TEMPORAL AND AGE TRENDS IN DIOXIN LEVELS IN US ADULTS AND CHILDREN

Arnold Schecter (1), Marian Pavuk (1), Olaf Päpke (2), Joanna McKey (1)

1.University of Texas Houston School of Public Health, Dallas Regional Campus; 6011 Harry Hines Blvd, Room V8.112; Dallas, Texas, 75390, USA arnold.schecter@utsouthwestern.edu
2.ERGO Research Laboratory, Hamburg, Germany

INTRODUCTION

Dioxin levels in humans appear to have been declining during the past decade or more, followed by a possible leveling off. However, in Germany, reports of a possible slight increase in levels of dioxins in blood or milk have been suggested. We have reported declining levels of dioxins, dibenzofurans, and polychlorinated biphenyls (PCBs) in German and American milk and blood during the past decades. Previous findings in US adults demonstrated a decline over time in adult milk as well as blood[1-5]. This year we again collected and analyzed a sample of pooled US blood and also blood from children at various ages.

Levels of dioxins in children have been shown to be low in cord blood [6]. Nursing infants have higher dioxin levels than do their mothers because of the concentration of dioxins and breast milk as the exclusive as source of food. Tissue dioxin levels decline during the first year of life as other food sources come into play [7].

In this paper we report on dioxin and dibenzofuran blood levels in collected pooled adult blood between 1980-2002. In addition, left over whole blood was collected on children in 5 different age groups and subsequently analyzed for dioxin and dibenzofuran levels.

METHODS

Samples of left over whole blood from adults were collected and pooled from different geographical locations over a period of 22 years. These samples were collected in New York in 1980 (N=28), Michigan in 1992 (N=44), New York in 1996 (N=100), and Dallas in 2000 (N=200) and 2002 (N=249) [8]. Additionally, whole blood convenience samples were collected and pooled from a Dallas children's hospital with an N of at least 50 for each age group. We wished to see if any variations could be noted in the levels of chlorinated organics over time and also between adults and different age groups of children.

The blood was sent to ERGO laboratory, which is certified by the World Health Organization for analysis of dioxins, dibenzofurans, and PCBs in human blood. High-resolution gas chromatography mass-spectrometry was used for analysis as previously described [9].

FINDINGS AND DISCUSSION

The data for the adult blood is shown in Table 1. It indicates that there appears to be a general decline in PCDD, TCDF and PCDD/ F Toxic Equivalents (TEQ) levels in 2000 and 2002 compared with findings the 1980s[5, 8]. However, blood from 2000 is lowest in dioxins whereas

blood from 2002 has slightly higher dioxin levels. This increase in the most recent sampling is similar to the German findings – The suggestion from these data is of TEFs in the 20 ppt range in the 1980s to 1996, with some decrease to the 15-19 ppt range in 2000 and 2002. The results of the children's blood at various ages, presented in Table 2, show markedly lower levels of PCDD, TCDF, and PCDD/F TEQ compared to adult blood levels. There does not appear to be a consistent or significant pattern of changes in the blood levels seen in the different age groups, as we expected. There does appear to be a slight increase during the middle age group followed by a decline in the older group. There is a drop in PCDF measured levels from the 0-4 to the 4-8years old group. Such pattern is not obvious with other congeners. The highest measured PCDD/F level is found in the 0-4 group. This is consistent with nursing and the higher dioxin intake reported in breast fed infants. The TEQs do not appear to have any clear pattern by age for the children, although the adult TEQ is markedly higher that in the younger cohorts. These findings suggest the need to repeat this study with a larger sample size. Our data seem to agree with the findings in Europe and the USA of a decrease in dioxins and dibenzofurans in adults from the 1980's to 2002.

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Table 1. Mean dixoin and dibenzofuran congeners and Toxic Equivalents blood levels in U.S. general population adults over time ppt lipid (pg/g lipid).

Congeners	I-TEF	1980's (N=28)	1992 (N=44)	1996 (N=100)	2000 (N=200)	2002 (N=249)
2,3,7,8-TCDD	1	3.5	3.8	4.3	2.6	3.2
1,2,3,7,8-PeCDD	1	7.7	9.3	8.7	6.3	5.4
1,2,3,4,7,8-HxCDD	0.1	9.3	9.8	9.7	6.4	9.7
1,2,3,6,7,8-HxCDD	0.1	64	72.1	63.7	32.8	29
1,2,3,7,8,9-HxCDD	0.1	13	12	7.8	4.9	4.5
1,2,3,4,6,7,8-HpCDD	0.01	135	119	102	49.2	53
1,2,3,4,6,7,8,9-OCDD	0.0001	1,113	794	780	330	386
2,3,7,8-TCDF	0.1	ND	2.3	ND(2.0)	ND(2.0)	n.d. (1)
1,2,3,7,8-PeCDF	0.05	ND	1.2	ND(1.4)	ND(1.0)	n.d. (1)
2,3,4,7,8-PeCDF	0.5	9.2	8.8	11.1	4.5	5.1
1,2,3,4,7,8-HxCDF	0.1	13.3	10.6	14.1	5.9	5.9
1,2,3,6,7,8-HxCDF	0.1	7.4	6.9	7.9	3.5	3.5
2,3,4,6,7,8-HxCDF	0.1	2	2.8	ND(3.7)	ND(1.0)	n.d. (17)
1,2,3,7,8,9-HxCDF	0.1	ND	2.8	3.5	1.5	n.d. 1.3
1,2,3,4,6,7,8-HpCDF	0.01	27	19.6	12	6.7	n.d. (9)
1,2,3,4,7,8,9-HpCDF	0.01	ND	3.1	ND(4)	ND(1.6)	n.d. (2)
1,2,3,4,6,7,8,9-OCDF	0.0001	ND	9.3	ND(5)	ND(5)	n.d. (8)
Total PCDD		1,342	1,016	977	537	490.8
Total PCDF		58.9	67.4	52	25.4	14.5
Total PCDD/F		1,401	1,083	1,029	562	505.3
Total PCDD TEQ		18.4	15.7	18.6	11.1	13.46
Total PCDF TEQ		7.1	7.1	8.6	3.5	5.86
Total PCDD/F TEQ		25.5	22.8	27.2	14.6	19.3

ND-non-detected, limit of detection in the brackets. Schecter et al. (1996), Schecter et al. (1997), Schecter et al. (2000).

Table 2. Dioxin and Dibenzofuran and WHO Toxic Equivalents in Whole Blood in Children from Dallas, Texas, 2002, in ppt (lipid)

Congeners	0-4yrs	4-8yrs	8-10yrs	10-12yrs	12-14yrs	Adult
2.3.7.8-Tetra-CDD	n.d. (1.0)	n.d.(1.0)	n.d.(1.0)	n.d.(1,0)	n.d.(1,0)	2.4
1.2.3.7.8-Penta-CDD	1.6	1.9	1.7	1.2	2.0	6.1
1.2.3.4.7.8-Hexa-CDD	n.d.(1.1)	1.0	1.1	n.d.(1,0)	n.d.(1.2)	4.8
1.2.3.6.7.8-Hexa-CDD	5.9	7.8	7.8	6.8	6.8	28.3
1.2.3.7.8.9-Hexa-CDD	n.d.(3.1)	n.d.(2.8)	n.d.(2.0)	n.d.(3.2)	n.d.(4.2)	3.0
1.2.3.4.6.7.8-Hepta-CDD	16.3	17.4	20.7	13.6	17.4	32.9
OCDD	140.7	140.2	166.5	112.9	123.8	262.6
2.3.7.8-Tetra-CDF	n.d.(1.2)	n.d.(1.0)	n.d.(1.0)	n.d.(1.0)	n.d.(1.1)	n.d.(1.7)
1.2.3.7.8-Penta-CDF	n.d.1.4)	n.d.(1,0)	n.d.(1,0)	n.d.(1,0)	n.d.(1,0)	n.d.(1,0)
2.3.4.7.8-Penta-CDF	1.3	1.3	1.1	1.0	1.0	14.6
1.2.3.4.7.8-Hexa-CDF	2.5	2.9	2.0	1.9	2.0	7.4
1.2.3.6.7.8-Hexa-CDF	1.4	1.3	1.6	1.5	1.4	6.0
1.2.3.7.8.9-Hexa-CDF	n.d.(4.3)	n.d.(1.6)	n.d.(2.1)	n.d.(1.9)	n.d.(3.1)	n.d.(16.4)
2.3.4.6.7.8-Hexa-CDF	n.d.(14)	n.d.(1.1)	n.d.(1.2)	n.d.(1.0)	n.d.(1.3)	1.6
1.2.3.4.6.7.8-Hepta-CDF	14.4	9.3	8.9	31.1	10.0	4.8
1.2.3.4.7.8.9-Hepta-CDF	n.d.(61)	n.d.(2.9)	n.d.(2.7)	n.d.(2.9)	n.d.(4.3)	n.d.(3.0)
OCDF	12.7	n.d.(4.6)	n.d.(5.2)	5.9	n.d.(5.5)	n.d.(4.4)
Measured PCDD	167	170	199	137	153	340
Measured PCDF	73	21	21	45	23	48
Measured PCDD/PCDF	240	191	220	182	176	388
WHO TEQ, PCDDs	3.08	3.61	3.41	2.74	3.64	12.47
WHO TEQ, PCDFs	2.5	1.39	1.25	1.39	1.26	9.79
WHO TEQ, PCDD/F	5.58	5.0	4.67	4.12	4.9	22.3

ND-non-detected, limit of detection in the brackets. Schecter et al. (1996), Schecter et al. (1997), Schecter et al. (2000).