyl phosphate)	Median	1.7	1.5	1.5	1.3	1.8	2.2	1.6
			Range	N.D.~22	0.24~19	0.31~62	N.D.~29	N.D.~18	N.D.~64	N.D.~64
		DEP (diethyl phosphate)	Median	3.7	2.5	2.0	1.9	2.0	3.1	2.5
			Range	N.D.~710	N.D.~190	N.D.~190	N.D.~310	N.D.~130	N.D.~180	N.D.~710
		DMTP (dimethyl thiophosphate)	Median	1.5	1.8	2.5	2.4	2.3	2.9	2.3
			Range	N.D.~23	N.D.~42	N.D.~160	N.D.~240	N.D.~50	N.D.~65	N.D.~240
		DETP (diethyl thiophosphate)	Median	N.D.	0.11	N.D.	N.D.	N.D.	N.D.	N.D.
			Range	N.D.~2.9	N.D.~4.6	N.D.~1.7	N.D.~18	N.D.~4.1	N.D.~3.2	N.D.~18
	Pyrethroid pesticide metabolites	PBA (phenoxybenzoic acid)	Median	0.21	0.32	0.30	–	–	–	0.28
			Range	N.D.~8.2	N.D.~7.0	N.D.~3.4				N.D.~8.2
		DCCA (dimethylcyclopropanecarboxylic acid)	Median	N.D.	0.36	0.42	–	–	–	0.29
			Range	N.D.~12	N.D.~6.0	N.D.~9.3				N.D.~12
	Neonicotinoid pesticides and their metabolites	Desmethyl acetamiprid	Median	0.24	0.26	0.20	0.22	0.44	0.35	0.27
			Range	0.022~39	0.0096~11	N.D.~8.4	0.0079~10	0.012~5.6	0.0098~21	N.D.~39
		Thiacloprid amide	Median	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
			Range	N.D.~0.035	N.D.~0.035	N.D.~0.16	N.D.~0.15	N.D.~0.37	N.D.~0.21	N.D.~0.37
		Desmethyl thiamethoxam	Median	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
			Range	N.D.~0.10	N.D.~0.048	N.D.~0.022	N.D.~0.041	N.D.~0.032	N.D.~0.041	N.D.~0.10
Others	Triclosan		Median	0.11	0.14	0.13	0.18	0.11	–	0.13
			Range	N.D.~14	N.D.~20	N.D.~17	N.D.~500	N.D.~150		N.D.~500
	Parabens	Methylparaben	Median	49	110	84	66	46	–	67
			Range	0.44~1,100	1.4~1,100	1.1~1,800	0.64~2,100	1.0~1,700		0.44~2100
		Ethylparaben	Median	2.5	1.1	3.1	1.5	2.9	–	2.1
			Range	N.D.~190	N.D.~230	N.D.~280	N.D.~860	N.D.~4,500		N.D.~4,500
		Propylparaben	Median	0.24	0.40	0.60	0.25	0.52	–	0.40
			Range	N.D.~230	N.D.~160	N.D.~490	N.D.~540	N.D.~170		N.D.~540
		Butylparaben	Median	N.D.	N.D.	N.D.	N.D.	0.027	–	N.D.
			Range	N.D.~53	N.D.~190	N.D.~86	N.D.~120	N.D.~160		N.D.~190
		Benzylparaben	Median	N.D.	N.D.	N.D.	N.D.	N.D.	–	N.D.
			Range	N.D.~0.18	N.D.~0.053	N.D.~0.24	N.D.~0.050	N.D.~0.016		N.D.~0.24
	Cotinine		Median	0.34	0.23	N.D.	N.D.	N.D.	–	0.087
			Range	N.D.~2,000	N.D.~1,800	N.D.~2,900	N.D.~1,200	N.D.~5,600		N.D.~5,600
	Benzophenone-3		Median	0.086	N.D.	N.D.	N.D.	0.039	–	0.0071
			Range	N.D.~320	N.D.~1.2	N.D.~120	N.D.~70	N.D.~30		N.D.~320

(※) Organophosphorus pesticide metabolites, neonicotinoid pesticides and their metabolites: n=603; triclosan, parabens, cotinine, benzophenone-3: n=485; pyreshroid pesticide metabolites: n=288

Note1 : N.D. : below limit of detection

● Comparison with previous surveys

Tables 14 and 15 show comparison with results of the 'Survey of the exposure to chemical compounds on humans' conducted from fiscal years 2011 to 2016.

Table 14　Comparison of urine plasticizer and pesticide concentrations. (unit: μg/g Cr)

	Chemical compounds		Statistics	FY 2011～2016 (※)	FY 2018～2024 (※※)
Plasticizers	Phthalate monoesters	MBP (monobutyl phthalate)	Median	16	12
			Range	3.7～5,200	2.0～200
		MEHP (mono(2-ethylhexyl)phthalate)	Median	2.6	1.7
			Range	0.23～22	N.D.～13
		MEHHP (mono(2-ethyl-5-hydroxylhexyl) phthalate)	Median	8.3	5.1
			Range	1.2～81	0.74～51
		MEOHP (mono(2-ethyl-5-oxohexyl) phthalate)	Median	5.4	3.1
			Range	0.37～35	0.36～20
		MBzP (monobenzyl phthalate)	Median	0.53	0.29
			Range	N.D.～200	N.D.～27
	Bisphenol A		Median	0.29	0.19
			Range	N.D.～31	N.D.～30
	Bisphenol S		Median	–	0.086
			Range		N.D.～5.8
	Bisphenol F		Median	–	N.D.
			Range		N.D.～15
Pesticides	Neoniconinoid pesticides	Acetamiprid	Median	N.D.	N.D.
			Range	N.D.～0.49	N.D.～1.0
		Imidacloprid	Median	0.026	0.014
			Range	N.D.～0.92	N.D.～0.58
		Thiacloprid	Median	N.D.	N.D.
			Range	N.D.～0.092	N.D.～0.35
		Thiamethoxam	Median	0.025	0.083
			Range	N.D.～1.0	N.D.～18
		Clothianidin	Median	0.14	0.23
			Range	N.D.～3.0	N.D.～28
		Dinotefuran	Median	0.59	0.74
			Range	N.D.～29	N.D.～49
		Nitenpyram	Median	N.D.	N.D.
			Range	N.D.～0.65	N.D.～11
	Phenylpyrazole pesticides	Fipronil	Median	All N.D.	N.D.
			Range		N.D.～0.027

(※) Phthalate monoesters, bisphenol A: n=420; pesticides: n=170
(※※) Pesticides: n=603; phthalate monoesters, bisphenol A: n=485; bisphenol S, bisphenol F: n=197

Survey : FY 2011: Survey of the exposure to dioxins and other chemical compounds in humans
FY 2012～2016 : Survey of the exposure to chemical compounds in humans
FY 2018～2024 : Survey of the exposure to chemical compounds in humans (Pilot survey)

Note 1 : N.D.: below limit of detection.
Note 2 : For some items, measurements were not conducted in certain fiscal years.
Note 3 : This survey began in fiscal year 2017 with a review of the survey methodology and the design of specific surveys. Starting from fiscal year 2018, it has been conducted as a pilot survey aimed to identify and to address issues related to the feasibility of participant recruitment methods. Therefore, it is important to note that the participant selection methods and their ages are not consistent, making comparisons with previous years' measurement results and other surveys difficult.

Table 15　Comparison of urine pesticide metabolites and other chemical substances concentrations.　(unit: μg/g Cr)

	Chemical substances		Statistics	FY 2011～2016 (※)	FY 2018～2024 (※※)
Pesticide metabolites	Organic phosphorus metabolites	DMP	Median	2.5	1.6
			Range	N.D.～140	N.D.～64
		DEP	Median	3.2	2.5
			Range	N.D.～520	N.D.～710
		DMTP	Median	3.6	2.3
			Range	N.D.～110	N.D.～240
		DETP	Median	N.D.	N.D.
			Range	N.D.～19	N.D.～18
	Pyrethroid pesticide metabolites	PBA	Median	0.33	0.28
			Range	N.D.～21	N.D.～8.2
		DCCA	Median	N.D.	0.29
			Range	N.D.～26	N.D.～12
	Neonicotinoid pesticide metabolites	Desmethylacetamiprid	Median	0.15	0.27
			Range	N.D.～73	N.D.～39
		Thiacloprid amide	Median	N.D.	N.D.
			Range	N.D.～0.0039	N.D.～0.37
		Desmethylthiamethoxam	Median	All N.D.	N.D.
			Range		N.D.～0.10
Others	Triclosan		Median	0.97	0.13
			Range	0.090～380	N.D.～500
	Parabens	Methylparaben	Median	72	67
			Range	1.3～2,500	0.44～2100
		Ethylparaben	Median	3.8	2.1
			Range	N.D.～410	N.D.～4,500
		Propylparaben	Median	0.62	0.40
			Range	N.D.～110	N.D.～540
		Butylparaben	Median	N.D.	N.D.
			Range	N.D.～87	N.D.～190
		Benzylparaben	Median	All N.D.	N.D.
			Range		N.D.～0.24
	Cotinine		Median	0.34	0.087
			Range	N.D.～3,600	N.D.～5,600
	Benzophenone-3		Median	N.D.	0.0071
			Range	N.D.～190	N.D.～320

(※) Organophosphorus pesticide metabolites, pyrethroid pesticide metabolites, triclosan: n=262; neonicotinoid pesticide metabolites: n=170; parabens, cotinine, benzophenone-3: n=90

(※※) Organophosphorus pesticide metabolites, neonicotinoid pesticides and their metabolites: n=603; triclosan, parabens, cotinine, benzophenone-3: n=485; pyreshroid pesticide metabolites: n=288

Survey : FY 2011 : Survey of the exposure to dioxins and other chemical compounds in humans
FY 2012～2016 : Survey of the exposure to chemical compounds in humans
FY 2018～2024 : Survey of the exposure to chemical compounds in humans (Pilot survey)

Note 1 : N.D.: below limit of detection.
Note 2 : For some items, measurements were not conducted in certain fiscal years.
Note 3 : This survey began in fiscal year 2017 with a review of the survey methodology and the design of specific surveys. Starting from fiscal year 2018, it has been conducted as a pilot survey aimed to identify and to address issues related to the feasibility of participant recruitment methods. Therefore, it is important to note that the participant selection methods and their ages are not consistent, making comparisons with previous years' measurement results and other surveys difficult.

Committee members of "Survey of the Exposures to Chemical Compound in Humans"

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(as of April 2024)

Supplementary Information

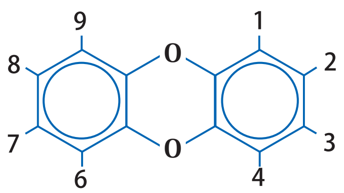
Chemical compounds measured in this survey

1. Dioxins

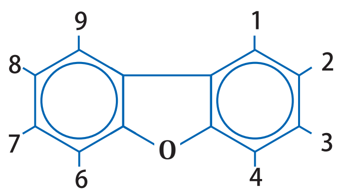
1.1 Structure of dioxins

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

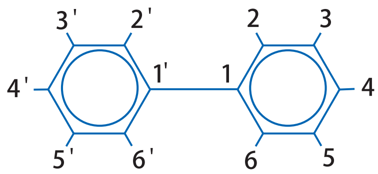
The chemical structure of a dioxin molecule is generally composed of two benzene rings (shown as "⬡" in the figure below) bound by oxygen atom(s) (shown as "O" in the figure below) with chlorine atoms attached. Chlorine or hydrogen atoms are attached at numbered positions 1–9 and 2'–6' in the figure below, and the chemical structure may differ depending on the number of chlorine atoms or its attached position. Therefore, there are 75 types of PCDDs, 135 types of PCDFs, and 12 types of co-planar PCBs (among which 29 types pose toxicities similar to 2,3,7,8-TCDD).



PCDDs



PCDFs



PCBs※

※ PCB compounds with two benzene rings on the same plane, are known as co-planar PCBs. Note that some PCBs without the planar structure but possess dioxin-like toxicity, are also classified as co-planar PCBs for a regulatory purpose.

1.2 Properties of dioxins

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

1.3 Dioxin toxicity

According to a report by the International Agency for Research on Cancer (IARC) of the World Health Organization (WHO), 2,3,7,8-TeCDD, the most toxic dioxin, is considered carcinogenic to humans based on evidence from high-concentration exposure incidents. However, the carcinogenicity of dioxins themselves is relatively weak. They do not directly act on genes to cause cancer but rather promote the carcinogenic process in cells already affected by other carcinogens (promotion effect).

In our country today, it is believed that the risk of developing cancer from dioxins at typical environmental contamination levels is minimal.

1.4 Evaluation of dioxin toxicity

Dioxins vary in their levels of toxicity, and among the PCDDs, the compound with chlorine atoms at positions 2, 3, 7, and 8 (2,3,7,8-TeCDD) is known to be the most toxic among dioxins.

Therefore, to evaluate the overall toxicity of dioxins, it is necessary to have a means to consider their combined effects.

Therefore, the toxicity of 2,3,7,8-TeCDD, the most toxic dioxin, is assigned a value of 1, and the toxicities of other dioxins are converted using this as a reference. The amounts and concentrations of various dioxins use this Toxic Equivalency Factor (TEF) to sum up the toxicities of dioxins, which is commonly referred to as the Toxic Equivalent (TEQ).

The TEQ of dioxins in this pamphlet was calculated using the WHO-TEF (2006), revised by the World Health Organization (WHO) in 2006.

1.5 Generation and behavior of dioxins in the environment

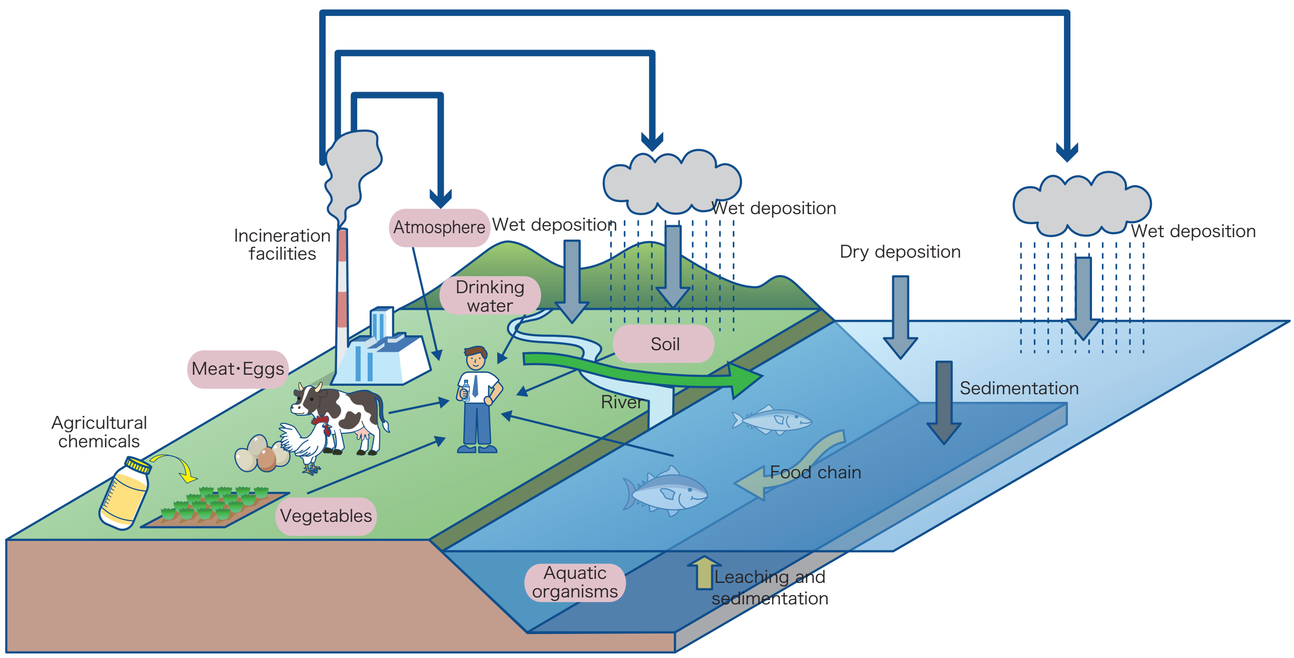
Dioxins are not produced intentionally except for research purposes, such as the production of standard materials for dioxin analysis. Dioxins are by-products generated when substances containing carbon, oxygen, hydrogen, and chlorine are heated.

The major source of dioxins today is waste incineration, and other sources include emissions from electric steelmaking furnaces, cigarette smoke, and automobile exhaust. Dioxins are formed from the combustion processes and emitted into the air when they are not captured by waste-gas mechanisms, particularly from the incineration of plastic waste and other products made from fossil fuels.

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. Dioxins in the air presumably are adsorbed to particulate matter, fall to the ground, and then pollute soil and water. It is considered that over a long period of time, these dioxins and others are released into the environment by various other pathways, and they ultimately accumulate in aquatic sediments and enter the food chain when ingested by plankton and fish, thereby accumulating in various organisms.

Although dioxins are mostly anthropogenically produced, small amounts are generated in nature through forest fires and volcanic activities.



2. Organofluorine compounds

Organofluorine compounds consist of carbon (C) bonded to fluorine (F), with a very strong bond between carbon and fluorine, making these compounds highly resistant to heat and chemicals.

They are used as surfactants, easily dissolving in both water and oil. Until recently, they were widely used in water-repellent sprays, foam fire extinguishers, and non-stick coatings for frying pans. However, it has been found that they are difficult to break down in the environment and within living organisms, and they tend to accumulate in the body.

Notably, PFOA, PFHxS, and PFOS are substances regulated under the Stockholm Convention on Persistent Organic Pollutants (POPs).

Table 16　Organofluorine compounds

Chemical substances	Usage, etc.
PFHxA (Perfluorohexanoic acid) PFHpA (Perfluoroheptanoic acid) PFOA (Perfluorooctanoic acid) PFNA (Perfluorononanoic acid) PFDA (Perfluorodecanoic acid) PFUdA (Perfluoroundecanoic acid) PFDoA (Perfluorododecanoic acid) PFTrDA (Perfluorotridecanoic acid) PFTeDA (Perfluorotetradecanoic acid) PFHxS (Perfluorohexanesulfonic acid) PFOS (Perfluorooctanesulfonic acid) PFDS (Perfluorodecanesulfonic acid)	Organofluorine compounds are known for their water and oil repellency, as well as their thermal and chemical stability. These properties make them useful in a wide range of applications, including water and oil repellents, surfactants, anti-reflective agents for semiconductors, metal plating agents, aqueous film-forming foam fire extinguishers, insecticides, and coatings for cooking utensils. There are various homologs of organofluorine compounds with different carbon chain lengths, and their properties can vary significantly depending their length.

3. Metals

Metals are widely distributed on the earth and are used for various purposes. However, some metals are potentially toxic to organisms.

In the past, Japan has experienced damage to thehealth of people by environmental heavy metal pollution, such as Minamata disease caused by methylmercury and Itai-Itai Disease caused by cadmium.

Table 17 Metals

Metals	Usage, etc.
Total mercury	Metallic mercury is used in devices such as blood pressure monitors, thermometers, and temperature gauges, as well as in mercury vapor lamps and fluorescent lamps. The methylation of metallic mercury produces “methylmercury,” which is highly toxic and was a key factor in environmental pollution incidents like Minamata disease.
Lead	Used widely in electrodes, weight, glass products , solder, and others. Excessive intake can cause neurological disorders and other issues.
Cadmium	Used in button batteries and plating materials. It is also produced alongside zinc and recovered during zinc refining. Excessive intake can cause kidney dysfunction and other issues.
Arsenic	In the past, arsenic compounds were used as rodenticides and other pesticides. Organic arsenic is commonly found in seafood (such as seaweeds, shrimps, and crabs) but are generally non-toxic. Inorganic arsenic is highly toxic. Excessive intake of inorganic arsenic can cause skin pigmentation changes, multiorgan failure, peripheral vascular disease, and cancer.
Copper	Widely used in various applications such as electrical wiring and roofing materials. It is an essential element for humans, and a deficiency can lead to conditions like anemia, reduced white blood cell count, and growth disorders. However, excessive intake can cause symptoms like fever and headaches.
Selenium	Used in various applications such as photocopier drums, solar cells, and as a coloring and decolorizing agent in glass. It is an essential element for humans. A deficiency can lead to conditions like myocardial disorders, while excessive intake can cause growth inhibition and abnormal gait.
Zinc	Widely used in galvanized steel sheets and as cathode plates in batteries. It is an essential element for humans. A deficiency can lead to conditions such as taste disorders and skin problems. However, excessive intake can inhibit the absorption of copper and iron, leading to anemia and immune disorders.
Manganese	Used in battery materials and as a raw material for fertilizers. It is an essential element for humans. A deficiency can lead to conditions such as dermatitis and hypocholesterolemia. However, excessive intake can cause walking difficulties and speech disorders.

4. Plasticizers, pesticides, and other chemical compounds

The summaries of plasticizers, pesticides, and others measured in this survey are shown.

Table 18　Plasticizers and pesticides

Chemical substances	Usage, etc.
Phthalate monoesters ・MBP (monobutyl phthalate) ・MEHP (mono(2-ethylhexyl) phthalate) ・MEHHP (mono(2-ethyl-5-hydroxyhexyl)phthalate) ・MEOHP (mono(2-ethyl-5-oxohexyl) phthalate) ・MBzP (monobenzyl phthalate)	Used as plasticizer in plastic, adhesive agents, and others. The measured substances were metabolites (monoesters),
Bisphenol A Bisphenol S Bisphenol F	Used as raw materials for synthetic resins such as polycarbonate and epoxy resins.
Organophosphorus pesticide metabolites ・DMP (dimethyl phosphate) ・DEP (diethyl phosphate) ・DMTP (dimethyl thiophosphate) ・DETP (diethyl thiophosphate)	Metabolites of organophosphorus pesticides used as pesticides, disinfectant, wood preservatives, and others.
Pyrethroid pesticide metabolites ・PBA (phenoxybenzoic acid) ・DCCA (dimethylcyclopropanecarboxylic acid)	Metabolites of pyrethroid pesticides used widely as pesticides, insecticides, and others (metabolites were measured).
Neonicotinoid pesticides and their metabolites ・Acetamiprid ・Imidacloprid ・Thiacloprid ・Thiamethoxam ・Clothianidin ・Dinotefuran ・Nitenpyram ・Desmethyl acetamiprid ・Thiacloprid amide ・Desmethyl thiamethoxam	Neonicotinoid pesticides and their metabolites, used as insecticides, are considered to have minimal impact on humans, leading to increased usage. However, they are believed to cause mass bee deaths and are banned in the EU.
Phenylpyrazole pesticides ・Fipronil	

Table 19　Other chemical compounds

Chemical substances	Usage, etc.
Triclosan	Primarily antimicrobial agents, added to soaps and detergents for their disinfectant properties.
Parabens ・Methylparaben ・Ethylparaben ・Propylparaben ・Butylparaben ・Benzylparaben	Used as preservatives (antimicrobial agents) in food, pharmaceuticals, and cosmetics.
Cotinine	Metabolites of nicotine found in tobacco serve as markers for both active smoking and passive smoking.
Benzophenone-3	Used in sunscreen cosmetics due to its ultraviolet absorption effect.

Dioxin intake

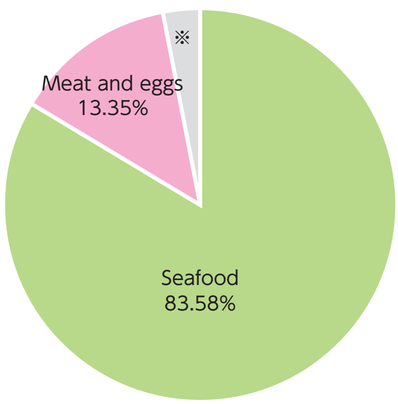
In Japan, based on scientific knowledge, the tolerable daily intake (TDI) of dioxins was set at 4 pg-TEQ/kg bw/day in June 1999. The safety evaluation of the total amount of ingested dioxins is conducted by comparing to this value.

On average, the daily dioxin intake of dioxins by the Japanese people is estimated to be approximately 0.45 pg-TEQ/kg bw/day. These levels are below the TDI and therefore considered to be below the level that can cause adverse effects on human health.

Conceivable routes of intake include food, ambient air, and soil, but the intake from food is estimated to account for the largest portion (Figure 1).

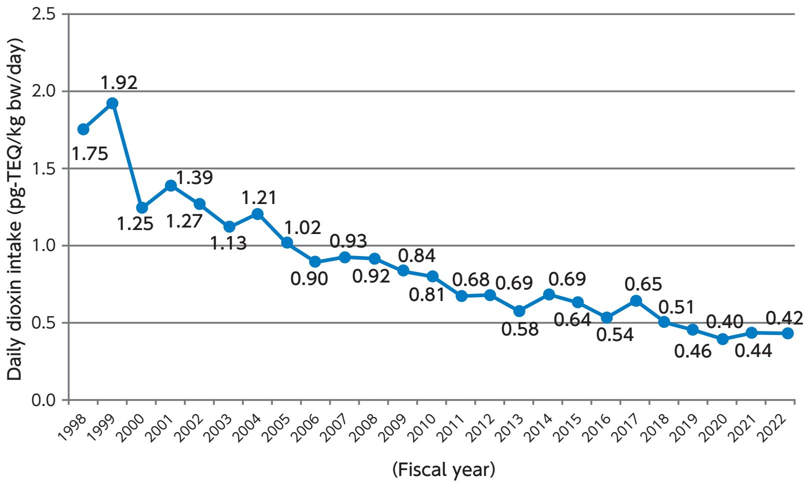
Figure 2 shows the chronological change of estimated total daily intake of dioxins by the Japanese people using the results of "Survey on the Daily Intake of Dioxins from Food" (Ministry of Health, Labour and Welfare, Japan). Enforcement of the "Law Concerning Special against Dioxins (January, 2000)" has greatly decreased emission of dioxins to environment. Dioxin concentrations in food and the environment (ambient air and soil) have also has decreased. As a result, the average daily dioxin intake of dioxins by the Japanese people shows a decreasing trend.

Figure 1 Daily intake of dioxins by Japanese people (FY 2022)[Note1]



※
Soil : 0.74% Ambient air : 0.99% Seasoning : 0.19%
Milk and dairy products : 0.19%
Sugar and confectionery : 0.14% Others : 0.81%

Figure 2 Trends in daily dioxin intake from food[Note2]



Note 1 : Prepared by the Ministry of the Environment (MOEJ) based on the 'FY 2022 Environmental Survey of Dioxins' and the 'FY 2022 Survey on the Daily Dioxin Intake from Food' (subsidized by the Ministry of Health, Labour and Welfare; MHLW).
Note 2 : 'FY 2022 Survey on the Daily Dioxin Intake from Food' (subsidized by MHLW).

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