MEASUREMENTS OF HOUSEHOLD DUST CONCENTRATIONS OF PCDDs, PCDFs, AND PCBs FROM A COMMUNITY IN MICHIGAN, USA

Zwica L[1], Knutson K[1], Towey T[2], Hedgeman E[1], Franzblau A[1], Chen Q[3], Lee S-Y[3], Sima C[3], Gillespie BW[3], Adriaens P[2], Demond A[2], Lepkowski J[4], Ward B[4], Ladronka K[4], Olson K[4], Sinibaldi J[4], Chang S-C[2], Gwinn D[5], Swan S[5], Garabrant D[1]

[1]Department of Environmental Health Sciences, University of Michigan School of Public Health, 109 S Observatory, Ann Arbor, MI 48109; [2]Department of Civil and Environmental Engineering, University of Michigan College of Engineering, 1351 Beal, Ann Arbor, MI 48109; [3]Department of Biostatistics, University of Michigan School of Public Health, 109 S Observatory, Ann Arbor, MI 48109; [4]Survey Research Center, Institute for Social Research, University of Michigan, 426 Thompson, Ann Arbor, MI 48104; [5]Center for Statistical Consultation and Research, Horace Rackham School of Graduate Studies, Ann Arbor, Michigan 48109;

Introduction

Dioxin-like compounds are a family of structurally related chemicals including polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and polychlorinated biphenyls (PCBs). The University of Michigan Dioxin Exposure Study (UMDES) was undertaken in response to concerns among the population of Midland and Saginaw Counties, Michigan, USA that dioxin-like compounds from the Dow Chemical Company have resulted in contamination of soils in the Tittabawassee River flood plain and areas of the City of Midland. There is concern that people's body burdens of PCDDs, PCDFs and PCBs may be elevated because of environmental contamination. A central goal of the UMDES is to determine the factors that explain variation in serum levels of PCDDs, PCDFs, and PCBs, and to quantify how much variation each factor explained. Household dust concentration and household dust loading of PCDDs, PCDFs, and PCBs were included in the list of potentially explanatory factors to investigate. The goal of this report is to describe the descriptive statistics and distributions of the household dust measurements.

Previous studies that have sought household dust concentrations of dioxin-like PCDDs, PCDFs, and PCBs are presented in Table 1. The results are difficult to compare against each other because of differences in congeners collected, sampling methods used, and TEQ calculation versions applied. With the exception of Tang 2004[1] which used a wipe method, all the listed studies utilized a vacuum method for sampling.

Table 1. Descriptions and results of studies that have reported household dust levels of PCDDs, PCDFs, and PCBs

Reference (Location)	Congeners Analyzed	No. of Samples	TEQ Version	Mean (Median)	Range
Christmann 1989[2]	7 PCDDs 10 PCDFs	4[a]	None applied	Results are congener specific	Results are congener specific
Berry 1993[3]	7 PCDDs 10 PCDFs	2	I-TEF/89	8.3 pg/g, 12 pg/g	NA
Wittsiepe 1997[4] (Germany)	7 PCDDs 10 PCDFs	10	I-TEF/89	101 ng/kg	7.83-332 ng/kg
Saito 2003[5] (Japan)	7 PCDDs 10 PCDFs 12 PCBs	10	WHO/97	15.6 pg/g (n=5) 16.0 pg/g (n=5)	8.6-26.0 pg/g, 5.9-30.5 pg/g
Tang 2004[1] (NY, USA)	7 PCDDs 10 PCDFs	114	WHO/97	0.63 ng/m^2 0.68 ng/m^2	0.48-0.83 ng/m^2 0.518-1.66 ng/m^2

Reference (Location)	Congeners Analyzed	No. of Samples	TEQ Version	Mean (Median)	Range
O'Conner 2005[6] (MS, USA)	7 PCDDs 10 PCDFs	14	I-TEF/89, WHO/97	WHO: 20.3 I-TEF: 25.2	WHO: 1.3-53.7 I-TEF: 2.3-63.6

[a] All samples were taken in rooms containing treated wood

The UMDES is the largest study on household dust contamination of PCDDs, PCDFs, and PCBs to date and provides useful data on household dust concentrations and loadings in a known soil contaminated area as well as in a community with no known source of exposure to PCDDs, PCDFs, and PCBs.

Materials and Methods

Five populations were studied in the UMDES. A random sample from each population was selected. The five populations were:

- Residents of Midland and Saginaw Counties who reside in the flood plain of the Tittabawassee River between the Dow Chemical plant in Midland and the confluence of the Tittabawassee and Shiawassee rivers in Saginaw (M/S FP)
- Residents of Midland, Saginaw, and Bay Counties who reside in census blocks adjacent to the flood plain of the Tittabawassee River between the Dow Chemical plant in Midland and the confluence of the Tittabawassee and Shiawassee Rivers in Saginaw (M/S Near FP)
- Residents of Midland, Saginaw and Bay Counties who do not reside in the flood plain of the Tittabawassee or Saginaw Rivers or the confluence flood plain of the Shiawassee River (M/S Out FP)
- Residents of Midland, Saginaw and Bay Counties who reside in the plume of the former Dow Chemical plant incinerator (M/S Plume)
- Residents of Jackson and Calhoun Counties, Michigan (Jackson/Calhoun)

All five populations were sampled using a two-stage area probability household sample design. In order to be eligible for participation in the survey, subjects had to be age 18 years or older and had to have lived in the residence at least five years. In order to be eligible for participation in household dust sampling, subjects had to also be the owner of their residence. A more detailed description of the populations and respondent selection methodology is reported elsewhere.[7]

Vacuum sampling for household dust was conducted in the home of each UMDES participant. The sampling protocol was based, with minor modifications, on the American Society for Testing and Materials (ASTM) method "Standard Practice for Collection of Floor Dust for Chemical Analysis".[8] The sample was taken from two sampling locations that presented the highest potential for human contact with household dust and dirt. The locations were generally a frequently occupied living space (e.g., living or family room) and a high traffic hallway or pathway. Samples were taken from both hard and soft surfaces and were not taken of undisturbed dust in generally inaccessible areas. The total surface area of all of the sampling areas was recorded, as well as the surface types from which the samples were taken. Analyses were performed by Alta Analytical Laboratory, Inc. (El Dorado Hills, California, USA) for the World Health Organization designated 29 PCDD, PCDF, and PCB congeners[9] using US EPA methods 8290[10] and 1668[11].

Descriptive analysis of PCDD, PCDF, and PCB household dust congener concentration and loading was performed for each of the five geographic regions. Both Stata[12] and SAS[13] statistical software packages were utilized to complete the analyses.

Results and Discussion

Results and discussion will not be available until after complete study results have been presented to the affected communities in August of 2006. The following results will be made available at that time:

- Distribution of TEQ-weighted household dust concentration for all samples
- Distribution of TEQ-weighted household dust loading for all samples
- TEQ-weighted household dust concentration mean, median, range, 75th and 95th percentile for all samples and by region
- TEQ-weighted household dust loading mean, median, range, 75th and 95th percentile for all samples and by region.
- Contribution of PCDDs, PCDFs, and PCBs to the TEQ for all samples and by region
- Non-TEQ-weighted concentration of select PCDD, PCDF, and PCB congeners by region

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