
**The University of Michigan Dioxin Exposure Study:
Study overview, population demographics and
serum dioxin concentrations**

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The University of Michigan Dioxin Exposure Study

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A large, semi-transparent watermark of the University of Michigan seal is centered in the background of the slide. The seal features a central sunburst, a book, and a lamp, surrounded by the text 'UNIVERSITY OF MICHIGAN' and '1817'.

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Financial support for this study comes from The Dow Chemical Company through an unrestricted grant to the University of Michigan.

The University of Michigan has complete independence to design, carry out, and report the results of the study.

The investigators report to an independent Scientific Advisory Board.

Background

The Dow Chemical Company has operated in Midland, Michigan since 1897 and is believed to have caused two major patterns of environmental contamination with polychlorinated dioxins and furans:



- Contamination of the Tittabawassee River downstream of the Dow plant, a 22 mile stretch of active floodplain
- An aerosol plume that has deposited on surface soils downwind of the plant, principally to the north and northeast in the City of Midland

Floodplain contamination

Background soil concentrations in the Lower Peninsula of Michigan range from 0.4 – 35 ppt dioxins.

Published soil concentrations from lands surrounding the Tittabawassee River range from 4 to 1,980 parts per trillion dioxins.

Fish and game harvested from areas downstream of the Dow Chemical Company have statistically elevated mean dioxin concentrations in their tissues.



The communities

Today, an estimated 293,000 people live in Midland County and neighboring Saginaw County (2000 Census)

These communities (and others) use the Tittabawassee River floodplain region for:

- Housing
- Farming crops and cattle (more so in the past)
- Recreation, including hunting & fishing
- Soil for fill dirt, topsoil and gardens

The University of Michigan Dioxin Exposure Study

We undertook The University of Michigan Dioxin Exposure Study (UMDES) in response to concerns that the dioxin-like compound contamination from the Dow Chemical Company facilities in Midland, Michigan have lead to an increase in residents' body burdens of dioxins, furans and PCBs.

Our goals were to -

1. Determine whether residents experience increased exposure to the elevated dioxin-like compounds in the environment
2. Identify the pathways of increased exposure
3. Communicate our results to involved communities

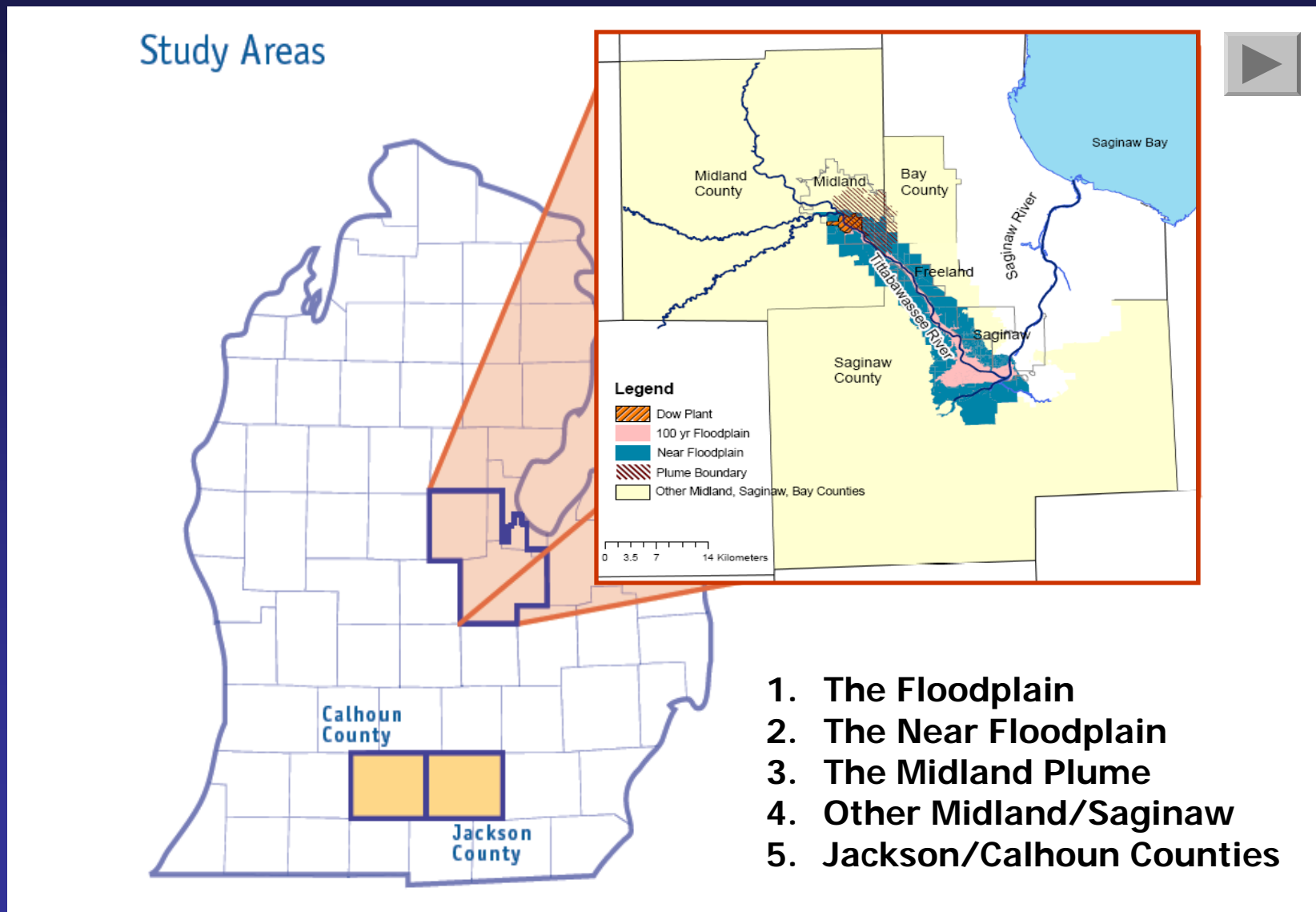
Study design

Our sample design was a stratified, multistage area probability sample of households and persons. Adults over the age of 18, who had lived in their current residence continuously for at least five years were eligible to participate.

Area of residence was further stratified into regions:

- The Floodplain of the Tittabawassee River
- The Near Floodplain
- The Midland Plume – downwind of the Dow plant
- Other Midland/Saginaw – not near the rivers or Dow
- For comparison, Jackson/Calhoun Counties

The five study populations



Study design

From each participant we gathered:

- A detailed, interviewer-administered questionnaire
- Whole blood sample
- Household dust sample (if the participant owned the property)
- Residential soil samples (if the participant owned the land)

Serum, household dust, and soil were analyzed for the 29 congeners recognized by the World Health Organization as having dioxin-like activity.

I will refer to the weighted summation of these 29 congeners as the 'total dioxins' or TEQ.

Results: Participant numbers

	Flood-plain	Near Flood-plain	Midland Plume	Other Midland/Saginaw	Jackson/Calhoun	Total
Interviews	326	264	71	304	359	1324
Blood Samples	251	197	48	199	251	946

Interviewing and sample collection took place in 2004 – 2005.

Demographics

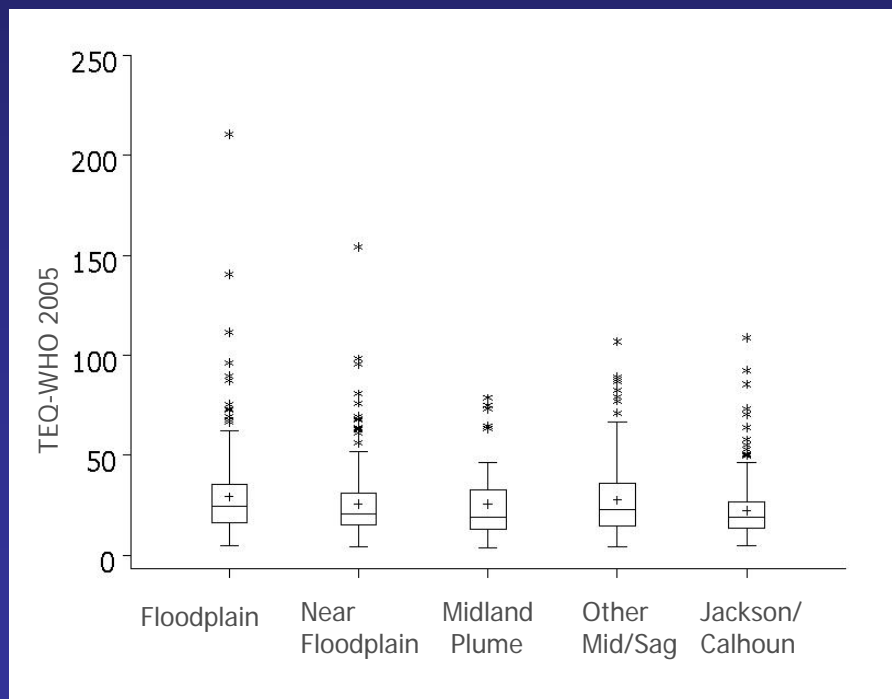
	Midland & Saginaw Counties				Jackson & Calhoun Counties
	Floodplain	Near Floodplain	Midland Plume	Other Midland/Saginaw	
<u>Mean (SE)</u>					
Age (years)	53.8 (1.1)*	50.9 (1.3)	50.9 (2.1)	52.6 (1.9)	49.9 (1.3)
BMI (kg/m ²)	27.8 (0.4)	27.6 (0.4)	29.6 (1.2)	29.1 (0.6)	28.7 (0.5)
Cigarette pack-years	12.6 (1.4)	8.2 (1.3)*	11.0 (3.4)	12.3 (1.6)	12.5 (1.4)
Years at Current Residence	18.9 (0.8)*	15.4 (0.8)	19.2 (2.7)	20.4 (1.5)*	15.9 (1.0)
<u>Frequency, %</u>					
White	100.0**	93.9	98.7	89.6*	95.2
Female	53.6	47.2*	77.4	51.1*	61.9
HS Graduate	91.5	94.5*	91.6	87.1	86.2

*Significantly different from the Jackson/Calhoun referent population, $p < 0.05$.

** Significantly different from the Jackson/Calhoun referent population, $p < 0.01$.

Median (& range) of serum TEQ for the five populations

	Midland & Saginaw Counties				Jackson/ Calhoun Counties
	Floodplain	Near Floodplain	Midland Plume	Other MS	
TEQ-WHO 1998	31.5** (5.3, 238)	29.0 (4.7, 210)	24.0 (6.9, 93.8)	28.0 (4.8, 129)	24.8 (5.2, 150)
TEQ-WHO 2005	23.3** (4.7, 211)	21.9 (4.2, 154)	18.7 (3.8, 75)	20.7 (4.1, 107)	18.5 (4.7, 109)



Median serum TEQ concentrations were similar across the populations, though statistically elevated in the Floodplain population.

Maximum serum TEQ concentrations were found in the Floodplain and Near Floodplain populations.

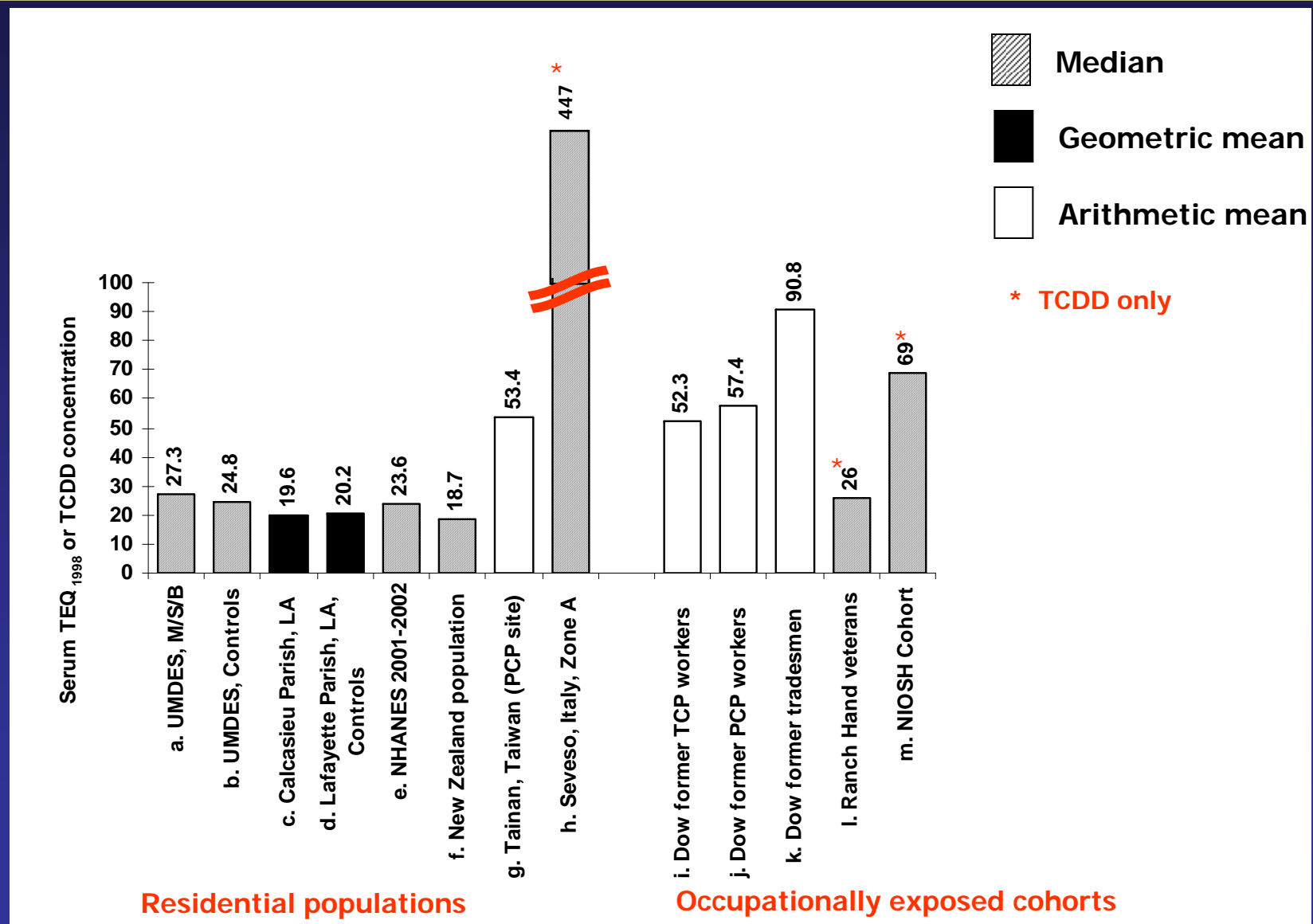
** Significantly different from the Jackson/Calhoun referent population, $p < 0.01$.

Serum TEQ distributions & comparison to US population

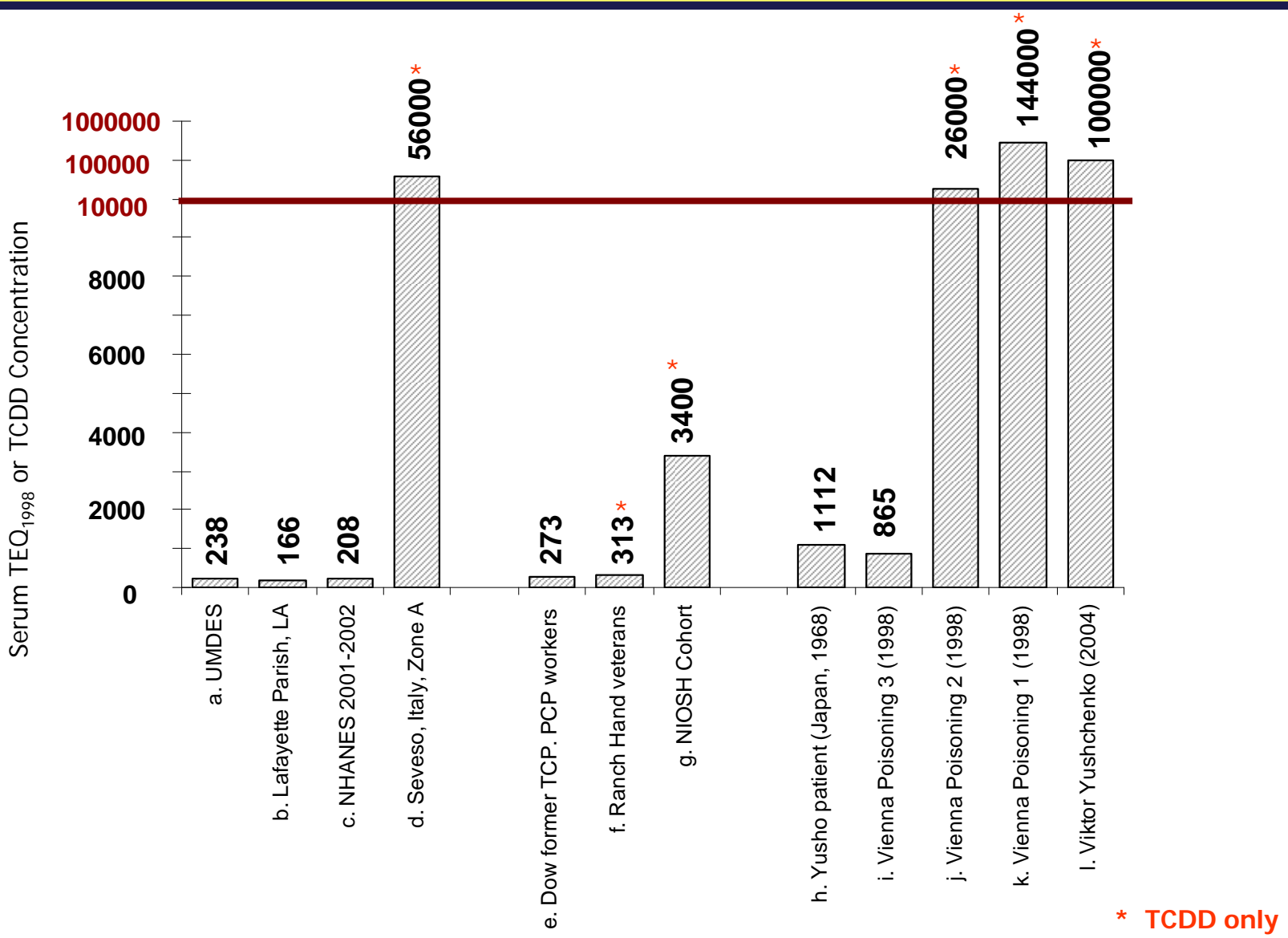
Population Studied	TEQ	N	Percentile Distribution of Serum TEQ, ppt					
			Min	25 th	50 th	75 th	95 th	Max
Midland & Saginaw Co	2005	695	3.8	13.8	20.7	32.3	62.9	211
Jackson & Calhoun Co	2005	251	4.7	12.4	18.5	25.3	46.5	109
Midland & Saginaw Co	1998	695	4.7	17.8	27.3	44.1	83.0	238
Jackson & Calhoun Co	1998	251	5.2	15.9	24.8	36.2	66.5	150
NHANES 2001-2002*	1998	1081	8.0	17.7	23.6	35.0	69.3	208

*Ferriby LL et al. 2007. JESEE 17:358-371.

Serum concentrations from notable populations



Maximum serum concentrations from notable populations



Conclusions

Our results indicate that

- The five populations are similar in age, race, gender
- The five populations have lived in their respective homes (and regions) for an extended length of time
- Median serum total dioxin concentrations vary by only 5 ppt across the regions, maximal levels vary by more than 130 ppt
- Median serum concentrations are still very similar to serum concentrations from recent studies of other US populations

Selected references

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Thank you

UMDES Scientific Advisory Board

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Midland and Saginaw Counties inset

