

## Levels of PCDD/PCDFs in Plasma of Nonoccupationally Exposed Persons from Southern Catalonia, Spain

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### Introduction

The public health impact associated with stack emissions from a hazardous waste incinerator (HWI) has focused on three classes of compounds: metals, semivolatile, and volatile compounds (1). Because of the important toxic effects of PCDD/Fs, risk assessment of emissions of these organic pollutants is a matter of great concern.

To assess human exposure to PCDD/Fs, it is essential to establish reference values for a normal population. While information about PCDD/F concentrations in tissues from the Spanish population is rather scarce (2-4), there are no available reference values for the inhabitants of Tarragona (southern Catalonia, Spain). The present study is one of a series of reports describing the results of a monitoring program for the environmental impact on public health of a HWI, which is now under construction in the area of Tarragona. This study was designed to determine the concentrations of PCDD/Fs in plasma from individuals living in this area, which will be under potential influence of the new facility. Analysis of the results was made in terms of age, sex, and proximity to a MSWI, which is operating since 1991.

### Materials and Methods

Blood samples were obtained from 7 women and 13 men (28-62 years old) living in the area of Tarragona during at least the last 10 years. Participants were chosen based on their different places of residence: an urban area (Tarragona downtown) and two industrial areas, near to a petrochemical complex, and near to a MSWI and two oil refineries. Nine of the participants lived at a distance < 1 km from the MSWI, while the remaining 11 subjects lived at distances between 3 and 5 km from that plant. None of the individuals had any known occupational exposure to PCDD/Fs.

Plasma was separated by centrifugation and immediately frozen at -20°C until analyzed. Lipids were extracted by isopropanol/hexane through a solid phase. Approximately 75 g of plasma

were spiked with 40  $\mu\text{l}$  of an internal  $^{13}\text{C}$ -PCDD/F standard solution before application on the column. The eluate (from two consecutive extractions) was collected, concentrated, and the lipids were gravimetrically determined. For analysis and detection of PCDD/Fs a high resolution gas chromatograph (HRGC, Hewlett Packard 5890), coupled to a high resolution mass spectrometer (HRMS, VG 70-250S) with a VG 11/250J data system was used.

Statistical significance was computed by the ANOVA test. A probability of 0.05 or less was considered as significant. When a result was under the quantitation limit (0.05 pg/g lipid), in order to calculate mean and TEQ values the congener was assumed to be present at one half of the method detection limit (MDL).

## Results and Discussion

The plasma levels of PCDD/Fs ranged between 14.8 and 48.9 pg I-TEQ/g lipid, with a mean value of 27.0 pg I-TEQ/g lipid. The average concentrations of PCDD/F congeners in human plasma are summarized in Table 1. In all samples, PCDD levels were considerably higher than those of PCDFs. OCDD was the predominant congener followed by HpCDD and 1,2,3,6,7,8-HxCDD. The median concentrations of PCDD/F in plasma were found to be higher in women (27.7 pg I-TEQ/g fat) than in men (25.2 pg I-TEQ/g fat). However, the difference did not reach the level of statistical significance ( $p > 0.05$ ). On the other hand, although it could be expected that people living within the main wind direction in the area, and near to the MSWI, should show the highest PCDD/F concentrations, there were no significant differences between the group living at distances  $< 1$  km from the MSWI and those living at greater distances. Linear regression and correlation analyses were performed to determine the degree of linear association ( $r$ ) between PCDD/F concentrations (I-TEQ) versus age. When plotting total I-TEQ for human plasma against age (Fig. 1), the correlation coefficient ( $r$ ) found was 0.565 ( $p < 0.01$ ). This coefficient was of the same order to that recently reported by Jimenez et al. (2) for a population of Madrid, Spain (0.79,  $p < 0.01$ ).

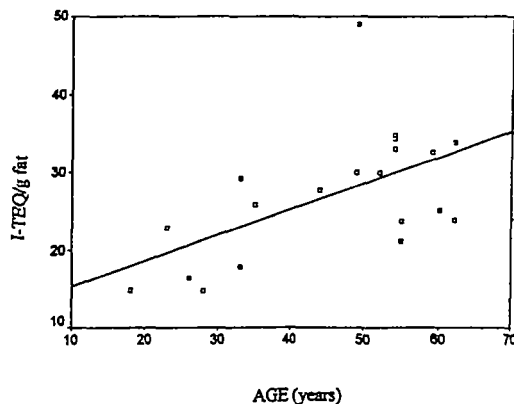


Figure 1: Correlation between I-TEQ in human plasma and age.

**Table 1:** Levels of PCDD/Fs (pg I-TEQ/g lipid) in plasma from subjects living in Tarragona (southern Catalonia, Spain)

CONGENER	Mean	SD	Minimum	Maximum
2,3,7,8- TetraCDD	1.9	1.2	0.9	5.3
1,2,3,7,8 PentaCDD	9.8	3.1	5.3	18.4
1,2,3,4,7,8 HexaCDD	5.5	2.0	2.7	9.8
1,2,3,6,7,8 HexaCDD	62.6	23.1	28.0	116.0
1,2,3,7,8,9 HexaCDD	11.1	4.7	3.70	19.2
1,2,3,4,6,7,8-HeptaCDD	123.6	62.5	42.0	258.0
OCDD	640.5	251.2	137.0	993.0
2,3,7,8-TetraCDF	1.0	0.4	0.4	1.7
1,2,3,7,8-PentaCDF	1.0	0.6	0.4	2.9
2,3,4,7,8-PentaCDF	15.9	5.4	7.5	28.5
1,2,3,4,7,8-HexaCDF	8.3	2.5	3.9	14.6
1,2,3,6,7,8-HexaCDF	8.5	2.9	4.1	17.0
1,2,3,7,8,9-HexaCDF	1.9	0.7	1.0	3.4
2,3,4,6,7,8-HexaCDF	3.1	1.3	1.0	7.1
1,2,3,4,6,7,8-HeptaCDF	10.9	3.1	6.1	16.1
1,2,3,4,7,8,9-HeptaCDF	1.5	0.5	0.9	2.7
OCDF	3.8	2.1	1.3	9.8
<b>I-TEQ PCDDs</b>	<b>16.6</b>	<b>5.4</b>	<b>8.9</b>	<b>30.4</b>
<b>I-TEQ PCDFs</b>	<b>10.4</b>	<b>3.3</b>	<b>5.1</b>	<b>18.5</b>
<b>I-TEQ TOTAL</b>	<b>27.0</b>	<b>8.2</b>	<b>14.0</b>	<b>49.0</b>

A comparison of these results with those reported in recent studies shows that the present levels of PCDD/Fs in plasma are higher than those found by Jimenez et al. (2) for a general population from Madrid (Spain), or those reported by various investigators in human blood from German people (5-8). However, the current plasma PCDD/F concentrations are similar to those found in human blood samples from Americans (9), as well as in samples collected in

Jerusalem (Israel) (10). In turn, the current concentrations of PCDD/Fs in human plasma are in the same range than those reported by Cole et al. (11) for a Canadian population.

The differences between the present results and those from previous investigations can be due to a number of factors such as the distinct environments for different geographical areas, the lack of a standard methodology of lipid quantitation, the notorious differences in food consumption by different populations, or the remarkable differences in smoking prevalence, among others. Anyhow, the PCDD/F concentrations found in plasma of the subjects living in the area of Tarragona should not be a health hazard for this population.

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