

IS THERE A DECREASE IN GENERAL POPULATION DIOXIN BODY BURDEN? A REVIEW OF GERMAN AND AMERICAN DATA

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ABSTRACT: Recent data from Europe suggests that dioxin levels in human tissues may have decreased rapidly over the past 4-6 years, in some instances as much as 40% TEQ. Because environmental sources, regulations, and enforcement may vary between the United States and Europe, we decided to compare dioxin values in blood and milk in both countries. In Germany, both in North Rhine Westphalia and elsewhere, dioxin levels in milk and blood from two analytical laboratories show a clear decrease in levels from the 1980's and 1990's. Our U.S. general population blood and milk data do not clearly show a decrease in dioxin body burden.

INTRODUCTION: Some sources of dioxins are known, whereas mass balance calculations suggest others may not be known.⁽¹⁾ With the finding of elevated levels of dioxins in all persons in industrial countries as compared with levels in the general population of less industrial countries, regulations have been put into effect to reduce dioxin formation and emission into the environment. Also, Europe has implemented improved technologies in municipal waste incinerators and decreased the use of leaded gasoline with halogenated scavengers. These actions may be responsible for the recent reports of lower dioxin body burdens found in Europeans and in European food.⁽²⁻⁵⁾ We decided to review older and newer blood and milk data from 3 groups actively involved in human tissue dioxin measurement, two in Germany and one in the US. Individual and pooled blood and milk samples collected and analyzed in the late 1980's and early to mid-1990's from German and US persons believed to have no special exposure to dioxins are compared.

METHODS: Specimens were collected in chemically cleaned containers, frozen, and shipped to the respective dioxin laboratories. All dioxin analyses were performed by World Health Organization "certified" laboratories for analysis of dioxins in human milk and blood. The methods involved in these analyses have previously been described.^(6,7)

RESULTS: The results from older and newer German blood and milk are shown on Table 1.^(8,9) German blood total PCDD/F and TEQ levels appear to be decreasing between 1989 (42 ppt) and 1994 (19 ppt). Milk levels also appear to be declining, from 23 to 16 ppt TEQ. Table 2 presents congener-specific analyses for US blood and milk. US blood from the 1980's and 1992 (26 and 23 ppt TEQ, respectively) decreased to 8.7 ppt TEQ, 1995 (N=4). US breast milk data from 1995/6 shows a decline from 20 to 8.16 ppt TEQ (N=5).

HUM II

However, pooled U.S. whole blood and serum samples (N=100 per sample) from 1996 are 27.1 and 27.6 ppt TEQ.

DISCUSSION: The decrease in German blood dioxin TEQ from 42 ppt to 19 ppt from non-randomly selected samples which may or may not be representative of the general population is consistent and striking. Decreased levels in breast milk, from younger nursing women, from 23 TEQ to 16 TEQ, are consistent with the blood findings. US milk data suggests a decrease in dioxin body burden from 20 ppt TEQ in our earlier samples to 8.16 ppt TEQ in 1995 samples. We report 26 ppt in serum in the 1980's and 8.7 ppt TEQ in four individual whole blood samples analyzed in 1995. However, our 1996 general population pooled blood samples (N=100 per sample) showed no decrease, with TEQ of 27.1 and 27.6 ppt.

A decrease in TEQ is consistently found in samples from Germany but not consistently found in the US. Congener-specific review may suggest contamination sources or point to source reduction. Further monitoring over time, and more systematic sampling to obtain representative samples of the US population remains to be done. These preliminary data from the US are not necessarily consistent with trends seen in Germany and Holland for humans and in England for food dioxin contamination.^(2,10) This data suggests that more comprehensive and representative sampling along with dioxin analysis is necessary to better characterize human dioxin body burden.

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TABLE 1. COMPARISON OF MEAN DIOXIN, DIBENZOFURAN, AND DIOXIN TOXIC EQUIVALENT BLOOD AND MILK LEVELS IN GENERAL POPULATION ADULTS FROM GERMANY AT DIFFERENT TIMES (ppt, lipid)

Congeners	TEF	German Blood*				German Breast Milk**			
		1989 N = 102		1994 N = 134		1991 N = 111		1995 N = 38	
		Measured	TEQ	Measured	TEQ	Measured	TEQ	Measured	TEQ
DIOXINS									
2,3,7,8-TCDD	1	3.6	3.6	2.9	2.9	3.4	3.4	2.1	2.1
1,2,3,7,8-PeCDD	0.5	13.8	6.9	6.3	3.15	8.0	4.0	5.7	2.85
1,2,3,4,7,8-HxCDD	0.1	10.9	1.09	6.9	0.69	7.8	0.78	4.8	0.48
1,2,3,6,7,8-HxCDD	0.1	54.6	5.46	26.7	2.67	29.3	2.93	21.8	2.18
1,2,3,7,8,9-HxCDD	0.1	10.6	1.06	4.9	0.49	4.6	0.46	2.9	0.29
1,2,3,4,6,7,8-HpCDD	0.01	92.4	0.92	45.3	0.45	35.8	0.36	21.9	0.22
1,2,3,4,6,7,8,9-OCDD	0.001	610	0.61	370	0.37	170	0.17	121.8	0.12
Total PCDDs		796	20	463	11	259	12	181	8
DIBENZOFURANS									
2,3,7,8-TCDF	0.1	2.3	0.23	1.9	0.19	0.8	0.08	0.6	0.06
1,2,3,7,8-PeCDF	0.05	2	0.1	0.5	0.025	0.4	0.02	0.3	0.015
2,3,4,7,8-PeCDF	0.5	37	18.5	12.8	6.4	19.2	9.6	13.5	6.75
1,2,3,4,7,8-HxCDF	0.1	15.4	1.54	7.9	0.79	7.5	0.75	4.9	0.49
1,2,3,6,7,8-HxCDF	0.1	13.3	1.33	5.8	0.58	5.4	0.54	3.7	0.37
2,3,4,6,7,8-HxCDF	0.1	4.3	0.43	2.6	0.26	2.6	0.26	1.7	0.17
1,2,3,7,8,9-HxCDF	0.1	1.7	0.17	nd	nd	--	--	--	--
1,2,3,4,6,7,8-HpCDF	0.01	23.4	0.234	11.4	0.114	4.4	0.044	2.8	0.028
1,2,3,4,7,8,9-HpCDF	0.01	1.5	0.015	0.6	0.006	--	--	--	--
1,2,3,4,6,7,8,9-OCDF	0.001	4.2	0.0042	2.6	0.0026	1.3	0.0013	0.7	0.0007
Total PCDFs		105.1	22.6	46.1	8.4	41.6	11.3	28.2	7.9
Total PCDD/PCDFs		901	42	509	19	300	23	209	16

* Individual samples analyzed by O. Pöpke, ERGO Laboratory (pg/g (ppt)). 1989 mean age = 36.6; mean age 1994 = 40.4

** Samples analyzed by P. FÜRST (ng/kg, (ppt))

TABLE 2. MEAN DIOXIN, DIBENZOFURAN, AND DIOXIN TOXIC EQUIVALENT BLOOD AND MILK LEVELS IN GENERAL UNITED STATES POPULATION ADULTS AT DIFFERENT TIMES (ppt, lipid)

Congeners	TEF	United States Blood										United States Breast Milk			
		1980's N = 28(a)		1992 N=44(b)		1995 N=4(c)		1996 N = 100 (d)		1996 N = 100 (e)		1988 (n = 43)(f)		1995/6 N=5	
		Measured	TEQ	Measured	TEQ	Measured	TEQ	Measured	TEQ	Measured	TEQ	Measured	TEQ	Measured	TEQ
DIOXINS															
2,3,7,8-TCDD	1	3.5 (g)	3.5	3.8 (h)	3.8	1.2	1.2	4.3	4.3	4.2	4.2	3.3	3.3	1.45	1.45
1,2,3,7,8-PeCDD	0.5	7.7	3.85	9.3	4.63	2.65	1.33	8.7	4.35	9.8	4.92	6.7	3.35	2.48	1.24
1,2,3,4,7,8-HxCDD	0.1	9.3	0.93	9.8	0.68	3.38	0.34	9.7	0.97	10.6	1.06	6	0.6	3.01	0.30
1,2,3,6,7,8-HxCDD	0.1	64	6.4	72.1	7.21	27.18	2.72	63.7	6.37	67.9	6.79	6.2	0.62	20.1	2.01
1,2,3,7,8,9-HxCDD	0.1	13	1.30	12	1.19	3.6	0.36	7.8	0.78	10.7	1.07	30.5	3.05	3.5	0.35
1,2,3,4,6,7,8-HpCDD	0.01	135	1.35	119	1.19	37.2	0.37	102.1	1.02	116.5	1.17	42	0.42	34.0	0.34
1,2,3,4,6,7,8,9-OCDD	0.001	1113	1.11	794	0.79	270	0.27	780.5	0.781	879.8	0.88	233	0.23	104	0.10
Total PCDDs		1342	18.4	1016	15.7	345	6.6	977	18.57	1100	20.1	328	11.6	169	5.8
DIBENZOFURANS															
2,3,7,8-TCDF	0.1	--	--	2.3	0.23	1.4	0.14	< (2)	0.10	<(2.00)	1.0	2.9	0.29	0.91	0.09
1,2,3,7,8-PeCDF	0.05	--	--	1.2	0.06	1.9	0.95	ND(1.4)	0.04	ND (1.9)	0.95	7.3	3.65	0.51	0.03
2,3,4,7,8-PeCDF	0.5	9.2	4.60	8.8	4.38	1.0	0.00	11.1	5.55	9.3	9.3	0.5	0.025	2.81	1.40
1,2,3,4,7,8-HxCDF	0.1	13.3	1.33	10.6	1.06	3.8	0.38	14.1	1.41	14.0	14.0	5.6	0.56	3.88	0.39
1,2,3,6,7,8-HxCDF	0.1	7.4	0.74	6.9	0.61	2.5	0.25	7.9	0.79	7.9	7.9	3.2	0.32	2.40	0.24
2,3,4,6,7,8-HxCDF	0.1	2	0.20	2.8	0.28	1.0	0.10	ND (3.7)	0.19	ND (4.1)	2.1	1.9	0.19	1.41	0.14
1,2,3,7,8,9-HxCDF	0.1	--	--	2.8	0.28	1.7	0.17	3.5	0.35	4.00	4.0	--	--	0.15	0.02
1,2,3,4,6,7,8-HpCDF	0.01	27	0.27	19.6	0.20	8.5	0.09	12	0.12	13.9	13.9	4.1	0.041	5.43	0.05
1,2,3,4,7,8,9-HpCDF	0.01	--	--	3.1	0.03	1.4	0.01	ND (4)	0.02	4.9	2.45	4.1	0.041	0.53	0.01
1,2,3,4,6,7,8,9-OCDF	0.001	--	--	9.3	0.01	5.0	0.003	< 5	0.003	ND(5.00)	2.50	4.1	0.0041	2.46	0.002
Total PCDFs		58.9	7.1	67.4	7.1	28.2	2.1	52.0	8.56	52.0	7.50	33.7	5.1	20.48	2.37
Total PCDD/PCDFs		1401	25.6	1084	22.8	373	8.7	1029	27.1	1152	27.6	398	20	189	8.16

(a) Mean of 28 individual serum analyses, Massachusetts Vietnam veterans (ref.8)
 (b) Mean for 44 blood serum samples pooled for one analysis, Michigan Vietnam Veterans (ref.9)
 (c) Four U.S. individuals from Florida.
 (d) Whole blood analyzed
 (e) Serum analyzed
 (f) Average of two pooled samples: Binghamton, NY (n=21); Los Angeles, CA (n = 22), collected and analyzed in the late 1980's.
 (g) TEQ for TCDD values<10 ppt
 (h) TEQs for 44 veterans without elevated TCDD levels