

## AN INVESTIGATION OF BLOOD DIOXIN LEVELS AMONG PERSONS IN CALCASIEU PARISH, LOUISIANA

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### Introduction

Calcasieu Parish, Louisiana contains a large number of chemical manufacturing plants that produce chlorinated hydrocarbon solvents, vinyl chloride monomer, and petroleum-based chemicals. Community members living near these industries were concerned about their effects on health and requested that the Environmental Protection Agency (EPA) investigate. In 1998, a resident of Calcasieu Parish asked the EPA to review blood dioxin results of 12 blood samples from citizens of Calcasieu Parish. The EPA requested that the Agency for Toxic Substances and Disease Registry (ATSDR) evaluate the blood data. ATSDR reviewed the blood data and determined that 4 of the 12 samples were elevated for dioxins.<sup>1</sup> Based on this finding, ATSDR conducted an exposure investigation (EI) in Mossville, Louisiana.

Since dioxin blood levels have been decreasing over time<sup>2</sup> and since many of the available levels of dioxin were studies conducted many years ago, the ATSDR worked with the Centers for Disease Control and Prevention, National Center for Environmental Health laboratory to develop a reference level for blood dioxin in the United States population. They used data from several studies that were conducted in 1995-1998. While this reference level does not represent the United States population, it does reflect several communities that have very low exposures to dioxins. This reference level will be referred to as the combined population reference.<sup>3</sup>

In the final EI report released in December 1999, dioxin TEQ concentrations of participants were compared using the combined population reference. The mean (68.3 ppt) and median (54.8 ppt) TEQs of EI participants exceeded the mean (21.0 ppt), median (19.9 ppt) and 95<sup>th</sup> percentile (37.5 ppt) of the combined reference. The TEQ of the EI participants ranged from 3.8 ppt to 186 ppt. Age was strongly correlated with dioxin levels with the highest levels in participants over age 45 years.<sup>4</sup>

The results of the exposure investigation raised questions regarding the representativeness of the results and whether exposure was ongoing or historic. To follow up on these questions, ATSDR launched an expanded blood dioxin exposure investigation in Calcasieu Parish in the summer of 2002.

The primary objectives of the 2002 investigation were: 1) to determine whether blood dioxin levels were elevated in a representative sample of Calcasieu Parish residents compared to a nonexposed comparison group of Lafayette Parish residents, and, if so 2) to determine if any patterns of elevated blood dioxin exist which would suggest time, geographic location or method of exposure.

### Methods and Materials

This investigation consisted of analyzing blood dioxin levels of 414 randomly selected participants - 294 participants were from one of three groups in the Calcasieu Parish target area. The first group consisted of 142 participants from an elliptical area of approximately 3 miles by 6 miles around the industrial corridor. The next group was made of 121 participants who lived in a 1.5 mile industrial buffer around the industrial corridor. The last group was 31 residents in the cities of Dequincy, Vinton, and Iowa - approximately 6 miles Northwest, West, and East of the industrial corridor and still in Calcasieu Parish (Figure 1). The comparison group consisted of 120 people from Lafayette Parish<sup>5</sup>. This parish was chosen as a comparison because it is demographically and geographically similar to Calcasieu Parish and does not have the type of industry present in Calcasieu. The investigation included persons as young as 15 in order to better characterize dioxin levels in younger persons. To be eligible for the investigation, participants must have

been age 15 and older, must have lived in their parish for 5 years or more, and for Lafayette participants, must have never lived in Calcasieu Parish. Participants answered a questionnaire and had 50 ml of blood drawn to be analyzed for serum dioxin.

Analysis of the serum samples was conducted by the Centers for Disease Control and Prevention, National Center for Environmental Health (NCEH) laboratory using high resolution gas chromatography/isotope-dilution high resolution mass spectrometry.<sup>6-8</sup> Serum samples were spiked with <sup>13</sup>C<sup>12</sup>-labelled internal standards. The analytes of interest are isolated using a C18 solid phase extraction procedure followed by a multi-column automated cleanup and enrichment procedure. The analytes are separated by a DB-5ms capillary column (30m x 0.25 μm film thickness) using a Hewlett-Packard 6890 gas chromatograph and quantified by ID-HRMS using selected ion monitoring at 10,000 resolving power with a Micromass Auto Spec ULTIMA or a Finnigan MAT95 mass spectrometer in the EI mode. The concentration of each analyte is calculated from an individual standard linear calibration curve. Each analytical run includes three unknown serum samples, a method blank, and a quality control sample. The analyst is blinded to the QC samples. After all data are reviewed using comprehensive quality assurance and quality control procedures, the analytical results are reported on both a whole-weight and a lipid-adjusted basis. TEQs are reported for PCDDs, PCDFs, CPCBs and other 'dioxin-like' PCBs based on the WHO-TEQ systems.<sup>9</sup>

We used a nonparametric median test to compare the difference between Calcasieu and Lafayette Parishes, and between the parishes stratified by age group and by fish eating. We also used median one-way analysis to compare the difference between the Calcasieu Parish area industrial corridor, industrial buffer, outer ring and Lafayette Parish.

### **Results and Discussion - These are preliminary results that have not been peer reviewed.**

Comparisons within Louisiana. This study set out to compare dioxin TEQ levels among residents in the target community (Calcasieu Parish) to those of residents in a comparison community (Lafayette Parish). The levels for participants from both parishes were very similar. While the TEQ level of people who lived in Calcasieu Parish were slightly lower than levels in Lafayette Parish (Table 1), the difference between the median dioxin levels in the two communities was not statistically significant (p=0.52).

When the Calcasieu area was divided into three areas (industrial corridor, industrial buffer, and outer ring) (Figure 1), the median dioxin TEQ levels in these three areas were similar to each other and to Lafayette Parish – the comparison community (Table 2). Although there is a slightly decreasing trend when moving from the inner ring to the outer ring in Calcasieu Parish and the TEQ levels were slightly higher in the comparison community, these differences were not statistically significant (p=0.84).

As reported in the literature, dioxin TEQ levels increased with age in Calcasieu and Lafayette Parishes (Table 3). When stratified by age, the median dioxin levels in both parishes were similar. This is illustrated by the p-values when comparing the two groups by age category: 15-29 years (p=0.61), 30-49 years (p=0.12), 45-59 years (p=0.83), and 60+ years (p=0.40). However, the TEQ of the 95<sup>th</sup> percentile blood dioxin TEQ level among participants older than 60 years in Calcasieu Parish (83.8 ppt) is lower than the same group in Lafayette Parish (113.0 ppt).

Calcasieu Parish residents who ate fish had similar dioxin TEQ levels as those who lived in Lafayette Parish who ate fish (p=0.57) (Table 4). Similar results are also found among those who did not eat fish (p=0.93). Within each of the two respective communities, residents who ate local fish had levels that were similar to those in residents who did not eat fish. However, people who ate locally caught fish had slightly lower median dioxin levels compared to those who did not eat fish. The small differences were not statistically significant.

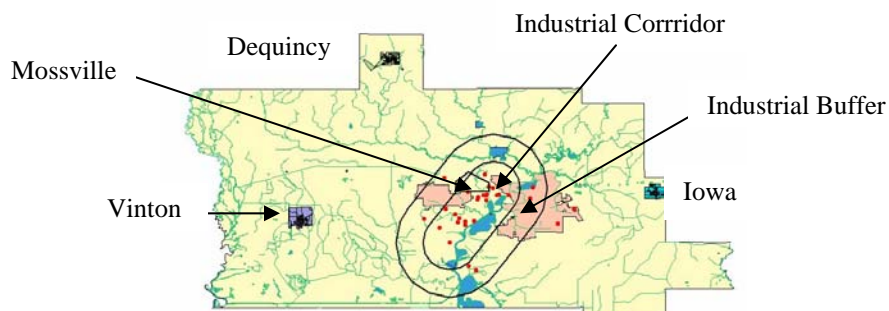
Other Comparisons. Comparison of the medians and 95<sup>th</sup> percentile levels (respectively) for Calcasieu Parish residents (13.7 ppt, 59.9 ppt), Lafayette Parish residents (15.0 ppt, 64.8 ppt), and the combined population group (19.9 ppt, 37.5 ppt) shows that the median dioxin level of the participants who lived in the parishes are slightly lower than the combined population reference and the 95<sup>th</sup> percentiles are higher in the parishes than in the combined population reference. Additionally, the arithmetic means are very similar

in Calcasieu, Lafayette, and combined population reference (18 ppt, 21.1 ppt, and 21ppt respectively). When looking at the dioxin TEQ of the 95<sup>th</sup> percentile of parish participants by age group, the TEQ is below the TEQ of the combined population reference (37.5 ppt) except for people who are older than 60 years. This observation may be explained by a larger age distribution of the parish population (15 to 91 years) than the age distribution of the combined population reference (20 to 68 years) and that the parish population has more older participants than the combined population reference.

### Summary

We found that dioxin TEQ levels in Calcasieu Parish residents were similar to the levels measured in Lafayette Parish residents. We also found that the dioxin TEQ mean and median level of the parish participants were similar to the combined population reference group. There was a small group of older current participants who had higher dioxin TEQ levels than the TEQ of the 95<sup>th</sup> percentile of the combined population reference group.

**Figure 1. Calcasieu Parish, Louisiana Dioxin Study Areas**



**Table 1 - Dioxin TEQ in Calcasieu and Lafayette (ppt)**

	N	Arithmetic Mean (95% CI)	Geometric Mean (95% CI)	Median (95% CI)	95 <sup>th</sup> Percentile (95% CI)
Calcasieu	294	18.0 (16.0 – 20.0)	11.3 (9.9 – 12.8)	13.7 (11.0 – 15.7)	59.9 (48.0 – 65.5)
Lafayette	120	21.1 (17.2 – 25.1)	13.4 (11.1 – 16.2)	15.0 (11.6 – 19.2)	64.8 (44.5 – 146)

**Table 2 - Dioxin TEQ in Calcasieu Study Areas and Lafayette (ppt)**

		N	Arithmetic Mean (95% CI)	Geometric Mean (95% CI)	Median (95% CI)	95 <sup>th</sup> Percentile (95% CI)
Calcasieu	Industrial Corridor	142	18.5 (15.7- 21.3)	11.7 (9.7 – 13.8)	14.6 (10.2 – 17.6)	55.4 (47.8-65.5)
	Industrial Buffer	121	18.2 (14.8-21.7)	11.3 (9.4 -13.5)	13.4 (9.5 – 16.1)	53.8 (42.9- 93.6)
	Outer Ring	31	15.1 (10.8-19.4)	9.5 (5.9 – 15.2)	12.8 (7.2 – 19.8)	40.2 (25.7 – 48.8)
Lafayette		120	21.1 (17.2 – 25.1)	13.4 (11.1 -16.2)	15.0 (11.6 – 19.2)	64.8 (44.5 – 146.4)

**Table 3 - Dioxin Levels by Age and Parish**

Age Groups	Parish	N	Arithmetic Mean (95% CI)	Geometric Mean (95% CI)	Median (95% CI)	95 <sup>th</sup> Percentile (95% CI)
15 – 29	Calcasieu	75	5.9 (4.4 – 7.4)	4.0 (3.2 – 5.0)	4.6 (3.6 – 5.8)	14.0 (10.9 – 53.9)
	Lafayette	26	5.8 (4.3 – 7.3)	4.22 (2.80 – 6.36)	5.3 (2.9 – 7.8)	11.7 (10.1 – 12.2)
30 – 44	Calcasieu	70	11.6 (9.6 – 13.6)	8.8 (7.2 – 10.8)	9.3 (7.0 – 12.1)	24.5 (21.1 – 50.4)

	Lafayette	31	13.6 (10.8 – 16.4)	11.2 (8.6, 14.6)	13.6 (9.1 – 17.6)	30.4 (21.0 – 32)
45 – 59	Calcasieu	79	19.1 (16.9 – 21.3)	16.0 (13.7 – 18.8)	18.6 (16.5 – 21.0)	35.2 (30.5 – 55.4)
	Lafayette	31	19.1 (15.3 – 22.8)	16.3 (13.1 – 20.3)	18.4 (12.2 – 26.0)	32.4 (29.4 – 46.4)
60 +	Calcasieu	70	36.2 (30.9 – 41.6)	29.0 (24.3 – 34.6)	33.0 (25.8 – 37.8)	83.8 (64.3 – 96.3)
	Lafayette	32	42.9 (32.0 – 53.8)	33.8 (25.8 – 44.3)	35.8 (31.4 – 44.5)	113.0 (73.0 – 146.4)

**Table 4 - Dioxin Level by Consumption of Locally Caught Fish**

Local Fish Ever	Parish	N	Arithmetic Mean (95% CI)	Geometric Mean (95% CI)	Median (95% CI)	95 <sup>th</sup> Percentile (95% CI)
Yes	Calcasieu	257	17.8 (15.7 – 20.0)	10.9 (9.5 – 12.5)	13.3 (10.4 – 15.7)	55.4 (48.0 – 75.0)
	Lafayette	56	21.2 (14.2 – 28.3)	11.9 (8.6 – 13.7)	11.7 (9.5 – 18.5)	77.8 (41.2 – 146)
No	Calcasieu	32	19.6 (14.4 – 24.9)	14.2 (10.2 -19.8)	18.2 (11.2 – 21.1)	53.9 (34.2 – 58.1)
	Lafayette	53	20.8 (16.2 – 25.4)	14.7 (11.3 – 19.0)	17.6 (12.2 - 24)	45.5 (35.4 – 86.3)

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