Low-level Lead Toxicity

The Ongoing Search for a Threshold

Bruce Lanphear, MD, MPH
Simon Fraser University
Vancouver, British Columbia

Collaborative on Health and Environment
The Lead Pandemic

Fig. 4. $^{207}\text{Pb}/^{206}\text{Pb}$ isotope ratios in teeth and lake sediments during the course of leaded gasoline introduction, peak, and phase-out. The line and shaded area for tooth isotope ratios is the smoothed average $+/−$ one standard error, and the open circles are individual tooth data points. The error bars on the individual lake sediment data points (not shown) were approximately the same size as the symbols.
Behavioral and Emotional Problems of Lead Exposure

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<tr>
<th>Class</th>
<th>Dentine Lead (ppm)</th>
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<td>&lt;1.1</td>
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<tr>
<td>2</td>
<td>5.1 to 8.1</td>
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<td>3</td>
<td>8.2 to 11.8</td>
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<td>11.9 to 17.1</td>
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<td>5</td>
<td>17.2 to 27.0</td>
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<td>6</td>
<td>&gt;27.0</td>
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Percentage Reported by Teachers

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<tr>
<th>Class</th>
<th>Unable to Follow Simple Directions</th>
<th>Hyperactive</th>
<th>Impulsive</th>
<th>Day Dreamer</th>
<th>Not Persistent</th>
<th>Dependent</th>
<th>Not Organized</th>
<th>Frustrated</th>
<th>Distractable</th>
<th>Unable to Follow Simple Sequences</th>
<th>Low Overall Functioning</th>
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Public Health Regulation and Children’s Blood Lead Levels, United States, 1970-2010

Adapted from CDC. MMWR. 2012;61 (Supplement)
No Acceptable Level?
Body Burden of Lead in Ancient Child, Typical Child (circa 1960) and Lead Poisoned Child

Adapted from Patterson et al (adapted from NRC Report).
The Prevention Paradox

The majority of disease and disability occurs in people who are at low to moderate risk
The Prevention Paradox

Estimated Loss of IQ in US Children at Different Intervals of Blood Lead

Current Reference Value = 5 µg/dl

- .5 Million
- 5.7 Million
- 6.4 Million
- 12.7 Million

2.10 µg/dl

- 6.1
- 1.6
- 0.9
- 0.3

1.43 µg/dl

- 3.1 Million
- 9.3 Million
- 5.7 Million
- 4.7 Million

No. of Children in Distribution x IQ Loss Average = Estimated IQ Points Lost
Dose Response Relationship of Maternal Blood Lead and Birthweight

Impact of Lead on PTB

$\text{OR}=1.9$

Low-Level Lead Toxicity and Psychopathology
Gray Matter Loss by Childhood Lead Exposure

Adjusted for child’s age, birth weight, Sex, gestational age, IQ, prenatal tobacco, prenatal alcohol, prenatal marijuana, total intracranial volume, SES and HOME Inventory did not alter results (Cecil K, PLoS Medicine, et al. 2008).
Reduction in Gray Matter by Childhood Blood Lead Levels and Subject’s Sex

Men (n=83)  
Women (n=74)
18% of ADHD

Tooth Lead Levels and Criminality

Lead Exposure and Homicides in the U.S.

Nevin R. Environmental Research 2000:83;1-22
“The problem is so well defined, so neatly packaged, with both causes and cures known, that if we don't end this social crime, our society deserves all the disasters that have been forecast for it.”

Rene Dubos, 1967
Sources of Lead Exposure

The Global Elimination of Lead Poisoning

• Set goal to achieve blood lead $< 1\mu g/dL$ by 2030 for all American children

• Eliminate all non-essential uses of lead worldwide and develop regulations to control lead emissions

• Establish empirically-derived health-based standards for lead in air, house dust, soil and water

• Screen housing units for lead hazards before purchase or occupancy, after renovation and abatement

• Develop strategy to replace lead lines and replace or cover contaminated soils