

HUMAN LEVELS OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN MISSOURI

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ABSTRACT

We evaluated various factors for predicting levels of 2,3,7,8-tetrachlorodibenzo-p-dioxin in a small number of people in Missouri. The best predictor for the residential population was whether the person was living in the contaminated areas during or shortly after the spraying of the roadways with the contaminated material.

KEYWORDS: 2,3,7,8-tetrachlorodibenzo-p-dioxin, Times Beach, Quail Run, Missouri

INTRODUCTION

Various methods have been used to assess human exposure to environmental toxicants. These include 1) questionnaire/history data; 2) laboratory measurements of environmental samples; 3) combination of the above; 4) laboratory measurements of human samples and 5) laboratory measurements of human samples and any or all of the above. Generally, the total cost and the ease of collecting the samples needed increase as the assessment progresses from #1 to #5. Therefore, it is tempting to assess human exposure by using only steps #1 through #3. However, we believe that to accurately assess human exposure to low-levels of an environmental toxicant it is necessary to measure that toxicant or its metabolites in humans. Previous presentations at the Dioxin Conferences exemplified that the exposure indices in the Vietnam Veteran Agent Orange Validation Study and in the Pilot Phase of the U.S. Air Force Ranch Hand Study were poor predictors of serum 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) levels in those populations (1,2). On the other hand, presenters from the National Institute for Occupational Safety and Health (3,4) have shown excellent correlations between serum TCDD levels and a careful, detailed review of their occupational history records of former workers of two plants that produce TCDD contaminated products; however, this exposure index cannot predict individual serum TCDD levels. In this presentation we shall focus on two different manners of potential exposures to TCDD -- recreational (horse back riders in Missouri arenas that had been sprayed with the TCDD contaminated oil) and residential (people living in Missouri areas that had been sprayed with the TCDD contaminated oil) - and how well the soil levels and other variables predict human levels.

RECREATIONALLY EXPOSED: In the early 1970s several horse riding arenas were sprayed with oils for dust control purposes (5); these oils were later found to have originated from an industrial waste residue that was contaminated with TCDD at levels measured at 305 ppm.

One of these arenas was that at the Bubbling Springs Ranch, which was sprayed in June, 1971 with TCDD contaminated still bottoms (from the manufacturing process) that had been diluted with used motor oil. In March, 1973, after several incidents of horse illnesses and deaths, about 850 cubic yards of soil was evacuated (if uniform, about 19 inches in depth). In May, 1982, TCDD levels from 1.5 to 9.5 ppb were found in soil samples at depths ranging to 12 inches. The riding activity on the TCDD contaminated soil in the Bubbling Springs Arena for the six riders for whom we also have TCDD values was from 1971-1976. We have TCDD levels for four other riders who rode in different arenas that had been similarly sprayed.

RESIDENTIALLY EXPOSED: Of the Missouri residential areas whose dirt roads were sprayed with the TCDD contaminated oil for dust control, the town of Times Beach and the Quail Run Mobile Home Park have been the most extensively studied. The roads in Times Beach were sprayed with this oil in 1972 and in 1973. From 1982 TCDD measurements of the roadways, it was estimated that 70% of the TCDD levels in the roads were from 1-1200 ppb. We have TCDD adipose tissue levels for four residents living on streets with levels < 1 ppb; three on streets with levels of 20-100 ppb and two on streets with levels greater than 100 ppb of TCDD. The Quail Run Mobile Home Park was sprayed during the same time period with contaminated waste oil that had been diluted very little. The highest TCDD levels of 560-1100 ppb (1 foot depth) were later found in the center of the main road near the entrance to the Park, except for one oily-looking spot that was found to contain 2200 ppb of TCDD. Sampling and analyses of 12 trailer yards on the north side of the road closest to the entrance found 0.9 to 11.7 ppb of TCDD in the top six inches. Yards south of the road had from 0.3 to 0.8 ppb TCDD. We have adipose tissue levels for ten residents of Quail Run. Of these, five lived near an area of the road with TCDD levels between 25-100 ppb and five with levels greater than 500 ppb although none of these latter five lived there during the time of spraying.

#### METHODS

All TCDD soil levels were supplied by the Missouri Department of Health and resulted from analyses by U.S. Environmental Protection Agency's contract laboratories. All TCDD measurements were performed in adipose tissue on a whole-weight basis at the U.S. Centers for Disease Control by the method of Patterson et al (6). Adipose tissue levels for all of the recreationally exposed, 16 of the 20 residentially exposed, and the controls have previously been reported by Andrews et al (7).

#### RESULTS AND DISCUSSION

RECREATIONALLY EXPOSED: The TCDD levels in the adipose tissue of ten horseback riders, who rode in arenas that had been sprayed with TCDD-contaminated oil, are presented in Table I. The TCDD levels for the riders at the Bubbling Springs Ranch range from 9.6 to 557 ppt and for the other arenas from 5.0 to 24 ppt. Accurate records as to the number of hours that each actually rode are not available; however, from the data available, no clear correlation between the time interval of riding and TCDD level is obvious.

TABLE I. Adipose Tissue Levels of TCDD in Riders in Arenas Sprayed With TCDD-Contaminated Oils

Arena	Riding Period	Year of Birth	TCDD Level (ppt)
Bubbling Springs	1971-76	1929	577
Bubbling Springs	1971-76	1956	9.6
Bubbling Springs	1971-76	1917	294
Bubbling Springs	1971-76	1943	11.5
Bubbling Springs	1971-76	1924	340
Bubbling Springs	1971-76	1923	33.3
Timberlake	1971-82	1934	24
Mid-America	1974-79	1961	5.1
Mid-America	1976-78	1960	7.5
Multiple	1972-76	1949	5.0

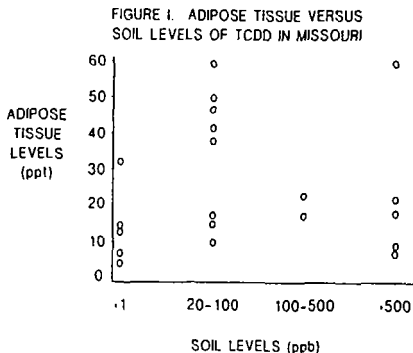
RESIDENTIALLY EXPOSED: The TCDD adipose tissue levels of residents of Times Beach and Quail Run and 128 controls from Missouri are presented in Table II. Although the number of measurements of the residents is quite small for both Times Beach and the Quail Run Mobile Home Park, the results are remarkably similar. Furthermore, the mean TCDD levels of these residents are 3-4 times that of the Missouri control population.

Table II. Levels (ppt) of TCDD in Residents of Missouri

	Times Beach	Quail Run	Controls
N	10	10	128
Median	18.4	17.2	6.1
Mean	24.8	24.4	7.0
S.D.	18.3	18.7	4.0
Range	2.8-59.1	6.2-59.1	ND - 20.2

We attempted to determine which variables best predict the TCDD levels of these residents. For this analysis we also included one other resident of another contaminated area in Missouri and for whom we had measured an adipose tissue level of 7.4 ppt. Each of the variables was compared using the mean TCDD level of each group and nonparametric tests for significance were performed. The variables examined include education level (< 12 grades vs. 12 or more grades completed), sex (male vs female), first years of exposure (resident during 1971-1973 vs 1974-1982), age at first exposure (< 20 years vs 20 years or more of age; no young children were measured), last years of exposure (resident during 1973-1979 vs 1980-1984), and total years of exposure (resident < 5 years vs. 5-12 years). The only significant variable ( $p = 0.029$ ) is whether the person resided in the exposed area from 1971-1973, which was during or soon after the time of spraying; women have higher levels than men ( $p = .085$ ). One can explain these significant variables in several ways including the following scenario: the concentration of TCDD and its availability for human exposure seems to be highest immediately after the spraying; this could be due to aerosol contamination (inhalation), tracking the oily material into the house, or in the yard the TCDD is on the surface of the soil and may not be as tightly bound; and because women spend more time in these contaminated areas than men.

One variable of particular interest was the correlation between soil levels and adipose tissue levels of TCDD. In Figure 1 we plotted the 20 individual adipose tissue levels of residents of Times Beach and Quail Run against the soil levels that were divided into four groups. There is no significant correlation between these two variables. However, it should be noted that for Times Beach alone, the people living on the more contaminated streets tended to have higher levels of TCDD, but they also tended to have lived there during 1971-1973.



For all of these variables the number of observations is quite small. However, they do suggest that of particular significance for predicting human TCDD levels is whether one was present at or near the time the actual contamination took place. This is not intended to mean that an individual living near a higher contaminated area is no more likely to be exposed than one living near a lesser contaminated area, but it does point out that predicting individual exposure and even group exposure based on questionnaire/history data and environmental data may be quite tenuous.

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