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SERUM LEVELS OF PCDDS AND PCDFS AMONG WORKERS EXPOSED TO 2,3,7,8-TCDD CONTAMINATED CHEMICALS.

LA Piacitelli[1], M Haring Sweeney[1], MA Fingerhut[1], DG Patterson Jr.[2], WE Turner[2], LB Connally[1], KK Wille[1] and B Tompkins[1].

[1]National Institute for Occupational Safety and Health, Robert A Taft Laboratories, 4676 Columbia Parkway, Cincinnati, OH, 45226, USA.

[2]Division of Environmental Health and Injury Control, Centers for Disease Control, Atlanta, GA, 30333, USA

ABSTRACT

The National Institute for Occupational Safety and Health (NIOSH) collected serum from workers exposed to chemicals contaminated with 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and from unexposed referents. A subset of serum samples were analyzed for polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs). In addition to a marked difference in serum levels between workers and referents for 2,3,7,8-TCDD, there was a small but significant difference for 2,3,7,8-PnCDF and 1,2,3,4,7,8-HxCDF. Funding was received for this study from the Agency for Toxic Substances and Disease Registry.

INTRODUCTION

In 1987-1988, NIOSH collected serum samples from workers exposed to 2,4,5-trichlorophenol, or one of it's derivatives, contaminated with 2,3,7,8-TCDD and from unexposed referents for analysis of PCDDs and PCDFs. A description of the workers, their exposure and interim results of the levels of serum 2,3,7,8-TCDD have been previously reported.[1]

METHODS

The collection and handling of serum samples was previously described.[2] Measurement and lipid-adjustment of PCDDs and PCDFs levels were conducted using methods reported for 2,3,7,8-TCDD and validated for the other PCDDs and PCDFs.[3 4 5 6 7 8 9]

Serum samples were analyzed for 2,3,7,8-TCDD for workers (N=280) and for a random sample of referents (N=99). A randomly selected sample of the

serum analyzed for TCDD was also analyzed for all PCDDs and PCDFs for 185 workers and 61 referents.

An estimation procedure described by Hornung and Reed was used to adjust for nondetectable samples.[10] Isomers with at least 50% detectable values approximated a log normal distribution. Two sample t-tests using the log transformed data were used to compare the mean PCDD and PCDF levels of workers and referents.

RESULTS

Lipid-adjusted serum levels are presented in Table 1 for 7 dioxin isomers and 4 furan isomers whose proportion of detectable sample results was at least 50%. Significant differences in mean levels between workers and referents were found for 2,3,7,8-TCDD ($p<.0001$), 2,3,4,7,8-PnCDF ($p<.023$) and 1,2,3,4,7,8-HxCDF ($p<.025$). For six furan isomers, detectable samples were found for only 10 to 40% of the samples analyzed. The previously described estimation procedure was not applicable. Lipid-adjusted serum levels for the detectable samples are listed in Table 2.

Table 1 Lipid-adjusted serum levels for seven of the PCDDs and four of of the PCDFs which were detected most frequently in parts per trillion.

ANALYTE	WORKER				REFERENT			
	N	Mean	Median	Range	N	Mean	Median	Range
2378-D	273	**220***	69	2-3400	79	**7 ***	6	2-20
12378D	161	**13**	11	4.5-50	54	**12**	10	3.5-51
123478D	153	**12**	11	1.9-41	49	**13**	11	3.2-58
123678D	150	**90**	84	38-290	53	**84**	73	17-183
123789D	151	**13**	12	3-39	49	**13**	12	3.6-33
1234678D	111	**160**	150	41-520	40	**160**	130	39-460
OCDD	102	**1090**	990	270-3800	42	**1010**	920	480-2300
23478F	131	**15 ***	12	3.8-170	44	**11 ***	9.4	3.3-28
123478F	94	**15 ***	13	4.2-120	34	**11 ***	9.6	4.2-28
123678F	102	**10**	8.7	3.3-49	37	**8.5**	7.5	3.7-18
1234678F	82	**23**	22	8-49	30	**20**	19	8.7-46

N Total number of samples analyzed that met quality control standards
* Mean serum levels of workers & referents significantly different $p<.05$

Table 2 Lipid-adjusted serum concentrations in parts per trillion of PCDFs with less than 50% detectable values.

ANALYTE	WORKERS				REFERENTS				LOD
	#	#D	Mean	Max	#	#D	Mean	Max	Mean
2378F	118	47 (40%)	2.4	160	41	15 (36%)	1.2	7	3.5
12378F	138	2 (1%)	0.08	6	46	0	--	--	11
123789F	153	4 (3%)	0.31	27	50	1 (2%)	0.23	12	5.4
234678F	131	40 (30%)	1.1	7	50	18 (36%)	1.5	11	4.9
1234789F	147	1 (0.6%)	0.15	23	52	2 (4%)	0.76	26	9
OCDF	73	6 (8%)	0.95	21	26	3 (11%)	1.1	16	11

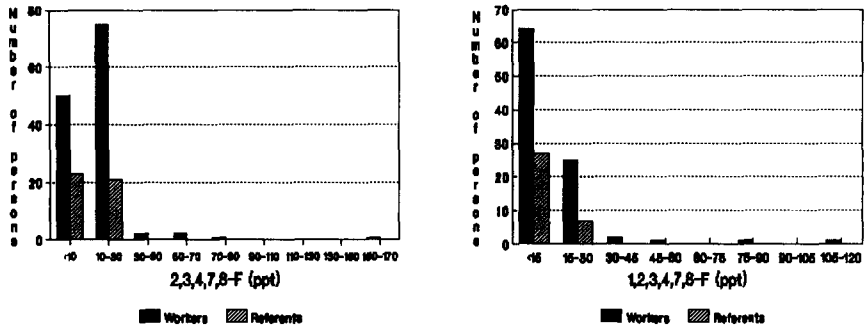
Total number of samples analyzed that met quality control standards
#D Number of detectable samples and percent of total number of samples
Mean Mean lipid-adjusted serum level in parts per trillion (ppt).
Max Highest lipid-adjusted serum level in ppt.
LOD Mean value of the lipid-adjusted limits of detection in ppt.

DISCUSSION

The examination of serum levels for PCDDs and PCDFs in a cohort of workers exposed to 2,3,7,8-TCDD contaminated chemicals and in a group of unexposed referents found that levels of 2,3,7,8-TCDD, 2,3,4,7,8-PnCDF, and 1,2,3,4,7,8-HxCDF were significantly elevated in the workers. The 2,3,7,8-TCDD levels found in these workers are among the highest levels reported in humans. The levels of 2,3,7,8-TCDD in the referents were consistent with levels reported for other unexposed populations.

Significant differences in the mean levels of 2,3,4,7,8-PnCDF and 1,2,3,4,7,8-HxCDF were small. For each isomer the mean for the workers was 15 ppt versus 11 ppt for the referents. The difference in the means may be related to very high levels in a few workers at the New Jersey facility.(Fig. 1)

Figure 1. Distributions of lipid-adjusted serum concentrations of 2,3,4,7,8-PnCDF and 1,2,3,4,7,8-HxCDF in ppt.



Their work histories are being examined to determine if their high levels are due to an exposure at the facility or due to a subsequent exposure at another place of employment. Further analysis using multiple linear regression is being conducted to evaluate the relationship between levels of serum PCDDs and PCDFs controlling for potential confounding covariates.

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