



LOGISTIC REGRESSION MODEL FOR PREDICTING HIGH SERUM 2,3,7,8-TCDD CONCENTRATIONS IN OR NEAR THE FLOOD PLAIN OF THE TITTABAWASSEE RIVER, MICHIGAN, USA

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INTRODUCTION & OBJECTIVES

- ❖ **Background:** There are concerns among the population of Midland and Saginaw Counties (Michigan, USA) that the discharge of dioxin-like compounds from the Dow Chemical Company facilities in Midland has resulted in contamination of soils in the Tittabawassee River flood plain and areas of the City of Midland, leading to an increase in residents' body burdens of PCDDs, PCDFs and PCBs.
- ❖ **Objective:** to identify factors associated with increased risk of having high serum 2,3,7,8-TCDD concentrations among the residents of the flood plain or near the flood plain of the Tittabawassee river, Michigan, USA.

DATA SOURCES

- ❖ In this study, a total of 447 residents in or near the flood plain who completed serum dioxin measurement were included.
- ❖ Blood serum, household dust, and soil were analyzed for 2,3,7,8-TCDD by Vista Analytical Laboratory, Inc.
- ❖ Other exposure information was obtained from the University of Michigan Dioxin Exposure Study (UMDES) questionnaire. The entire protocol can be found on our study website. www.umdioxin.org
- ❖ The **outcome of interest** is a binary variable of serum 2,3,7,8-TCDD concentration (**high versus normal**).

STATISTICAL METHODS

- ❖ **Definition of high serum TCDD:** A resident in the flood plain or near the flood plain was defined as having a high serum TCDD level if his serum TCDD level was higher than the 90th percentile of the serum TCDD concentration among the referent population residents of his age.
- ❖ **Logistic regression,** accounting for sampling design information, was employed to study the environmental factors associated with high serum 2,3,7,8-TCDD.
- ❖ Stepwise selection was used to identify important predictors, which were defined as having a p-value ≤ 0.1 .

RESULTS

Figure 1: Scatter plots of serum TCDD by age

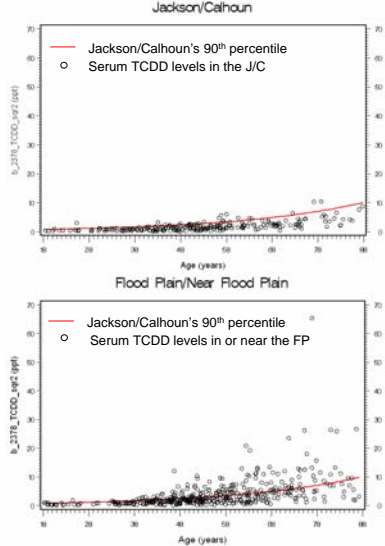


Table 1: Parameter estimates for logistic regression model of high serum TCDD levels

Variable	Odds Ratio	P-value
Intercept	0.12	0.06
House perimeter top 1" soil > 90th %ile of the referent population soil	0.90	0.79
Garden soil > 90th %ile of the referent population soil	1.74	0.25
House dust concentration > 90th %ile of referent population dust	0.85	0.69
Region (1=flood plain; 0=near flood plain)	1.01	0.96
Lived in Midland/Saginaw before 1980 (per 10 years)	1.63	0.00
Lived in Midland/Saginaw after 1980 (per 10 years)	0.43	0.02
Home ever flooded by Tittabawassee River	0.51	0.07
Body mass index (BMI)	1.05	0.05
BMI loss in the last 12 months	1.21	0.01
Sex (1=female; 0=male)	5.76	0.00
Breast feeding (per 10 months)	0.71	0.08
Smoking status (1=present smoker; 0=past smoker)	0.40	0.05
Pack-years smoking (per 10 pack-years)	0.75	0.02
Lived with Dow worker after 1980 (per year)	0.89	0.03
Worked at Dow after 1980 (per year)	1.15	0.01
Fishing in Saginaw River or Bay after 1980 (per 10 years)	1.03	0.01
Ate liver of game meat before 1980 (per 10 years)	0.67	0.06
Ate eggs before 1980 (per 10 years)	1.44	0.03
Ever ate skin of wild turkey, pheasant, grouse, quail or woodcock.	5.47	0.01
Lived on property in last 5 years with vegetable or flower garden (per year)	0.80	0.00
Ate vegetables/fruits at least once per week that were grown in the Tittabawassee river flood plain	2.44	0.03
Ever ate eggs, milk, or dairy raised in Tittabawassee River flood plain	2.55	0.09

- ❖ **Figure 1.** Upper Figure: scatterplot of serum TCDD and the predicted 90th percentile among the referent population by age. Lower Figure: scatterplot of serum TCDD among the flood plain/near flood plain subjects with the predicted 90th percentile among the referent population by age superimposed. This shows that many subjects in the flood plain/near flood plain were above the 90th percentile in the referent population especially at ages over 40.
- ❖ **Table 1 Logistic regression model (all results are adjusted for all other variables in the model).**
 - ❖ **Soil and dust:** Neither the high level TCDD concentrations in soil (greater than 90th percentile of the reference population soil) taken from the top 1" around the house perimeter, in garden soil (taken at 0-6" depth), nor in household dust was significantly associated with high serum TCDD.
 - ❖ **Region:** There was no effect of living in the flood plain versus near flood plain. Living in any area of Midland/Saginaw before 1980 was associated with increased risk of high serum TCDD, whereas living there after 1980 was associated with reduced risk.
 - ❖ **Demographics:** Higher BMI and loss of BMI in the past 12 months were associated with increased risk of high serum TCDD. Females had increased risk of high serum TCDD compared to males. Risk was reduced among current smokers and decreased additionally as pack years increased. Risk was reduced among subjects who lived with Dow workers any time after 1980, but was increased among those who worked at Dow after 1980.
 - ❖ **Fishing, hunting, and diet:** Eating eggs before 1980 and ever eating the skin of wildfowl were associated with increased risk of high serum TCDD, regardless of where these foods came from. Living on property with a flower or vegetable garden during the last 5 years was associated with reduced risk. Eating vegetables or fruits grown in the Tittabawassee River flood plain and fishing in the Saginaw River or Bay after 1980 were significantly associated with increased risk. No other foods from the contaminated area were significantly associated with increased risk.
- ❖ **Conclusions:** Serum TCDD levels in the flood plain/near flood plain subjects are elevated in comparison to the referent subjects. Among the flood plain/near flood plain population, the risk of having a high serum level is associated with the factors in the logistic regression model. Most interestingly, soil and household dust contamination were not clearly associated with increased risk. Living in Midland/Saginaw before 1980 and a number of other exposures prior to 1980 were associated with increased risk. This is consistent with the likely higher environmental contamination levels in that historic period. A number of dietary factors were associated with increased risk, regardless of when those foods were eaten. The results showing increased risk for fruits and vegetables from the contaminated area but not fish from the contaminated area are inconsistent with the linear regression models shown previously. Further analysis of this issue is in progress.

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