Lead Exposure and School Performance in Chicago

Presentation to the Board of Health
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The problem

– New research highlighting the impact of lead exposure – even at very low levels – on academic performance is a problem that continues to plague or educational systems.

What to do about it?

– Information: Better surveillance and data sharing
– Interventions for Kids that have already been exposed
– Primary Prevention to reduce ongoing exposures

Why it’s important now

– Current federal and local initiatives to improve educational outcomes
Why is this study important?

- Describes the **effect of childhood lead exposure on school performance** in a large, urban public school system
- Explores **racial disparities** in lead exposure and academic achievement
- Considers the impact of lead exposure on **school readiness and academic achievement**
- Provides basis for **evaluating the economic impact** of lead exposure on a public school system
- Further **informs discussion** on policies related to public health intervention and school readiness.
Findings

• We examined children’s school performance and low level lead exposure in one of the largest urban public school systems.

• We found that low level lead exposure is inversely related to standardized test performance.

• We found that low level lead exposure increases the risk of school failure.

• We estimated the failure rate that can be attributed to low level lead exposure.
BACKGROUND

Sources of exposure:

• Lead Based Paint in Housing
• Contaminated Dirt or Soil
• Contaminated Water
• Contaminated Food
• Some Cosmetics made outside the U.S.
• Some ceramics and products made outside U.S.
The Dose-Response relationship is steeper at lower blood lead levels


Objective: to determine whether blood lead levels in early childhood are related to educational achievement in early elementary school as measured by performance on end-of-grade testing.

Results: Blood lead levels are significantly associated with declines in 4th grade reading & math scores, and this impact is very significant in comparison with the effects of covariates typically considered profoundly influential on educational outcomes.
Although Childhood Lead Poisoning Rates Are Declining, Rates Remain high in Cities

- Risk factors for increased blood lead levels in children include: minority race/ethnicity; **urban residence**; low income; older (pre-1950) housing; recent or ongoing home renovation or remodeling; use of ethnic remedies, certain cosmetics, and exposure to lead-glazed pottery;

According to the U.S. Preventive Services Task Force (USPSTF) 2007
Lead Poisoning Rates in Selected Midwestern and Eastern Cities

% of Children Tested with EBLs

- Philadelphia
- Detroit
- Chicago
- Cleveland
- Providence
- Milwaukee
- New York City

% of Children Tested with EBL

- Philadelphia
- Detroit
- Chicago
- Cleveland
- Providence
- Milwaukee
- New York City


% of Children Tested with EBL
Study Design
Chicago Study Design


- Uses Birth Registry, Blood Lead Data and School Performance Data

- Matching of Existing Administrative Datasets
Data Linking Protocol

- CDPH provided two large files (blood lead and birth registry) with the names and birth dates of all Chicago children with all health information encoded.

- CPS linked the CDPH file against their CPS data extract using data-matching protocol. Once the link was complete, all identifying information (names and dates of birth) in the three datasets was replaced with unique identifiers linking the three files.

- The resulting de-identified data set was returned to CDPH, and de-coded.

Unprecedented cooperation between two large public agencies (CDPH & CPS) and the School of Public Health, with support of Chapin Hall.
This Study was carried out under the review of the UIC IRB

Research Protocol # 2009-0217
“School Performance and Lead Poisoning in Chicago”

University of Illinois, Chicago
Office for the Protection of Research Subjects
March, 2009
What the data shows.....
Unadjusted Results: Mean Reading/Math ISAT Scores decrease as BLLs increase
Unadjusted Results: Percent of Children Failing Reading/Math ISAT increases as BLLs increase
## Descriptive Statistics for All Children in the Study

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean BLL</th>
<th>Sample Size</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH_Black</td>
<td>7.74</td>
<td>38,970</td>
<td>67.20%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>4.99</td>
<td>14,098</td>
<td>24.30%</td>
</tr>
<tr>
<td>NH_White</td>
<td>4.50</td>
<td>4,391</td>
<td>7.60%</td>
</tr>
<tr>
<td><strong>Other Significant Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low income</td>
<td>7.00</td>
<td>51,846</td>
<td>88.40%</td>
</tr>
<tr>
<td>Very Low BirthWeight or Pre-Term</td>
<td>7.65</td>
<td>2568</td>
<td>4.38%</td>
</tr>
<tr>
<td>Independent Education Plan</td>
<td>6.92</td>
<td>5,357</td>
<td>9.10%</td>
</tr>
<tr>
<td>Adequate Yearly Progress for School</td>
<td>5.67</td>
<td>13213</td>
<td>22.53%</td>
</tr>
<tr>
<td><strong>Mom's Education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some high school</td>
<td>7.45</td>
<td>24,807</td>
<td>42.30%</td>
</tr>
<tr>
<td>High School Graduate</td>
<td>6.74</td>
<td>19,952</td>
<td>34.00%</td>
</tr>
<tr>
<td>Some College</td>
<td>5.92</td>
<td>10,004</td>
<td>17.10%</td>
</tr>
<tr>
<td>College Graduate</td>
<td>4.57</td>
<td>2,536</td>
<td>4.30%</td>
</tr>
<tr>
<td>Post College Education</td>
<td>4.78</td>
<td>1,351</td>
<td>2.30%</td>
</tr>
<tr>
<td><strong>ALL TESTS</strong></td>
<td>6.76</td>
<td>58,650</td>
<td>100%</td>
</tr>
</tbody>
</table>
Children in 3rd Grade Sample Compared to all 3rd Graders (2003 – 2006)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample Size</th>
<th>% of Total</th>
<th>Sample Size</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children with BLLs less than 10 μg/dL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH_Black</td>
<td>30,080</td>
<td>62.2%</td>
<td>77,357</td>
<td>51.6%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>13,076</td>
<td>27.0%</td>
<td>55,511</td>
<td>37.1%</td>
</tr>
<tr>
<td>NH_White</td>
<td>4,086</td>
<td>8.4%</td>
<td>11,808</td>
<td>7.9%</td>
</tr>
<tr>
<td>Low income</td>
<td>42,143</td>
<td>87.1%</td>
<td>128,819</td>
<td>86.0%</td>
</tr>
<tr>
<td>Independent Education Plan</td>
<td>4,370</td>
<td>9.0%</td>
<td>13,481</td>
<td>9.0%</td>
</tr>
<tr>
<td>Adequate Yearly Progress for School</td>
<td>11,719</td>
<td>24.2%</td>
<td>34,451</td>
<td>23.0%</td>
</tr>
<tr>
<td>ALL TESTS</td>
<td>48,378</td>
<td>100%</td>
<td>149,789</td>
<td>100%</td>
</tr>
</tbody>
</table>

NOTE: A model with readscore as an outcome and whether the child had a BLL as an independent variable was analyzed, and it was not significant.
Children in the Study

Children were excluded because:

- Born outside Chicago Metro Region
- Did not get a blood lead test or did not reside in Chicago when tested
- Did not take the ISAT at CPS in 3rd grade
Measure of Exposure: Blood Lead Levels (BLLs)

Distribution of Blood Lead Levels by Race/Ethnicity

- NH_White
- NH_Black
- Hispanic

BLL (mcg/dL) vs Frequency
Unadjusted Distribution of Reading Scores for NH_Black Children - Mean Reading Score shifts from 154 to 149

Distribution of Reading Scores shifts to the left as blood lead levels increase.
Results
Results

• After adjusting for other predictors of school performance including poverty, race/ethnicity, gender, maternal education and very low birth weight or preterm birth, we found that BLLs below 10 and below 5 μg/dL, were inversely associated (p<0.0001) with reading and math ISAT scores in 3rd grade children.

• For a 5 μg/dL increase in BLL, the risk of failing increased by 32% for reading (RR=1.32, 95%CI=1.26, 1.39)

• In the population studied, we estimated the population attributable risk percentage
Economic Impacts include...

- Raising math and reading scores by 0.40 of a standard deviation results in a change in lifetime earnings ranging from $10,634 to $53,175

  (Magnuson, K. et al. 2004)

- Costs associated with school failure are many, but include the cost of repeating a grade
What to do about it?

1. Document the costs currently born by our educational system.

2. Develop a more robust research agenda to help educators understand what interventions work best for lead poisoned children.

3. Improve services for children:
   - Include lead poisoning as an eligibility listing (under diagnosed medical conditions that typically resulting in developmental delay) for Early Intervention (EI) services.
   - Work with Head Starts, Ready to Learn and Preschool for all programs to ensure that children with lead poisoning are receiving services from these programs.
What to do about it?

4. Improve public health surveillance systems to better document lead exposure at the school district level, and develop systems to assure that educational leaders have access to this information in order to develop intervention strategies.

5. Increase primary prevention to eliminate lead hazards, including enforcement of the RRP rule, inspections at rental turn-over, and funding for abatement.
Why is it important now?

• To both protect health and further our educational goals, it is critical that policy makers fully fund efforts to address remaining sources of environmental lead.

• As leaders continue to prioritize education in the 2014 budget by proposing key investments in education that would strengthen the middle class, grow the economy and provide opportunities for success to all Americans – especially our nation’s most vulnerable children.

• This agenda must include lead poisoning prevention and interventions if it is to be successful.
Thank You
Questions & Discussions