

The relationship between blood serum dioxin levels and breast feeding

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 - Regional Medical Labs

Funding

- This study was funded by The Dow Chemical Co. through an unrestricted grant to the University of Michigan.
- The University has complete independence to design, carry out, and report all aspects of the study.
- The investigators report to an independent Scientific Advisory Board (SAB)

Presentation Objective

- The objective of this study is to examine the relationship between serum dioxin levels and breast feeding:
 - Whether this relationship is different among women who live in the contaminated region versus those who live in the referent region.
 - How this relationship differs in different historic periods.

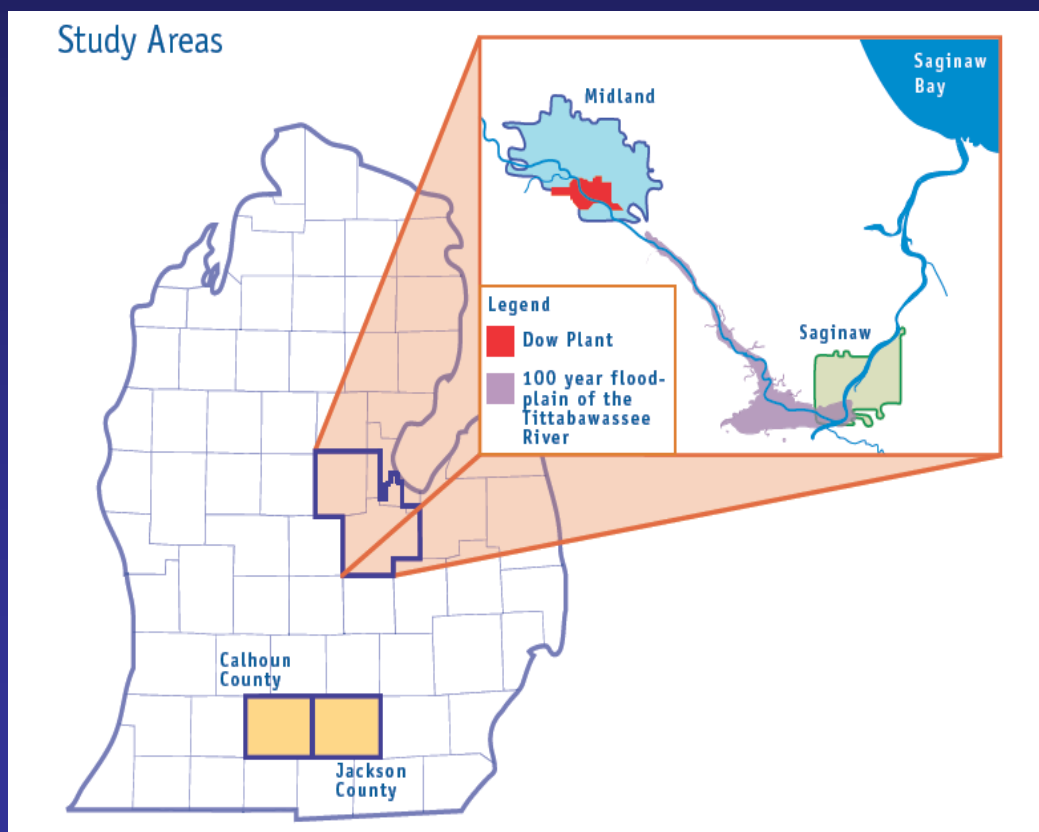
The University of Michigan Dioxin Exposure Study

- The UMDES was conducted in response to concerns that environmental contamination, largely from the Dow Chemical Company facilities located in Midland, Michigan, was leading to increased body burdens of dioxins.
- The goal of the study was to identify exposure pathways by which dioxin contamination in the environment contribute to dioxin concentrations in blood.



Study Design

- Eligible subjects were selected using a multi-stage probability sampling procedure from five populations in Michigan, USA.
 - Four populations from Midland and Saginaw counties and a control population from Jackson and Calhoun counties



Study Design

- Adults age 18 and over who had lived in their current residence for at least five years were eligible to participate.
- From each eligible participant we attempted to obtain:
 - An hour-long interview
 - Including questions regarding each pregnancy and its outcome, the number of children breast fed, duration of breast feeding, and dates of each event
 - Blood sample
 - Household dust sample
 - Soil sample



Study Design

	Floodplain	Near Floodplain	Midland Plume	Other Midland/Saginaw	Jackson/Calhoun	Total Across All Areas
Interviews	326	264	71	304	359	1324
Blood Samples	251	197	48	199	251	946
Household Dust Samples	207	159	37	163	198	764
Soil Samples	203	164	37	168	194	766
Interviews, blood dust and soil	195	156	35	162	183	731

Analytic Methods

- Serum, household dust, and soil samples were analyzed for the 29 congeners recognized by the World Health Organization as having dioxin-like activity
 - Samples that fell below the limit of detection were estimated using $LOD/\sqrt{2}$.
 - All serum results were lipid adjusted and survey weighted to reflect the entire referent population.
 - Multiple imputation procedures were used (five imputations) to impute missing values in explanatory variables.

Analytic Methods

- Breast feeding analyses were performed on the female participants in the UMDES for:
 - TEQ (calculated using the 2005 TEFs)
 - Five congeners providing the greatest contribution to the serum TEQ (2378-TCDD, 12378-PeCDD, 123678-HxCDD, 23478-PeCDF, and PCB126)
- Survey weighted stepwise linear regression was used to estimate the log₁₀ of the serum dioxin concentration in relation to age, BMI, smoking status, food consumption and recreational activities
 - $$\text{Log}_{10}(\text{blood}) = \alpha + \beta_1(\text{factor}_1) + \dots + \beta_n(\text{factor } n) + \text{error}$$
- Influence diagnostics were performed on each model to investigate the effects of potentially influential observations.

Results

532 women in the UMDES with blood samples



442 had at least one child



241 breast fed for at least one month.



Results: Breast feeding habits in M/S and J/C

Variable	Midland/Saginaw			Jackson/Calhoun		
	N	Duration of Breast Feeding (months)		N	Duration of Breast Feeding (months)	
		Mean (se)	Median		Mean (se)	Median
Total lifetime breast feeding	157	14.3 (4.33)	6	84	13.9 (2.83)	8
Duration of breast feeding, before 1959	31	5.56 (1.72)	4	19	6.53 (1.18)	6
Duration of breast feeding, 1960 to 1979	73	10.2 (2.55)	6	34	10.8 (5.75)	8
Duration of breast feeding, after 1980	78	14.6 (38.2)	6	45	14.7 (6.0)	8

- For all measures of breast feeding habits, the M/S and J/C populations were comparable.
 - For M/S women, the mean duration of lifetime breast feeding was 14.3 months compared to 13.9 months in J/C women.
 - Both M/S and J/C had right skewed distributions of the duration of breast feeding.

Results: Dioxin concentrations in serum samples by duration of breast feeding in M/S and J/C

Duration of Breast Feeding (months)	Midland/Saginaw		Jackson/Calhoun		p-value (t-test* of M/S vs. J/C)
	N	Mean (pg/g lipid)	N	Mean (pg/g lipid)	
TEQ					
0 months	216	30.3	75	20.3	0.0112
1-3 months	41	24.4	25	24.6	0.5122
4-6 months	37	35.3	11	37.9	0.5840
7-12 months	33	18.3	15	17.9	0.8628
>12 months	46	21.2	33	22.0	0.5756

* based on log10 mean concentrations adjusted for age, age2, and BMI; ** Gray – not significant at p < 0.05

Results: Relationship between lifetime breast feeding and serum dioxin concentrations in M/S and J/C

	Midland/Saginaw			Jackson/Calhoun		
	b (se) per month of breast feeding	p-value	6 month change (%)	b (se) per month of breast feeding	p-value	6 month change (%)
Duration of Breast Feeding (months)						
TEQ	-0.0034 (0.0006)	<0.001	-4.6	-0.0024 (0.0012)*	0.0630	-3.2
2378- TCDD	-0.0033 (0.0020)*	0.0969	-4.4	-0.0039 (0.0015)*	0.0177	-5.2
12378-PeCDD	-0.0034 (0.0004)	<0.001	-4.5	-0.0040 (0.0008)	<0.001	-5.4
123678-HxCDD	-0.0025 (0.0005)	<0.001	-3.4	-0.0036 (0.0009)	0.0006	-4.8
23478-PeCDF	-0.0020 (0.0005)	0.0002	-2.7	-0.0020 (0.0019)	0.3031	-2.8
PCB126	-0.0039 (0.0013)*	0.0042	-5.2	-0.0021 (0.0012)*	0.0931	-2.8

* Unstable model; ** Gray – not significant at $p < 0.05$

Results: Relationship between historic period of breast feeding and serum dioxin concentrations

	Midland/Saginaw			Jackson/Calhoun		
	b (se) per month of breast feeding	p-value	6 month change (%)	b (se) per month of breast feeding	p-value	6 month change (%)
Serum dioxin congener/Historic period of breast feeding						
TEQ						
Before 1959	0.0055 (0.0027)*	0.0452	7.9	0.0080 (0.0050)*	0.1319	18.2
1960-1979	-0.0047 (0.0008)	<0.001	-6.3	-0.0010 (0.0022)	0.6638	10.7
After 1980	-0.0032 (0.0007)	<0.001	-4.3	-0.0033 (0.0008)	0.0008	16.0

* Unstable model; ** Gray – not significant at $p < 0.05$

Conclusions

- In general, serum dioxin levels were inversely associated with the duration of breast feeding in both Midland/Saginaw and Jackson/Calhoun women.
- In Midland/Saginaw, the duration of total lifetime breast feeding was significantly associated with lower serum TEQ, 12378-PeCDD, 123678-HxCDD, and 23478-PeCDF concentrations and the results for Jackson/Calhoun were quite similar.

Conclusions

- The duration of breast feeding before 1959, when there were fewer dioxins in the environment, was not significantly associated with serum concentrations (except TCDD in M/S), while the duration of breast feeding from 1960-1979 and after 1980, when there were more dioxins in the environment, was significantly associated with serum concentrations for several congeners.
- Breast feeding does not always reduce serum dioxin concentrations. While you are breast feeding, it depends on whether you are replacing contaminated lipids with contaminated dietary lipids or clean dietary lipids.

Questions

