

4. Food Survey

In the food survey, the concentrations of PCDD+PCDF+Co-PCB in food were measured by collecting all the replicated food samples during the three days. Survey subjects were also asked to fill out dietary logs recording the contents of their meals, and those contents were checked by dietitians when the food was collected. This survey of food was conducted three times in a month for reducing statistical fluctuation.

Results

The results of measurement of PCDD+PCDF+Co-PCB concentrations in food (concentration as mean quantity per gram of three samplings) are as shown in Table 4-1 (cf. Table 4-2).

Table 4-1. Results from Measurement of PCDD+PCDF+Co-PCB in Food

(Unit: pg-TEQ/g)

	Osaka Prefecture Nose Town Regions		Saitama Prefecture Regions			Hiroshima Prefecture Fuchu City Regions	
	A region (n=22)	B region (n=15)	A1 region (n=14)	A2 region (n=22)	B region (n=13)	A region (n=16)	B region (n=19)
PCDD+PCDF							
Mean	0.018	0.020	0.021	0.018	0.017	0.014	0.014
Standard deviation	0.0091	0.012	0.0095	0.0089	0.0057	0.0092	0.0065
Median	0.015	0.019	0.018	0.018	0.018	0.012	0.013
Range	0.0041 -0.038	0.0079 -0.056	0.0092 -0.042	0.0047 -0.038	0.0048 -0.024	0.0049 -0.044	0.0046 -0.025
Co-PCB							
Mean	0.027	0.024	0.026	0.021	0.016	0.017	0.025
Standard deviation	0.019	0.014	0.023	0.012	0.0077	0.010	0.013
Median	0.023	0.022	0.019	0.019	0.014	0.014	0.023
Range	0.0053 -0.082	0.011 -0.065	0.0084 -0.095	0.0060 -0.050	0.0066 -0.028	0.0048 -0.049	0.0069 -0.053
PCDD+PCDF +Co-PCB							
Mean	0.045	0.044	0.047	0.039	0.033	0.030	0.038
Standard deviation	0.027	0.022	0.031	0.020	0.013	0.020	0.018
Median	0.038	0.041	0.042	0.038	0.027	0.026	0.036
Range	0.0091 -0.11	0.018 -0.095	0.018 -0.14	0.012 -0.086	0.011 -0.050	0.0097 -0.095	0.011 -0.075

Notes:

- 1 Isomers which were at levels below the lower limit of determination (ND) were assigned a zero value in calculation.
- 2 The lower limits of determination were as follows:
T₄CDD, T₄CDF: 0.001 (pg/g), P₅CDD, P₅CDF: 0.001 (pg/g)
H₆CDD, H₆CDF: 0.002 (pg/g), H₇CDD, H₇CDF: 0.002 (pg/g)
O₈CDD, O₈CDF: 0.005 (pg/g), Co-planar PCB: 0.002 (pg/g)

Table 4-2. Results from Measurement of PCDD+PCDF+Co-PCB in Food (for Reference)

(Unit: pg-TEQ/g)

	Osaka Prefecture Nose Town Regions		Saitama Prefecture Regions			Hiroshima Prefecture Fuchu City Regions	
	A region (n=22)	B region (n=15)	A1 region (n=14)	A2 region (n=22)	B region (n=13)	A region (n=16)	B region (n=19)
PCDD+PCDF							
Mean	0.019	0.021	0.021	0.019	0.017	0.014	0.014
Standard deviation	0.0088	0.011	0.0094	0.0087	0.0052	0.0092	0.0062
Median	0.016	0.019	0.018	0.019	0.018	0.013	0.014
Range	0.0055 -0.038	0.0089 -0.056	0.010 -0.042	0.0061 -0.038	0.0063 -0.024	0.0060 -0.045	0.0057 -0.026
Co-PCB							
Mean	0.027	0.024	0.026	0.021	0.016	0.017	0.025
Standard deviation	0.019	0.014	0.023	0.012	0.0077	0.010	0.013
Median	0.023	0.022	0.019	0.019	0.014	0.014	0.023
Range	0.0053 -0.082	0.011 -0.065	0.0084 -0.095	0.0060 -0.050	0.0066 -0.028	0.0048 -0.049	0.0069 -0.053
PCDD+PCDF +Co-PCB							
Mean	0.045	0.045	0.047	0.039	0.033	0.031	0.039
Standard deviation	0.027	0.021	0.031	0.020	0.012	0.019	0.018
Median	0.039	0.041	0.043	0.038	0.028	0.027	0.037
Range	0.011 -0.11	0.019 -0.095	0.019 -0.14	0.013 -0.087	0.013 -0.050	0.011 -0.095	0.013 -0.076

Note: When the actual measurement of an isomer was below the lower limit of determination (ND), its actual concentration was calculated by applying one-half the value of the detection limit.

Analysis and Evaluation

Based on the results for PCDD+PCDF+Co-PCB concentrations in food, the exposure to PCDD+PCDF+Co-PCB through food was estimated, and the regions were then compared in terms of estimated exposure to PCDD+PCDF+Co-PCB through food.

(a) Estimation of Exposure to Dioxins through Food

Based on the results for PCDD+PCDF+Co-PCB concentrations in food, the daily exposure per kilogram of body weight to PCDD+PCDF+Co-PCB through food was estimated.

As a rule, the method of estimation followed the formula below :

Exposure through food (pg-TEQ/kg/day) = PCDD+PCDF+Co-PCB concentrations in food (pg-TEQ/g) × quantity of food ingested daily (g/day) ÷ body weight of survey subject (kg)

In some cases, part of the food ingested during the three-day period was not collected. In these cases, the dietary logs recording the contents of meals were used as a basis for inferring the amount of food not collected, and estimation proceeded on the assumption that the food that was not collected had the identical PCDD+PCDF+Co-PCB concentrations to the food that was collected.

The estimated exposure to PCDD+PCDF+Co-PCB through food is shown in Table 4-3. The analysis of the estimated exposure to PCDD+PCDF+Co-PCB through food used results corrected by the above formula.

Table 4-3. Estimated Exposure to PCDD+PCDF+Co-PCB by through Food

(Unit: pg-TEQ/kg/day)

	Osaka Prefecture Nose Town Regions		Saitama Prefecture Regions			Hiroshima Prefecture Fuchu City Regions	
	A region (n=22)	B region (n=15)	A1 region (n=14)	A2 region (n=21)	B region (n=13)	A region (n=16)	B region (n=19)
PCDD+PCDF							
Mean	0.75	1.1	0.87	0.92	0.78	0.58	0.61
Standard deviation	0.39	0.78	0.42	0.41	0.29	0.37	0.31
Median	0.62	0.86	0.80	0.90	0.68	0.51	0.57
Range	0.22 – 1.7	0.53 – 3.6	0.49 – 2.1	0.29 – 1.6	0.38 – 1.5	0.15 – 1.5	0.15 – 1.3
Co-PCB							
Mean	1.1	0.99	0.87	0.90	0.62	0.67	1.1
Standard deviation	0.95	0.53	0.53	0.47	0.30	0.41	0.60
Median	0.87	0.96	0.75	0.96	0.62	0.56	1.1
Range	0.23 – 4.6	0.46 – 2.6	0.31 – 2.2	0.26 – 2.2	0.21 – 1.0	0.15 – 1.6	0.21 – 2.3
PCDD+PCDF +Co-PCB							
Mean	1.8	2.1	1.7	1.8	1.4	1.2	1.7
Standard deviation	1.3	1.0	0.81	0.84	0.56	0.77	0.84
Median	1.6	1.9	1.6	1.7	1.2	1.1	1.8
Range	0.45 – 6.2	1.0 – 4.7	0.84 – 3.2	0.60 – 3.7	0.70 – 2.4	0.32 – 3.2	0.35 – 3.3

(b) Comparison of Regions

As shown in Table 4-3, all the regions showed a broad range of estimated exposures to PCDD+PCDF+Co-PCB through food. Figure 4-1 is a histogram of individual exposure to dioxins (through food).

The comparison of regions in the Nose Town area of Osaka Prefecture showed that mean and median values for estimated exposure to PCDD+PCDF+Co-PCB were lower in A region than in B region. In the Saitama Prefecture areas, the mean value in the B regions were lower than in the A1 regions and A2 regions. In the Fuchu City area of Hiroshima Prefecture, both the mean and median values were lower in the A regions than in the B regions. No significant difference was apparent in estimated exposures to PCDD+PCDF+Co-PCB through food in any of the three areas. The dietary logs recording the contents of meals were used as a basis for inferring the amount and proportion of each food group in each region. No distinct differences were observed among the regions (Table 4-4). Likewise, no distinct differences were observed among the regions with respect to total daily intake of energy, fat, energy from fat, and so on (Table 4-5).

(c) Miscellaneous

No distinct correlation was observed between the amount of home-grown food ingested and the estimated exposure to PCDD+PCDF+Co-PCB through food (Figure 4-2).

The relationship between number of food types ingested and estimated exposure to PCDD+PCDF+Co-PCB through food is shown in Figure 4-3.

Note: This analysis deals only with the correlation between the estimated exposure from the portion of food that was collected and the amount of home-grown food included in that portion that was ingested.

Summary of Food Survey

The comparison of regions showed that the mean values for estimated exposure to PCDD+PCDF+Co-PCB in the Nose Town area of Osaka Prefecture were lower in A region than in B region, while the mean values were lower in B region than in A region. In Saitama Prefecture, the median values in B regions were lower than in the A1 regions or A2 regions. In the Fuchu City area of Hiroshima Prefecture, both the mean values and median values were lower in the A regions than in the B regions. In none of the three areas, however, was any distinct difference observed in the estimated exposure to PCDD+PCDF+Co-PCB through food.

In fiscal 1998, the food survey was conducted once for three days (a total of three times), while in fiscal 1999, the food survey was conducted three times for three days each (a total of nine days). This is thought to have smoothed the measurements of the amount of dioxin intake from the food.

Table 4-4. Food Group Amounts and their Proportion According to Dietary Logs Recording Meal Contents
(Mean Values from Three Samplings in Three Days)

Nose Area

Group	A Region		B Region		Overall	
	Weight (g)	proportion (%)	Weight (g)	Proportion (%)	Weight (g)	Proportion (%)
Group 1 (Rice, processed rice products)	406	20.6	442	19.6	421	20.1
Group 2 (Grains, potato, taro)	158	8.0	123	5.4	143	6.9
Group 3 (Sugar, sweets)	8	0.4	11	0.5	9	0.4
Group 4 (Fats and oils)	9	0.4	8	0.3	8	0.4
Group 5 (Beans and processed bean products)	47	2.4	72	3.2	57	2.7
Group 6 (Fruits)	105	5.3	138	6.1	118	5.7
Group 7 (Yellow-green vegetables)	76	3.8	79	3.5	77	3.7
Group 8 (Vegetables, seaweeds)	148	7.5	197	8.7	168	8.0
Group 9 (Seasonings, luxury items)	731	37.1	806	35.7	761	36.4
Group 10 (Seafood)	72	3.6	94	4.2	81	3.9
Group 11 (Meat, eggs)	85	4.3	94	4.2	88	4.2
Group 12 (Milk, dairy products)	86	4.3	137	6.1	107	5.1
Group 13 (Other foods)	43	2.2	59	2.6	50	2.4
Total	1,973	100.0	2,260	100.0	2,089	100.0

Saitama Area

Group	A1 Region		A2 Region		B Region		Overall	
	Weight (g)	Proportion (%)						
Group 1 (Rice, processed rice products)	365	18.5	340	16.7	339	16.8	347	17.3
Group 2 (Grains, potato, taro)	169	8.5	158	7.8	207	10.3	175	8.7
Group 3 (Sugar, sweets)	7	0.4	9	0.4	13	0.6	9	0.5
Group 4 (Fats and oils)	7	0.3	7	0.4	10	0.5	8	0.4
Group 5 (Beans and processed bean products)	74	3.7	66	3.2	57	2.8	66	3.3
Group 6 (Fruits)	118	6.0	96	4.7	134	6.6	113	5.6
Group 7 (Yellow-green vegetables)	90	4.6	89	4.4	110	5.5	95	4.7
Group 8 (Vegetables, seaweed)	165	8.4	172	8.5	186	9.2	174	8.6
Group 9 (Seasonings, luxury items)	599	30.4	770	37.8	643	31.9	686	34.1
Group 10 (Seafood)	76	3.8	73	3.6	60	3.0	70	3.5
Group 11 (Meat, eggs)	90	4.6	74	3.6	78	3.9	80	4.0
Group 12 (Milk, dairy products)	158	8.0	129	6.3	135	6.7	139	6.9
Group 13 (Other foods)	56	2.8	52	2.5	44	2.2	51	2.5
Total	1,972	100.0	2,035	100.0	2,016	100.0	2,012	100.0

Note: The following correction was made to allow for portions of food that were not collected:

[Total amount ingested (after correction) ()]

= [Total amount ingested (before correction) ()] × (Corrected amount of food used for calculation of exposure) / (Actual measured weight of food)

[(Amount of food group ingested (after correction))

= [(Amount of food group ingested (before correction)) + [(-) × (Proportion of food group)]

(The proportion of food group in the food that was not recovered is assumed to be identical to that in the food that was recovered.)

Fuchu Area

Group	A1 Region		B Region		Overall	
	Weight (g)	Proportion (%)	Weight (g)	Proportion (%)	Weight (g)	Proportion (%)
Group 1 (Rice, processed rice products)	451	21.5	492	21.7	473	21.6
Group 2 (Grains, potato, taro)	119	5.7	100	4.4	109	5.0
Group 3 (Sugar, sweets)	11	0.5	11	0.5	11	0.5
Group 4 (Fats and oils)	6	0.3	6	0.3	6	0.3
Group 5 (Beans and processed bean products)	70	3.3	86	3.8	78	3.6
Group 6 (Fruits)	137	6.6	150	6.6	144	6.6
Group 7 (Yellow-green vegetables)	74	3.6	78	3.4	76	3.5
Group 8 (Vegetables, seaweeds)	202	9.6	215	9.5	209	9.6
Group 9 (Seasonings, luxury items)	765	36.5	802	35.4	785	35.9
Group 10 (Seafood)	75	3.6	80	3.5	78	3.6
Group 11 (Meat, eggs)	85	4.1	90	4.0	88	4.0
Group 12 (Milk, dairy products)	65	3.1	125	5.5	97	4.5
Group 13 (Other foods)	33	1.6	28	1.2	30	1.4
Total	2,094	100.0	2,263	100.0	2,186	100.0

Table 4-5. Daily Intake of Energy, Fatty Acids, and so forth from Food

Nose Area

Item	A Region				B Region			
	Mean	S.D.	Minimum	Maximum	Mean	S.D.	Minimum	Maximum
Total energy (kcal)	1,743	418	1,034	2,845	1,951	328	1,453	2,953
Fat (g)	45.3	12.5	21.5	85.6	51.3	11.5	36.4	80.4
Energy from fat (%)	23.5	3.7	14.4	31.9	24.0	5.3	16.5	39.7
Fatty acids (g)	27.7	8.2	13.7	50.3	30.9	8.3	17.9	53.7
Saturated fatty acids (g)	9.1	3.9	3.3	21.2	10.6	4.1	5.3	22.5
Monounsaturated fatty acids (g)	10.8	3.4	4.7	19.2	12.0	3.6	5.2	23.3
Polyunsaturated fatty acids (g)	7.9	1.9	4.1	12.9	8.4	2.2	5.2	13.7
Edible fiber (g)	11.0	3.1	4.7	19.2	12.6	2.8	7.0	19.6

Saitama Areas

Item	A1 Region				A2 Region				B Region			
	Mean	S.D.	Minimum	Maximum	Mean	S.D.	Minimum	Maximum	Mean	S.D.	Minimum	Maximum
Total energy (kcal)	1,797	413	1,009	2,728	1,752	412	658	2,671	1,804	318	1,210	2,408
Fat (g)	50.9	13.7	24.7	79.1	50.0	14.0	16.2	85.6	47.0	11.0	23.7	72.7
Energy from fat (%)	27.7	8.5	14.3	50.4	25.9	4.6	12.7	39.1	23.6	4.4	12.1	32.1
Fatty acids (g)	31.9	10.3	13.6	61.5	29.7	10.0	9.6	57.2	26.8	7.8	8.9	45.6
Saturated fatty acids (g)	11.1	4.8	3.7	26.9	10.2	3.9	3.0	18.2	8.8	2.8	3.1	14.5
Monounsaturated fatty acids (g)	12.0	4.4	4.7	22.0	10.8	4.0	3.8	21.3	10.0	3.2	3.0	17.8
Polyunsaturated fatty acids (g)	8.9	3.3	3.3	16.0	8.7	3.2	2.8	19.5	8.1	2.5	2.9	13.4
Edible fiber (g)	11.4	3.4	5.6	19.1	11.6	5.1	3.0	27.1	12.5	4.8	5.9	26.1

Note: In the cases where the parts of food consumed were not retrieved, energy and other values were estimated from the dietary logs and correction was made by multiplying the value by:
 (Corrected weight of food used for exposure estimate) / (Actual measured weight of food).

Fuchu Area

Item	A Region				B Region			
	Mean	S.D.	Minimum	Maximum	Mean	S.D.	Minimum	Maximum
Total energy (kcal)	1,891	496	1,087	2,845	1,880	386	1,181	2,854
Fat (g)	47.8	17.6	22.2	101.6	46.7	16.6	18.4	91.2
Energy from fat (%)	22.9	6.1	10.3	36.7	22.2	5.5	13.2	35.5
Fatty acids (g)	29.2	12.3	10.6	61.8	29.7	9.8	14.0	50.2
Saturated fatty acids (g)	8.8	3.8	2.4	19.5	9.9	4.1	4.0	20.3
Monounsaturated fatty acids (g)	11.2	5.3	4.1	26.3	11.0	4.0	4.7	20.4
Polyunsaturated fatty acids (g)	9.3	4.0	3.8	22.2	8.9	3.0	4.4	16.4
Edible fiber (g)	12.1	3.8	5.7	21.8	14.2	4.5	7.9	25.3

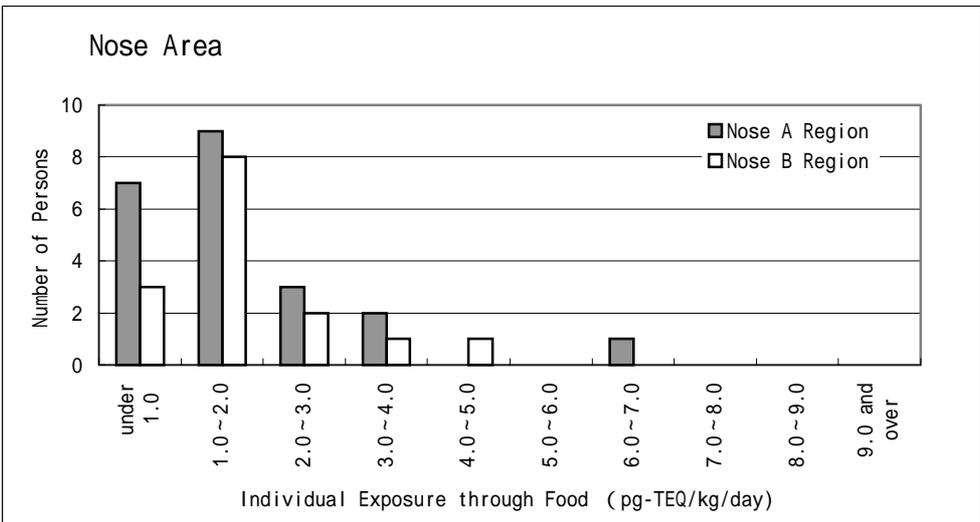
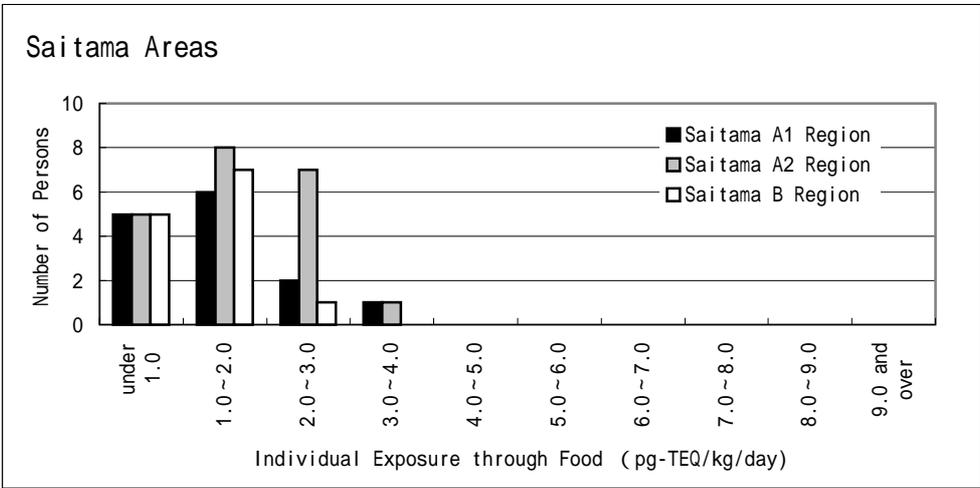
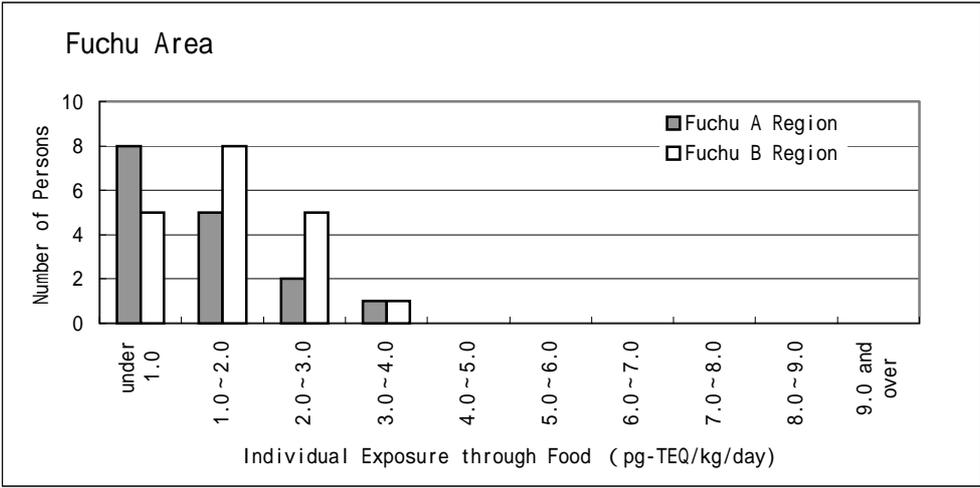


Figure 4-1. Histograms of Individual Exposure to Dioxins (through Food)

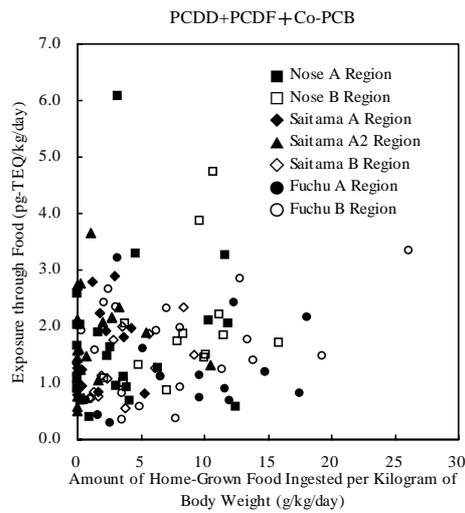
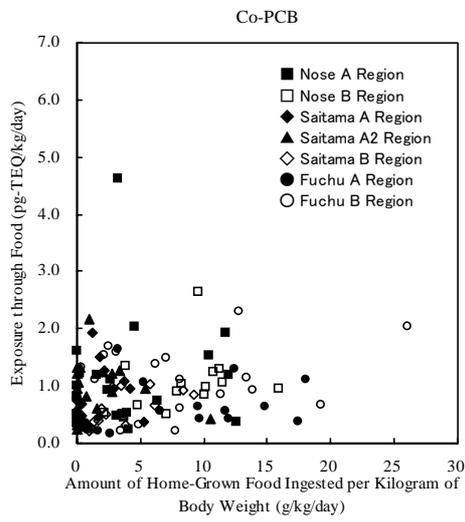
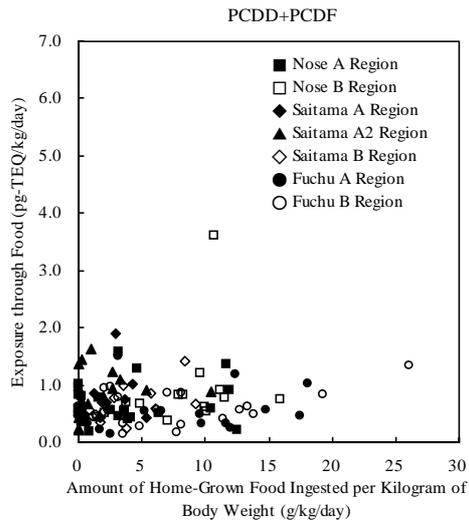


Figure 4-2. Relationship between Exposure through Food and Amount of Home-Grown Food Ingested

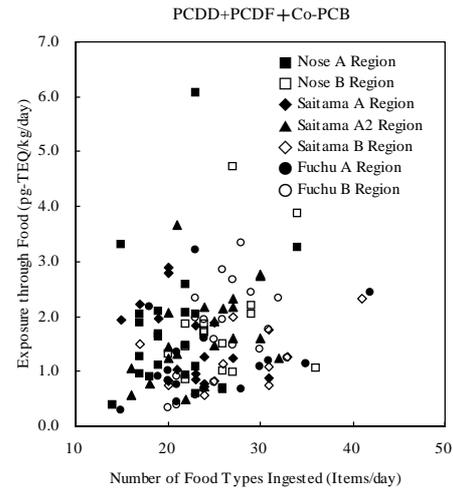
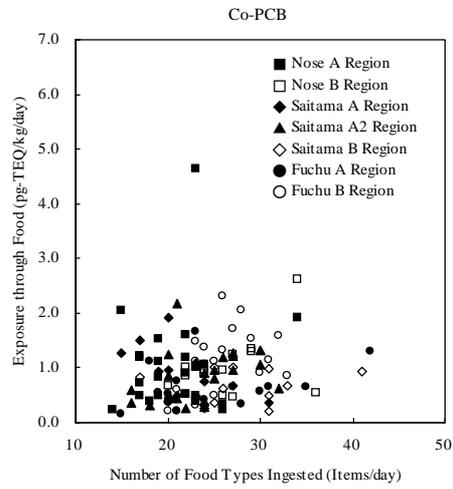
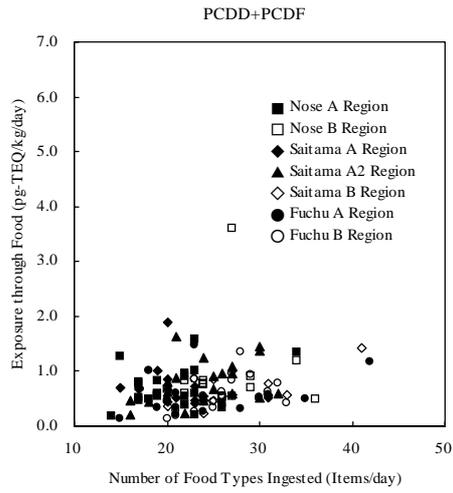


Figure 4-3. Relationship between Exposure through Food and Number of Food Types Ingested