Proximate demolition activity and elevated blood lead in Detroit, 2014-2016

Abstract
Blight demolition has clear public health benefits, including improving mental health, reducing crime, and improving socioeconomic circumstances. Detroit's blight removal program is the world's largest and follows the strictest published protocols to mitigate lead release. However, demolition may still have some potentially negative consequences, such as the release of lead into the environment. Nearly 9% of children tested were found to have elevated blood lead in Detroit in 2015, although that number has decreased from 19% in 2009. We sought to understand the influence of demolition activity on lead exposure in children under 6 between 2014 and 2016 in Detroit. We conducted a retrospective analysis of 50,094 unique children to understand the influence of demolition activity on the likelihood of a positive test adjusting for individual and neighborhood factors. We found that living within 400 feet of a demolition increased the odds of elevation 20%. The odds increased 38% if there were two or more demolitions. Significance of this relationship was limited to summer months. Sensitivity analyses showed a dose-response relation between proximity in time and space to demolition and risk of elevated blood lead. On a population level, about 2.4% of cases of elevated blood lead levels in Detroit may be attributable to demolitions. Our findings suggest that further protections are necessary to mitigate the potential harm for high-volume demolition.

Introduction

The charge of public health is to produce the maximal health benefit for the greatest number, equitably across society. In that respect, any potentially positive health consequences of a given project or policy must be weighed against potential hazards.

Childhood lead exposure is a serious challenge in Detroit where 7.5% of children under 6 and 9% of children aged one and two years old were exposed in 2015. [1] This is largely due to exposure in homes laden with lead-based paints, which were not outlawed until 1978. Over 90% of Detroit homes were built before 1978. Nevertheless, childhood lead exposure declined over 50% between 2009 and 2015. [2] While the causes of this decline are not known, they are likely the byproduct of improved knowledge

[1] Maqsood J, Stanbury M, Miller R. 2015 Data Report on Childhood Lead Testing and Elevated Blood Lead Levels: Michigan. Michigan Department of Health and Human Services. February 2017.
[2] El-Sayed A, Hill A, Haroon H. Lead Report 2016. Detroit Health Department. April 2016.

about the causes of lead exposure among parents, abatement of homes where children are exposed, and the removal of blighted homes.

In 2014, the City's Blight reduction task force identified over 40,000 blighted homes, with an additional 39,000 at risk for becoming blighted. Blighted homes present a substantial public health burden. Directly, they are a nidus for criminal activity—including violent crime and drug abuse—stray dogs, and injuries for children who wander onto the premises. Indirectly, they depress surrounding housing prices, reinforcing the cycle of poverty that drives poor health in urban areas like Detroit.

The City of Detroit is demolishing blighted homes at an unprecedented rate. Between May 2014 and December 2016, over 10,000 structures were demolished. Given the potential for lead release into the environment during demolition, [3,4] and the potential for elevated blood lead levels among children exposed to demolitions,[5] there is concern about how best to mitigate the potentially hazardous consequences of demolition when it occurs at such a rapid pace. Officials at the Detroit Building Authority have innovated in their approach to lead suppression in response, using a 'wet-wet-wet' protocol, which involves flooding the home prior to demolition, wetting the home throughout demolition, and using a water canon at the point of the loading of debris.

Nevertheless, considering the unprecedented scale of demolitions in Detroit, the potentiality of a relation between demolition activity and lead exposure remains. Three years into the demolition program, the Detroit Health Department assessed the relation between demolition activity and the risk of childhood lead exposure in children under 6 years old.

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[3] Farfel MI, Orlava AO, Lees PS, Rohde C, Ashley PJ, Chisolm JJ. A study of urban housing demolitions as sources of lead in ambient dust: demolition practices and exterior dust fall. Environ Health Perspect. 2003;111(9):1228-34.
[4] Jacobs DE, Cali S, Welch A, et al. Lead and other heavy metals in dust fall from single-family housing demolition. Public Health Rep. 2013;128(6):454-62.
[5] Rabito FA, Iqbal S, Shorter CF, et al. The association between demolition activity and children's blood lead levels. Environ Res. 2007;103(3):345-51.

Methods

A retrospective cohort study examined the relationship between exposure to home demolitions and subsequent elevated blood lead level (EBLL) by combining lead test data from the Michigan Department of Health and Human Services (MDHHS) with publically available data. Using data from Detroit's Open Data Portal,[6] we established a count of home demolitions conducted within a 400-foot radius of the address of a child who received a blood lead test between 2014 and 2016, and no more than 45 days before the blood lead test occurred. The 400-foot radius accounts for the estimated dispersion zone for lead dust from a demolition employing dust suppression techniques (e.g. wetting),[7] and the 45-day period accounts for the half-life of lead in the blood.[8] The demolition variable was first categorized into two levels of exposure: one demolition and two or more demolitions. To retain power in sub-analyses, we also created a dichotomous exposure variable (any demolitions/no demolitions).

EBLL status was determined using Michigan Department of Health and Human Services data from all reported blood lead tests for children six years old and younger in Detroit, tested between January 1, 2014 and December 31, 2016. The original dataset included 74,309 geocoded observations representing 50,094 unique Detroit residents from birth to age six. For children who received multiple tests in the past three years, only the most recent test was used for analysis. The children were grouped into three categories based on lead test results: low blood lead levels (1 µg/dL – 4 µg/dL), moderately elevated blood lead levels (5 µg/dL – 10 µg/dL), and severely elevated blood lead levels (10 µg/dL or higher).

Proportional odds ordered logistic regression models were used to examine the relationship between the intensity of demolition activity and subsequent blood lead levels in nearby children.

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[6] City of Detroit. Detroit Open Data Portal. Accessed 02/02/2017. https://data.detroitmi.gov/.
[7] Rabinowitz MB, Wetherill GW, Kopple JD. Kinetic analysis of lead metabolism in healthy humans. J Clin Invest. 1976;58(2):260-70.
[8] Jacobs DE, Cali S, Welch A, et al. Lead and other heavy metals in dust fall from single-family housing demolition. Public Health Rep. 2013;128(6):454-62.

Potential models were compared to minimize confounding and maximize fit, power, relevance and interpretability. The final model adjusts for potential confounding by age, sex, proximity to other vacant structures, season, and neighborhood social vulnerability. Age at the time of lead testing, calculated using the child's birthday and the test date, was coded into three categories to account for the fact that the risk to EBL by age is not linear, but rather changes over development stages, such as crawling beginning and ending. A binary variable for child's sex, from MDHHS lead test data, was also included. The model attempts to account for the likelihood that children living near demolitions also live near other vacant structures that contribute to EBL risk. We also included a binary control variable for season (May to September versus October to April), because both demolition density and blood lead levels are higher in the summer. Finally, we attempted to control for neighborhood socioeconomic status by including the CDC's Social Vulnerability Index (SVI), which is produced using 15 census variables capturing various socioeconomic indicators. All models were fit using the R package "ordinal."[9]

Sub-analyses were performed to assess dose-response by proximity in space and time, and varying effects by year and season. We conducted two sensitivity analyses to assess whether the relationship between exposure to demolitions and EBLL follows an anticipated dose-response pattern, strengthening at closer distance and in shorter time frames. To explore potential differences by length of time between exposure to demolitions and subsequent blood lead test, we created a set of models that specified whether or not any demolitions occurred in the following time periods: during the 15-day pre-test period, between 15 and 30 days pre-test, between 30 and 45 days pre-test, and between 45 and 60 days pre-test. The use of time intervals allow us to isolate the influence of additional demolitions further in time from the child's lead test. A similar approach was used for distance, starting with a 200-

[9] Christensen, R. H. B. (2015). ordinal - Regression Models for Ordinal Data. R package version 2015.6-28. http://www.cran.r-project.org/package=ordinal/

foot buffer and adding increasingly distant rings in 200-foot intervals to a maximum distance of 1000 feet from the child's residence.

Using the original 400-foot buffer and 45-day time frame, we also considered attributable risk proportions among exposed children and among all children included in the analysis. We then explored two potential interactive factors: year and season. Interaction by year was anticipated due to the increased rigor of dust suppression protocols introduced in 2015. To assess potential interaction by year, we compared interaction models to models without interaction terms, using likelihood ratio tests to assess whether interaction terms improved model fit. After testing for interaction, we re-ran the regression stratified by year. We also examined whether the relationship between exposure to demolitions and EBLL differs in the summer, when children are home from school and likely to play outside. Demolition activity and blood lead levels also tend to be greater in the summer. We again fit and compared interaction models to models without interaction terms, and then fit models stratified by season.

Results

Descriptive analyses reveal that about half of children tested for lead in Detroit are tested during the months between May and September, and that children under one year old and older than four years old are less likely to be tested than children between ages one and four (Table 1). The children included in this study live in disproportionately vulnerable neighborhoods as compared to their national peers, with 83.2% residing in a census tract that is deemed by the CDC to be in the most vulnerable quartile (Table 1). In addition to living in vulnerable neighborhoods, the children in our sample are highly exposed to vacant structures that can serve as sources of lead exposure and other dangers. About a third of the children in our sample live within 200 feet of five or more vacant structures (Figure 1).

Nearly 6% of children in our sample were exposed to at least one demolition within 400 feet of their residence in the 45 days before they received a blood lead test, as compared to about 2% within 200 feet and about 20% within 1,000 feet (Table 2). About 7% of the children in our sample have blood lead levels at or above 5 µg/dL (Table 3).

Table 4 describes five increasingly adjusted ordinal logistic regression models quantifying the relationship between exposure to demolitions within 400 feet of a child's home and the results of a blood lead test taken within the subsequent 45 days. The final model, adjusted for age, sex, neighborhood social vulnerability, season, and vacancy, suggests that a child exposed to one demolition within 400 feet of his or her house, as compared to an unexposed child, has 20% higher odds of moving from low blood lead to moderately elevated blood lead (95% CI for OR: 1.03 – 1.40), or from moderate EBL to severe EBL. A child exposed to two or more demolitions appears to have 38% higher odds of moving from low blood lead levels to moderate EBL or from moderate EBL to severe EBL, as compared to an unexposed child (95% CI for OR: 1.07 – 1.74). This discrepancy is evidenced in the higher relative prevalence of EBL among children exposed to demolitions as compared to unexposed children (Table 5). The discrepancy between exposed and unexposed children accounts for a population attributable risk fraction of 2.39% (95% CI 1.47% - 3.30%).

The results of the sensitivity analyses (Tables 6 and 7) suggest a dose-response relationship between demolitions and EBL, with strength increasing with proximity in both space and time. After accounting for the first 15 days between demolition and test, point estimates remain elevated but insignificant for two subsequent 15-day time intervals. After 45 days, there is no longer an association between demolition activity and EBLL. Similarly, children exposed to demolitions in a 200-foot buffer around their residence, and within an additional 200-foot ring extending out to 400 feet have higher odds of EBL as compared to unexposed children. A relationship between demolition exposure and odds of EBL is not evident for children who live more than 400 feet from a demolition site.

Interaction analyses (Tables 8 and 9) reveal significant interaction by season and by year. During the months between May and September, the odds ratio for EBL among children exposed to one demolition versus unexposed children increases from 1.20 (95% CI: 1.03 – 1.40) in the all-years model to 1.35 (95% CI: 1.13 – 1.61) in the summer-only model. The odd ratio for moving into a more severe EBL category when exposed to two or more demolitions, compared to no demolitions, increases in the summer from the all-year estimate of 1.38 (95% CI: 1.07 – 1.74) to the summer-only estimate of 1.59 (95% CI: 1.20 – 2.07). Between October and April, our ordinal logistic regression model detects no association.

Results of ordinal logistic regression models stratified by year (Table 9) suggest an abatement of the association in 2015, with an odds ratio of 1.05 (95% CI 0.74 – 1.44) for exposure to one demolition as compared to none. The odds of EBL following exposure to a single demolition appears lower in 2016 (OR 1.19, 95% CI: 0.97 – 1.45) as compared to 2014 (OR 1.49, 95% CI 1.05 – 2.07), but exposure to multiple demolitions appears to increase odds of EBL more in 2016 than in any of the previous years (OR 1.73, 95% CI: 1.23 – 2.38).

Discussion

Our retrospective observational analysis of 50,094 unique observations over 3 years of EBL tests in Detroit demonstrated a significant association between demolition activity within 400 feet of a child's home and likelihood of elevated blood lead in a subsequent blood lead test. Our analysis suggests a dose-response relation, demonstrating that the risk of elevations decrease with distance in time and space. In addition, our findings showed no association during winter months. The population attributable risk fraction reveals that less than 3% of all cases of EBL in Detroit are attributable to demolitions. Taken together, our findings suggest that demolition activity may increase risk of EBL during the summer months when children are most likely to be exposed to environmental lead release from demolition activity. However, demolition activity does not appear to be a major driver of EBL among children in Detroit on a population level.

Our findings are subject to a number of critical limitations. Our findings are retrospective and observational. While we adjusted for several important confounders and conducted sensitivity analyses stratified across third variables, there remains the potential for confounding given that children most likely to be exposed to demolition activity are also most likely to be exposed to lead in their homes and neighborhoods. Further, we were unable to assess the mechanism of action connecting demolition activity and EBL. While it is clear that demolition activity can release lead into the environment, the form in which lead is most likely to reach children is not.

Our findings suggest that additional protections are needed to limit the potential health consequences of demolition activity. A task force to identify opportunities for further improvement and implementation is recommended. Further, more research is needed to understand the mechanisms by which lead may be released and children may be exposed. This research should be prospective, identifying lead release into air, water, and soil resulting from demolition activity. Finally, these findings must be balanced against the clear public health benefits of demolition activities. While taking precautions to limit and mitigate the potential negative consequences of demolition activities is necessary and prudent, this must be weighed against the long-term benefits of blight demolition for mental health, crime, and lead elimination. Toward that end, more research is also needed to understand the long-term health consequences of demolition activity in Detroit.

Table 1. Descriptive statistics from Detroit children 6 years and younger who received a blood test for lead between 2014 and 2016 (n=50,094)

Child-Level Measurement	Percent of children (n)
Age at last birthday	
Less than 1 year old	6.5% (3232)
1 year old	20.9% (10493)
2 years old	15.5% (7745)
3 years old	15.5% (7758)
4 years old	22.2% (10601)
5 years old	12.5% (6242)
6 years old	8.0% (4023)
Sex	
Female	48.8% (24457)
Male	50.7% (25404)
Unknown or Other	0.5% (233)
Season of Test	
May – September	49.2% (24631)
All Other Months	50.8% (25463)
Census Tract Social Vulnerability Index	
0 – 25	0.2% (120)
25 – 50	2.8% (1379)
50 – 75	13.8% (6914)
75 – 100	83.2% (41586)

Demo

Figure 1. Vacant houses within 200ft of residence among children 6 years and younger tested for lead in Detroit, 2014-2016

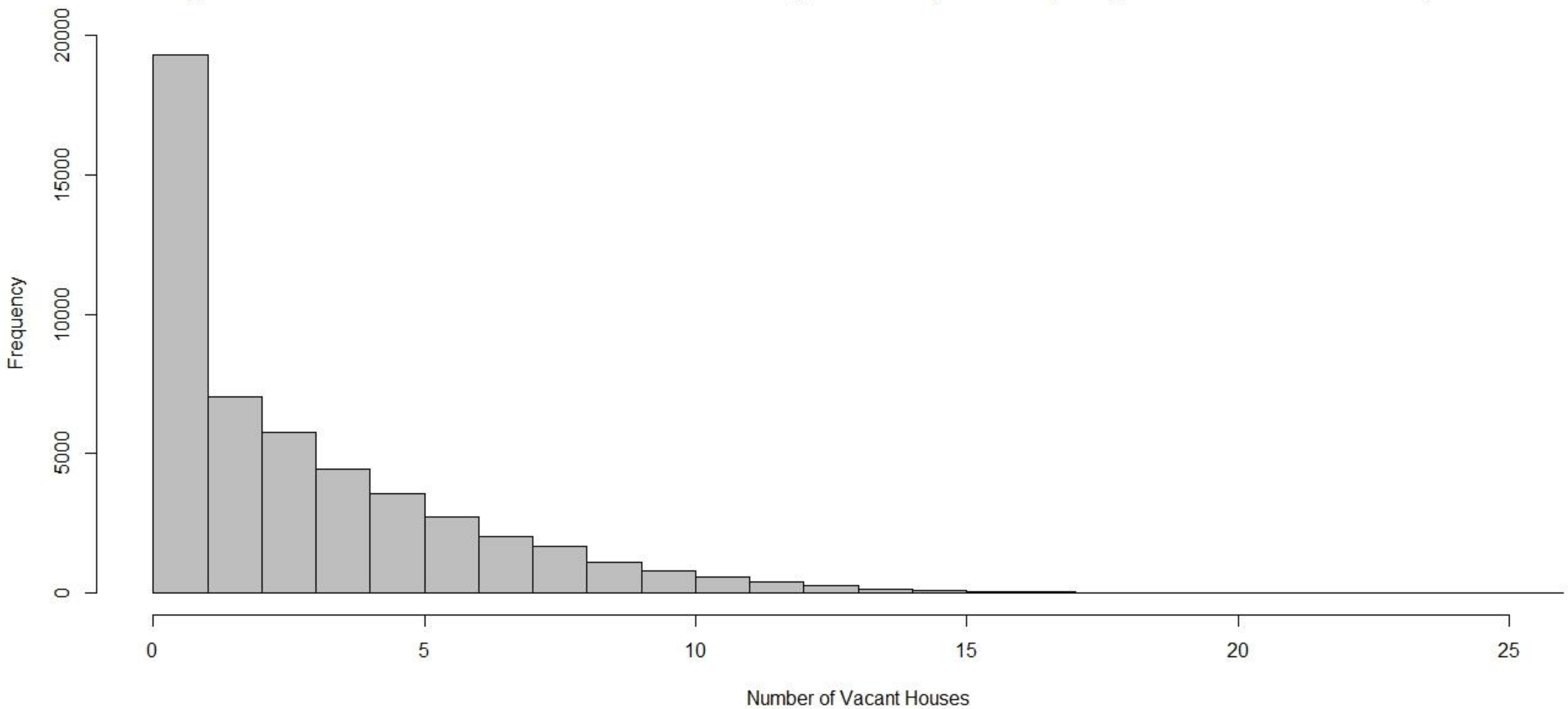

Table 2. Intensity of demolitions within 200ft or 400ft of a child's residence and within 45 days of that child receiving a blood lead test, among Detroit children six years old and younger who received a blood lead test between 2014 and 2016 (n=50,094)

Number of demolitions, 45 days before lead test	**400 feet from residence**	**200 feet from residence**	**1,000 feet from residence**
	Percent of children (n)		
0 Demolitions	94.3% (47227)	98.1% (49167)	79.6% (39874)
1 Demolition	4.3% (2164)	1.6% (799)	11.5% (5749)
2 or More Demolitions	1.4% (703)	0.3% (128)	8.9% (4471)
Range of demolition exposure (count in buffer zone, 45 days pre-test)	0 – 14	0 – 5	0 – 62

Table 3. Distribution and summary statistics of blood lead level (BLL) results from children six years old and younger in Detroit, 2014-2016 (n=50,094)

BLL Range	Percent of children (n)
0 – 5 µg/dL	93.2% (46664)
5 – 10 µg/dL	5.6% (2812)
10 µg/dL or higher	1.2% (618)

Blood Lead Levels (BLL) Summary Statistics	Amount of lead in micrograms per deciliter
Range of BLL	1 µg/dL – 47 µg/dL
Geometric Mean BLL	1.72 µg/dL

Table 4. Unadjusted and increasingly adjusted ordered logistic regression models examining the relationship between blood lead levels (low, moderate, and severe) and exposure to demolitions (none, one, two or more) within a 400 foot radius in the 45 days before testing, among all tested Detroit children 6 years old and younger, 2014-2016

	Odds Ratios(95% CI) for Categorical Blood Lead Level (Low, Moderate, Severe)				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Demolition Activity					
1 Demolition	1.40***	1.42***	1.37***	1.31***	1.20**
	(1.20, 1.62)	(1.21, 1.64)	(1.17, 1.58)	(1.12, 1.52)	(1.03, 1.40)
2 or More Demolitions	1.71***	1.76***	1.70***	1.61***	1.38***
	(1.34, 2.16)	(1.37, 2.22)	(1.32, 2.14)	(1.26, 2.03)	(1.07, 1.74)
Covariates					
Age 1-2		2.71***	2.70***	2.69***	2.69***
		(2.23, 3.32)	(2.22, 3.31)	(2.22, 3.30)	(2.22, 3.30)
Age 3-6		1.87***	1.85***	1.81***	1.79***
		(1.55, 2.30)	(1.53, 2.27)	(1.50, 2.22)	(1.47, 2.19)
Male Sex		1.21***	1.21***	1.21***	1.22***
		(1.13, 1.30)	(1.13, 1.30)	(1.13, 1.30)	(1.14, 1.31)
Census Tract SVI			1.02***	1.02***	1.01***
			(1.01, 1.02)	(1.01, 1.02)	(1.01, 1.02)
May to September				1.30***	1.31***
				(1.21, 1.39)	(1.22, 1.40)
Vacancy within 200ft					1.07***
					(1.06, 1.08)
N	50094	49861	49766	49766	49766
Log Likelihood	-14115.84	-13954.98	-13898.97	-13872.34	-13792.06

***p < .01; **p < .05; *p < .1

Table 5. Prevalence and attributable fraction among the exposed and among the population of children included in analysis for elevated blood lead levels (at or above 5 µg/dL) by exposure to demolitions within 400ft of residence in the 45 days before receiving a blood lead test among children 6 years old and younger who received a blood lead test in Detroit between 2014 and 2016 (n=50,094)

Prevalence of EBLL	Per 100 Children
Exposed	9.56
Unexposed	6.69
All	6.86
Attributable Fraction	**Per 100 Children (95% CI)**
Exposed	29.97 (21.23, 37.73)
Population	2.39 (1.47, 3.30)

Table 6. Adjusted ordinal logistic regression models considering the potential dose-response relationship between exposure to nearby demolition activity (400ft radius) and blood lead levels (low, moderate, severe) within mutually exclusive 15-day time intervals from 0 to 60 days

	Odds Ratios(95% CI) for Categorical Blood Lead Level (Low, Moderate, Severe)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Demolitions				
Any Demolitions 15 Days Pre-Test	1.34*** (1.08, 1.64)	1.35*** (1.09, 1.65)	1.35*** (1.09, 1.66)	1.35*** (1.09, 1.66)
Any Demolitions 15-30 Days Pre-Test		1.18 (0.94, 1.47)	1.18 (0.94, 1.47)	1.18 (0.94, 1.47)
Any Demolitions 30-45 Days Pre-Test			1.19 (0.94, 1.49)	1.19 (0.94, 1.49)
Any Demolitions 45-60 Days Pre-Test				1.00 (0.77, 1.27)
Covariates				
Age 1 – 2 Years	2.69*** (2.22, 3.30)	2.69*** (2.22, 3.31)	2.69*** (2.22, 3.30)	2.69*** (2.22, 3.30)
Age 3 – 6 Years	1.79*** (1.48, 2.20)	1.79*** (1.48, 2.20)	1.79*** (1.48, 2.20)	1.79*** (1.48, 2.20)
Male Sex	1.22*** (1.13, 1.30)	1.22*** (1.13, 1.31)	1.22*** (1.13, 1.31)	1.22*** (1.13, 1.31)
Census Tract SVI	1.01*** (1.01, 1.02)	1.01*** (1.01, 1.02)	1.01*** (1.01, 1.02)	1.01*** (1.01, 1.02)
May-September	1.31*** (1.23, 1.41)	1.31*** (1.22, 1.41)	1.31*** (1.22, 1.40)	1.31*** (1.22, 1.40)
Vacancy in 200ft Radius	1.07*** (1.06, 1.08)	1.07*** (1.06, 1.08)	1.07*** (1.06, 1.08)	1.07*** (1.06, 1.08)
N	49766	49766	49766	49766
Log Likelihood	-13794.10	-13793.11	-13792.03	-13792.03

***p < .01; **p < .05; *p < .1

Table 7. Adjusted ordinal logistic regression models considering the potential dose-response relationship between exposure to nearby demolition activity and blood lead levels (low, moderate, severe) within 45 days, with dichotomous exposure in 200ft concentric rings from 0ft to 1000ft in Detroit, 2014-2016

	Odds Ratios(95% CI) for Categorical Blood Lead Level (Low, Moderate, Severe)				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Demolitions					
Any Demolitions 200ft Buffer	1.30** (1.05, 1.61)	1.32** (1.06, 1.63)	1.32** (1.06, 1.63)	1.31** (1.05, 1.62)	1.32** (1.05, 1.62)
Any Demolitions 200ft – 400ft Ring		1.21** (1.03, 1.42)	1.21** (1.03, 1.42)	1.20** (1.02, 1.41)	1.21** (1.02, 1.41)
Any Demolitions 400ft – 600ft Ring			1.03 (0.88, 1.21)	1.03 (0.87, 1.20)	1.03 (0.88, 1.20)
Any Demolitions 600ft – 800ft Ring				0.87 (0.74, 1.03)	0.88 (0.74, 1.04)
Any Demolitions 800ft – 1000ft Ring					1.06 (0.90, 1.23)
Covariates					
Age 1 – 2 Years	2.69*** (2.22, 3.30)	2.69*** (2.22, 3.30)	2.69*** (2.22, 3.30)	2.69*** (2.22, 3.30)	2.69*** (2.22, 3.30)
Age 3 – 6 Years	1.79*** (1.48, 2.20)	1.79*** (1.48, 2.19)	1.79*** (1.47, 2.19)	1.79*** (1.48, 2.20)	1.79*** (1.48, 2.19)
Male Sex	1.22*** (1.13, 1.31)	1.22*** (1.14, 1.31)	1.22*** (1.14, 1.31)	1.22*** (1.14, 1.31)	1.22*** (1.14, 1.31)
Neighborhood SVI Rank	1.01*** (1.01, 1.02)	1.01*** (1.01, 1.02)	1.01*** (1.01, 1.02)	1.01*** (1.01, 1.02)	1.01*** (1.01, 1.02)
May-September	1.32*** (1.23, 1.41)	1.31*** (1.22, 1.40)	1.31*** (1.22, 1.40)	1.31*** (1.22, 1.41)	1.31*** (1.22, 1.41)
Vacancy in 200ft Buffer	1.07*** (1.06, 1.08)	1.07*** (1.06, 1.08)	1.07*** (1.06, 1.08)	1.07*** (1.06, 1.08)	1.07*** (1.06, 1.08)
N	49766	49766	49766	49766	49766
Log Likelihood	-13794.83	-13792.29	-13792.21	-13790.95	-13790.69

***p < .01; **p < .05; *p < .1

Table 8. Adjusted ordered logistic regression models examining the relationship between blood lead levels (low, moderate, and severe) and exposure to demolitions (none, one, two or more) within a 400 foot radius in the 45 days before testing, among all tested Detroit children 6 years old and younger, 2014-2016, stratified by season

	Odds Ratios(95% CI) for Categorical Blood Lead Level (Low, Moderate, Severe)	
	Summer	**Not Summer**
	May to September	October to April
Demolition Activity		
1 Demolition	1.35***	0.90
	(1.13, 1.61)	(0.65, 1.21)
2 or More Demolitions	1.59***	0.85
	(1.20, 2.07)	(0.46, 1.44)
Covariates		
Age 1-2	2.65***	2.74***
	(2.04, 3.50)	(2.06, 3.72)
Age 3-6	1.56***	2.10***
	(1.21, 2.07)	(1.58, 2.85)
Male Sex	1.24***	1.19***
	(1.13, 1.37)	(1.07, 1.32)
Neighborhood SVI Rank	1.01***	1.02***
	(1.01, 1.02)	(1.01, 1.02)
Vacancy in 200-foot Buffer	1.07***	1.07***
	(1.05, 1.08)	(1.05, 1.09)
N	24479	25287
Log Likelihood	-7382.36	-6397.71

***p < .01; **p < .05; *p < .1

Table 9. Adjusted ordered logistic regression models examining the relationship between blood lead levels (low, moderate, and severe) and exposure to demolitions (none, one, two or more) within a 400 foot radius in the 45 days before testing, among all tested Detroit children 6 years old and younger, stratified by year (2014 – 2016)

	Odds Ratios(95% CI) for Categorical Blood Lead Level (Low, Moderate, Severe)		
	2014	**2015**	**2016**
Demolition Activity			
1 Demolition	1.49**	1.05	1.19*
	(1.05, 2.07)	(0.74, 1.44)	(0.97, 1.45)
2 or More Demolitions	1.33	0.94	1.73***
	(0.80, 2.09)	(0.50, 1.63)	(1.23, 2.38)
Covariates			
Age 1-2	4.16***	2.76***	2.47***
	(2.37, 8.15)	(1.81, 4.45)	(1.96, 3.16)
Age 3-6	3.06***	2.07***	1.59***
	(1.76, 5.97)	(1.36, 3.32)	(1.26, 2.03)
Male Sex	1.19**	1.19**	1.23***
	(1.02, 1.39)	(1.02, 1.38)	(1.12, 1.34)
Census Tract SVI	1.01***	1.02***	1.01***
	(1.01, 1.02)	(1.01, 1.02)	(1.01, 1.02)
May to September	1.08	1.36***	1.34***
	(0.92, 1.27)	(1.17, 1.58)	(1.22, 1.47)
Vacancy within 200ft	1.08***	1.06***	1.07***
	(1.05, 1.10)	(1.03, 1.08)	(1.06, 1.09)
N	11569	13784	24406
Log Likelihood	-2802.13	-3153.76	-7759.12

***$p < .01$; **$p < .05$; *$p < .1$