

Potential Occupational Exposure of Municipal Waste Incinerator Workers with PCDD/PCDF

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Abstract

We report on the analysis of 10 whole blood samples from workers engaged in operating a Municipal Waste Incinerator (MWI). The values are compared with the so called "background" values from 102 subjects in Germany. Concerning the MWI-workers, it is striking, that in some cases Hexa- and Hepta-CDF show elevated concentrations.

Introduction

The presence of Polychlorodibenzo-p-dioxins (PCDD) and Polychlorodibenzofurans (PCDF) in human samples can be attributed to a variety of sources. Because of the widespread distribution of PCDD/PCDF humans build up their body burden mainly via food consumption. Because certain chemical and thermal processes lead to the formation of PCDD/PCDF a take up through occupational exposure may also take place. It has been found that workers engaged in the production processes of trichlorophenol, pentachlorophenol, herbicides and metal reclamation can show high PCDD/PCDF levels in adipose and blood /1/ - /3/.

The results of investigations of a pooled sample of 56 municipal incinerator workers from New York have been reported recently /4/. Compared with a reference group (n=14) the MWI-workers showed elevated PCDF levels. Following this observation we analysed 10 individual blood samples from MWI-workers from the FRG.

Experimental

Whole blood was frozen immediately after collection and kept frozen until analysed for PCDD/PCDF. The analytical methods were nearly identical to those used for the successful participation in recent WHO interlaboratory validation studies on human blood /5/ and will not be described here.

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Session 12

Whole blood samples from 10 employees of a municipal waste incinerator in the south of Germany were investigated in this study. The workers were engaged in different activities at the facility. The ranges, means and medians of age, weight and height of the participants are presented below:

	Minimum	Maximum	Mean	Median
Age (Years)	33	52	42,8	41,5
Weight (kg)	73	115	84,9	83,5
Height (cm)	168	184	175	173

Results

The individual data from this investigation are presented in Table 1. The TEQ-values were calculated according to the German Federal Health Office (FHO) as well as NATO-CCMS model.

From 10 samples analysed 4 show increased levels of individual isomeres when compared to the highest controls. The 2.3.4.6.7.8-Hexa-CDF values measured exceed the highest background levels in 4 cases, the 1.2.3.4.6.7.8-Hepta-CDF in 3 cases and the 1.2.3.4.7.8.9-Hepta-CDF in 2 cases. Only in one case is the Octa-CDD value found to exceed the highest control.

To demonstrate this in Fig. 1 the PCDD/PCDF pattern in the blood lipids of worker No.2 is compared with the pattern of the controls (n=102, median values, /3/).

With 2178 pg/g total PCDD and 291 pg/g total PCDF worker No.2 shows the highest levels measured. None of the samples measured show TEQ-levels higher than the highest background value.

The specific patterns found in the blood samples have been compared with those of original exposure material, e. g. fly ash. It can be shown that - regarding 2.3.7.8-isomeres - close similarities exist.

Furthermore the PCDD/PCDF patterns of blood samples of the MWI-workers show similarities with those of a metal reclamation plant workers.

References

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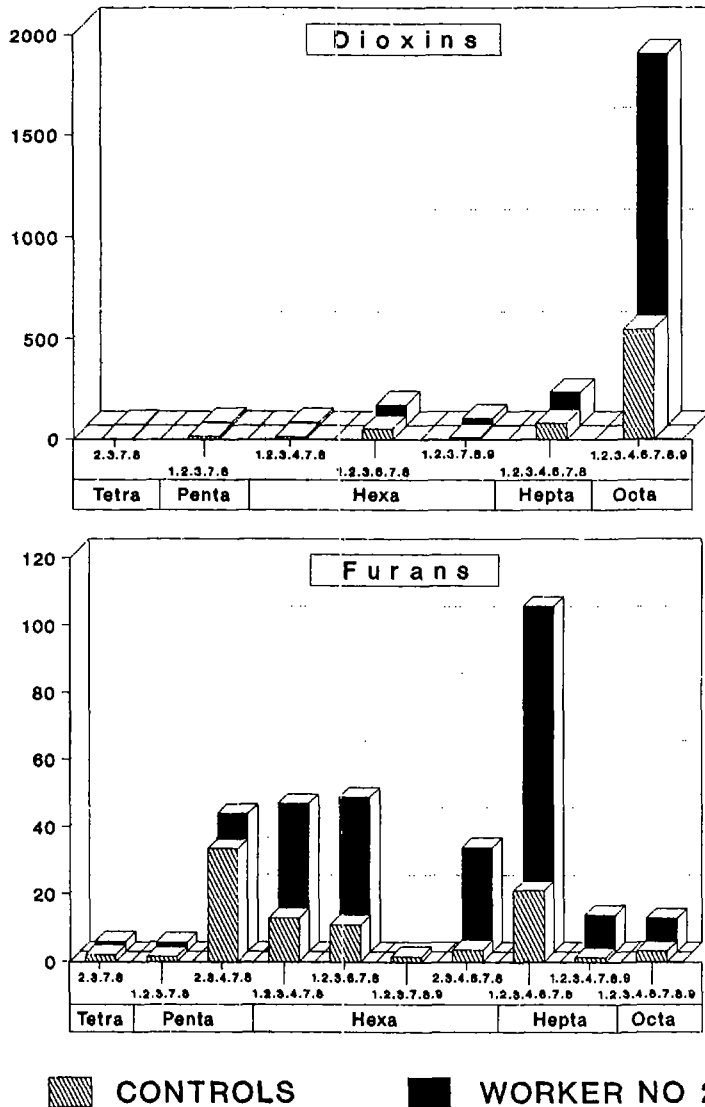
Table 1: PCDD/PCDF-Level in Municipal Waste Incinerator Workers.
 Values in pg/g (ppt) lipid based

Worker No. ▶	1	2	3	4	5	6	7	8	9	10	Controls, n=102 /3/	
											MEDIAN	RANGE
2.3.7.8-Tetra-CDD	3.2	5.0	2.0	2.1	5.0	3.5	4.4	2.3	3.3	2.6	3.2	0.6 - 9.1
1.2.3.7.8-Penta-CDD	8.6	16	11	8.6	13	12	11	4.9	14	11	13	2.1 - 39
1.2.3.4.7.8-Hexa-CDD	9.0	17	18	9.8	18	18	12	9.5	14	14	9.9	1.0 - 33
1.2.3.6.7.8-Hexa-CDD	43	101	50	40	58	66	45	37	45	78	50	15 - 124
1.2.3.7.8.9-Hexa-CDD	11	36	18	6.7	17	22	9.9	14	7.2	15	8.2	0.5 - 71
Total Hexa-CDD	63.0	154	86	56.5	93	106	66.9	60.5	66.2	107	71.8	21 - 252
1.2.3.4.6.7.8-Hepta-CDD	167	164	113	48	122	87	111	85	125	85	80	19 - 280
Octa-CDD	1382	1839	649	605	1485	941	509	967	811	1325	549	145 - 1524
2.3.7.8-Tetra-CDF	5.3	3.1	2.8	1.7	M 4.3	1.2	3.5	2.2	1.2	2.0	2.0	0.5 - 6.7
1.2.3.7.8-Penta-CDF	< 3.7	2.8	< 3.8	ND (1.0)	ND (1.0)	ND (1.0)	< 1.6	ND (1.0)	ND (1.0)	ND (1.0)	1.4	0.5 - 7.1
2.3.4.7.8-Penta-CDF	28	41	28	16	36	35	21	23	23	30	33.5	6.3 - 99
Total Penta-CDF	29.9	43.8	29.9	16	36	35	21.8	23	23	30	33.4	6.8 - 99.5
1.2.3.4.7.8-Hexa-CDF	24	44	17	14	17	27	14	14	14	23	13	3.6 - 49
1.2.3.6.7.8-Hexa-CDF	19	46	19	8.6	16	31	8.4	9.5	10	18	11	2.7 - 53
1.2.3.7.8.9-Hexa-CDF	ND (1.4)	ND (2.0)	ND (1.3)	ND (1.0)	ND (1.0)	ND (2.1)	ND (1.0)	ND (1.0)	ND (1.1)	ND (1.0)	1.5	0.5 - 9.4
2.3.4.6.7.8-Hexa-CDF	20	31	16	4.2	8.8	16	12	5.7	6.1	9.3	3.5	0.5 - 14
Total-Hexa-CDF	63	121	52	26.8	41.8	74	34.4	29.2	30.1	50.3	29.5	8.3 - 91.5
1.2.3.4.6.7.8-Hepta-CDF	67	103	29	27	30	67	32	22	21	41	21	4.8 - 55.0
1.2.3.4.7.8.9-Hepta-CDF	< 3.8	11	< 2.8	ND (1.1)	ND (1.3)	8.8	ND (1.1)	ND (1.1)	ND (1.0)	ND (1.1)	1.3	0.5 - 4.0
Total Hepta-CDF	68.9	114	30.4	27	30	75.8	32	22	21	41	22	5.4 - 57.1
Octa-CDF	7.9	10	ND (5.8)	8.4	ND (2.6)	ND (2.1)	ND (4.1)	ND (6.5)	ND (3.2)	ND (2.4)	3.1	1.0 - 15
Total PCDD	1623.8	2178.0	861.0	720.2	1718.0	1149.5	702.3	1119.7	1019.5	1530.6	703	221 - 1983
Total PCDF	175.0	291.9	115.1	79.9	112.1	186.0	91.7	76.4	75.3	123.3	91	27 - 192
Total PCDD/PCDF	1798.8	2469.9	976.1	800.1	1830.1	1335.5	794.0	1196.1	1094.8	1653.9	836	269 - 2134
TEQ (FHO)	23.9	43.4	22.3	14.4	26.8	28.9	20.1	16.3	19.0	25.2	20.8	7.0 - 43.9
I-TEQ (NATO-CCMS)	38.5	66.1	37.8	24.3	46.4	47.7	32.9	27.5	33.8	41.6	37.8	11.6 - 93.5

ND = not detectable, Detection limits in (), values with < contribute with 50 %, M = maximum level

Figure 1

**PCDD/PCDF in Human Blood
Municipal Waste Incineration Worker**
Values in pg/g (ppt), lipid based



Comparison with median-CONTROL-levels, /3/