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

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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 months getting tested\(^4\)
  - 5% of those tested have 1+ tests greater than or equal to 10 \(\mu\)g/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
  - Looked at all tests taken between 0-5 years
  - Reference group: \( \leq 4 \, \mu g/dL \)
  - 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 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

<table>
<thead>
<tr>
<th>BLL</th>
<th>%Pre_50s</th>
<th>%HS_Grad</th>
<th>Sex</th>
<th>Med_Inc</th>
<th>Hs_MedValue</th>
<th>Prs/Fam</th>
<th>Age</th>
<th>%Poverty</th>
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</thead>
<tbody>
<tr>
<td>BLL</td>
<td>1.0000</td>
<td></td>
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<tr>
<td>%Pre_50s</td>
<td>1.0000</td>
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<td></td>
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<td></td>
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<td></td>
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<tr>
<td>%HS_Grad</td>
<td>-0.2079*</td>
<td>-0.1587*</td>
<td>1.0000</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Sex</td>
<td>-0.0921*</td>
<td>-0.0862*</td>
<td>0.0494</td>
<td>1.0000</td>
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<td></td>
<td></td>
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<tr>
<td>Med_Inc</td>
<td>-0.2407*</td>
<td>-0.0183</td>
<td>0.5195*</td>
<td>0.0109</td>
<td>1.0000</td>
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<td></td>
</tr>
<tr>
<td>Hs_MedValue</td>
<td>0.0000</td>
<td>0.0000</td>
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<td></td>
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</tr>
<tr>
<td>Prs/Fam</td>
<td>0.3307*</td>
<td>0.0934*</td>
<td>-0.1681*</td>
<td>-0.0095</td>
<td>-0.3854*</td>
<td>-0.6448*</td>
<td>1.0000</td>
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</tr>
<tr>
<td>Age</td>
<td>0.1677*</td>
<td>0.0253</td>
<td>0.0183</td>
<td>-0.0025</td>
<td>-0.0281</td>
<td>-0.0817*</td>
<td>0.0826*</td>
<td>1.0000</td>
</tr>
<tr>
<td>%Poverty</td>
<td>0.2738*</td>
<td>0.0370</td>
<td>-0.5800*</td>
<td>-0.0032</td>
<td>-0.9440*</td>
<td>-0.6275*</td>
<td>0.4702*</td>
<td>0.0381</td>
</tr>
</tbody>
</table>

* indicates significance at the 0.01 level.
Regression Results for Exploration of Potential Confounders

Logistic regression, accounting for clustering by census tract

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Bivariate Models</th>
<th>Model with All Covariates n = 581</th>
<th>Model with Chosen Covariates n = 591</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median Income</td>
<td>-2.491</td>
<td>-0.828</td>
<td></td>
</tr>
<tr>
<td>(change in ug/dL per $10,000 increase)</td>
<td>(-3.717, -1.264)</td>
<td>(-3.520, 1.864)</td>
<td></td>
</tr>
<tr>
<td>Persons per Family</td>
<td>9.779</td>
<td>9.017</td>
<td>9.009</td>
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<tr>
<td>Housing Median Value</td>
<td>-0.904</td>
<td>0.287</td>
<td></td>
</tr>
<tr>
<td>(change in ug/dL per $10,000 increase)</td>
<td>(-1.453, -.355)</td>
<td>(-.399, .973)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.826</td>
<td>0.771</td>
<td>0.742</td>
</tr>
<tr>
<td></td>
<td>(.177, 1.476)</td>
<td>(.156, 1.387)</td>
<td>(.133, 1.352)</td>
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<tr>
<td>Percent Housing Pre-1950</td>
<td>7.321</td>
<td>4.149</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.288, 12.353)</td>
<td>(-.438, 8.737)</td>
<td></td>
</tr>
<tr>
<td>Percent Income to Poverty Ratio</td>
<td>14.898</td>
<td>1.524</td>
<td></td>
</tr>
<tr>
<td>Less than 1.00</td>
<td>(8.896, 21.099)</td>
<td>(-10.830, 13.877)</td>
<td></td>
</tr>
<tr>
<td>Percent HS Graduates</td>
<td>-49.234</td>
<td>-22.51</td>
<td>-37.24</td>
</tr>
<tr>
<td></td>
<td>(-75.061, -23.407)</td>
<td>(-47.338, 2.320)</td>
<td>(-58.034, -16.447)</td>
</tr>
<tr>
<td>Sex</td>
<td>-1.716</td>
<td>-1.426</td>
<td></td>
</tr>
<tr>
<td>(1 = F, 0 = M)</td>
<td>(-3.584, .152)</td>
<td>(-3.156, .303)</td>
<td></td>
</tr>
</tbody>
</table>

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
Far-reaching implications of lead exposure
  - Economic
  - 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


