

Community Report

Comparison of Exposures to Volatile Organic Compounds among Louisiana Residents

The Agency for Toxic Substances and Disease Registry (ATSDR) conducted a study to find out if Louisiana residents had been exposed to volatile organic compounds (VOCs). We tested blood samples of residents of Calcasieu and Lafayette Parishes for these exposures in 2002. This report describes the findings from that 2002 study.

About the Study

Calcasieu Parish, in southwest Louisiana, has many manufacturing and industrial businesses. The discovery of petroleum and natural gas there in the late 1920s led to the growth of many chemical plants, particularly in the Lake Charles area. The manufacturing plants make chemicals and solvents from petroleum. In the year 2000, the Toxic Chemical Release Inventory of the U.S. Environmental Protection Agency showed that only five parishes in the state were more contaminated than Calcasieu Parish. In that year, thirty-one industries within the parish released a combined total of over 14 million pounds of environmental contaminants. So, Calcasieu Parish residents were concerned that exposures to those contaminants were affecting their health. ATSDR's 2002 study measured amounts of VOCs in the blood samples of the residents living around the industries. Blood samples of a group of Calcasieu Parish residents and a group of Lafayette Parish residents were measured and compared. We chose Lafayette Parish because its population (the parish as a group) is similar to Calcasieu in characteristics like geography, total population, age and race mix, poverty level, diet and lifestyle, but it has fewer industries.



What are VOCs?

VOCs are chemicals that evaporate easily into the air. Common VOC sources include tobacco smoke, petroleum products, paints, polishes, lubricants, and insecticides. VOCs come from many different natural and manmade sources and are in almost all homes and workplaces. These chemicals enter our body when we breathe, eat or drink, or touch them. VOCs don't stay in our body a long time but repeated exposures to high levels can cause them to build-up in our body. A blood test can show the amount of VOCs in a person's body. If the concentrations are high enough, VOCs may cause health problems such as lung irritation. Long-term exposure to low concentrations of VOCs may damage the liver or kidneys.

The Study Methods

This study was conducted along with ATSDR's dioxin study in 2002. In this study, we wanted to find out if participants in Calcasieu Parish had higher amounts of VOCs in their blood than participants in Lafayette Parish. The Calcasieu Parish study population had to have lived in that parish for the last 5 years and be at least 15 years of age. The Lafayette Parish study population had to have lived in that parish for the last 5 years, never have lived in Calcasieu Parish, and be at least 15 years of age. Because smoking is a major source of VOCs, current smokers and people who had smoked in the last five years, could not be in the study.

We enrolled 297 people in the study. Of these, 204 lived in Calcasieu Parish and 93 lived in Lafayette Parish. We told the participants about the study, and discussed their rights. All participants signed consent forms, and we took some blood from their arms for the study. We asked them about their age, race, sex, work history, smoking history, how long they had lived in the parish, what kind of water they used for cooking and drinking, and if they used any household chemical products.

Of the 297 participants, 283 had acceptable blood samples and 14 blood samples were excluded. We could not use 13 blood samples because they had high levels of a compound that is found in tobacco smoke, and any VOCs we found could be due to tobacco smoke.

We also could not use the sample of a resident who admitted to smoking on the day blood samples were drawn. The final group of 283 study participants included 192 who lived in Calcasieu Parish and 91 who lived in Lafayette Parish. We tested the blood samples for VOCs at the Centers for Disease Control and Prevention's (CDC) National Center for Environmental Health (NCEH) laboratory.

We compared blood VOC levels of Calcasieu and Lafayette Parish participants and blood VOC levels of Calcasieu Parish participants living in three areas: the industrial corridor, the industrial buffer, and the outer zone. These areas were based on how close the residents lived to the sources of contamination. We also compared the blood VOC levels of participants in each parish and both parishes combined with national levels, which are the levels of people across the United States. Comparing the blood VOC level of a person or a population (a specific group of people) to national levels tells us if the individual levels are high. The national VOC levels were taken from CDC's 1999 – 2000 National Health and Nutrition Examination Survey (NHANES). The NHANES measures the health and nutritional status of the U.S. population who are not in institutions.

The Study Results

Table 1 describes the study participants. The participants ranged in age from 15 to 91 years old; 46% were men, and 89% were white. Participants from both parishes were exposed to VOCs at work, and used products that contained VOCs during the three days before their blood was drawn. In Calcasieu Parish more people lived in the parish greater than 20 years compared to Lafayette Parish (Lafayette Parish 51%; Calcasieu Parish 75%). Self-reported use of chemical products that contained VOCs is described in Table 2. The residents of Calcasieu Parish used diesel fuel and kerosene more often.

We tested the blood samples of 283 participants for 30 VOCs. Of the 30 VOCs, 24 could be seen in very small amounts in the blood of some people but fewer than 25% of persons tested had enough in their blood to measure. Therefore, we could not make any comparisons about these 24 VOCs. This report is about the 6 (of 30) VOCs that were at levels that we could measure in at least 25% of the samples tested.

We compared the blood levels of six VOCs among participants from each parish. The average blood levels of six VOCs were similar in participants of Calcasieu and Lafayette Parishes. We compared blood VOC levels of participants in three areas in

Calcasieu Parish (industrial corridor, industrial buffer, and the outer zone) and we found no differences. We then compared the blood levels of six VOCs from each parish and both parishes combined with national levels from the 1999 – 2000 NHANES (Table 3). The average blood levels of five VOCs were either similar to or lower than the levels shown in the 1999 – 2000 NHANES. The average blood level of one was slightly higher than the levels shown in the 1999 – 2000 NHANES (see figure below).

Discussion and Conclusion

In this study, we wanted to find out if blood VOC levels were higher among participants in Calcasieu Parish, which had more industrial VOCs, than among participants in Lafayette Parish. We chose Lafayette Parish as the comparison group because it was similar to Calcasieu Parish and had fewer industrial sources of VOCs. Because VOCs do not stay in the body for a long time, this study shows exposure at the time the blood was taken but not past exposure. Blood levels of 24 of the 30 VOCs were too low for us to measure. We measured the blood levels of 6 of the 30 VOCs. Although Calcasieu Parish had more VOC sources, Calcasieu Parish participants did not have higher blood levels of the six VOCs we tested for than Lafayette Parish participants.

We compared blood VOC levels of Calcasieu Parish participants, Lafayette Parish participants, and the combined blood VOC levels from both parishes with national levels. We found that the average blood levels of six VOCs were not elevated in Calcasieu Parish participants. The blood levels of six VOCs among participants in three areas in Calcasieu Parish were similar to each other and similar to participants in Lafayette Parish. We also found that the blood levels of five VOCs were either lower than or similar to the national levels. We did not find blood levels of the six VOCs high enough to cause health concern.

Our study had some limitations. We did not take into account weather conditions such as the wind direction and rain when blood was collected. These conditions can affect people's exposure to air pollutants. However, these limitations did not affect our overall ability to assess blood VOC levels in this population.

Our study had several strengths. Testing blood or other body fluids is the best way to find out if a person has been exposed to toxic substances. We compared the blood VOC levels of Calcasieu Parish and Lafayette Parish participants and compared these levels with national levels. We had strong support from the community and they were actively involved in developing this study.

Table 1: Lifestyle and characteristics by parish in Louisiana (Calcasieu n=192, Lafayette n=91, Total n=283)

Characteristic	Description	Calcasieu Number/Percent	Lafayette Number/Percent
Used city water as drinking and cooking source	Yes	152 (85%)*	80 (88%)
	No	38 (15%)	11 (12%)
Gender	Male	82 (48%)	40 (44%)
	Female	110 (52%)	51 (56%)
Smoked in past 5 years	Yes	15 (8%)	10 (11%)
	No	177 (92%)	81 (89%)
Age group (years)	15 – 29	36 (17%)	16 (17%)
	30 – 44	48 (24%)	19 (25%)
	45 – 59	52 (30%)	27 (34%)
	60 and older	56 (29%)	29 (24%)
Race	White	174 (88%)	82 (90%)
	Non-white	18 (13%)	9 (10%)
Exposed to VOCs at work	Yes	69 (51%)	36 (46%)
	No	97 (49%)	41 (54%)
Year moved to parish**	1900 – 1940	16 (7%)	7 (6%)
	1941 – 1960	52 (29%)	18 (20%)
	1961 – 1980	76 (42%)	24 (25%)
	1981 – Present	48 (22%)	42 (49%)

n = number of participants; VOCs: volatile organic compounds;
 *2 missing values for Calcasieu Parish (n=190); and
 **Year moved to parish was the only significant factor between the parishes, Calcasieu Parish before 1981 and Lafayette Parish after 1981.

Table 2: Self-reported use of chemical products that contained VOCs by parish

Product	Calcasieu (%)	Lafayette (%)
Gasoline	54%	43%
Air freshener	53%	61%
Bug spray	17%	12%
Diesel fuel or kerosene*	16%	3%
Bleach	13%	17%
Solid toilet bowl deodorizer	13%	9%
Nail polish	13%	8%
Cut or sand wood	11%	4%
Varnish	10%	10%
Pressure treated wood products	9%	7%
Dry cleaning	8%	8%
Weed killer	6%	3%
Spray paint	6%	4%
Door spray lubricant	5%	6%
Model glue	4%	8%
Paint thinner	3%	6%
Type writer correction fluid	2%	4%
Paint primer	1%	6%

VOC: volatile organic compounds; and
 *Diesel fuel or kerosene was the only significant chemical product that contained VOC that was used more often in Calcasieu Parish

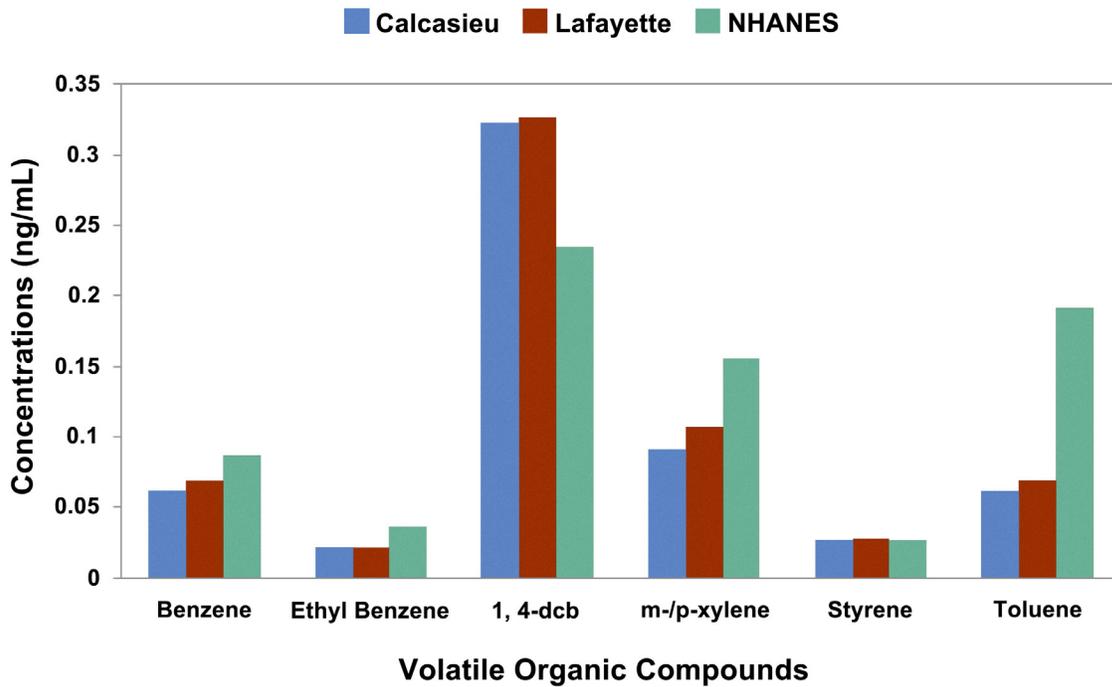
Table 3: Comparison of blood VOC levels (ng/mL) by parish to NHANES 1999 – 2000

Chemical	Calcasieu, mean* (ng/mL)	Lafayette, mean* (ng/mL)	NHANES mean* (ng/mL)
Benzene	0.062	0.069	0.087
Ethyl Benzene	0.021	0.022	0.036
1,4-dichlorobenzene	0.322	0.327	0.235
m-/p-xylene	0.091	0.107	0.156
Styrene	0.027	0.028	0.027
Toluene	0.062	0.069	0.191

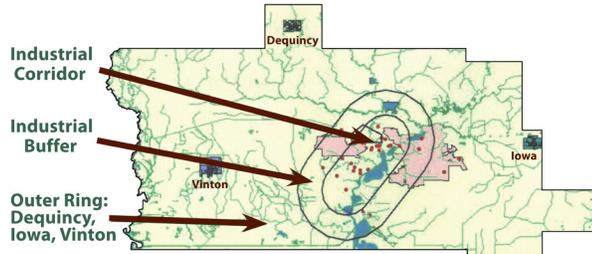
ng/mL: nanogram per milliliter; VOC: volatile organic compounds; NHANES: National Health and Nutrition Examination Survey; and
 *Geometric means were used to compare the VOC results. NHANES values were expressed in geometric means.

Note: The geometric mean is a type of average (mean) which indicates the typical value of a set of numbers.

Figure 1: Comparison of blood volatile organic compounds (VOCs) concentrations (nanogram per milliliter, ng/mL) among residents of Calcasieu Parish, Lafayette Parish and NHANES 1999 – 2000.



**Calcasieu Parish, Louisiana
Dioxin, PCB and VOC Study Areas**



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