

Maternal Residential Proximity to Superfund Sites & Low Birth Weight in Offspring

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Background

In 2001, the Texas Legislature passed legislation establishing **the Texas Environmental Health Institute (TEHI)**. The **mission of TEHI** is “to examine ways to identify, treat, manage, prevent, and reduce health problems associated with environmental contamination.”

(Source: <http://www.dshs.state.tx.us/epitox/tehi.shtm>)

Objective of this Project

- The **objective of this project** was to examine whether maternal residential proximity to superfund sites is associated with low birth weight in offspring.
- Hazardous waste sites
 - Heavy metals
 - Polycyclic aromatic hydrocarbons (PAHs)
 - Solvents



Related Work (12 out of 28 articles published in ISI monitored journals)

- 1985 Goldman *et al.* *Hazardous Waste & Hazardous Materials*
- 1995 Goldberg *et al.* *Environmental Research*
- 1997 Berry M & Bove F. Birth weight reduction associated with residence near a hazardous waste landfill. *Environmental Health Perspectives*
- 1998 Dolk *et al.* *Lancet*
- 1999 Johnson *American Journal of Obstetrics and Gynecology*
- 2000 Vrijheid *Environmental Health Perspectives*
- 2001 Elliott *British Medical Journal*
- 2003 Baibergenova *et al.* *Environmental Health Perspectives*
- 2004 Morgan *et al.* *Archives of Environmental Health*
- 2006 Gilbreath S & Kass PH. Adverse birth outcomes associated with open dumpsites in Alaska native villages. *American Journal of Epidemiology*
- 2007 Mueller *et al.* *Environmental Health Perspectives*
- 2008 Stillerman *et al.* *Reproductive Sciences*

Research Procedure

- **Preparation of Databases**
 - Environmental databases; Case & Control Databases
- **Enhancement of GIS-EpiLink**
- **Linking Environmental & Health Outcome Data**
- **Exposure Assessment**
- **Epidemiological Analysis: Case-Control Study**
- **Analysis of Results**

Types and Sources of Environmental Data

- **Hazardous waste sites**
 - ATSDR HAZDAT database
 - Texas Commission on Environmental Quality
 - Record abstraction
- **TRI facilities**
 - U.S. Environmental Protection Agency

Available Variables of Hazardous Waste Sites

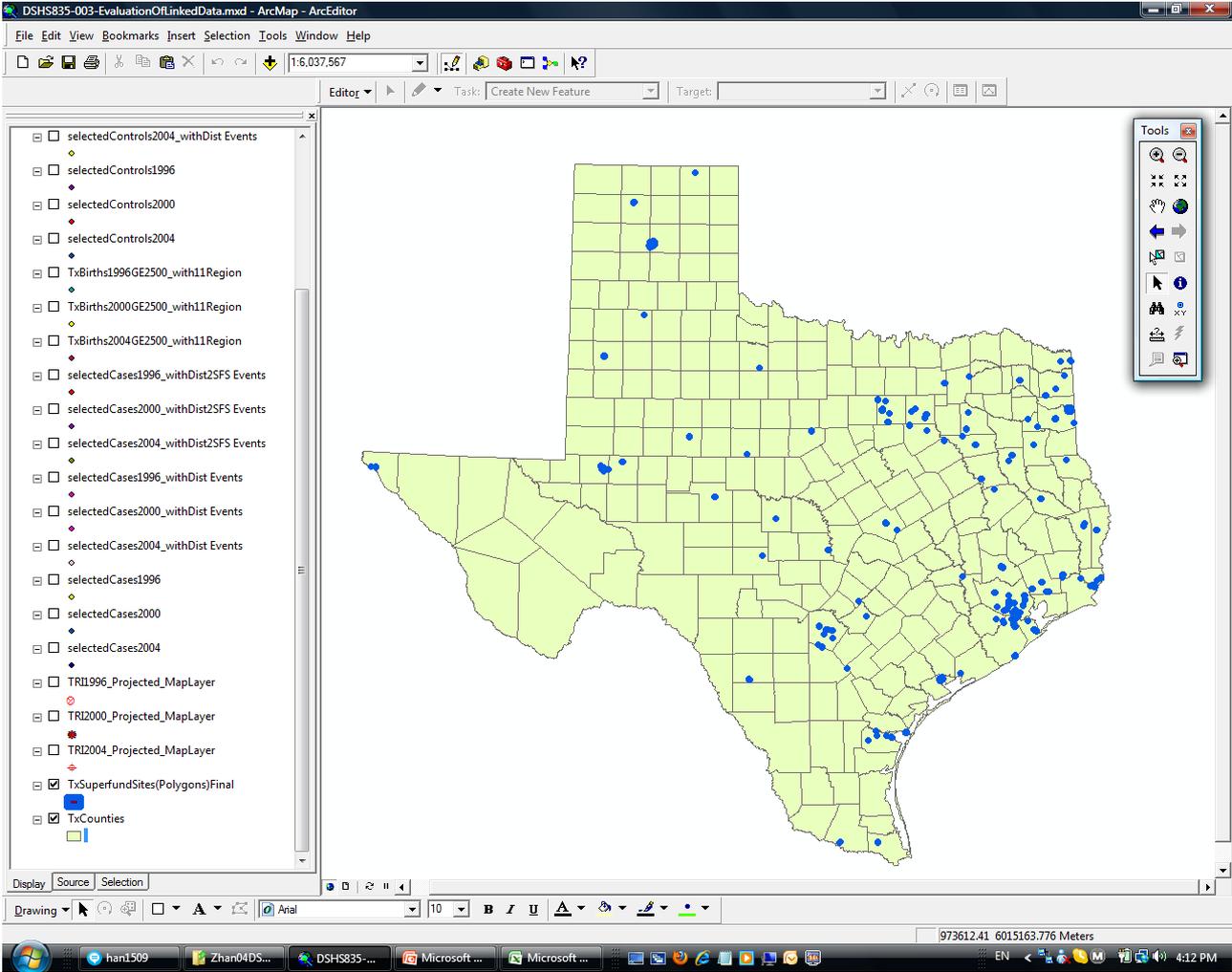
- **Type of site**
 - Federal/state
- **Geographic Location: Site Polygon Boundaries & Latitude and longitude**
- **Contaminants present**
- **Status**
 - Active/deleted

Available Variables of TRI Facilities

- **Facility name**
- **Location**
- **Year of report**
- **Industry**
 - Code (SIC)
- **Chemicals released**
 - Name
 - CAS number
 - Environmental media
 - focus on air emissions
 - Amount released in pounds

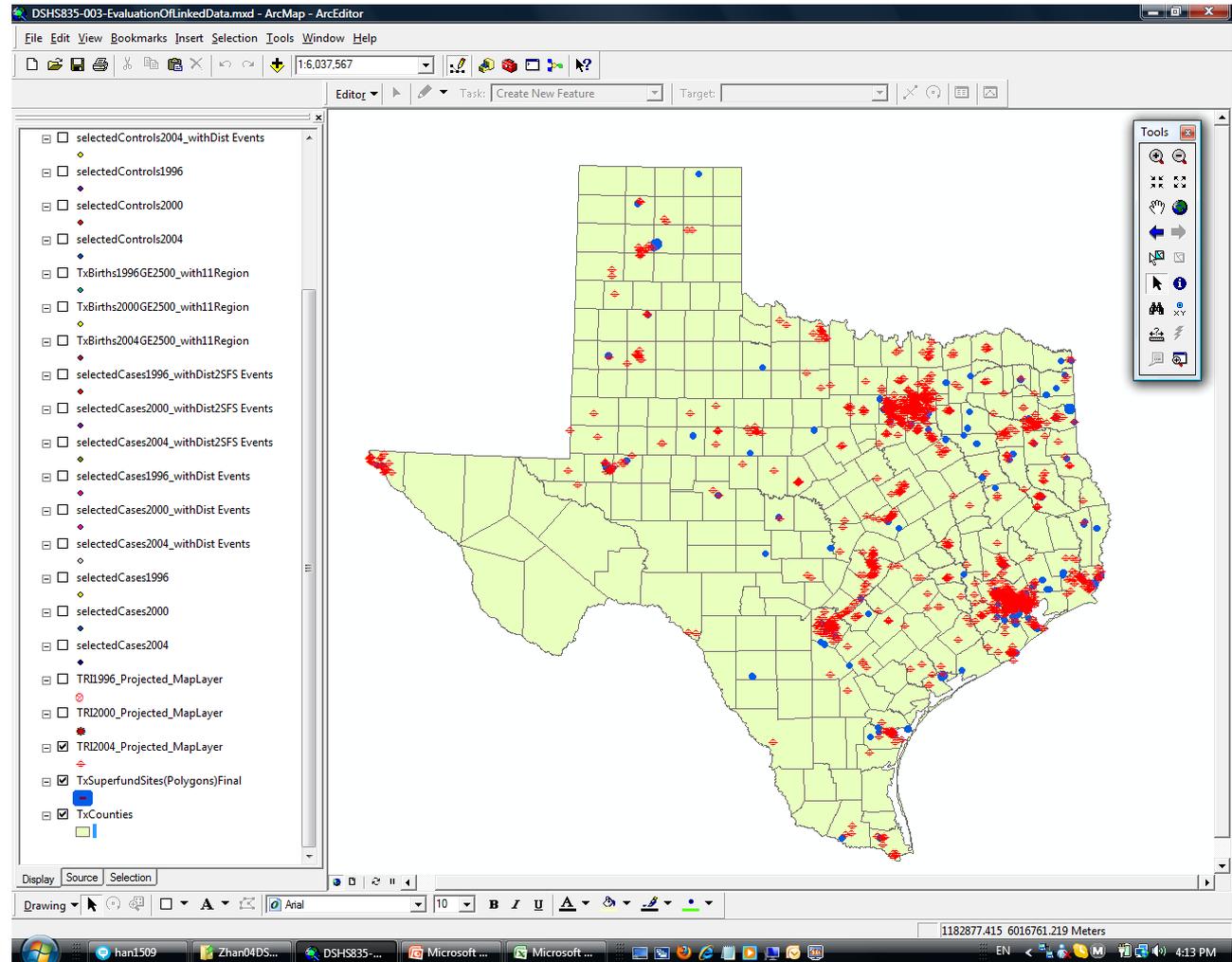
Distribution of Superfund Sites in Texas

The 145 waste sites in Texas (last updated in 2008)



Examples of Waste Sites and TRI Facilities

Environmental Data:
145 superfund sites &
the 1,316 geocoded
TRI facilities in 2004



Study Population

- **Source of data:** DSHS—Center for Health Statistics; Geocoded birth data from the Texas Birth Data Databases from 1996 to 2004 for the entire state of Texas
- **Case births:** Births with low weights (<2,500 grams)
- **Control births:** Births with normal weights ($\geq 2,500$ grams)
- **Selection of control births:** Control births were randomly selected with a ratio of one control per case; they were frequency-matched by year of birth and mother's residence at the time of delivery (Texas Public Health Regions)

Number of Cases & Controls Needed

Detectable Odds Ratio*	No. of Cases and Controls Needed	
	Cases (LBW)	Controls
1.5	3,437	3,437
1.4	5,111	5,111
1.3	8,626	8,626
1.2	18,377	18,377

(Note: *90% power, 5% significance level – two-sided, 3.33% control mothers living within 1 mile of waste site)

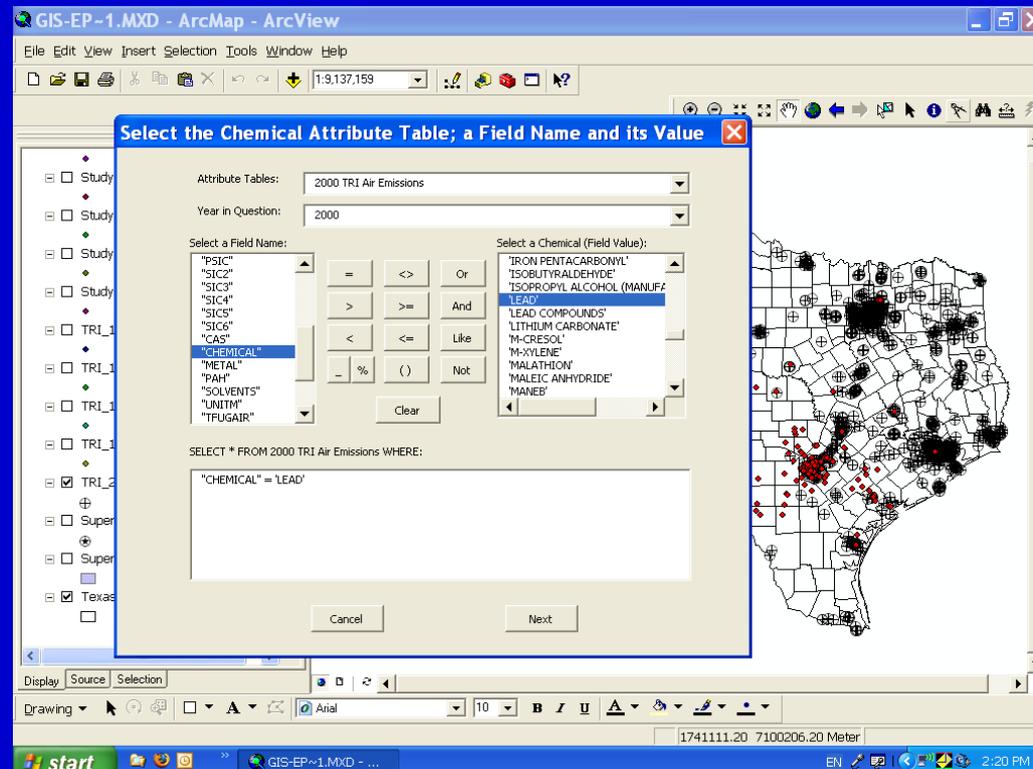
Number of Selected Cases & Controls by Year

Year	No. of Cases	No. of Controls
1996	477	477
1997	490	490
1998	518	518
1999	529	529
2000	550	550
2001	571	571
2002	599	599
2003	616	616
2004	654	654

(Note: Total no. of cases and controls across all years: 5,004 each)

GIS-EpiLink: A Spatial Search Tool for Linking Environmental and Health Data

(Zhan *et al.* 2006. *J. of Medical Systems*, 30(5): 405-412.)



Epidemiological Analysis

- **Case-Control Study**
- **Exposure Assessment:** Use distance from maternal residence at the time of delivery to a superfund site as proxy of exposure
- **Logistic Regression Analysis**
 - Odds ratios were adjusted for a number of variables including **maternal age, race/ethnicity, education, parity, multiple births,** and **proximity to TRI sites.**
 - Residential proximity is defined as a maternal residence **within one mile or closer** distances from active superfund sites.
 - **Referent (unexposed) group** were women who lived **one or more miles away** from superfund sites.

Characteristics of Low Birth Weight Births and Comparison Births (2500+ grams), Texas, 1996–2004 Singleton Births

Characteristic	Low birth weight births		Comparison births		p-value
	Number	%	Number	%	
Infant sex					
Male	1878	47.8	2532	51.2	0.001
Female	2052	52.2	2410	48.8	
Year of birth					
1996	374	9.5	473	9.6	0.999
1997	396	10.1	483	9.8	
1998	407	10.4	513	10.4	
1999	410	10.4	522	10.6	
2000	439	11.2	547	11.1	
2001	441	11.2	563	11.4	
2002	466	11.9	594	12.0	
2003	468	11.9	602	12.2	
2004	529	13.5	645	13.1	
Public Health Region					
1	160	4.1	195	3.9	0.998
2	82	2.1	103	2.1	
3	1083	27.6	1386	28.0	
4	135	3.4	161	3.3	
5	103	2.6	123	2.5	
6	972	24.7	1246	25.2	
7	371	9.4	478	9.7	
8	411	10.5	508	10.3	
9	110	2.8	128	2.6	
10	173	4.4	210	4.2	
11	330	8.4	404	8.2	

Characteristic	Low birth weight births		Comparison births		p-value
	Number	%	Number	%	
Maternal race/ethnicity					
Non-Hispanic white	1218	31.0	1922	38.9	< 0.001
African American	821	20.9	572	11.6	
Hispanic white	1734	44.1	2279	46.1	
Other	157	4.0	169	3.4	
Maternal age (years)¹					
< 20	824	21.0	736	14.9	< 0.001
20-24	1128	28.7	1353	27.4	
25-29	889	22.6	1365	27.6	
30-34	656	16.7	993	20.1	
35-39	338	8.6	410	8.3	
40+	92	2.3	85	1.7	
Maternal education² (years)					
0-8	404	10.6	471	9.7	< 0.001
9-11	1021	26.7	1113	22.9	
12	1303	34.0	1489	30.6	
13-15	596	15.6	817	16.8	
16 or more	504	13.2	974	20.0	
Parity³					
0	1847	48.8	1906	40.1	< 0.001
1	939	24.8	1494	31.5	
2	569	15.0	840	17.7	
3 or more	428	11.3	509	10.7	

(Note: ¹Information missing for 3 births; ²Information missing for 180 births; ³Information missing for 340 births)

Results: Maternal Residential Proximity to Waste Sites and Industrial Facilities and Low Birth Weight in Offspring, Texas, 1996 - 2004

Residential Characteristic	Low Birth Weight Births		Comparison Births		Unadjusted OR and 95% CI	Adjusted ¹ OR and 95% CI
	N	%	N	%		
All Public Health Regions Combined						
Within 1 mile of active waste site	121	3.1	153	3.1	0.99 (0.78, 1.3)	0.93 (0.72, 1.2) ²
1 or more miles from site	3809	96.9	4789	96.9	Referent	Referent
Within 1 mile of industrial facility	796	20.3	945	19.1	1.1 (0.97, 1.2)	0.99 (0.88, 1.1) ³
1 or more miles from facility	3134	79.7	3997	80.9	Referent	Referent
Within 1 mile of waste site and industrial facility	49	1.6	57	1.4	1.1 (0.75, 1.6)	0.85 (0.56, 1.3)
1 mile or more from waste and industrial sites	3062	98.4	3901	98.6	Referent	Referent
Public Health Region 6 Only						
Within 1 mile of waste site	50	5.1	61	4.9	1.1 (0.72, 1.5)	0.86 (0.57, 1.3) ²
1 or more miles from site	922	94.9	1185	95.1	Referent	Referent
Within 1 mile of industrial facility	250	25.7	276	22.2	1.2 (1.0, 1.5)	1.2 (0.98, 1.5) ³
1 or more miles from facility	722	74.3	970	77.8	Referent	Referent
Within 1 mile of both waste site and industrial facility	28	3.8	27	2.8	1.4 (0.81, 2.4)	1.1 (0.059, 1.9)
1 mile or more from both waste and industrial sites	700	96.2	936	97.2	Referent	Referent

(Note: ¹Adjusted for sex of birth and maternal race/ethnicity, age, education, and parity; ²Also adjusted for residential proximity to TRI facilities; ³Also adjusted for residential proximity to waste sites.)

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Conclusions & Discussions

- **Overall, this study did not find any compelling evidence that a maternal residence near hazardous waste sites at delivery was associated with low birth weight in offspring.**
- **Limitations**
 - All low weight births were included without respect to being preterm or having congenital malformations.
 - The study did not control for smoking, an important risk factor for low birth weight births (Bada *et al.*, 2005; Magee *et al.*, 2004).
 - Maternal residences were restricted to only those at delivery.
 - Residential proximity to the waste sites cannot be equated with (exact) exposure.

Acknowledgments

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