Elevated Blood Lead Levels of Children at Age Three

Given Low Levels at Ages One and Two

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in collaboration with
Maryland’s Department of the Environment
and Johns Hopkins School of Medicine
Lead Hazard & Exposure

- Attributed to:
  - Learning disabilities
  - Shortened attention span
  - Lower IQ
  - Behavior problems
  - Growth delays
  - Damage to multiple organs
  - Death

- Deteriorating surfaces with lead-based paint
  - Paint flaking, chipping, peeling, and dusting
  - Windows, door frames, and porches
  - Contamination of house dust and residential surface soil

Source: Home*A*Syst
Susceptibility of Children

- **Ingestion**
  - most common route

- **Sociological risk**
  - crawl and play on the floor
  - put objects in their mouth (pica)

- **Physiological risk**
  - greater absorption due to developing body
  - less protection due to developing organ systems

Source: The LEAD Group Inc.
Blood Lead Tests

- Taken at well-child visits
  - Few distinguishable symptoms
  - Unless suspected exposures
- Venous test preferred over capillary
  - Medical lab draw sites
  - Health care provider offices
- Sent for analysis to blood lead laboratories
- Recorded in Childhood Lead Registry
- CDC & AAP recommends
  - Elevated blood lead (EBL) level = 10 μg/dL
  - 1991 - universal screening for ages 1 and 2
  - 1997 - statewide targeted screening
Maryland

- 1997 - Childhood Lead Screening Law
  - Collaborative effort of DHMH and MDE
- 2000 - Maryland Childhood Lead Screening Program
  - Managed by the Center for Maternal and Child Health
  - Identify at risk communities by census tract
  - Blood test for all children up to age six who had an affirmative answer to a lead risk questionnaire
- Universal testing for ages one and two living in risk area

<table>
<thead>
<tr>
<th>Risk</th>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
<th>Negligible</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Predicted EBL</td>
<td>&gt;16%</td>
<td>5-16%</td>
<td>1-4%</td>
<td>unknown</td>
</tr>
<tr>
<td># Census Tracts</td>
<td>46</td>
<td>77</td>
<td>238</td>
<td>790</td>
</tr>
</tbody>
</table>
### Methods

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>9-15</th>
<th>15-21</th>
<th>21-27</th>
<th>27-33</th>
<th>33-39</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>1</td>
<td>not used</td>
<td>2</td>
<td>not used</td>
<td>3</td>
</tr>
<tr>
<td>Average BLL (μg/dL)</td>
<td>1.6</td>
<td>5.3</td>
<td>4.2</td>
<td>7.4</td>
<td>5.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># Tests @ each Age</th>
<th>Single Test</th>
<th>Multiple @ Age 1 or 2</th>
<th>Multiple @ Age 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Tests</td>
<td>1,163</td>
<td>212</td>
<td>51</td>
<td>1,426</td>
</tr>
<tr>
<td>Children</td>
<td>1,163</td>
<td>100</td>
<td>22</td>
<td>1,285</td>
</tr>
</tbody>
</table>

- Venous over capillary, then test closest to actual birthday
- Follow-up testing:
  - age one to two: 23,000
  - age two to three: 4,300
## Hypothesis

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLL (µg/dL)</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>≥10</td>
</tr>
<tr>
<td>%</td>
<td>100%</td>
<td>100%</td>
<td>1%</td>
</tr>
</tbody>
</table>

H₀: probability of EBL at age 3 ≥ 1%
Hₐ: probability of EBL at age 3 < 1%

Assumptions:
- All blood lead level (BLL) tests <10 at ages one and two
- Change in residency if blank
## Results

**Children at Age Three with BLL < 10 μg/dL at Ages One and Two**

<table>
<thead>
<tr>
<th></th>
<th>Constant Residence</th>
<th>All Children</th>
<th>Moved Only @ Age 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>615</td>
<td>1285</td>
<td>185</td>
</tr>
<tr>
<td>BLL ≥ 10 μg/dL</td>
<td>6</td>
<td>17</td>
<td>5</td>
</tr>
</tbody>
</table>

![Graph showing percentage comparison between Constant Residence, All Children, and Moved Only @ Age 3]
## Results

Children at Age Three with \( \text{BLL} < 10 \mu g/dL \) at Ages One and Two

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<tr>
<td>All</td>
<td>615</td>
<td>1285</td>
<td>185</td>
</tr>
<tr>
<td>( \text{BLL} \geq 5 \mu g/dL )</td>
<td>86</td>
<td>211</td>
<td>33</td>
</tr>
</tbody>
</table>

### Graph

- **Constant Residence**
- **All Children**
- **Moved Only @ Age 3**

- Chart showing percentages for the different residence status categories.
## Results

**Children at Age Three with BLL ≥ 5 μg/dL at Ages One and Two**

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<th>Moved Only @ Age 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All</strong></td>
<td>42</td>
<td>100</td>
<td>14</td>
</tr>
<tr>
<td><strong>BLL ≥ 5 μg/dL</strong></td>
<td>27</td>
<td>57</td>
<td>8</td>
</tr>
</tbody>
</table>

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![Graph showing constant residence, all children, and moved only at age 3 with BLL ≥ 5 μg/dL](image-url)
## Results

Children at Age Three with BLL < 5 µg/dL at Ages One and Two

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<th>Constant Residence</th>
<th>All Children</th>
<th>Moved Only @ Age 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>464</td>
<td>912</td>
<td>130</td>
</tr>
<tr>
<td>BLL ≥ 5 µg/dL</td>
<td>25</td>
<td>54</td>
<td>8</td>
</tr>
</tbody>
</table>

![Bar chart showing the percentage of children at different residence statuses in relation to BLL levels.]
Recommendations

Primary Prevention
- Anticipatory guidance through parental education
- Further lead abatement in old housing

Secondary Prevention
- Universal blood lead testing up to age three
- Targeted screening to consider change in residency

Future Studies
- Maryland prospective study
- Similar studies in other states