

Children's Health and the Environment

Lynn Goldman, MD, MPH
Professor, Bloomberg School of Public Health
Johns Hopkins University

Overview

- Children's Environmental Health
- Johns Hopkins University National Children's Study Center (Baltimore County, MD)
- Childhood Lead Poisoning and Results of Recent Study in Baltimore, MD

Protection of children's environmental health

CHILDREN ARE NOT "LITTLE ADULTS"

They are particularly vulnerable to acute and chronic effects of environmental hazards

Children are more exposed

- They breathe more air, drink more water and eat more food, pound for pound, than adults.
- Children play close to the ground, where some pollutants concentrate.
- Normal hand-to-mouth activity exposes kids to pollutants in dust and soil.

Children have different metabolism

- They may be more or less capable of breaking down, excreting, inactivating, or activating toxic substances. These differences should be taken into account.

Multiple threats

- Children in the worst environments also:
 - Are at greater risk for injuries
 - Have more exposure prenatally and during life to harmful substances like tobacco and ethanol
 - Are more likely to suffer from poverty and racism
 - Are more likely to be poorly nourished
- Environmental exposures rarely occur singly
 - For example, human biomonitoring studies find dozens of chemicals at low levels in blood, urine, breast milk
 - Interactions among numerous chemicals are poorly understood

"Vulnerability windows"

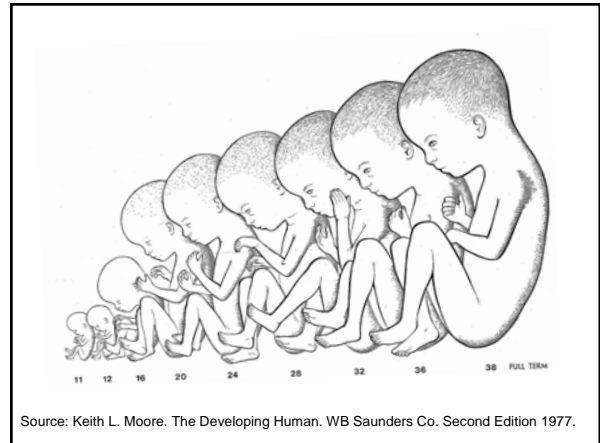
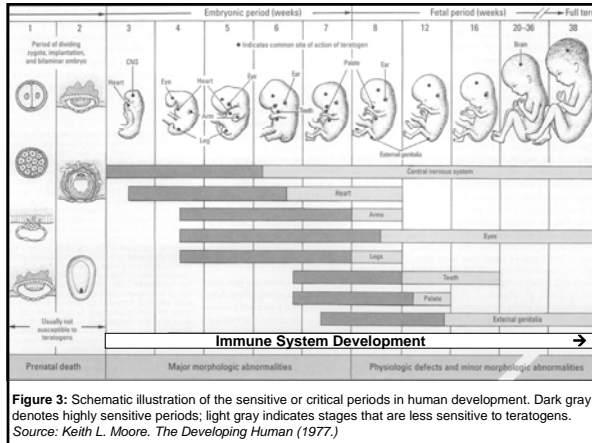
Children's CNS, immune, reproductive and digestive systems are still developing in utero and through much of childhood



Why should we care about prenatal exposures?

Vulnerable period of development

- Decreased ability of detoxification
- Rapid cell growth and differentiation
- Development of organ systems
- Development of immune system



Johns Hopkins University
 National Children's Study Center
 Lynn Goldman, Principal Investigator



Baltimore County MD Study Location
 Laura Caulfield, Principal Investigator

National Children's Study Description

•The National Children's Study is the largest study to be conducted on the effects of environmental and genetic factors on child and human health in the United States. The study will follow a representative sample of 100,000 children from before birth to age 21, seeking information to prevent and treat some of the nation's most pressing health problems, including autism, birth defects, diabetes, heart disease, and obesity.

Study Rationale: Converging factors

- Increased vulnerability to environmental exposures among children
- Exposures to some agents (lead, alcohol) have caused serious developmental effects
- Known current exposures of high frequency—pesticides, toxics, violence
- Conditions with possible environmental cause—autism, birth defects, diabetes, learning disabilities

Study Concepts

- Aims
 - Identify potential environmental effects: harmful, harmless, helpful
 - For important conditions and diseases of children, identify potential preventable causes
- Hypothesis driven
- Exposure begins with pregnancy
- Has power to study high priority conditions (n~100,000)
- Gene environment interactions
- National resource for future studies

National Children's Study Locations



Study Design

- In the first stage of sampling 105 locations were selected as the geographic areas from which participants will be recruited
- The second stage will sample from each demographic stratum in each location
- The primary method of recruitment is through household screening
- We will recruit subjects (mothers, fathers) prior to conception and (infants) after birth
- Data collection will follow a standard protocol

Schedule for Hopkins Study Center

- November 2007: Hire community liaison, develop primary sample, community engagement plan, historical birth data
- December 2007: Hire hospital negotiator, form advisory committee
- June 2008: Complete OMB and IRB approvals for protocols, begin to negotiate hospital agreements and secondary IRBs, begin preparations for data collection
- October 2008: Begin to hire Battelle fieldwork staff
- June 2009: Begin recruitment, women already pregnant in first trimester and women who may become pregnant over the next three years
- January 2010: First birth. Project 250 births/yr X 4 yr

Lead Health Hazards

- Multiple systems:
 - Brain
 - Kidneys
 - Growth
- Depend on level and chronicity of exposure



Lead Health Hazards

LEAD ENCEPHALOPATHY (BLL > ~60 mg/dL)

Acutely, headache, anemia, abdominal pain, loss of appetite, constipation, clumsiness, agitation, decreased activity and drowsiness. If untreated, this may progress to vomiting, stupor, convulsions and death. Over time, there is risk of severe cognitive impairment.

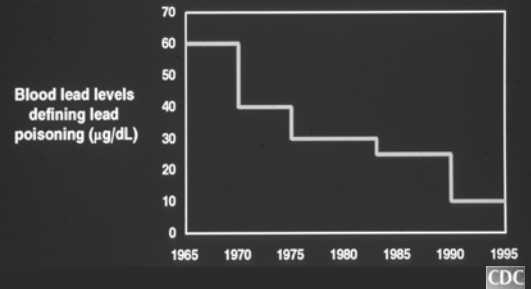
MODERATE LEAD TOXICITY (~25 mg/dL - ~60 mg/dL)

Acutely, anemia, mild behavioral change, and constipation. Over time, decreased IQ and increases in undesirable classroom behavior, decreased academic achievement and increases in aggressive and delinquent behaviors.

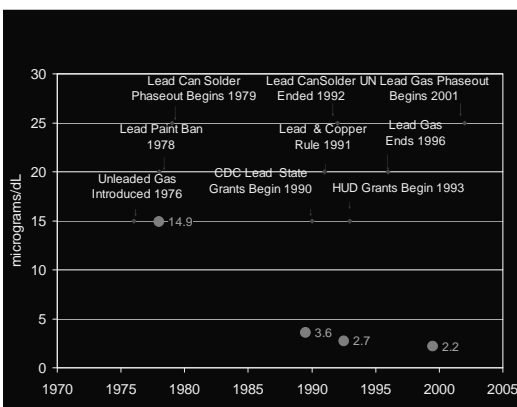
SUBCLINICAL LEAD TOXICITY (BLL ~10--25 mg/dL)

On an population wide basis, in epidemiological studies, the following are observed: decreased stature, diminished hearing acuity, elevated blood pressure, and lowered IQ scores. There may not be a threshold for these effects.

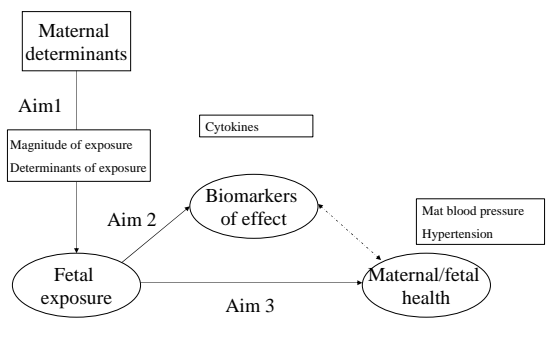
Human studies using blood lead as the measure of exposure have found health effects at lower and lower blood lead levels



Childhood Blood Lead Levels, US NHANES, geometric mean



THREE Study Overview



Study Hypotheses (to Date)

To describe the determinants of lead cord blood levels

Hypothesis: Demographic, geographic, and medical factors are determinants of lead exposure

Specific Aim 2:

To assess association between lead levels and health outcomes

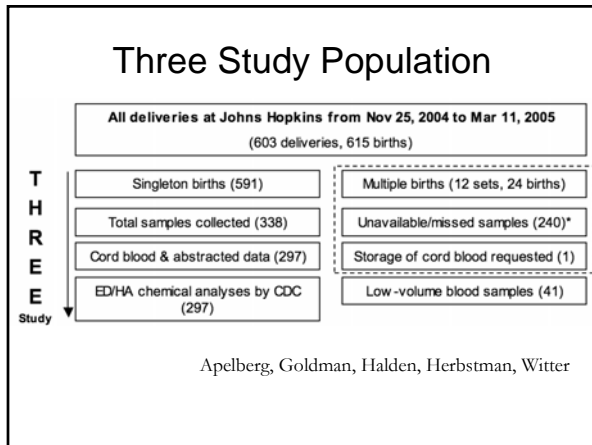
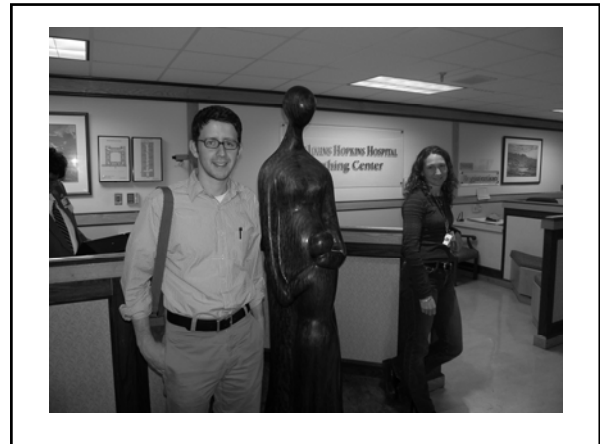
Hypothesis: Increased cord serum levels of lead are associated with increased maternal blood pressure

Methods



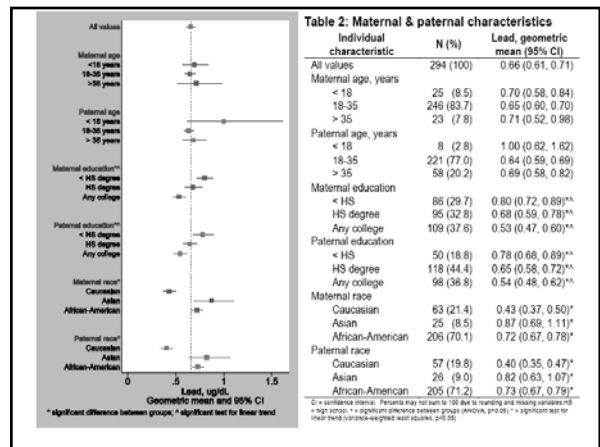
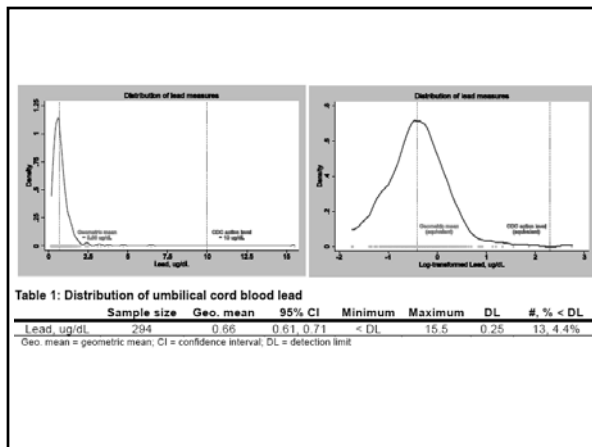
The Baltimore THREE study is designed to investigate prenatal exposure to environmental chemicals and how this may affect newborn growth and development.

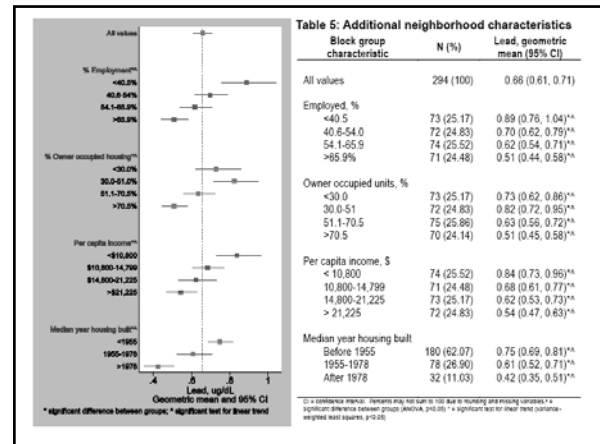
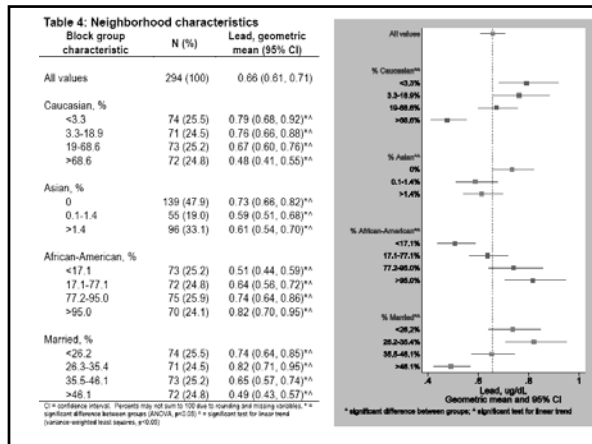
- Cord blood was collected from a cohort of babies delivered at the Johns Hopkins Hospital
- Eligibility: All singleton births
- Collection period: 11/26/04 to 3/17/05
 - Until 300 samples with sufficient quantity and quality were obtained
- Cord blood collected by nursing and house medical staff and processed by THREE study staff.
 - JHSOM Institutional Review Board
 - JHH Maternal and Fetal Research Committee
 - Maryland DHMH Institutional Review Board
- Medical records were abstracted
- Cord blood was analyzed:
 - Quest: Thyroids
 - CDC: PCBs and PBDEs



Study Population Characteristics

Characteristic	Value	N (%)
Maternal Age	<18 years	24 (8.2)
	18-35 years	246 (84.0)
	>35 years	23 (7.8)
Race/Ethnicity	White	60 (20.5)
	Asian	25 (8.5)
	Black	208 (71.0)
Education	<HS diploma	86 (29.8)
	HS diploma	96 (33.2)
	1-4 years college	65 (22.5)
	5+ years college	42 (14.5)
Body Mass Index	Underweight (<18.5)	16 (5.6)
	Normal (18.5-24.9)	132 (46.6)
	Overweight (25-29.9)	64 (22.6)
	Obese (30+)	71 (25.1)
Primiparous	Yes	171 (58.4)
Marital Status	Unmarried	196 (66.9)
Smoker	Active	55 (18.8)
Delivery Mode	Vaginal	228 (77.8)
Infant Gender	Male	162 (55.3)





Predictors of cord blood lead in multivariate models

- Individual attributes: race (black, asian), smoking, > 3 living children and increased PbB
- Neighborhood attributes: % homes on block built prior to 1955, low percent of adults in neighborhood employed (<40.5%), and increased PbB

Findings to Date on Blood Pressure

- Relation between higher blood leads and higher blood pressures at admission and maximum blood pressure during labor and delivery
- Consistent with earlier studies but blood leads generally are lower
- Further studies underway:
 - Additional analyses of lead and neighborhood attributes
 - Additional analyses of lead and blood pressure
 - Lead and micronutrients (copper and selenium) and cord blood cytokine levels

Conclusions

- Generally low levels of lead in cord blood (consistent with observation that blood leads increase rapidly in the first 1-2 years of life)
- Most vulnerable population is minorities, living in older houses in lower income neighborhoods
- Even at fairly low levels of blood lead evidence for a small but significant impact on maternal blood pressure

Acknowledgements

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