Exposure to PCDD/F of a population group from the Marsberg area (Germany)

Wittsiepe, J. [A], **Ewers, U.** [A], **Schrey, P.** [A], **Kramer, M.** [A], **Exner, M.** [A], **Selenka, F.** [B], **Beine, W.** [C], **Kemper, K.** [C], **Schmeer, D.** [D], **Weber, H.** [E]

[A] Hygiene-Institut des Ruhrgebiets, Institut für Umwelthygiene und Umweltmedizin an der Ruhr-Universität Bochum, Rotthauser Str. 19, D-45879 Gelsenkirchen, Germany

[B] Ruhr-Universität Bochum, Institut für Allgemeine- und Umwelthygiene, Universitätsstr. 150, D-44801 Bochum, Germany

[C] Gesundheitsamt des Hochsauerlandkreises, Steinstr. 27, D-59872 Meschede, Germany

[D] Gesundheitsamt des Kreises Steinfurt, Tecklenburgerstr. 10, D-48565 Steinfurt, Germany

[E] Ministerium für Arbeit, Gesundheit und Soziales des Landes Nordrhein-Westfalen, Horionplatz, D-40213 Düsseldorf, Germany

Introduction. The objective of the present study was to assess the degree of exposure to PCDD/F of a selected population group living in the vicinty of a former copper smelter, located at Marsberg, Germany. The copper smelter was in operation until 1945. In 1991 it was discovered that the surrounding area was signifantly polluted by PCDD/F and copper. High levels of PCDD/F were found particularly in materials from the slag dumps of the former copper smelter (10.000 - 100.000 ng TE/kg). Dust material from the former stack was found to contain 2.37 mg TE/kg. The levels of PCDD/F in superficial soil of residental and agricultural areas nearby ranged up to 400 ng TE/kg. High levels of PCDD/F were also found in river sediments and in the soil of flood areas, indicating that a significant contamination had occured also through the aqueous pathway.

Questions that had to be answered in the present study:

- Do persons, who were in close contact with contaminated material from the slags dumps, or persons, who live or had lived in the vicinity of the former copper smelter, have an increased body burden of PCDD/F?
- Is there a need for a large-scale study of the general population of Marsberg?

The following sections give a short summary of the results of the study that was conducted between May and September 1991. For more details, including analysis of toxic metals, clinical laboratory test parameters and investigations on health disorders the reader is referred to an extensive report published by the Ministry of Work, Health and Social Affairs of Northrhine-Westfalia [WITTSIEPE, EWERS (1991)].

Subjects. The study was confined to selected persons (n = 56) who lived or had lived in the vicinity of the former copper smelter and to persons who were or had been in close contact with PCDD/F-containing material from the slag dumps (n = 40). Since the material from the

slag dumps had been marketed to a large extent for covering sporting grounds and playgrounds (trade-name: "Kieselrot") five former transportation workers were included in the study. A group of Motocross-drivers comprises 11 young males who had conducted sporting activities as Motocross-drivers on the slag dumps.

Since for PCDD/F in human blood only limited reference data were available at the time the study was set up, blood samples of a reference group were collected and analysed in the same way. The reference subjects were selected, applying the matched-pair approach, from the county of Steinfurt, a rural area in North-West Germany. The matching criteria were sex, age (± 3 years) and body mass index. Most of the reference subjects were administrative workers of the county of Steinfurt.

PCDD/F in whole blood were determined by high resolution gas chromatography/high resolution mass spectrometry in two laboratories (Hygiene-Institut des Ruhrgebiets, Gelsenkirchen/Bochum; Gesellschaft für Arbeitsplatz- und Umweltanalytik, Münster). Both laboratories successfully participated in the WHO interlaboratory quality control study on levels of PCDD/F in human blood conducted in 1992. The levels of PCDD/F in whole blood results were adjusted to blood fat; the results are given as pg/g blood fat. The toxicity equivalents (TE) were calculated by using the factors proposed by the German Federal Health Office (BGA-TE) and those proposed by NATO-CCMS (I-TE).

Questionnaire. A questionnaire was applied to all participants of the study in order to collect data on age, sex, place(s) of residence, occupation(s), smoking and dietary habits, and possible health disorders. Furthermore, the individuals were asked for possible contact with PCDD/F containing materials (e.g. PCP-containing wood preservatives) at work or at home.

Fig. 1: Mean blood-levels [pg I-TE/g blood fat] of PCDD/F in both populations

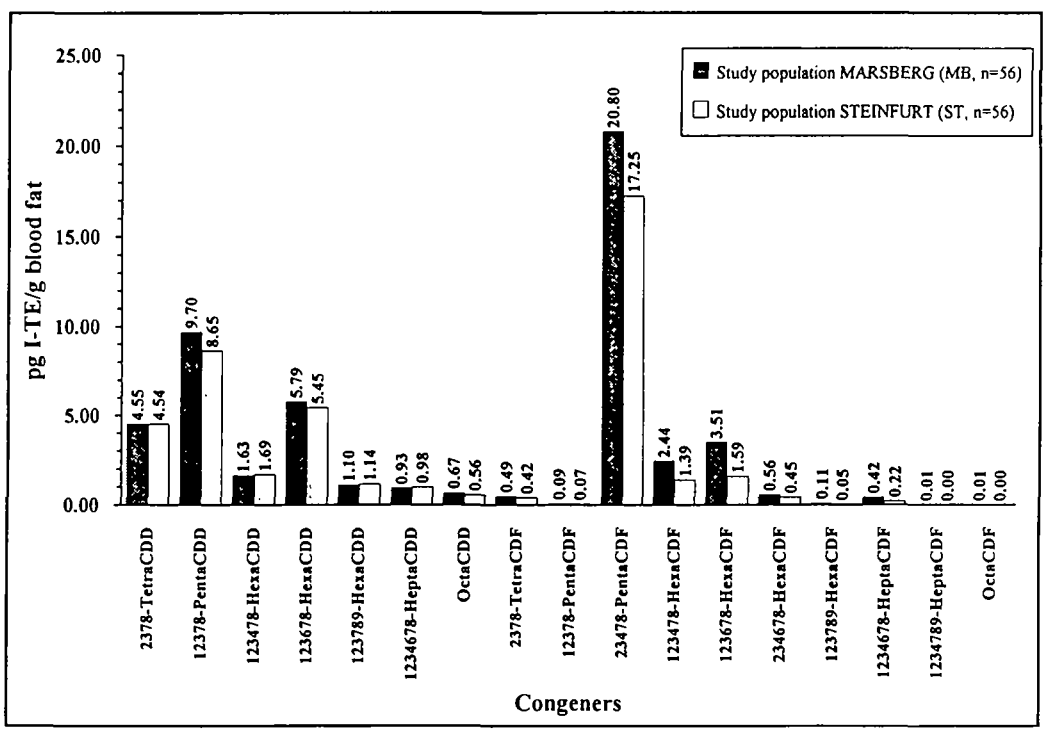

Table 1: PCDD/F in whole blood [pg/g blood fat] of subjects from Marsberg and of subjects from Steinfurt county (refernce group)

	MARSBERG (n=56)					STEINFURT (n=56)				
	Arithm. mean	Standard deviation	Median	Minimum	Maximum	Arithm. mean	Standard deviation	Median	Minimum	Maximum
Age [years]	40.7	14.0	41.0	19	83	40.8	13.9	40.0	21	79
Body weight[kg]	75.2	12.4	76.0	42	102	76.2	12.2	78.0	52	98
Body height [cm]	174.0	8.8	175.0	156	190	174.8	7.1	176.0	157	188
Blood fat [mg/g]	4.8	1.1	5.0	2.5	7.3	5.1	1.4	5.0	3.3	12
	PCDD/F-concentrations [pg/g blood fat]					PCDD/F-concentrations [pg/g blood fat]				
2378-TetraCDD	4.6	2.5	4.2	n. d.	12	4.5	2.5	4.5	n. d.	12
12378-PentaCDD	19.4	11.7	16.3	6.7	80	17.3	7.4	16.0	6.7	43
123478-HexaCDD	16.3	8.4	14.5	5.3	51	16.9	7.3	16.2	3.6	38
123678-HexaCDD	57.9	19.1	56.0	19	110	54.5	18.3	54.0	18	110
123789-HexaCDD	11.0	4.6	10.0	3.4	31	11.4	4.1	11.0	4.7	23
1234678-HeptaCDD	93.2	47.6	77.4	18	248	98.3	40.7	92.6	30	210
OctaCDD	666	357	554	120	1770	565	216	525	180	1100
2378-TetraCDF	4.9	3.4	5.5	n. d.	12	4.2	3.0	3.7	n. d.	12
12378-PentaCDF	1.8	2.0	1.3	n. d.	10	1.4	1.4	0.9	n. d.	4.4
23478-PentaCDF	41.6	33.8	31.5	13	240	34.5	16.5	31.0	11	91
123478-HexaCDF	24.4	18.5	19.0	5.1	120	13.9	6.4	13.0	4.0	34
123678-HexaCDF	35.1	41.1	24.1	6.5	280	15.9	6.0	15.3	6.6	33
234678-HexaCDF	5.6	3.5	5.2	0.7	20	4.5	1.8	4.4	n. d.	7.9
123789-HexaCDF	1.1	1.9	n. d.	n. d.	8.0	0.5	1.1	n. d.	n. d.	4.7
1234678-HeptaCDF	42.1	29.1	35.5	7.4	180	22.4	8.9	21.4	10	66
1234789-HeptaCDF	0.5	0.8	n. d.	n. d.	3.2	0.4	0.8	n. d.	n. d.	4.2
OctaCDF	5.8	14	n. d.	n. d.	57	3.5	11.9	n. d.	n. d.	71
Sum P(4-8)CDD	882	416	773	186	2120	779	260	775	339	1430
Sum P(4-8)CDF	168	105	141	67	744	103	36	99.3	41	227
Sum P(4-8)CDD/F	1050	446	962	253	2280	882	281	879	394	1660
BGA-TEq	28.5	14.1	24.4	11.3	103	23.9	8.0	23.4	9.1	48.9
NATO/CCMS-TEq	52.7	31.5	43.2	22.1	231	44.4	16.8	43.0	16.9	98.0

Results. The results of the PCDD/F blood analyses are shown in Table 1 and Figure 1. The median I-TE-values of the Marsberg group (43.2 pg I-TE/g blood fat) and the reference group (43.0 pg I-TE/g blood fat) were not much different, whereas the arithmetic mean of the Marsberg group (52.7 pg I-TE/g blood fat) was higher than that of the Steinfurt group (44.4 pg I-TE/g blood fat). The frequency distribution of the individual TE-values of the Marsberg group is slightly shifted towards higher values: 8 out of 56 subjects had TE values greater than 80 pg I-TE/g blood fat, whereas only two persons of the reference group had TE values exceeding 80 pg/g blood fat (see Figure 1). Some individuals of the Marsberg group could be identified, who had TE-values exceeding background levels, ranging up to 231 pg I-TE/g blood fat.

Considering the different groups of chlorohomologues, it is obvious that the individuals of the Marsberg group have, on average, higher blood levels of PentaCDF, HexaCDF and HeptaCDF than those of the reference group. On average, they have higher levels of PCDF in blood, and the average PCDF/PCDD ratio is higher than that of the reference group. A pronounced difference between the two groups was found particularly for 1,2,3,6,7,8-HexaCDF (Figure 1).

Conclusion. The higher levels of PCDF found in the blood of the Marsberg group and the increased TE-values found in the blood of some individuals suggest that there has been an increased absorption of PCDD/F, probably by ingestion or inhalation of contaminated dust or soil. The waste material of the slag dumps, which had been marketed as "Kieselrot", was found to contain high levels of higher chlorinated PCDF and OCDD. A similar pattern was found in the soil and sediment samples. Thus, the finding of increased levels PCDF in the blood appears to parallel the pattern of PCDD/F found in the environmental media.

It should be noted that, for a number of subjects, exposure to PCDD/F containing dust and soil belonged to the past. Due to the long biological half-time of PCDD/F in the human body it could be assumed, however, that an increased exposure in the past would be detectable even 10 or 20 years later.

Furthermore, it should be emphasized that the present case study was not a respresentative epidemiological study of the population of Marsberg. As mentioned above, the study was confined to individuals who were or had been in close contact with PCDD/F containing material from the slag dumps of the former copper smelter or who lived or had lived in the vicinity of the former copper smelter. The general population of Marsberg who had not been in close contact with contaminated soil or dust should have been less exposed than the individuals selected for this study.

Based on the present findings it was concluded, therefore, that - with respect to PCDD/F - there was no need for a large-scale study or medical survey of the general population of Marsberg. Furthermore, it was concluded that there is no increased health risk associated with exposure to PCDD/F in the general population of Marsberg.

References

WITTSIEPE, J., EWERS, U., *Kieselrot-Studie - Humanmedizinische Untersuchungen. Bericht des Hygiene-Instituts des Ruhrgebiets - Institut für Umwelthygiene und Umweltmedizin,* Ministerium für Arbeit, Gesundheit und Soziales des Landes NRW (Hrsg.), Düsseldorf, September 1991