

Health Effects of Lead Exposure



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Periodic Table of the Elements

Legend:

- Alkali Metals (IA)
- Alkaline Earth Metals (IIA)
- Transition Metals (Groups IIIA to VIIIA)
- Other Metals (Groups IIA to VIIA)
- Nonmetals (Groups VIIA to VIIIA)
- Noble Gases (Group VIIIA)
- Inner Transition Metals (Lanthanide and Actinide Series)
- Gaseous State (Green)
- Liquid State (Blue)
- Solid State (Yellow)
- Synthetically Prepared (Pink)

Latin: *plumbus*

Lead poisoning: plumbism

Health Effects of Lead Toxicity



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Great Lakes Center for Children's Environmental Health

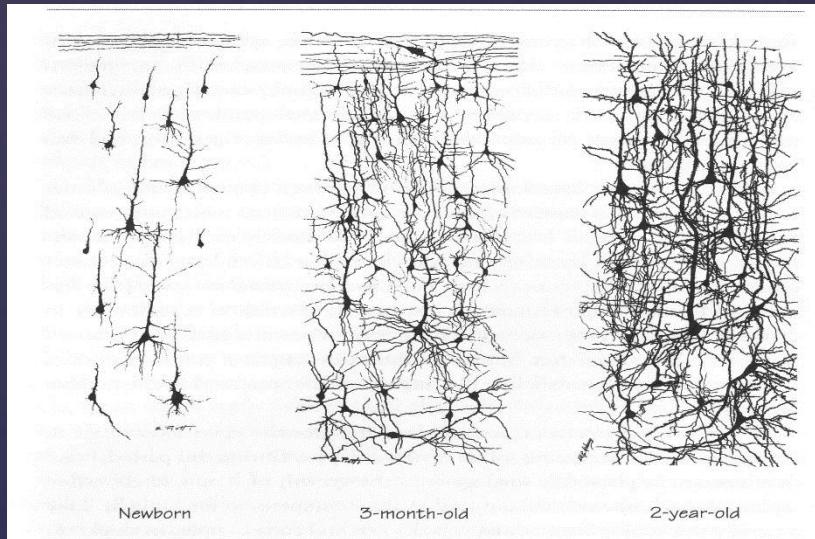
University of Illinois at Chicago School of Public Health

- ⌘ *The findings and conclusions in this presentation have not been formally disseminated by the Agency for Toxic Substances and Disease Registry and should not be construed to represent an agency determination or policy.*
- ⌘ *Acknowledgement: The U.S. Environmental Protection Agency (EPA) supports the PEHSU by providing partial funding to ATSDR under Inter-Agency Agreement number **DW-75-95877701**. Neither EPA nor ATSDR endorse the purchase of any commercial products or services mentioned in PEHSU publications.*
- ⌘ *Dr. Helen Binns, Dr. Daniel Hryhorczuk*

Acknowledgement/Disclosure

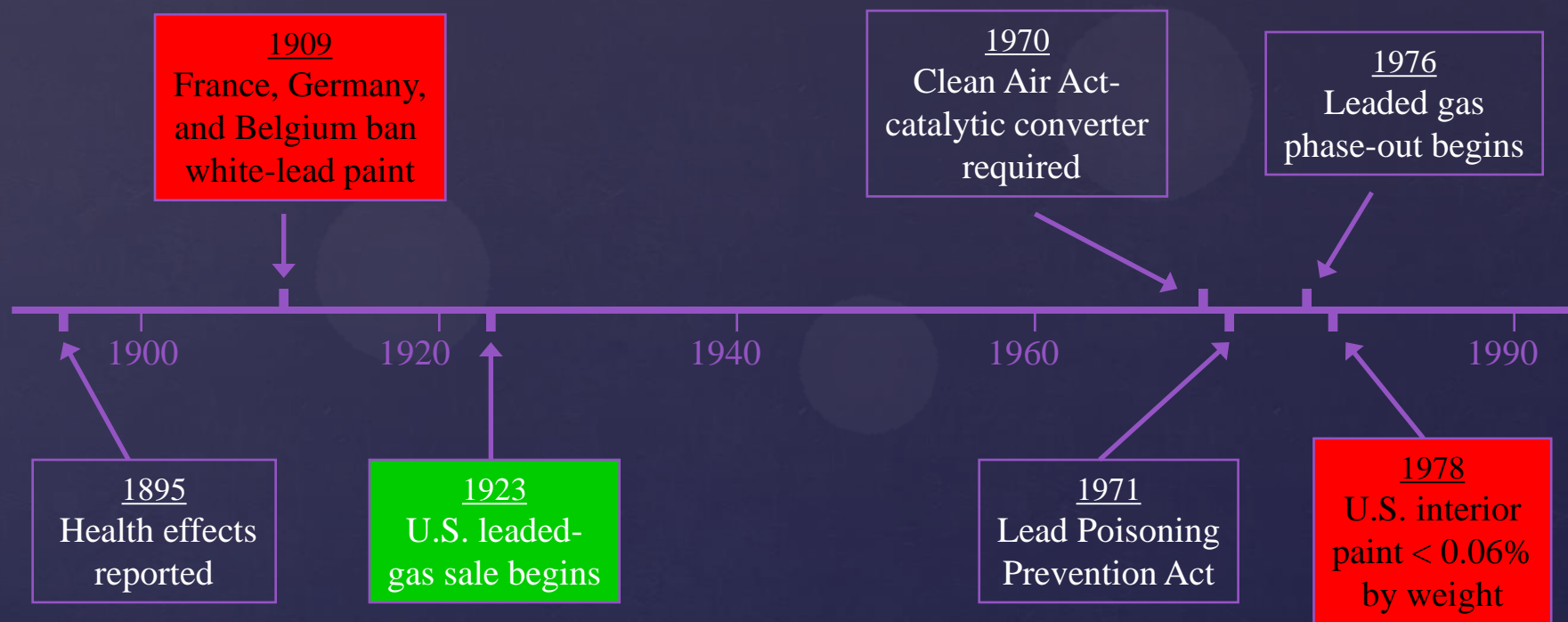


Children are a High Risk Population for Environmental Exposures



- ⌘ Developing brain
- ⌘ Higher absorbed dose
- ⌘ Different diets
- ⌘ Longer life span
- ⌘ High risk behaviors

Lead Timeline

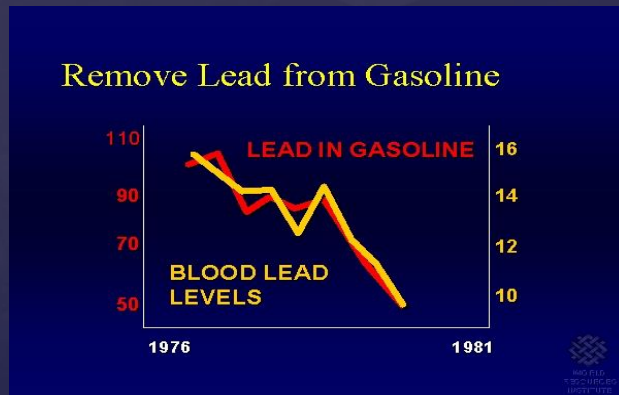


Markowitz, *AJPH* 2000;90:35-46

Lead in Paint and Gasoline



‣ More than 80% of U.S. housing built before 1978 contains lead paint



‣ Soil levels continue to be high

Lead in Drinking Water



“Tap water once contributed to as much as 10-20% of total Pb exposure in the US.”

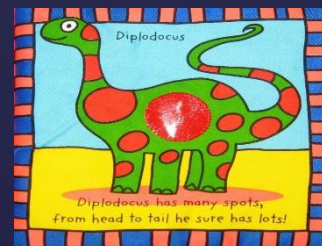
No known reports of community mean BLL over “level of concern” due to contaminated drinking water (Pb in plumbing)

- ⌘ Up to 20% of BLL may be due to lead in tap water [US EPA 1993]
- ⌘ For bottle-fed infants may be > 50% [US EPA]
- ⌘ Association between lead in tap water and BLL (OR 4.7, CI 2.1-10.2) [Levallois 2014] and $p < 0.05$ [Lanphear 1998]
- ⌘ Correlation coefficient for lead in tap water and BLL: $R^2 = 0.43$ [Fertmann 2004]

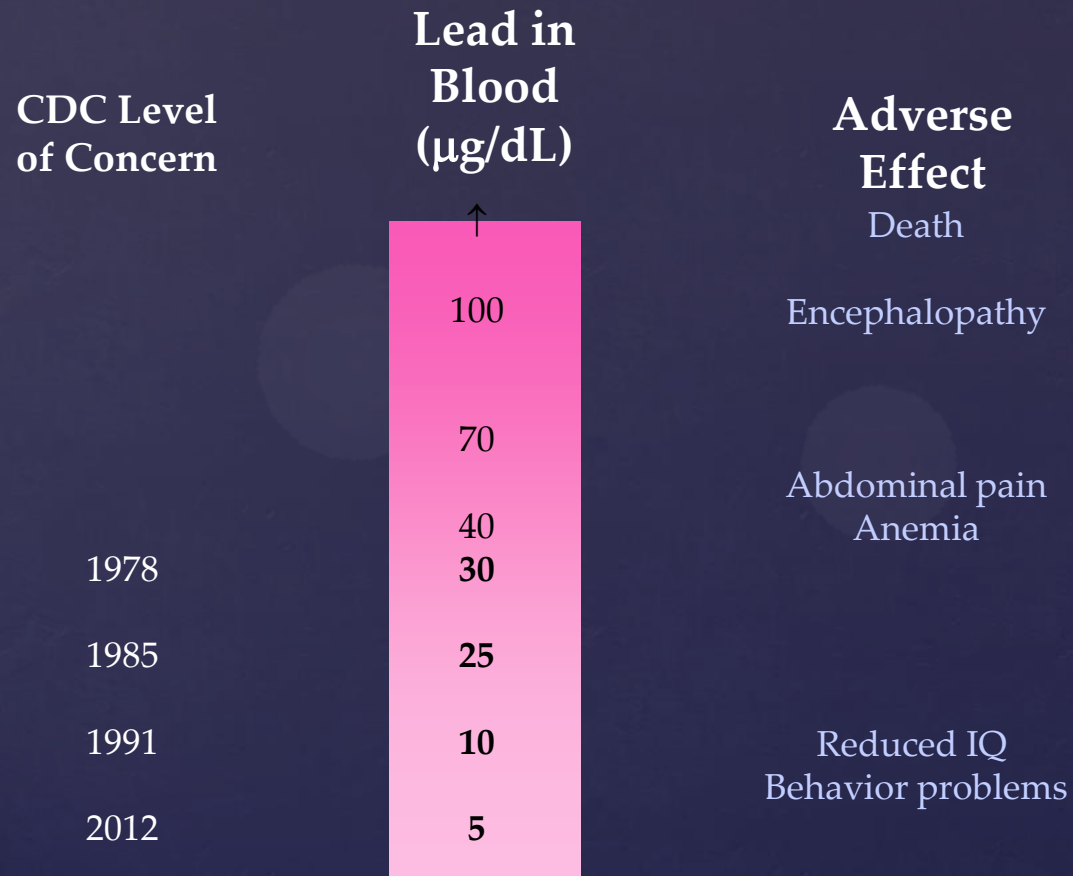
The contribution of tap water to BLL

Common Lead Sources

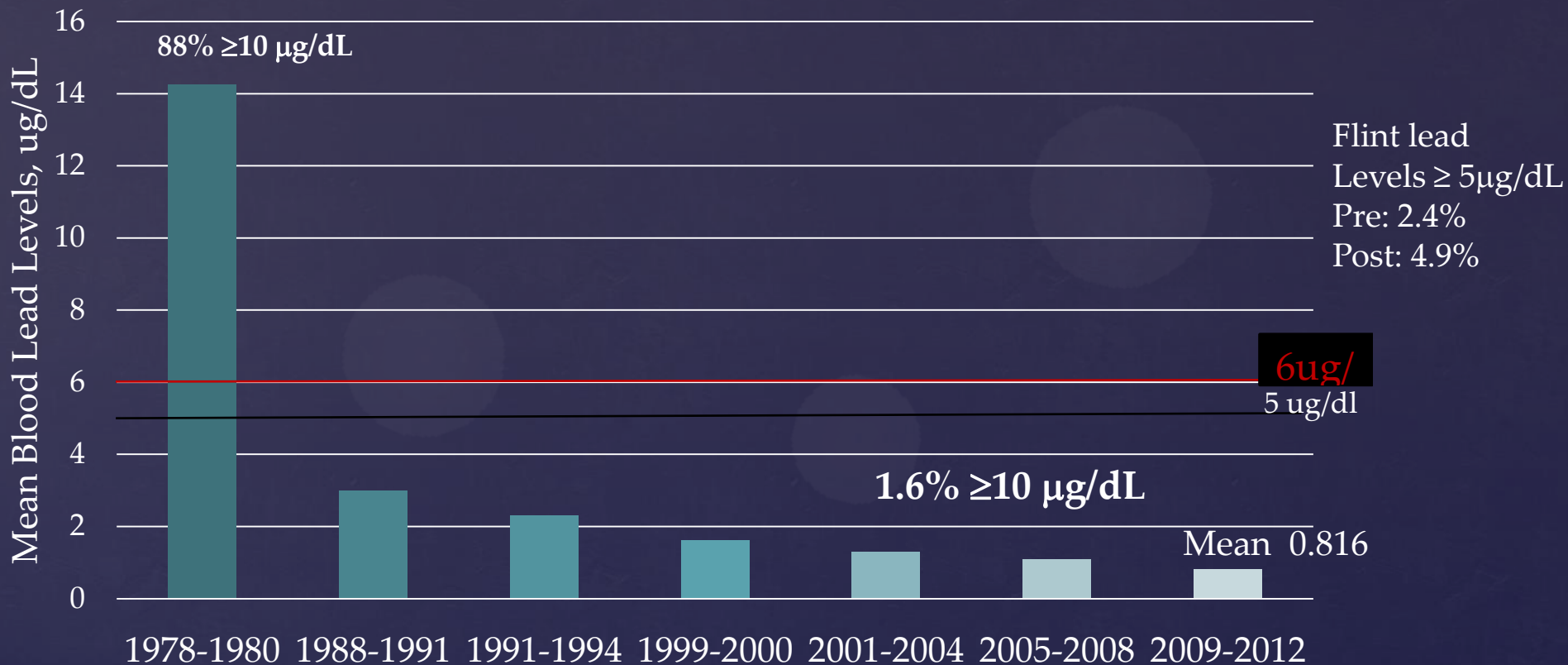
- ↳ Deteriorated leaded paint, dust
- ↳ Lead contaminated soil
- ↳ Occupational sources (take-home)
- ↳ Folk remedies (greta, azarcon)
- ↳ Food & food containers (including lead-glazed ceramics)
- ↳ Lead-contaminated drinking water
- ↳ Other (fishing sinkers, lead shot)
- ↳ Painted toys and furniture made before 1976
- ↳ Painted toys from outside the U.S.



Historic Overview



Mean Blood Lead Levels in US Children (1-19 yo)



Source: The National Health and Nutrition Examination Survey

76-80 data: <http://www.ncbi.nlm.nih.gov/pubmed/6333758>

91-94 data: <http://www.cdc.gov/mmwr/preview/mmwrhtml/00048339.htm>

88-91 data: <http://www.cdc.gov/mmwr/preview/mmwrhtml/00032080.htm>

99-12 data: http://www.cdc.gov/biomonitoring/pdf/FourthReport_UpdatedTables_Feb2015.pdf

OSHA Lead Standard



Workers are removed when blood lead is **50-60ug/dl**

Return to work when blood lead decreases to **40ug/dl**

Health Effects - **Overt** Signs and Symptoms of Lead Poisoning

Low

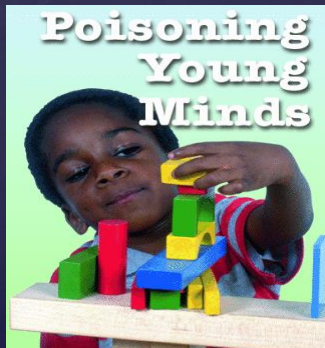
- Usually NONE

Moderate

- Constipation
- Abdominal pain
- Poor appetite
- Anemia
 - (~40 $\mu\text{g}/\text{dL}$)

High

- Vomiting
- Irritability
- Lethargy
- Seizures



Low-Level Environmental Lead Exposure and Children's Intellectual Function: An International Pooled Analysis

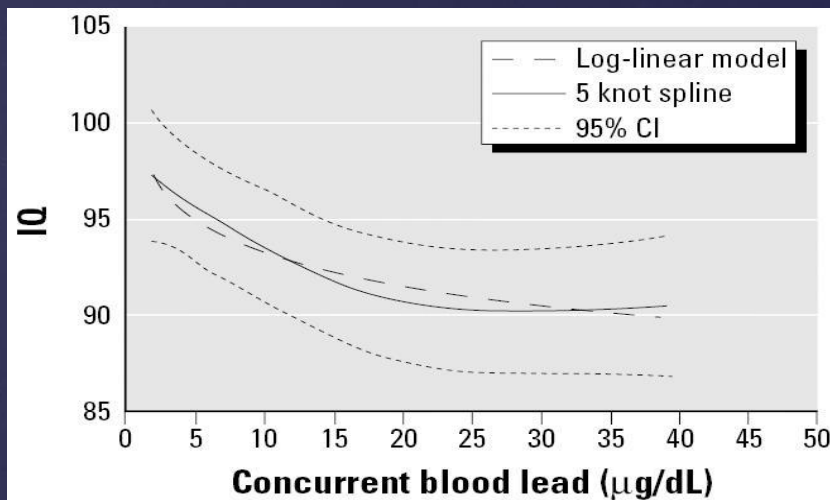
⌘ Pooled analysis, 7 studies, N= 1,333

Increase in lead:

⌘ from 2.4 to 10 $\mu\text{g/dL}$ \rightarrow
 $\varnothing \downarrow 3.9$ IQ points

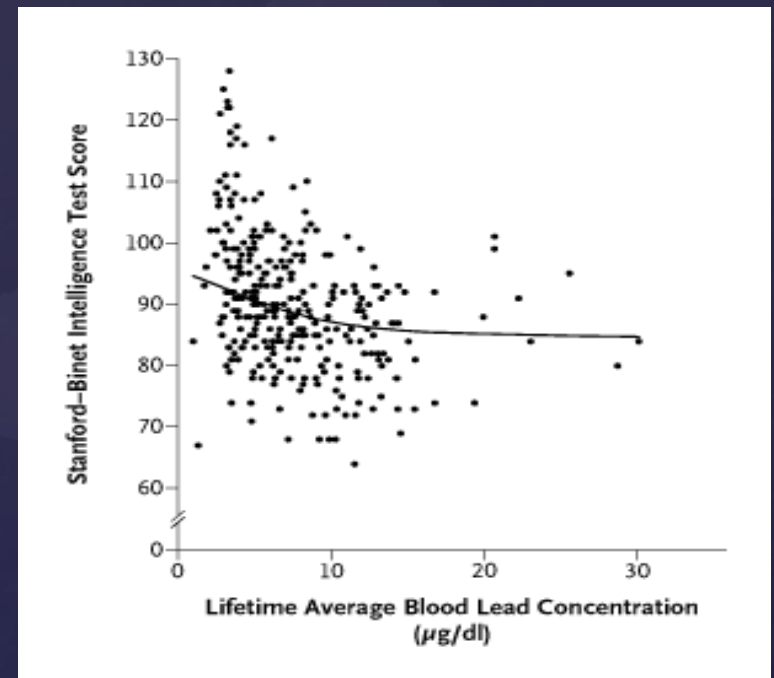
⌘ from 10 to 20 $\mu\text{g/dL}$ \rightarrow
 $\varnothing \downarrow 1.9$ (95% CI, 1.2-2.6)

⌘ from 20 to 30 $\mu\text{g/dL}$ \rightarrow
 $\varnothing \downarrow 1.1$ (95% CI, 0.7-1.5)

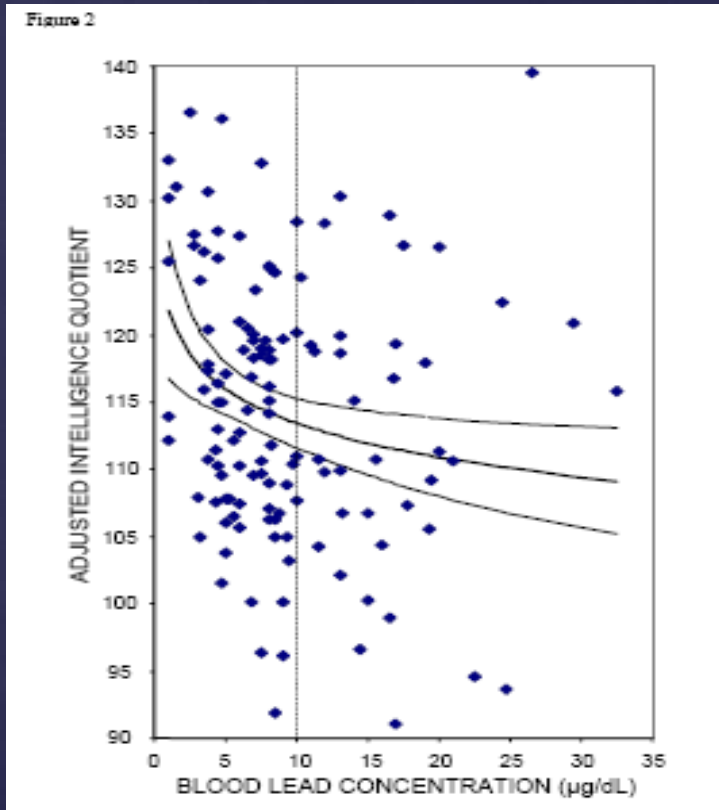


Intellectual Impairment in Children with Blood Lead Concentrations below 10 μg per Deciliter

- ⌘ 172 inner city children (101 with peak blood lead $<10 \mu\text{g}/\text{dL}$)
- ⌘ -7.4 points IQ for lifetime avg BLL \uparrow from 1 to $10 \mu\text{g}/\text{dL}$

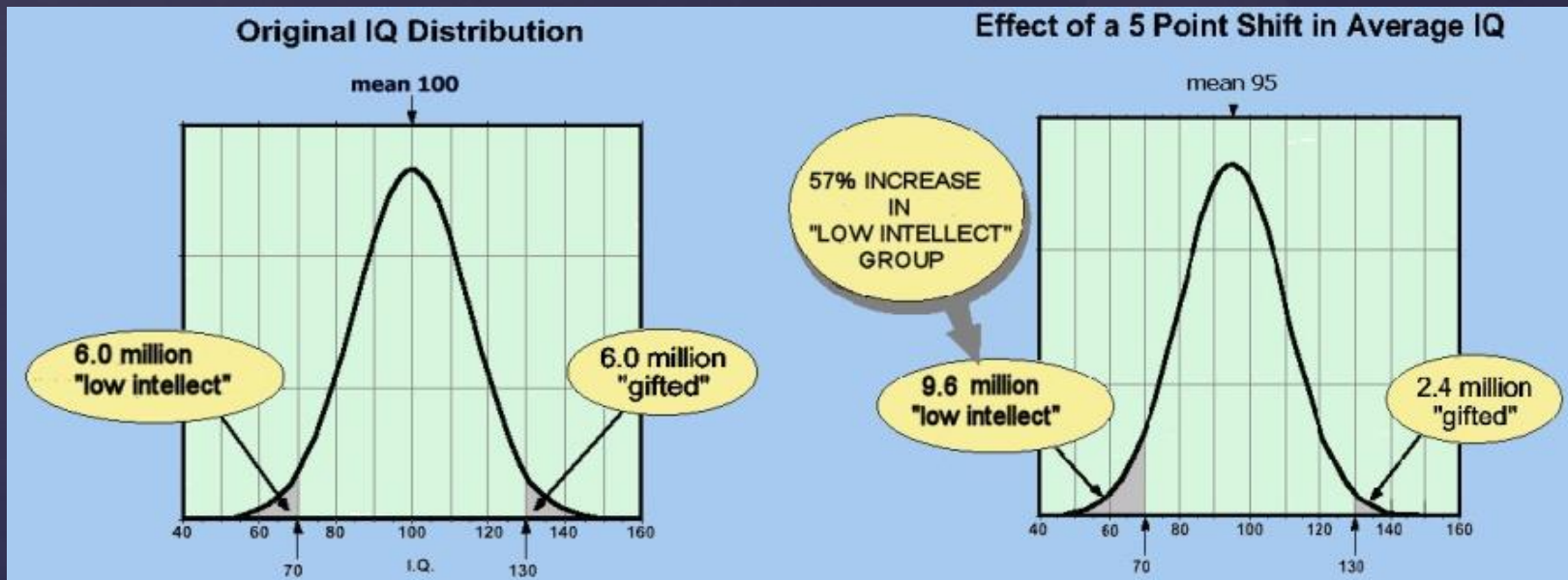


Reduced intellectual development in children with prenatal lead exposure



- ⌘ Study from Mexico, 150 children
- ⌘ Geometric mean BLL in pregnancy, 8.0 $\mu\text{g/dL}$
- ⌘ Maternal blood lead at 28 wks gestation, significantly assoc with child IQ at age 6-10 yrs

Result of a 5 point reduction in average IQ



Expected

Shifted by 5 IQ points

Original Contributions

Bone Lead Levels and Delinquent Behavior

Herbert L. Needleman, MD; Julie A. Riess, PhD; Michael J. Tobin, PhD; Gretchen E. Biesecker; Joel B. Greenhouse, PhD

JAMA 1996

- ⌘ Bone lead and CBCL scores in 7 and 11 yr old boys
- ⌘ Higher lead associated with delinquency, aggression, inattention, social problems

Lead Neurotoxicity: Behavior

At mean blood lead levels < 5ug/dl

⌘ Sufficient evidence for:

- ⌘ *Attention-related problems*
- ⌘ *Greater incidence of problem behaviors*
- ⌘ *Decreased cognitive performance*



National Toxicology Program