PHASE Symposium Presentation
May 16, 2008

Assessing the Relationship Between Lead Exposure and Violence and School Dropout in Baltimore City

Dani Saba
MHS Candidate
Johns Hopkins Bloomberg
School of Public Health

WHY PHASE?

- Experience!
- Real public health practice
- **Thank you, Caroline!**

Background

- Lead poisoning has been shown to have negative implications for IQ, reading abilities and aggression – all related to poor school outcomes and subsequent delinquent behavior.
  - Lead exposure as low as 10 μg/dL affects IQ[1]
  - Children with high bone lead levels are more frequently rated as “delinquent” and “aggressive” by parents and teachers[2]
  - A significant relationship found between preschool blood lead levels and trends in criminal activity at an ecological level[3]

Why Pay Attention?

- In Baltimore City, 45% of children 0 - 35 ms getting tested[4]
  - 5% of those tested have 1+ tests greater than or equal to 10 μg/dL
- Lead paint dust in pre-1950s homes
  - Estimated 57,000 homes in Baltimore City[5]
- As a study of this relationship has yet to be done in Baltimore City, determining whether lead poisoning is contributing to the city's woes could assist in local advocacy efforts.

Objective

- To determine whether an association exists between childhood blood lead level (BLL), high school dropout and related school outcomes, and suspensions/expulsions related to violence in Baltimore City

- To explore potential confounders in this relationship

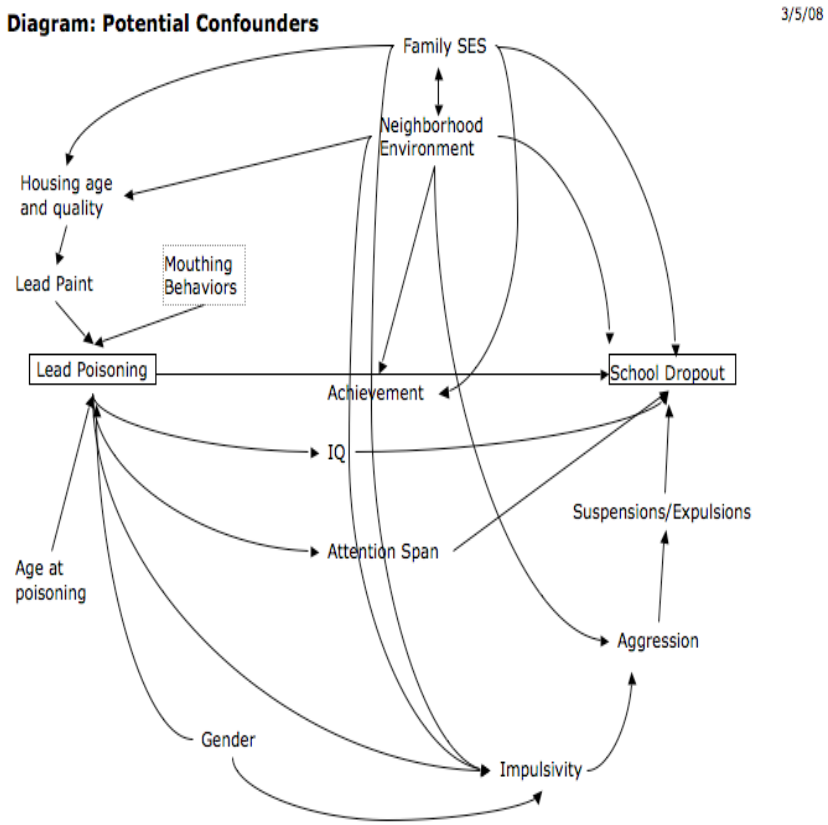
Collaborators

- Baltimore City Health Department (BCHD)
  - Caroline Fichtenberg, PhD (Preceptor)
  - Lauren Necochea, MPA
  - Sarah Norman, MPP
  - Madeleine Shea, PhD
- Maryland Department of the Environment (MDE)
  - Ezatollah Keyvan, MD, DrPH
  - Sharon Seligson, BSN, RN
- Baltimore City Public School System (BCPSS)

Research Methods

- Retrospective cohort design
- Random sample of children born in 1991 with elevated BLL and a random sample of children born in 1991 without elevated BLL
  - Looked at all tests taken between 0-5 years
  - Reference group: <=4 μg/dL
  - 5 exposure groups allowing for dose-response exploration
  - 101 observations per group, N = 606
- Inclusion criteria
  - First and last names, birthdates and a geo-codable address in Baltimore City
  - Both males and females were included

Potential Confounders



Preliminary analysis using 1990 census tract information[6] and each child's descriptive data

Are certain characteristics associated with blood lead level?

- Sex of child
- Age at testing
- Median housing value
- Median income
- Persons per family
- % pre-1950s housing
- % high school graduates
- % percent of persons with ratios of income to poverty level <1 (% poverty)

Correlations

	BLL	%Pre_50s	%HS_Grad	Sex	Med_Inc	Hs_MedValue	Prs/Fam	Age	%Poverty
BLL	1.0000								
	591								
%Pre_50s	0.1393*	1.0000							
	591	591							
	0.0007								
%HS_Grad	-0.2079*	-0.1587*	1.0000						
	591	591	591						
	0.0000	0.0001							
Sex	-0.0921*	-0.0862*	0.0494	1.0000					
	581	581	581	581					
	0.0264	0.0379	0.2345						
Med_Inc	-0.2407*	-0.0183	0.5195*	0.0109	1.0000				
	591	591	591	581	591				
	0.0000	0.6579	0.0000	0.7929					
Hs_MedVal	-0.3165*	-0.3880*	0.2818*	0.0446	0.6349*	1.0000			
	591	591	591	581	591	591			
	0.0000	0.0232	0.0000	0.8192	0.0000	0.0000			
Prs/Fam	0.3307*	0.0934*	-0.1681*	-0.0095	-0.3854*	-0.6448*	1.0000		
	591	591	591	581	591	591	591		
	0.0000	0.0000	0.0000	0.2827	0.0000	0.0000			
Age	0.1677*	0.0253	0.0183	-0.0025	-0.0281	-0.0817*	0.0826*	1.0000	
	591	591	591	581	591	591	591	591	
	0.0000	0.5400	0.6566	0.9528	0.4960	0.0470	0.0448		
%Poverty	0.2738*	0.0370	-0.5800*	-0.0032	**-0.9440***	-0.6275*	0.4702*	0.0381	1.0000
	591	591	591	581	591	591	591	591	591
	0.0000	0.3689	0.0000	0.9382	0.0000	0.0000	0.0000	0.3553	

Regression Results for Exploration of Potential Confounders

Logistic regression, accounting for clustering by census tract

Covariate	Bivariate Models	Model with All Covariates n = 581	Model with Chosen Covariates n = 591
Median Income (change in ug/dL per $10,000 increase)	**-2.491** (-3.717, -1.264)	-0.828 (-3.520, 1.864)	
Persons per Family	**9.779** (6.893, 12.664)	**9.017** (5.110, 12.9234)	**9.009** (6.241, 11.778)
Housing Median Value (change in ug/dL per $10,000 increase)	**-0.904** (-1.453, -.355)	0.287 (-.399, .973)	
Age	**0.826** (.177, 1.476)	**0.771** (.156, 1,387)	**0.742** (.133, 1.352)
Percent Housing Pre-1950	**7.321** (2.288, 12.353)	4.149 (-.438, 8.737)	
Percent Income to Poverty Ratio Less than 1.00	**14.898** (8.896, 21.099)	1.524 (-10.830, 13.877)	
Percent HS Graduates	**-49.234** (-75.061, -23.407)	-22.51 (-47.338, 2.320)	**-37.24** (-58.034, -16.447)
Sex (1 = F, 0 = M)	-1.716 (-3.584, .152)	-1.426 (-3.156, .303)	

Statistically significant, p<.05

Next Steps

- Awaiting school data from BCPSS
  - Merging of data sets
- Outcomes:
  - High School Dropout
  - Attendance
  - Truancy
  - Suspensions/Expulsions related to violence
- Statistical analyses:
  - Multiple logistic regression
  - BLL as categorical and continuous variable
  - Control for potential confounders

Expected Results

- Odds of dropout, truancy, low attendance, and suspensions/expulsions related to violence should be statistically significantly greater for lead exposed individuals than for unexposed
- Expect to see dose-response relationship across BLL
- Population attributable risk

Discussion - Limitations

- Timing!
- Preliminary analysis essentially an ecological study
- Dropped and missing observations in preliminary analysis
  - Census tract, sex

Addressing Core PH Functions

- To diagnose and investigate health problems and health hazards in the community
  - Empower individuals
- To mobilize community partnerships and action to identify and solve health problems
  - Collaboration
- To develop policies and plans that support individual and community health efforts
  - Publicizing prevention methods

ADVOCACY!

- Far-reaching implications of lead exposure
  - Economic[7]
  - Social
- Awareness and resource allocation
- The hope is that the results of this study will spur further discussion about lead's potential contributions to social issues and to public health problems throughout Baltimore City.

What I've Learned…

- IRB Approval!
- Complexity of research design
  - Hands-on process, constantly evolving
  - Variety of ways to complete a study
- Practical STATA use
  - More complicated than it seems!
- Increased respect for research process

A big THANK YOU to all who made this experience possible!

References

1 Canfield, R.L., Henderson, Jr., C.R., Cory-Slechta, D.A., Cox, C., Jusko, T.A., & Lanphear, B.P. (2003). Intellectual Impairment in Children with Blood Lead Concentrations below 10 ug per Deciliter. *The New England Journal of Medicine,* 348, 1517 – 1526.

2 Needleman, H.L., McFarland, C., Ness, R.B., Fienberg, S.E., & Tobin, M. (2002). Bone Lead Levels in Adjudicated Delinquents: A Case-Control Study. *Neurotoxicology and Teratology*, 24, 711- 717.

3 Nevin, R. (2007). Understanding International Crime Trends: The Legacy of Preschool Lead Exposure. *Environmental Research,* 104, 315-336.

4 Maryland Department of the Environment. (2007). 2006 Annual Report: Childhood Blood Lead Surveillance in Maryland. Retrieved from the Web November 13, 2007. http://www.mde.state.md.us/assets/document/LeadCoordination/WasLeadSURrptCLR2006Annual.pdf

5 Abell Foundation. (2002). Childhood Lead Poisoning in Baltimore: A Generation Imperiled as Laws Ignored. *The Abell Report*, 15(5).

6 U.S. Census Bureau: American Fact Finder. (1990). 1990 Decennial Census. Retrieved from the Web April 17, 2008. http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=DEC&_tabId=DEC2&_submenuId=datasets_1&_lang=en&_ts=227648743296

7 Presidential Task Force on Environmental Health Risks and Safety Risks to Children. (2000). Eliminating Childhood Lead Poisoning: A Federal Strategy Targeting Lead Paint Hazards. Washington, D.C.: Government Printing Office.