

Lead Poisoning: Where are We Now? Where are We Going?

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MEDICINE *of* THE HIGHEST ORDER



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ROCHESTER
MEDICAL CENTER

What Have We Known For a Long Time About Lead Poisoning?

- Lead is a poison that has no useful role in the human body. It can cause seizures, mental confusion, coma and death if there is significant exposure.

“Lead makes the mind give way.”

-- Dioscorides – 2nd Century B.C.

- Significant environmental exposure can be harmful

A Plea for Painted Railings and Painted Walls of Rooms as the Source of Lead Poisoning Amongst Queensland Children

--J. Lockhart Gibson, *Australasian Medical Gazette*, April 20, 1904

- The U.S. was very slow to address the lead problem

Lead paint was outlawed in most European countries in early 1920s after the League of Nations recommended it be banned due to the danger of lead poisoning

Lead paint only outlawed in the U.S. in 1978

It Wasn't Only Paint Though: Ethyl Isn't Just a Woman's Name

“A colorless liquid of sweetish odor, very poisonous if absorbed through the skin, resulting in lead poisoning almost immediately.”

-- Pierre du Pont, (Chairman of DuPont Chemical Company and General Motors), 1922

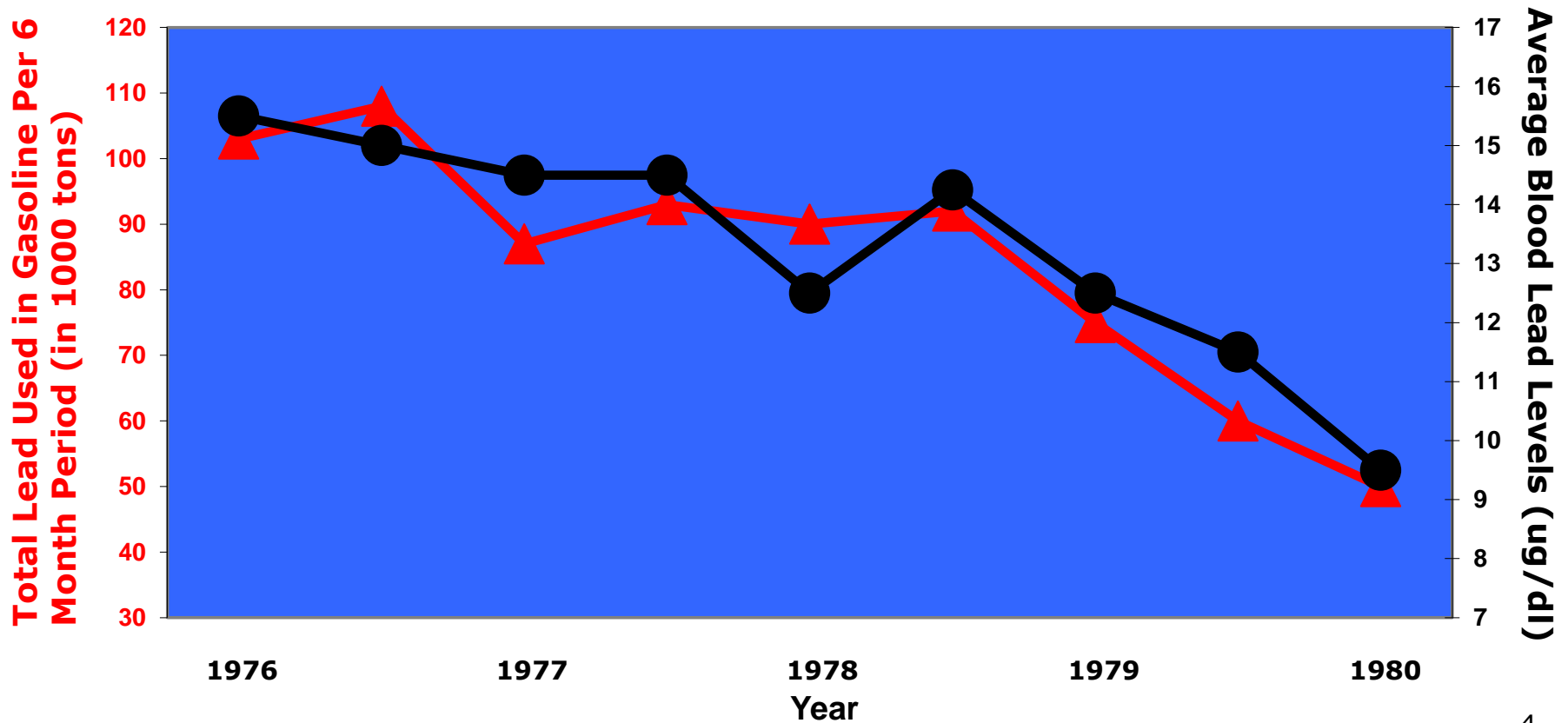
“The main factory where ‘Ethyl’ was produced was nicknamed the House of Butterflies because of the hallucinations, impaired judgment and staggered gait of the lead-polluted employees”

-- *The Ethyl Poisoned Earth* by Alan Bellows



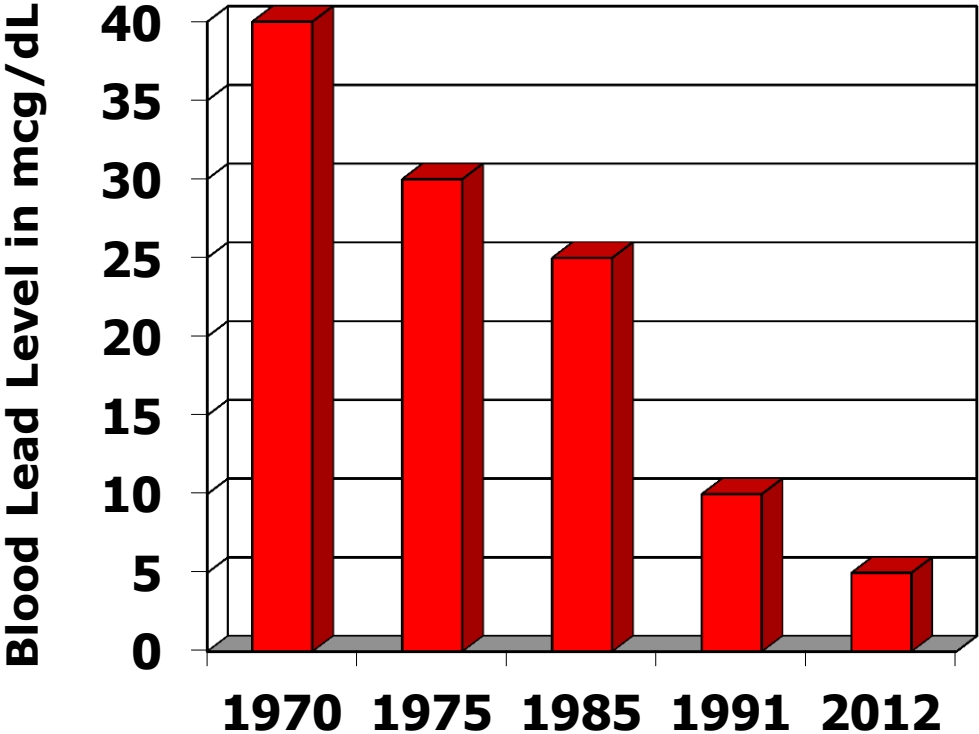
The Effect of Removing Lead From Gasoline

Change in Blood Lead Levels in Relation to a Decline in Use of Leaded Gasoline in the U.S., 1976-1980

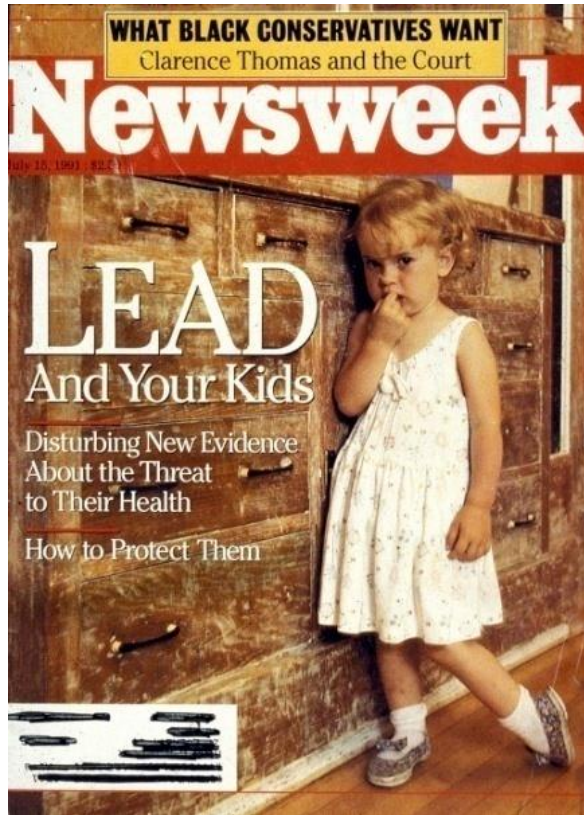


Our Knowledge About the Adverse Effects of Lead Has Come a Long Way

Blood Lead Cut-offs As Determined by the CDC



The State of Our Knowledge in 1991 When the CDC's Blood Lead Level of Concern Was Lowered to 10mcg/dL



- Lead exposure mostly targets low socioeconomic status inner city minority populations, especially children
- Lead exposure has affected multiple generations in these populations

The Conclusion of the National Academy of Sciences' Review of the Evidence Concerning the Effects of Lead

“Lead is toxic wherever it is found ... and it is found everywhere.”

National Academy of Sciences, 1993.

What Kind of Harm Does Lead Cause in Children?

- **Irreversible IQ deficits**
- **Elevated hearing thresholds and associated auditory processing problems**
- **Problems with attention and impulsivity**
- **Poor control of emotions; increased likelihood of aggressive behavior and conduct problems**
- **Significantly increased likelihood of delinquency and incarceration**

The Rochester Lead Study

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812

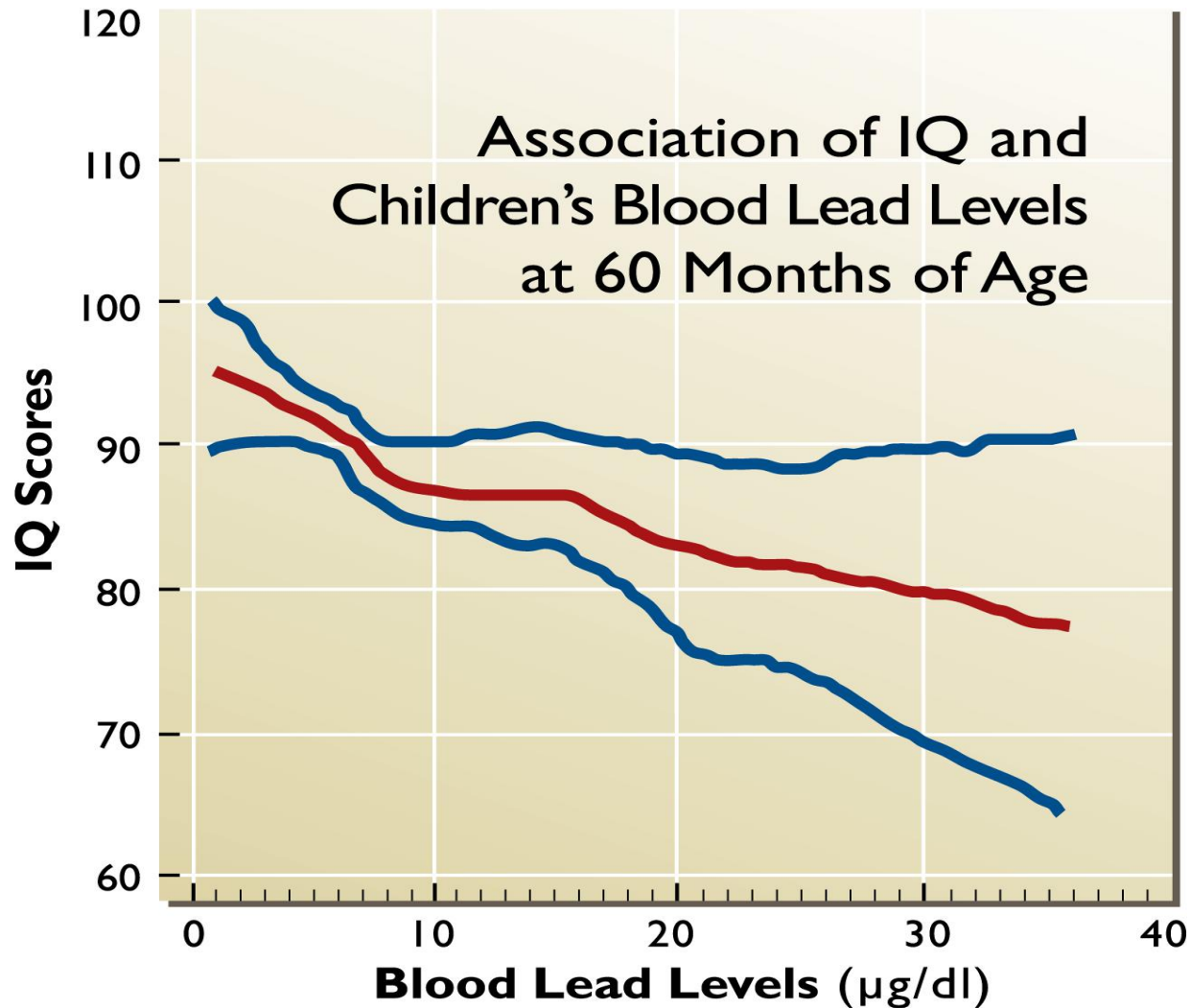
APRIL 17, 2003

VOL. 348 NO. 16

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

Richard L. Canfield, Ph.D., Charles R. Henderson, Jr., M.A.,
Deborah A. Cory-Slechta, Ph.D., Christopher Cox, Ph.D., Todd A. Jusko, B.S.,
and Bruce P. Lanphear, M.D., M.P.H.

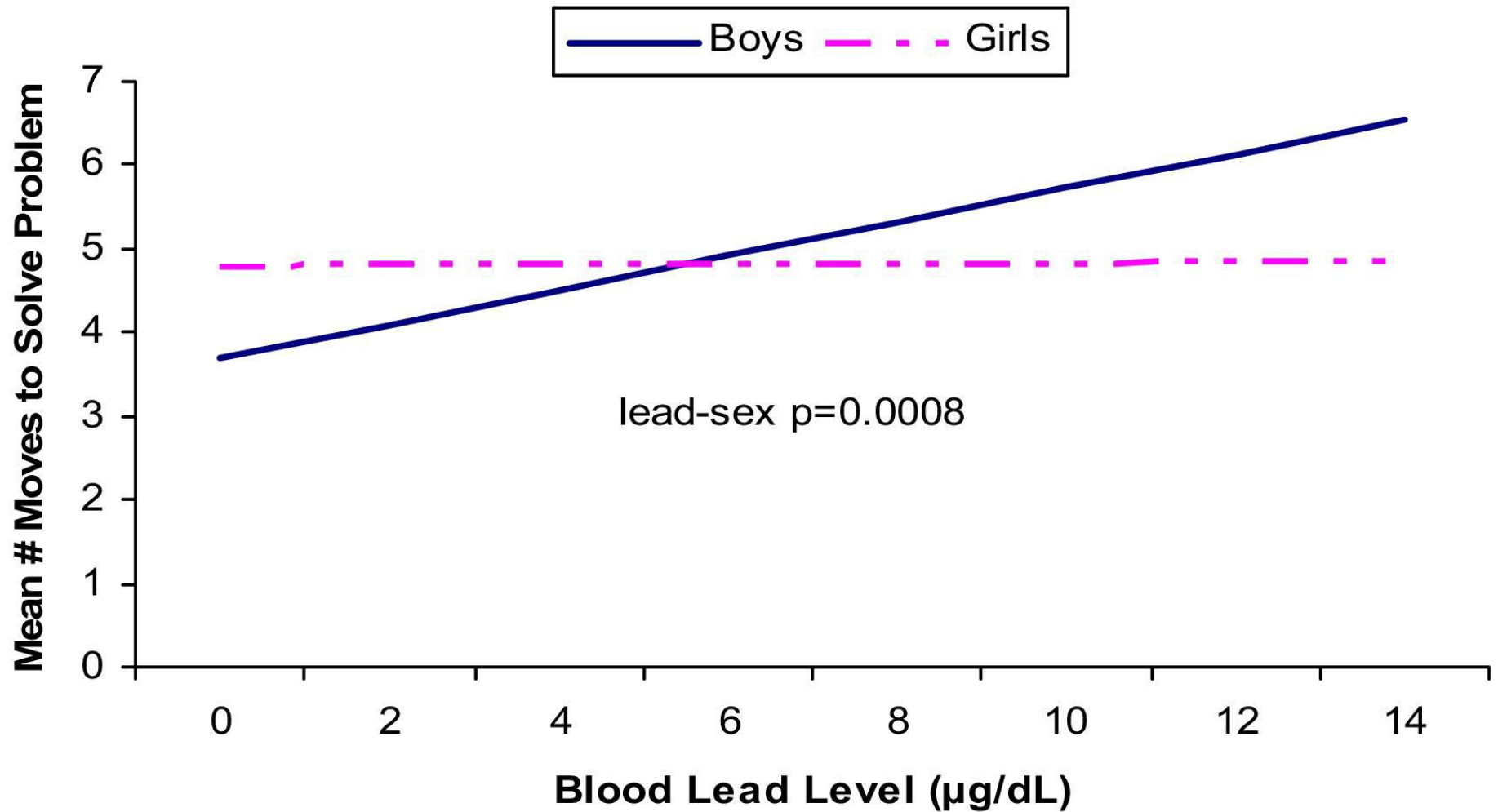
The Effects of Low-Level Lead Exposure on IQ in Young Children



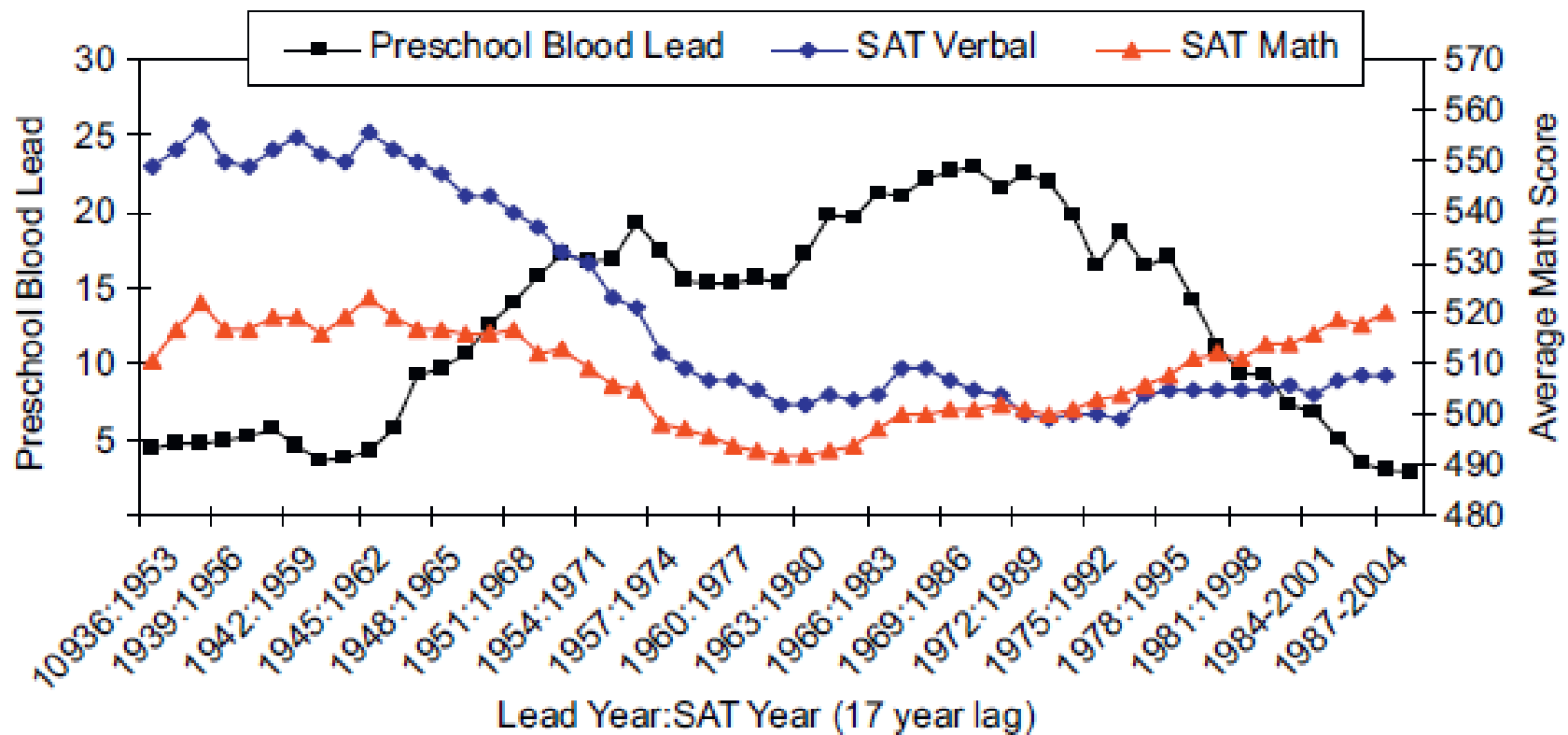
What Do We Now Know About Lead Poisoning?

- **Unlike most toxins, there is no threshold exposure level below which the adverse effects of lead are not seen**
- **Even at very low levels, lead can cause harm, particularly for young children whose brains are developing**
- **The effect of lead is much more pronounced on males than on females**

Gender-Specific Effects of Lead on Executive Functioning (Learning How to Solve a Puzzle)



Lead Exposure and SAT Scores



Nevin R. Trends in preschool lead exposure, mental retardation and scholastic achievement: association or causation. *J Env. Research.* 2008.

Which Children Exposed to Lead Have the Greatest IQ Deficits?

Table 3

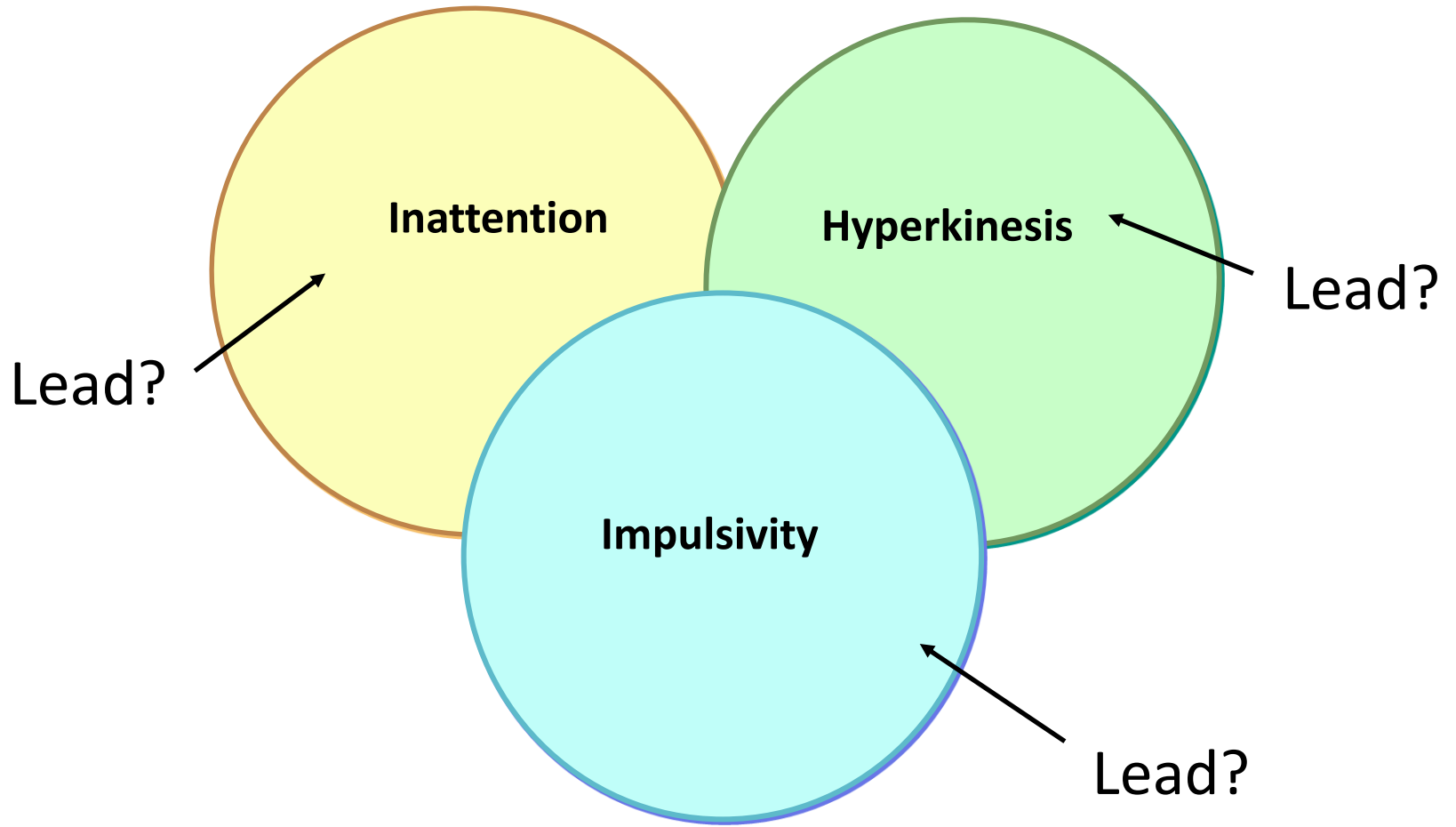
Log-linear relationship between IQ and BPb level at each of six ages.^a

Age (years)	β	SE	p-Value
1	-0.08	1.02	0.934
2	-0.46	1.08	0.670
3	-2.61	1.05	0.013
4	-2.85	1.07	0.008
5	-4.39	0.95	< 0.001
6	-3.49	1.03	< 0.001

^aAdjusted for study site, birth weight, HOME score, maternal education, and IQ.

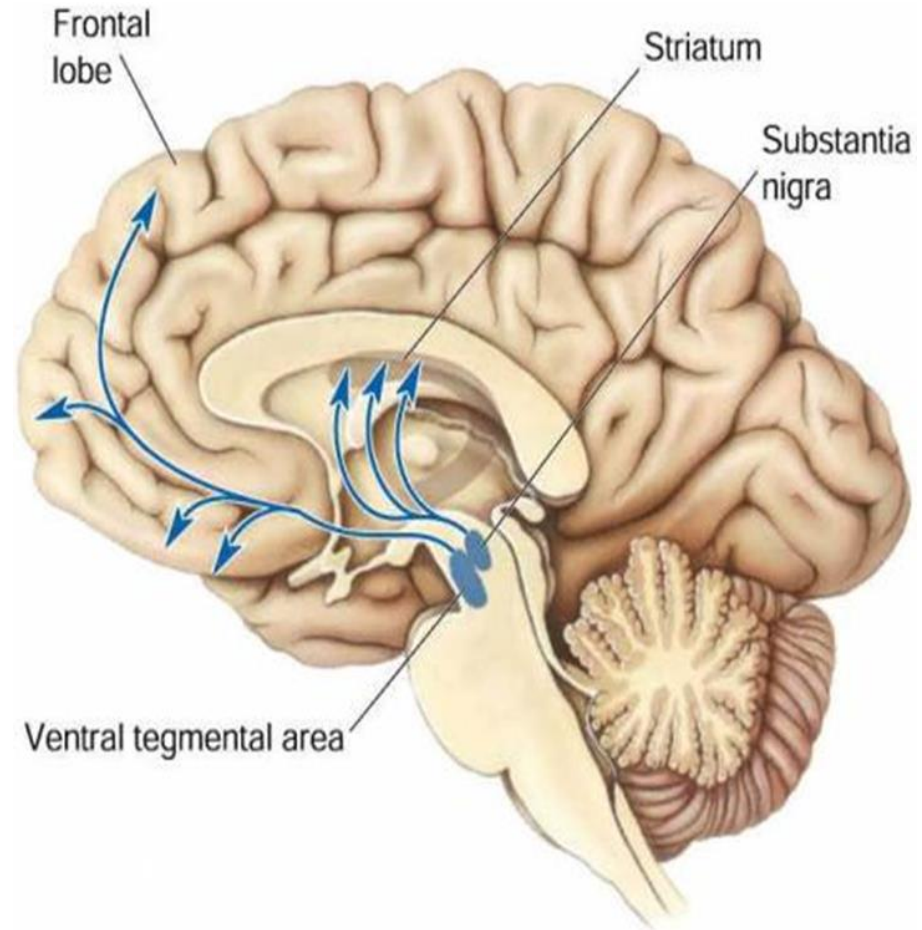
Hornung RW, et al. *Environmental Health Perspectives*, 2009; 117:1309-1312.

Lead and ADHD



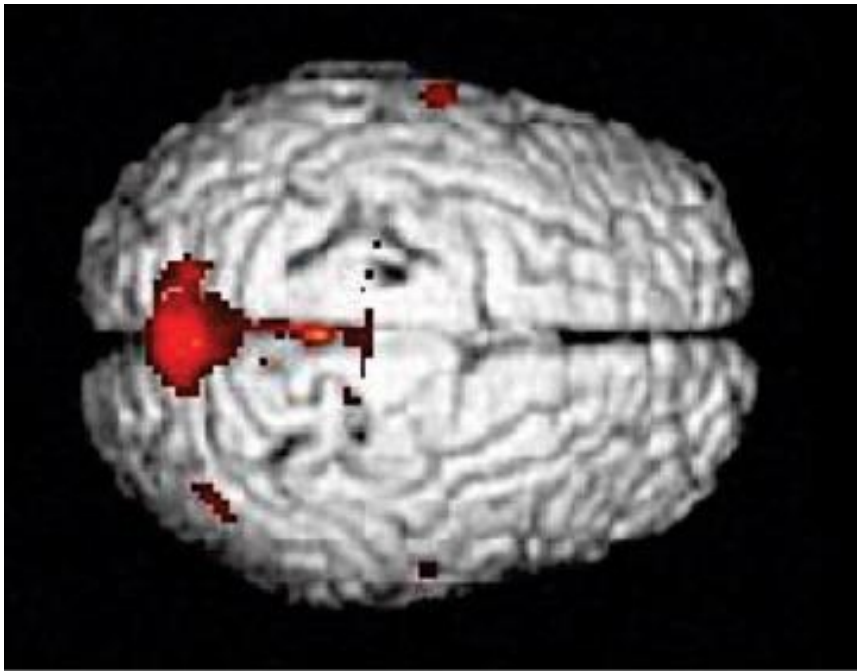
Neurobiological Mechanisms: The Mesocorticolimbic Dopamine (DA) System as a Target of Lead

- Mesocorticolimbic system:
 - ◆ Learning, executive function, attention, reward, addiction
- Nigrostriatal system:
 - ◆ Motor function, Parkinson's disease

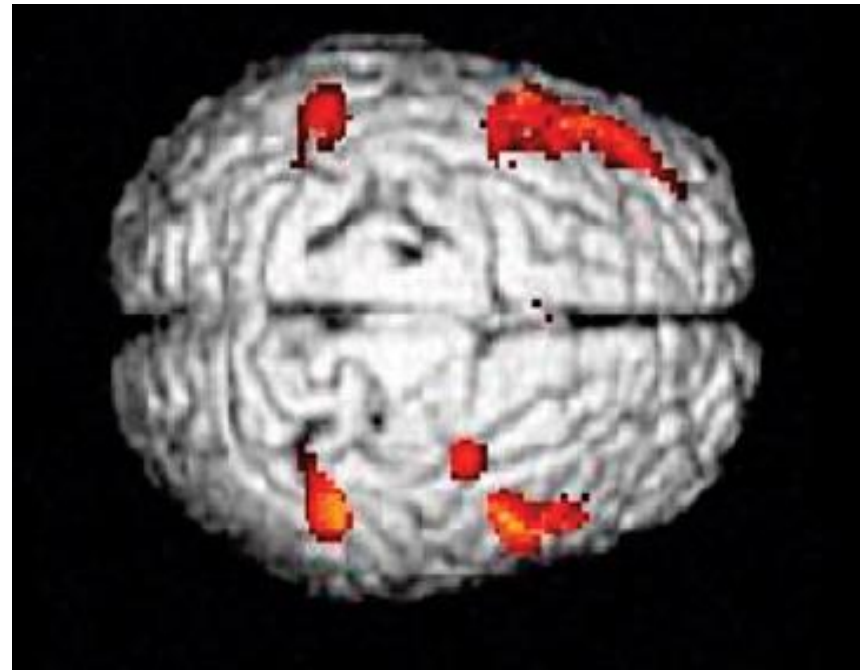


Brain Function Later in Life After Lead Exposure

Functional MRIs showing areas of brain function after tasks requiring impulse control were given to adults



Brain of an adult who was previously exposed to lead as a child

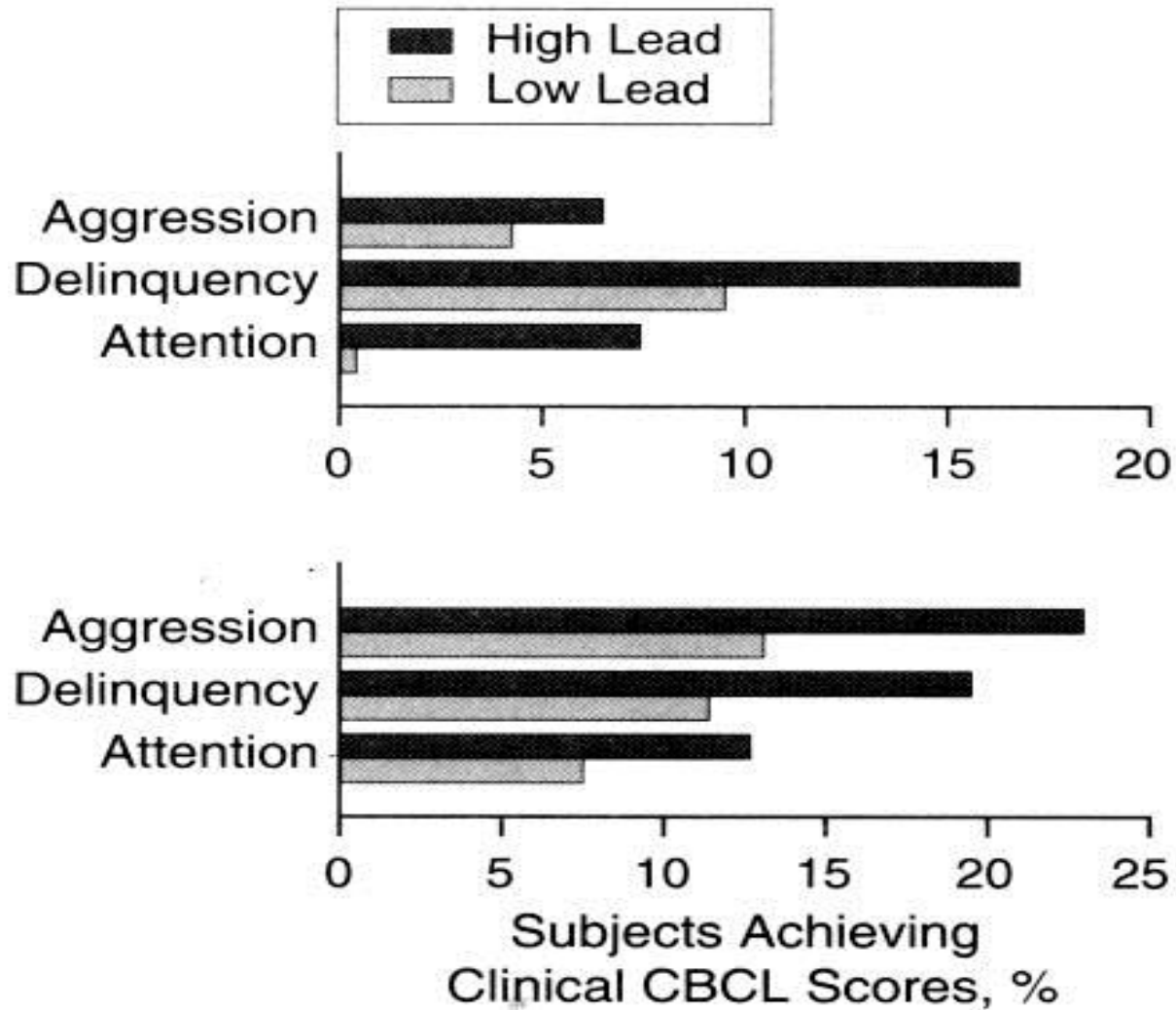


Brain of an adult who was not previously exposed to lead as a child

Does Lead Cause Anti-Social Behavior and Delinquency?



Lead Levels and Aggression, Delinquency and Attention Issues



Delinquency and Bone Lead Levels

Bone Lead Levels of Adjudicated Teens

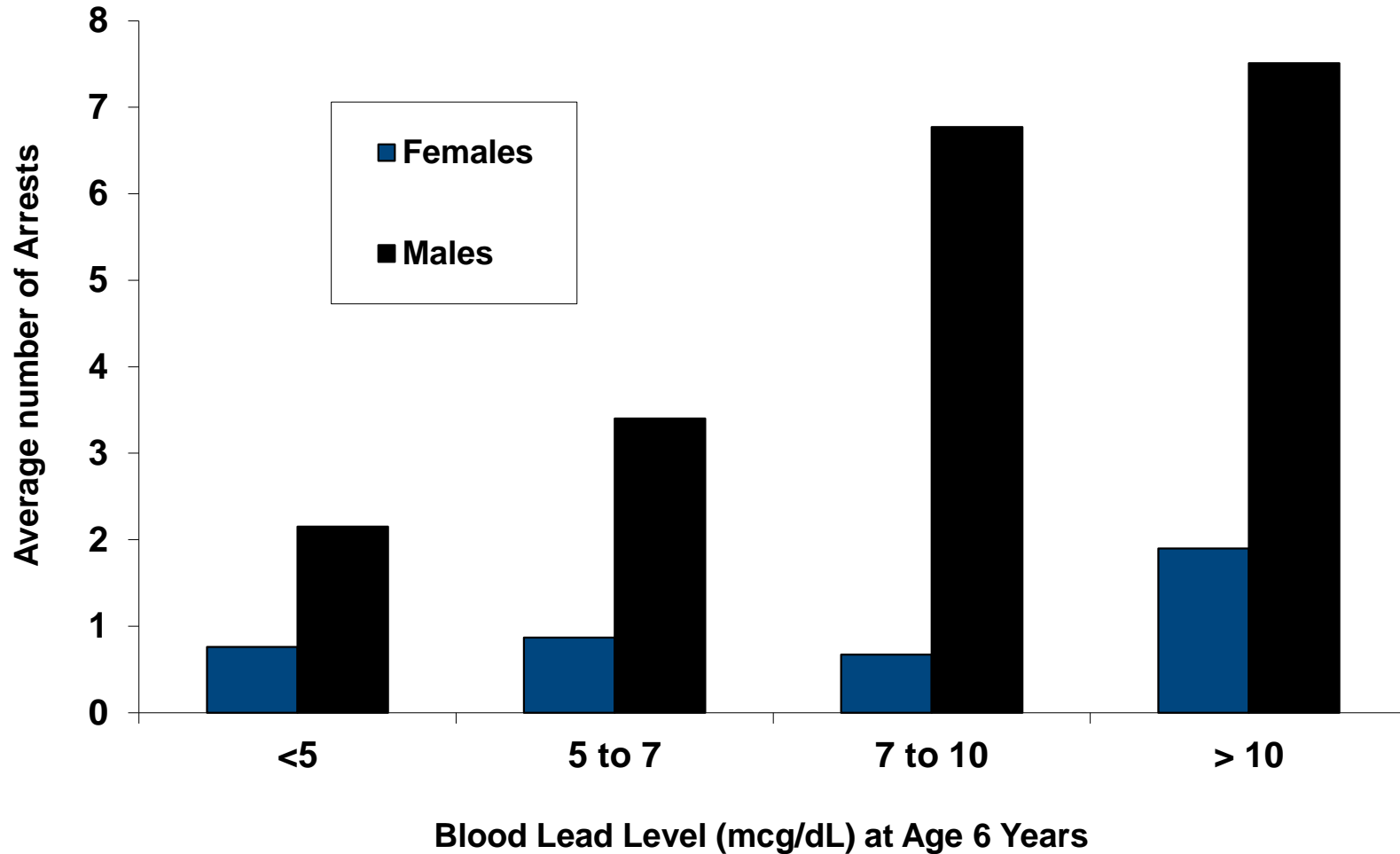
<u>Subjects</u>	<u>Cases</u>	<u>Controls</u>	<u>P-value</u>
African-American	9.0	1.5	0.05
White	20.0	3.5	0.008

Needleman HL. *Neurotox Teratol.* 2002;24:711.

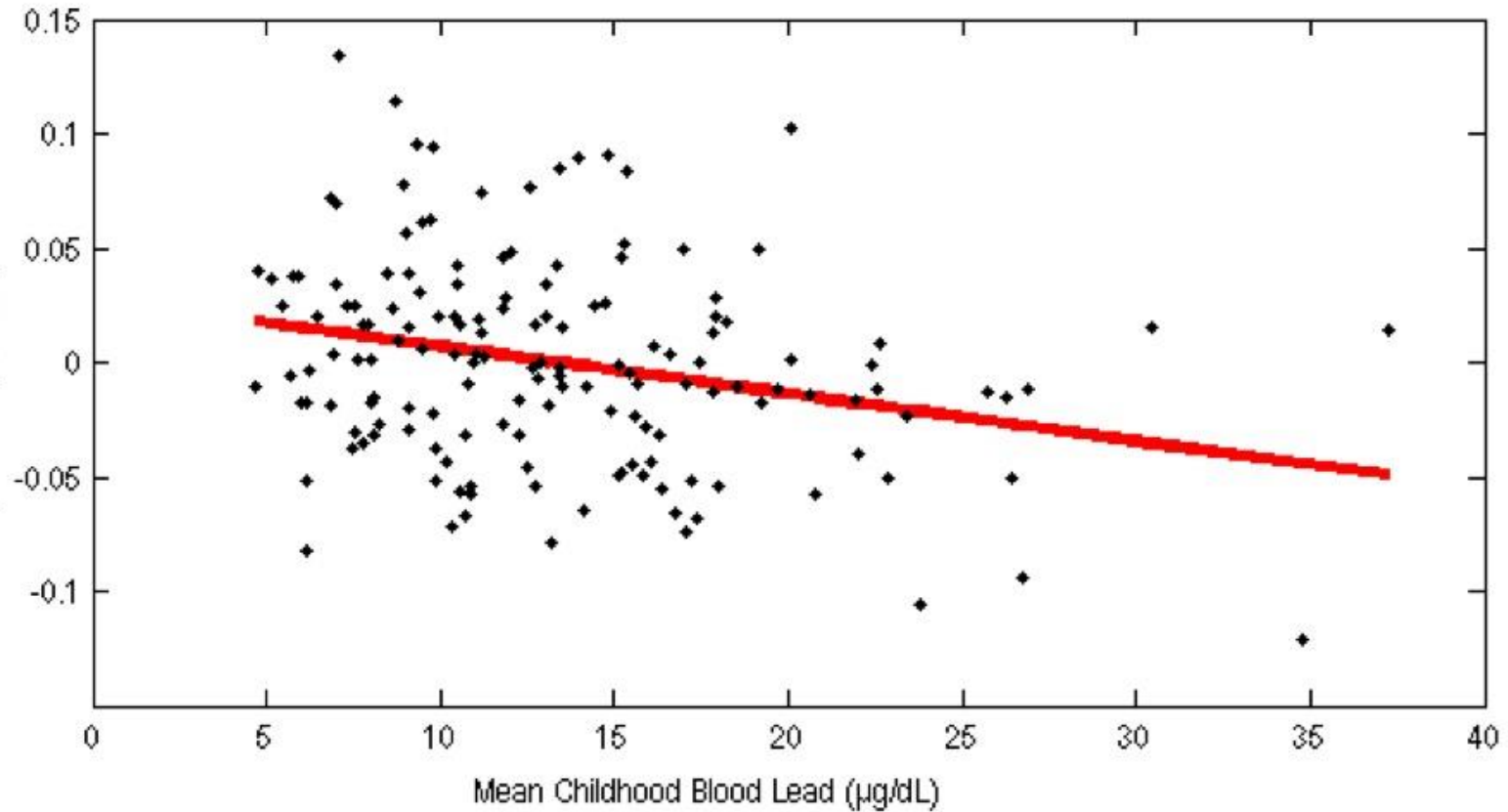
The Cincinnati Lead Study

- Prospective, longitudinal study initiated in 1979 is examining the effects of childhood lead exposure on growth and development with a particular emphasis on central nervous system outcomes.
- Data collected on exposure (blood lead levels), neurobehavior, child health, environment, and sociodemographic variables on a quarterly to yearly basis since its inception.

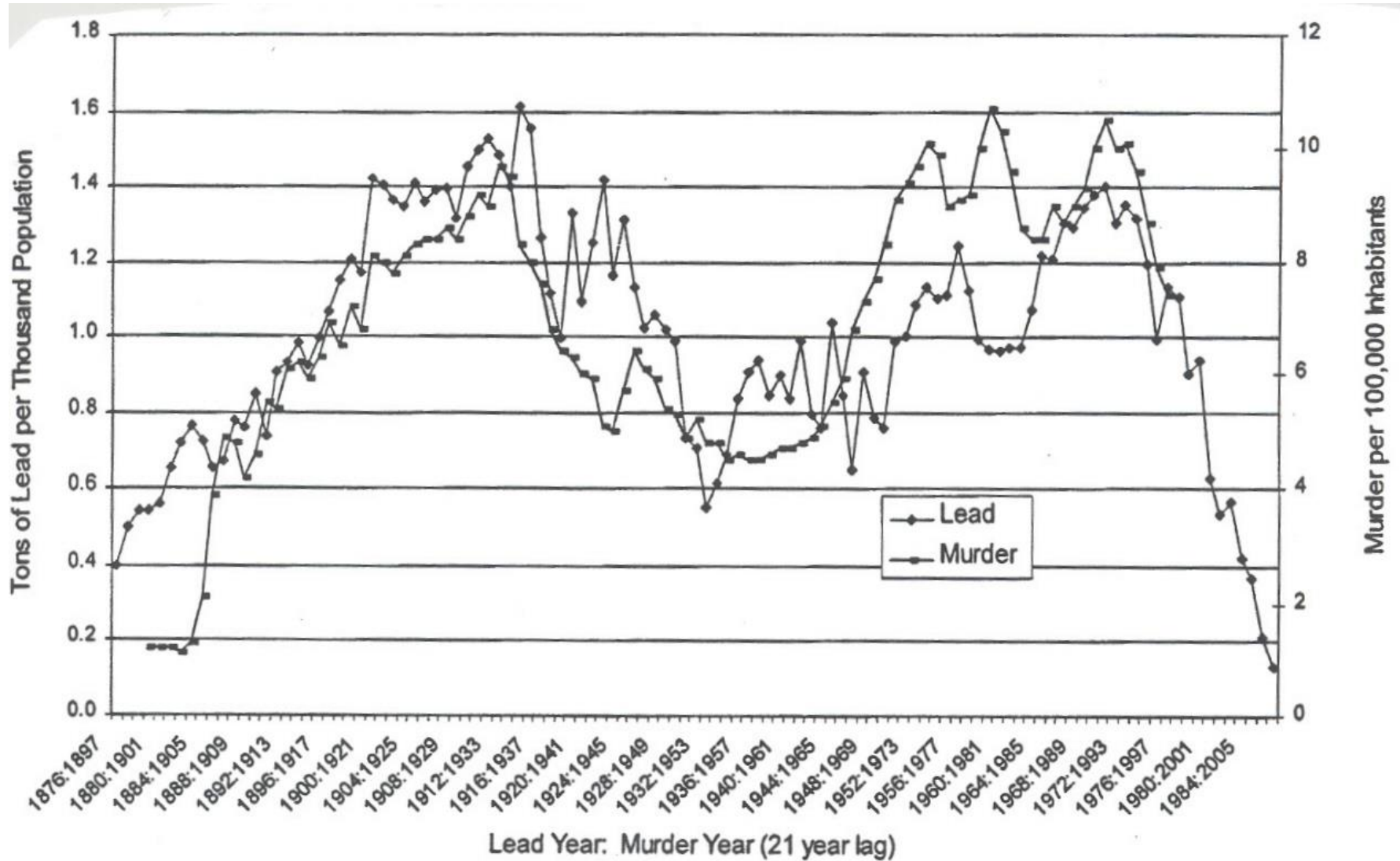
Number of Criminal Arrests by Blood Lead Levels and Sex



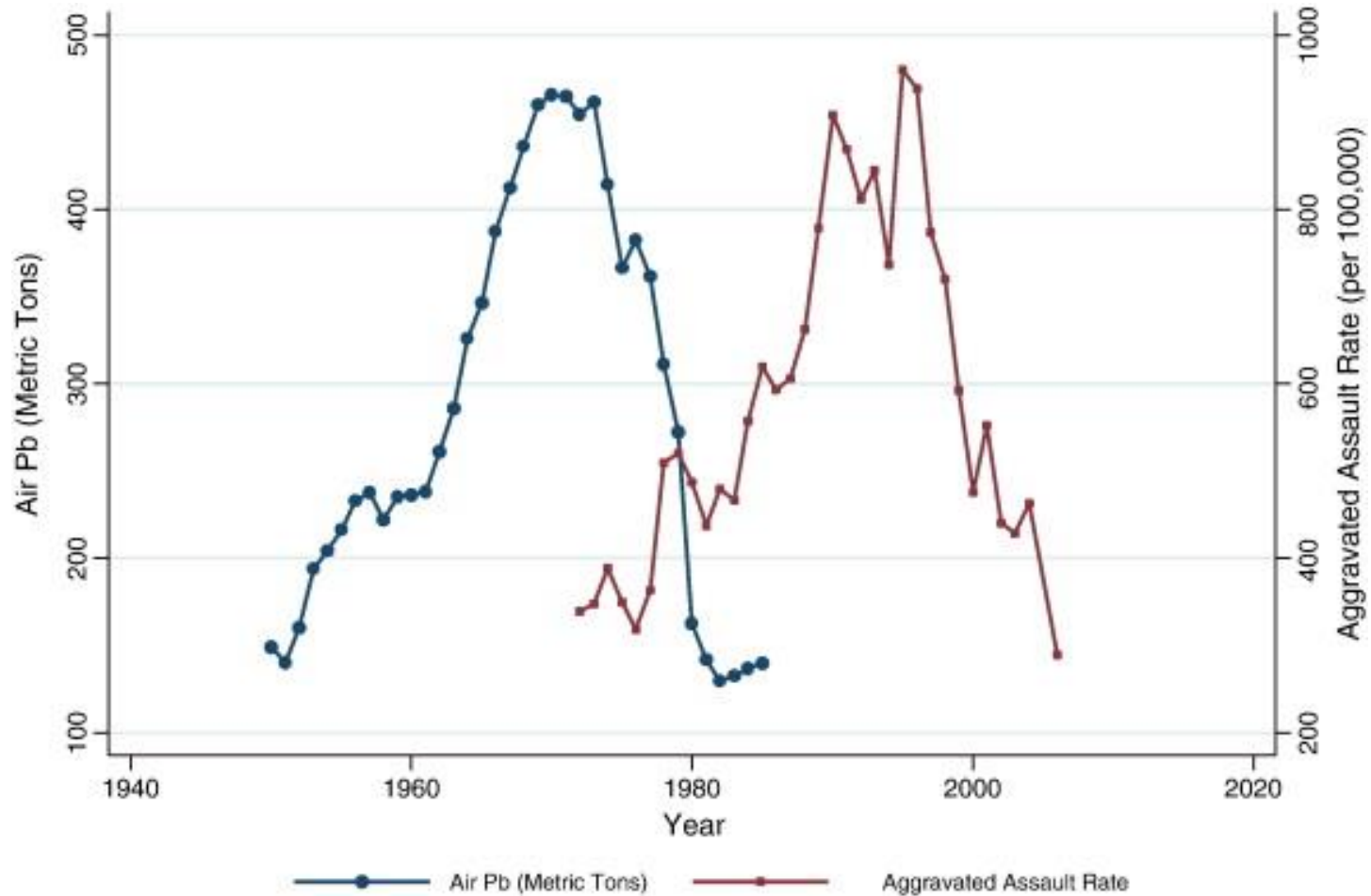
Lead-Associated Grey Matter Loss in the Adult Brain



U.S. Air Lead Concentrations and Murder Rates 21 Years Later



Air Lead Concentrations and Aggravated Assault Rates



Mielke and Zahran. *Environment International*. 2012;43:48-55.

How Are Children Exposed to Lead?

While some causes of lead exposure are easy to identify, others are not.

The Most Common Sources of Lead Exposure 15-20 Years Ago



Sources of Lead Past and Present

Sources Frequently Encountered in the Past:

Paint

Air

Soil

Sources Seen with Increased Frequency Now:

Dust

Imported Cosmetics

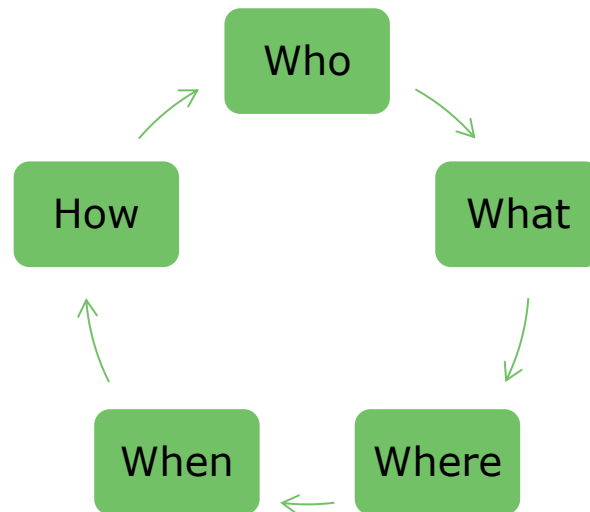
Imported Foods & Spices

Ceramic Pottery

Lead-Containing Toys

Sources of Lead – It's Not Always Obvious

- Peeling paint is now less likely to be the cause of lead exposure
- Unusual exposures now need to be considered
- Careful family histories and close observation are essential in uncovering sources of lead exposure



Case 1

A Natural Ecologic Comparison

A Triplet with Lead Poisoning

- A 25 month old triplet admitted in March for chelation because of a blood lead level (BLL) of 47mcg/dL. Sibs have BLLs of 8mcg/dL and 6mg/dL. The triplets are always together; never spend time outside of the home.
- X-ray of the abdomen shows flecks of lead in intestines
- Health department inspection finds a home in excellent condition; only hazards are on a window sash in the child's bedroom (shared with sibs) and some minor exterior violations.

Why is this child's blood lead level so much higher than those of his siblings?

- The child's crib is by the bedroom window and lead dust was found on the crib (Mom had started opening the windows when the weather got nice in early spring).
- Sibs' cribs are further from the window.
- Mom reports that this child was always later to reach gross motor developmental milestones and begin speaking later than his triplet sibs

Case 2

An Unusual Source of Lead

- 12 month old child who went for routine check-up.
- Fingertstick BLL=100mcg/dL; Repeat venous BLL=97mcg/dL
- Child immediately admitted for chelation
- Abdominal x-ray done:



Source of Exposure

- A pewter charm was removed from the child's stomach
- Its outer surface was degraded revealing an inner lead core
- Lead content of charm 'off the charts'
- Asymptomatic child; blood lead level noted by happenstance
- How would she have presented if it had not been detected then?

Case 3

An Adopted Child

- 11 month old girl adopted from an orphanage in Southern China
- Asymptomatic child evaluated by pediatrician 10 days after arrival in the U.S.
- Venous BLL=55mcg/dL
- No hazards found in the home

The Source of the Exposure

- Parents who recently adopted children from that orphanage were in contact with each other
- 2 other young children recently adopted from the same orphanage were also admitted for lead chelation (one in NYC, one in Minnesota)
- Lead smelter located in town in China where orphanage is located
- NYSDOH and CDC send out alerts about lead poisoning in children being adopted from China

Case 4

Immigrant Family

- Pregnant woman, immigrant from Eritrea, found to have BLL in 20s during her pregnancy which eventually rose to 34mcg/dL
- Umbilical cord blood lead level in newborn infant = 16mcg/dL
- Child was breastfed
- Child's BLLs subsequently rise to 27mcg/dL, then fall slowly to 6mcg/dL over 18 months

Source of the Mother's Exposure

- Health Department did home inspection – no violations found
- Parents cook with chili powder sent from Eritrea – found to contain lead
- Husband's BLLs not elevated
- Likely that mother had earlier exposure as a child

Case 5

Another Immigrant Family

- Immigrant family from Laos
- 22 month old child born in the U.S. found to have BLL=42mcg/dL
- Health Department did home inspection and obtained a careful history

Multiple Sources of Lead Found

History reveals:

- Children wear charms depicting Buddha. When using the restroom, it is the custom for them to put the charms in their mouths so Buddha cannot see what they are doing. Charms found to contain lead.



- Lead pellets for an air rifle found on porch of child's home
- Dad was taking children along to work when childcare was not available (he buys up and renovates houses). Exposed to lead there.

Case 6

One More Immigrant Family

- Family from India living in a suburban apartment complex
- Dad is a researcher at a university
- Child found to have venous BLL=17mcg/dL on routine testing at 18 months of age

Source of the Exposure

- Health department did home inspection
- Apartment complex is lead-free
- Inspector noticed child and older sib wearing eyeliner; parent explained that in Indian culture, girls begin to wear eyeliner from an early age
- Eyeliner tested – found to be high in lead (it was manufactured in Pakistan and was purchased at an Indian products store in NYC)
- Eyeliner contained kohl

Eyeliners Containing Lead From Pakistan



NYSDOH and NYC Dept. of Health and Mental Hygiene subsequently sent out alerts about these products

Case 7

A Teen With Lead Poisoning After Being Shot

- Older adolescent female shot in the face with buckshot after an argument with her boyfriend
- Admitted to ICU with major facial injuries
- Buckshot in jaw, soft tissue in angle of both carotid arteries, right ventricle, lower lobe of left lung
- BLL 1 week after admission = 21mcg/dL, subsequently rising to 32mcg/dL 3 weeks later, then 43mcg/dL 10 days after that. Teen then underwent lead chelation
- Post-chelation BLLs: 8mcg/dL, 7mcg/dL, 15mcg/dL, 20mcg/dL at weekly intervals, then subsequently rose to low 30s weeks after discharge

Follow-up

- Patient needs to have BLLs followed regularly after hospital discharge due to potential for a late rise in BLLs as a result of retained lead.
- Cases have been reported with significant symptomatic lead poisoning and even death due to lead poisoning years after firearm injuries

The Changing Face of Lead Poisoning in 2012

Lessons:

- Refugee and immigrant families and adopted children are often at particular risk due to:
 - Traditional remedies
 - Foods and cosmetics obtained from abroad
 - Cultural factors
 - Poor housing conditions
- Pregnancy can result in mobilization of lead stored in bones decades earlier
- Families can have multiple sources of exposure
- Obtaining a careful history and closely inspecting the home and its contents are important in finding sources of lead

What Should Health Providers Do?

- Educate families about the risks of lead poisoning and how to prevent their children from being exposed
- Ensure that children have diets containing adequate amounts of iron, calcium and Vitamin C
- Ask screening questions to determine if children may be exposed to lead – if so, provide them with information about how to have the child's environment evaluated for lead
- Test all children at 12 and 24 months of age; consider testing children at 18 months of age as well
- Refugee and internationally adopted children should be tested upon arrival in the U.S. and 3-6 months later
- Work closely with local health departments when dealing with children having elevated blood lead levels
- Be proactive and avoid complacency

Identifying Children with Lead Poisoning

- Why test children for lead?
- Is doing risk assessment sufficient?
- Since there is no effective treatment for lead poisoning, why bother testing children?



Call 585-256-2267

www.lead-safe-by-2010.org

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Prevention vs. Treatment



Prevent Lead Poisoning.

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Get your child tested.
Get the facts!**

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What Did the CDC's Childhood Lead Poisoning Prevention Advisory Committee Recently Recommend?

C.D.C. Lowers Recommended Lead-Level Limits in Children

By ANEMONA HARTOCOLLIS
Published: May 16, 2012

The New York Times

Thursday, May 17, 2012 Last Update: 3:48 AM ET

CDC adopts tougher rules about lead poisoning in kids

May 17, 2012 | [Comments](#)



CDC lowers lead poisoning threshold

A sixfold increase in Maryland children potentially at risk



CDC Cuts Lead-Poisoning Limit For Kids



Lead Poisoning Threshold Lowered By CDC, Five Times More Children Now Considered At Risk

THE HUFFINGTON POST

National Trends in Blood Lead Levels

	Percent of Children with Lead Levels:	
	$\geq 5\text{mcg/dL}$	$\geq 10\text{mcg/dL}$
1988-1991	31.4%	8.6%
1991-1994	20.9%	4.4%
1999-2004	7.4%	1.4%
2010	2.5%	0.6%

New Areas of Emphasis Recommended

- **Primary prevention**
- **Education of medical providers so that they can educate families**
- **Encouragement of home inspections for at-risk children prior to determining that children have blood lead levels**
- **Close follow-up of children with blood lead levels $\geq 5\text{mcg/dL}$ and communication of blood lead testing results to parents**
- **Data sharing between health and housing authorities**
- **Financing for lead hazard control**
- **Inspections for all residential units in a property when a lead hazard is found in any unit of the property**

One Major Impediment to Implementation of the Recommendations



Another Major Impediment to Implementation of the New CDC Recommendations



What's Needed Going Forward

To successfully implement primary prevention there needs to be a community focus:

- Government
- Housing authorities
- Medical providers
- Educators
- Media
- Community leaders



It's lead paint. And about 1,000 children in Monroe County are poisoned by it each year. That's three kids a day. Make sure your home is safe. Call 2-1-1 or visit www.lead-safe-by-2010.org.



Resources

- Local county health departments
- NYSDOH web site: www.health.state.ny.us/environmental/lead
- CDC web site: www.cdc.gov/cneh/lead
- EPA web site: www.epa.gov/lead or call 1-800-424-LEAD
- Rochester's Coalition to Prevent Lead Poisoning:
www.letsmakeleadhistory.org
- WNY Lead Poisoning Resource Center – 585-275-0267 or 877-352-5775

The Message That We Want to Send



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unleaded**

 U.S. Environmental
Protection Agency
EPA 747-11-98-002

For more information on preventing lead poisoning
call 1-800-424-LEAD or visit www.epa.gov/lead.

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