Patterns of Serum PCDD/Fs Affected by Vegetarian Regime, Consumption of Locally Produced Food, and Resident Places of Residents Living Near Incinerators

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Introduction

Previous reports have been estimated that more than 90% of serum PCDD/Fs can be accounted for by the consumption of various food groups [1,2]. Nouwen et al. suggested residents living near incinerators with the elevated dioxin exposure while they ate locally produced food compared to the general population from other areas [3]. PCDD/Fs usually abound in fatty meats and marine foods, and consumption of which is the major pathway of human expose to PCDD/Fs [4]. However, no distinct association was shown between vegetarian regime of human and their corresponding serum PCDD/Fs concentration. In addition, the resident region is associated to their corresponding dietary consumption and ambient exposure of PCDD/Fs, especially for subjects consumed the local foods with special dioxin-like contamination.

The current study, therefore, was set to examine how dietary habits, including vegetarian regime and consumption of local food original for residents living near the incinerators are associated to serum PCDD/F concentrations. In addition, the further aim is to assess the influence on the serum PCDD/Fs levels resulting from subjects living in the alternative resident regions, even all of them exposed to PCDD/Fs emission from incinerators.

Material and Methods

One thousand seven hundred and eighty-eight volunteers living near 19 municipal waste incinerators were recruited. Subject selection was designed based on the population distribution in each district. All volunteers were between 18-65 years old and had lived in the selected incinerators for at least 5 years. These participants were considered to have potential exposure to dioxin emissions from the incinerators. All selected volunteers were categorized into 5 groups on the following scenarios: land usage, such as fishing areas and marine agricultural districts: Group 1 is urban area, Group 2 is industrial area, Group 3 is rural area, Group 4 is a fish port or land usage is major for marine aquaculture, and Group 5 is an urban and rural area. After signing a consent form and the day after completing an overnight fast, each study participant provided 60 mL of venous blood.

Seventeen 2,3,7,8-substituted PCDD/Fs were measured in biological samples, including human blood samples and fish samples, using isotope dilution high-resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS). The procedures used in this study to analyze PCDD/Fs have been reported elsewhere [5,6]. The method included extraction, cleanup, concentration, and instrumental analysis.

Information obtained from the questionnaire included personal characteristics (sex, age, height, weight, occupational history, neighborhood geography, pregnancy history, etc), life style (alcohol intake and tobacco usage), and the quantity of dietary intake for the previous 1 year based on a food semi-quantitative frequency questionnaire. In addition, information of subjects consumed local food or bought it from market was also collected by questionnaire. Trained interviewers administered the questionnaires according to standard operating procedures prepared in advance.

Results

Table 1 performed the distribution of demographic characteristics of the group 1 to 5.

Table 2 presented the distributions of serum PCDD/Fs levels in vegetarian and non-vegetarian, and in subjects consumed local food and not. Thirty-four persons (1.9%) are vegetarian among all study subjects. Higher proportion of women is found in vegetarian than non-vegetarian, and marginal significant higher lipid content was found in vegetarian than non-vegetarian ($p=0.098$). In addition, higher serum PCDD/Fs level was significantly higher in non-vegetarian than vegetarian ($p=0.009$). About 242 persons (20 %) of total participants responded that they often eat vegetables planted or poultry meat grew originally in local place. Higher proportion of women is found in subjects responded they often eat local food than those responded never, as well as for serum PCDD/Fs levels ($p=0.0002$). Table 3 performed the distribution of serum PCDD/Fs levels in different group. The highest serum PCDD/Fs level was observed in group 4 (24.6 pg WHO-TEQ/g lipid), the following is in group 2 (21.8 pg WHO-TEQ/g lipid). In subjects respond they often eat local food, the highest level was observed in group 2 (26.2 pg WHO-TEQ/g lipid) and following in group 4 (22.4 pg WHO-TEQ/g lipid). Results also showed the significant lower serum PCDD/Fs levels in vegetarian than non-vegetarian after adjustment for age and lipid content, as well as the subjects do not consume local food (data not shown). Figure 1 presented the distribution of proportion of each PCDD/Fs compound in serum levels in the vegetarian or non-vegetarian. Except for OCDD, the result indicated that proportions of other PCDD/Fs congeners in non-vegetarian were higher than those of vegetarian, however, no obvious difference was observed between subjects' consumption with local food or not (Figure 2).

Discussions

1.9 % of the study participants were vegetarian and 20 % of those often consume local food in the current study. The previous report from food analysis show that the highest PCDD/F levels are in fish, following in dairy products, and finally in other meats [7,8]. Another Russian study also shows that the higher PCDD/F concentration is in pork, poultry meats and beef, and evaluations in all vegetables are lower than detection limits except for unwashed cabbage [9]. The results seem to be interpreted that vegetarian regime may be used to explain for human's low PCDD/Fs levels. From Table 3, the result showed the significant high serum PCDD/Fs levels was in subjects consuming local food than those without. In the literatures reviews, it have been found that the highest and lowest PCDD/F concentrations of soil are found at 750 m (44.26 ng TEQ/kg) and 3000 m (0. 30 ng TEQ/kg) distant from the stack of a municipal solid waste incinerator [10]. PCDD/Fs concentration from vegetation samples collected in the vicinity of an incinerator indicate that other potential combustion sources, such as burned agricultural waste or used of the gasoline can emit amount of PCDD/Fs to air and then deposited on vegetation [11]. Meanwhile, the other study reveal a significant interaction between age-adjusted dioxin levels of residence around incinerators and the consumption of fat from local origin, especially bovine and poultry products [12].Therefore, we might interpreted that serum PCDD/Fs levels of residents in the vicinity of the incinerator would be related to their consumption of the local food grew or planted originally, especially in poultry products.

An study evaluate the human exposure of PCDD/Fs for those resided approximately 18 years in the vicinity of two old incinerators. Significantly higher serum dioxins levels is found in subjects residing around the incinerator in the rural area than controls (38 vs. 24 pg TEQ/g fat), however, it show no significant difference in residents living around the two incinerators in the rural and urban areas. In addition, Maystrenko shows that the dioxin concentration in human organism depends on the living place, and it result from dioxin emission of industrial factory instead of by food [9]. Kiviranta also indicate that age, amount of fish eaten, and place of residence are significant predictors to PCDD/Fs plus PCBs levels [13]. The present study proved that the resident place probable to be a predictor to PCDD/Fs accumulation for human living in different incinerators. In addition, multivariate regression model showed that the vegetarian regime or residents consumed local food grew or planted originally was associated to their corresponding serum PCDD/Fs levels. In future, it would be necessary to set a strategy in foodstuff to prevent the excess PCDD/Fs accumulation from the food plant or grow originally near a probable contaminant source.

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Table 1. Demographic characteristics of the study subjects

	Group1	Group2	Group3	Group4	Group5	P value
N=	414	574	169	374	203	
Age (Years)	46.2±11.6	44.4±11.6	47.1±12.0	47.5±12.7	43.5±12.2	<0.0001 ¥,**
Sex						0.149 #
Male	188(45.4)	278(48.4)	91(53.9)	197(52.7)	107(53.0)	
Female	226(54.6)	296(51.6)	78(46.2)	177(47.3)	95(47.1)	
Education						<0.0001 #, **
0	31(7.5)	46(8.0)	20(11.8)	48(12.9)	49(24.3)	
1-6 years	69(16.7)	123(21.9)	62(36.7)	143(38.4)	45(22.3)	
7-15 years	275(66.4)	356(62.2)	84(49.7)	174(46.8)	104(51.5)	
>15 years	37(8.9)	44(7.7)	3(1.8)	7(1.9)	3(1.5)	
BMI	24.1±3.3	23.9±3.6	24.4±4.0	24.6±3.7	25.0±4.1	<0.0001 ¥,**
Smoking habit						<0.0001 #,**
Never	201(48.6)	200(35.1)	53(31.4)	107(28.8)	70(34.7)	
Smokers	100(24.2)	163(28.6)	59(34.9)	114(30.7)	15(32.2)	
Passive smokers	113(27.3)	207(36.3)	57(33.7)	150(40.4)	67(33.2)	
Alcohol intake						0.267 #
Never	340(82.1)	447(78.3)	130(76.9)	284(76.6)	153(75.7)	
Yes	74(17.9)	124(21.7)	39(23.1)	87(23.5)	49(24.3)	

¥: ANOVA, #: Chi-Squared test, **: p<0.0001

Note: Group 1 is urban type, Group 2 is industrial type, Group 3 is rural type, Group 4 is a fishing port, Group 5 is an urban and rural type

Table 2 Distribution of serum PCDD/Fs levels in vegetarian and non-vegetarian

Intake habit	Vegetarian	Non-Vegetarian	P value	Local food¶	Non-local food§	P value
N=	34	1761		242	1206	
Male ratio	46.0	50.0	0.306 #	47.5	50.1	0.482 #
Age (years old)	46.7±9.9	45.6±12.1	0.744 ‡	46.9±13.4	45.7±11.91	0.065 ‡
Lipid content (%)	28.2±5.6	26.7±6.6	0.098 ‡	26.1±7.0	26.9±6.5	0.119 ‡
Serum PCDD/Fs levels†	16.5±8.5	20.2±11.4	**0.009 ‡,***	23.4±11.5	20.6±10.9	**0.0002‡,***

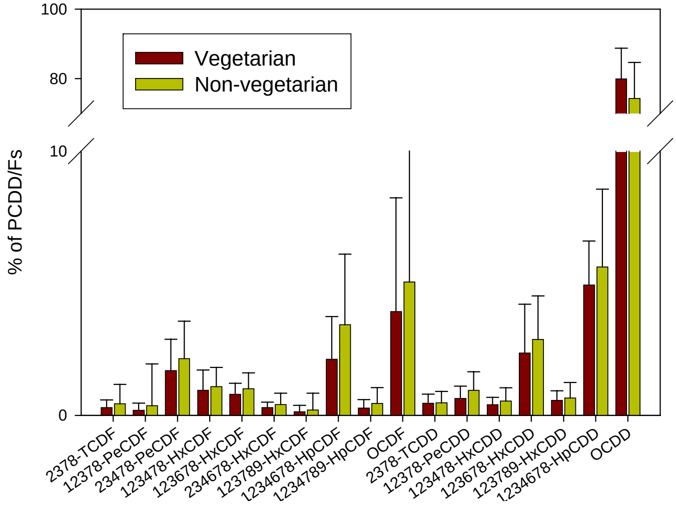
†: Pg WHO-TEQ/g lipid, ‡: Kruskal-Wallis test, #: Chi-Squared test,

¶: Subjects consumed with local food, §: Subjects consumed food from other, *: p<0.05

Table 3 Distribution of serum PCDD/Fs levels of vegetarian and non-vegetarian among 5 resident areas

	Group1	Group2	Group3	Group4	Group5	P value
N=	414	574	169	374	203	
Vegetarian (n)	4	11	8	6	5	--
Vegetarian time (Year)	15 (5-30)	13.7 (0-35)	13.7 (1-26)	19.2 (0-50)	20.3 (7-45)	--
Serum PCDD/Fs of vegetarian†,¶	13.0 (9.4-19.8)	14.9 (5.8-27.1)	17.6 (8.6-30.8)	21.7 (13.1-52.2)	14.6 (10.9-17.5)	0.675
Subjects consumed local food (n)	11	110	18	68	27	--
Subjects consumed local food†,¶	21.8±10.7 (8.3-41.5)	26.2±13.5 (8.8-89.2)	20.0±10.7 (8.3-49.9)	22.4±8.3 (7.5±46.7)	17.5±7.1 (7.3-33.8)	0.002
Subjects consumed food from others†,¶	18.6±8.2 (4.6-60.1)	21.3±8.5 (5.0-52.2)	17.7±6.8 (6.4-42.7)	24.0±15.9 (5.1-197.7)	15.6±6.5 (5.7-44.3)	<0.0001**
PCDD/Fs conc. of total subjects†, ¶	17.0±9.1	21.8±10.1	17.9±7.3	24.6±15.3	16.5±7.9	<0.0001**

†: pg WHO-TEQ/g lipid, ¶: Kruskal-Wallis test, **: p<0.0001



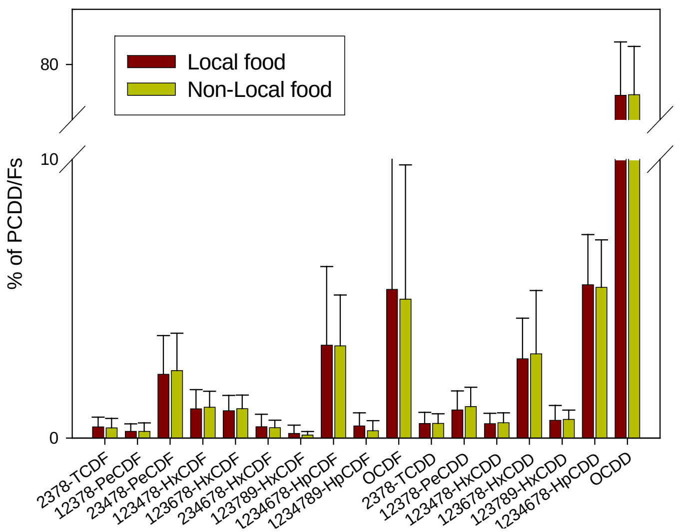


Figure 1 and 2. Distribution of PCDD/Fs patterns (% of PCDD/Fs levels) of vegetarian and non-vegetarian, and subjects consumed local food or not.