

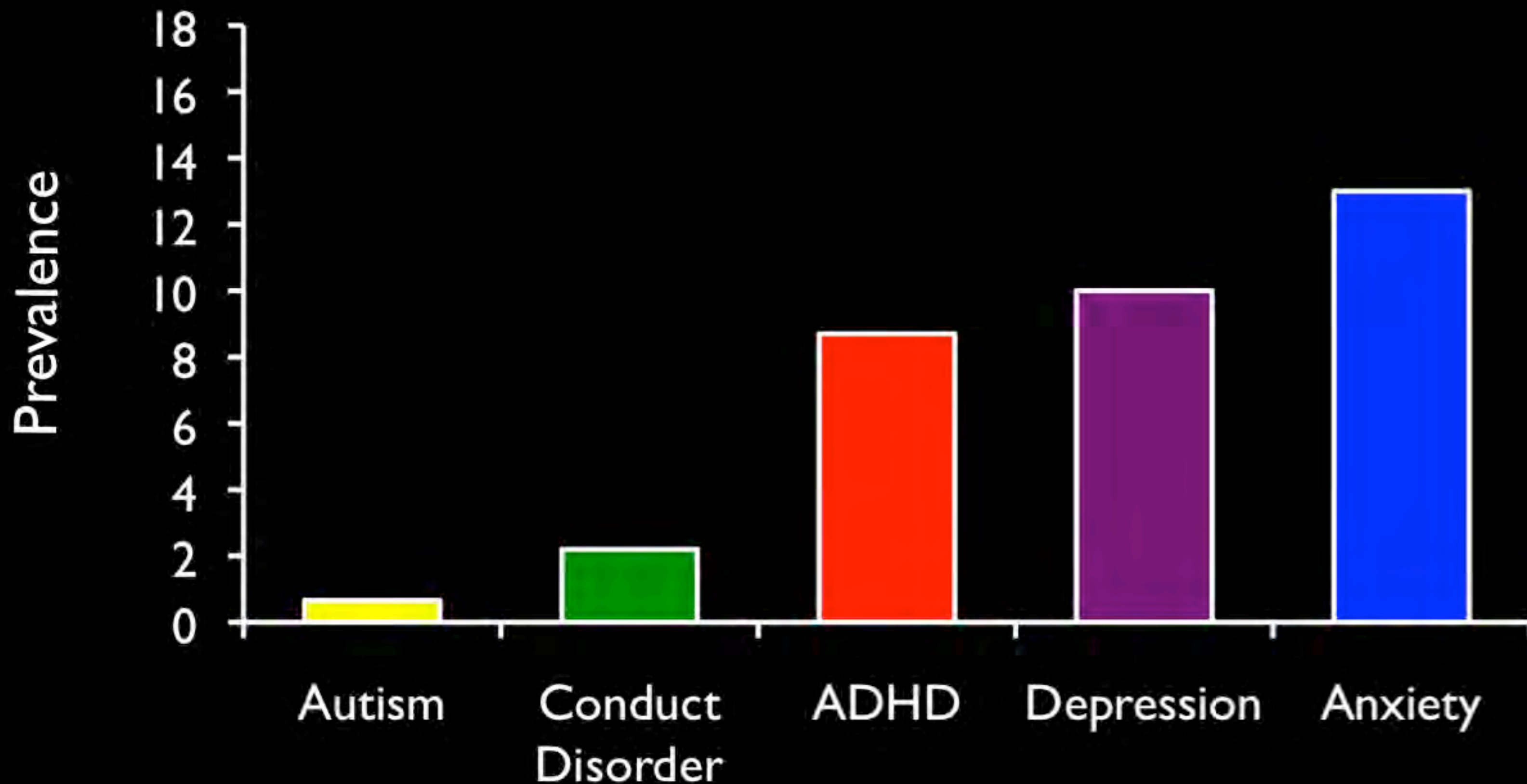
Little Things Matter



The Impact of Toxins on the Developing Brain

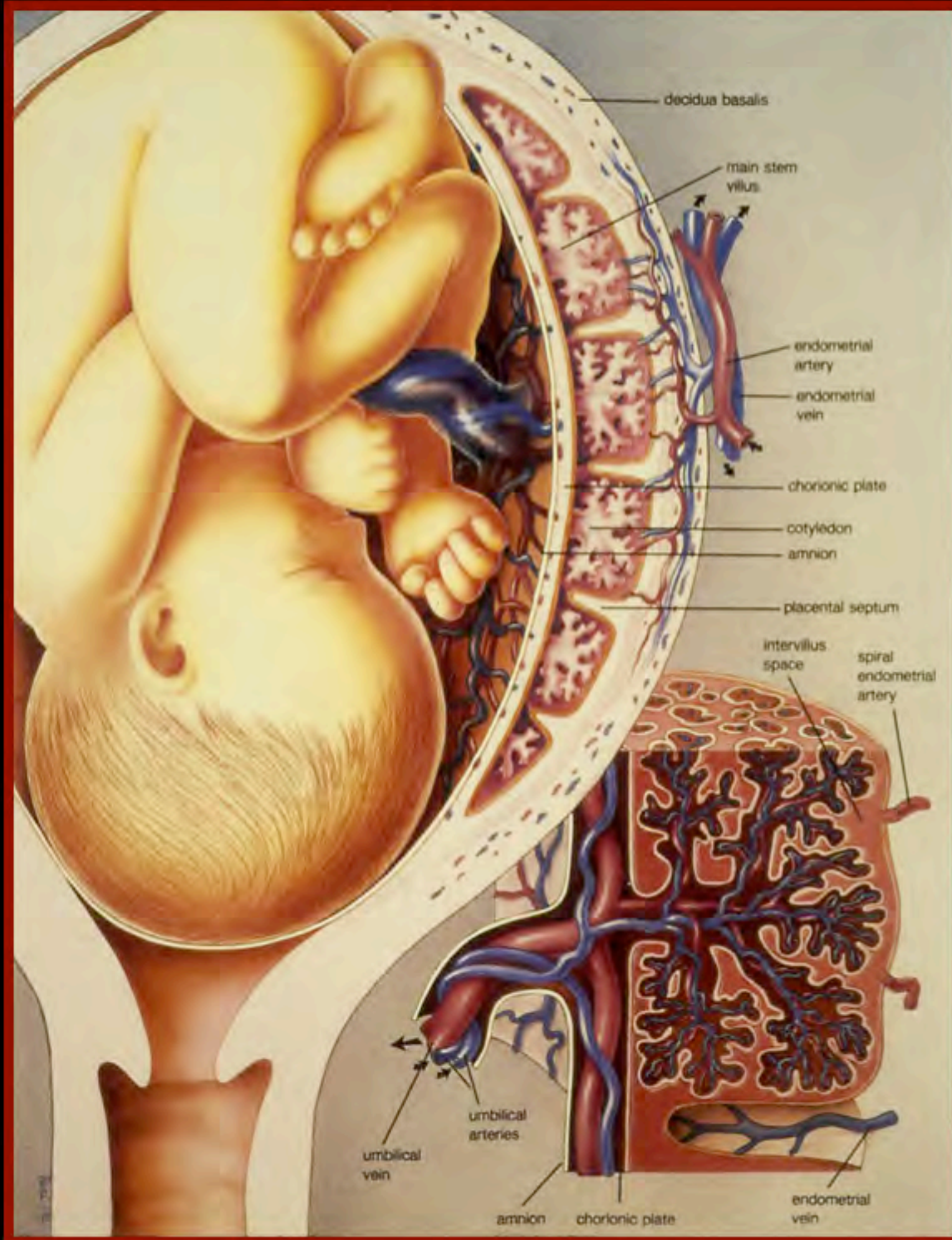
Bruce Lanphear, MD, MPH
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Faculty of Health Sciences, Simon Fraser University

Brain-based Disorders in Children



Boyle C, et al. Pediatrics 1994;93:399-403; Froehlich T, et al. Arch Ped Adolesc Med 2007;161:857-864; Braun J, et al. Environ Health Perspect 2008;116:956-962; Kovacs M. J Child Psychology Psychiatry 1997;38:287-298; Shaffer D, et al. J Am Acad Child Adolescent Psychiatry 1996;35:865-877.

Factors that Impact Brain Development



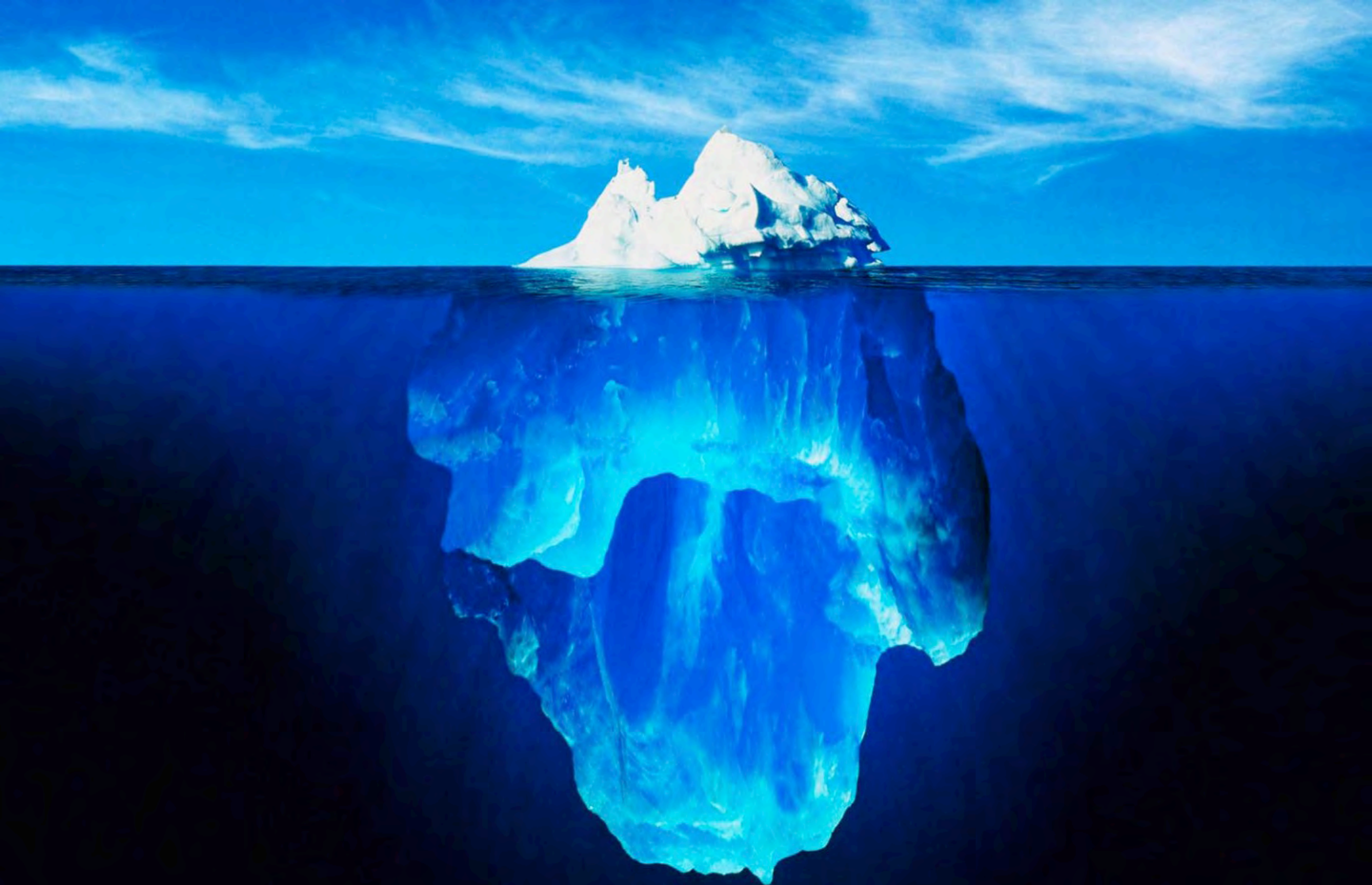
- Sex
- Nutrition
- Preterm Birth
- Social Stressors
- Built Environment
- Maternal Depression
- Genetic Susceptibility
- Preschool Attendance
- Environmental Toxins

Environmental Toxins

- Most recognized toxins were discovered only as a result of an environmental disaster
- Increasing evidence linking toxins with disease and disability at levels previously thought to be safe
- Need to revise regulations and reduce exposures to environmental chemicals and toxins

Environmental Disasters





... are just the tip of the iceberg



BodyBurden

The Pollution in Newborns

A benchmark investigation of industrial chemicals, pollutants, and pesticides in human umbilical cord blood

Vulnerability of the Developing Brain

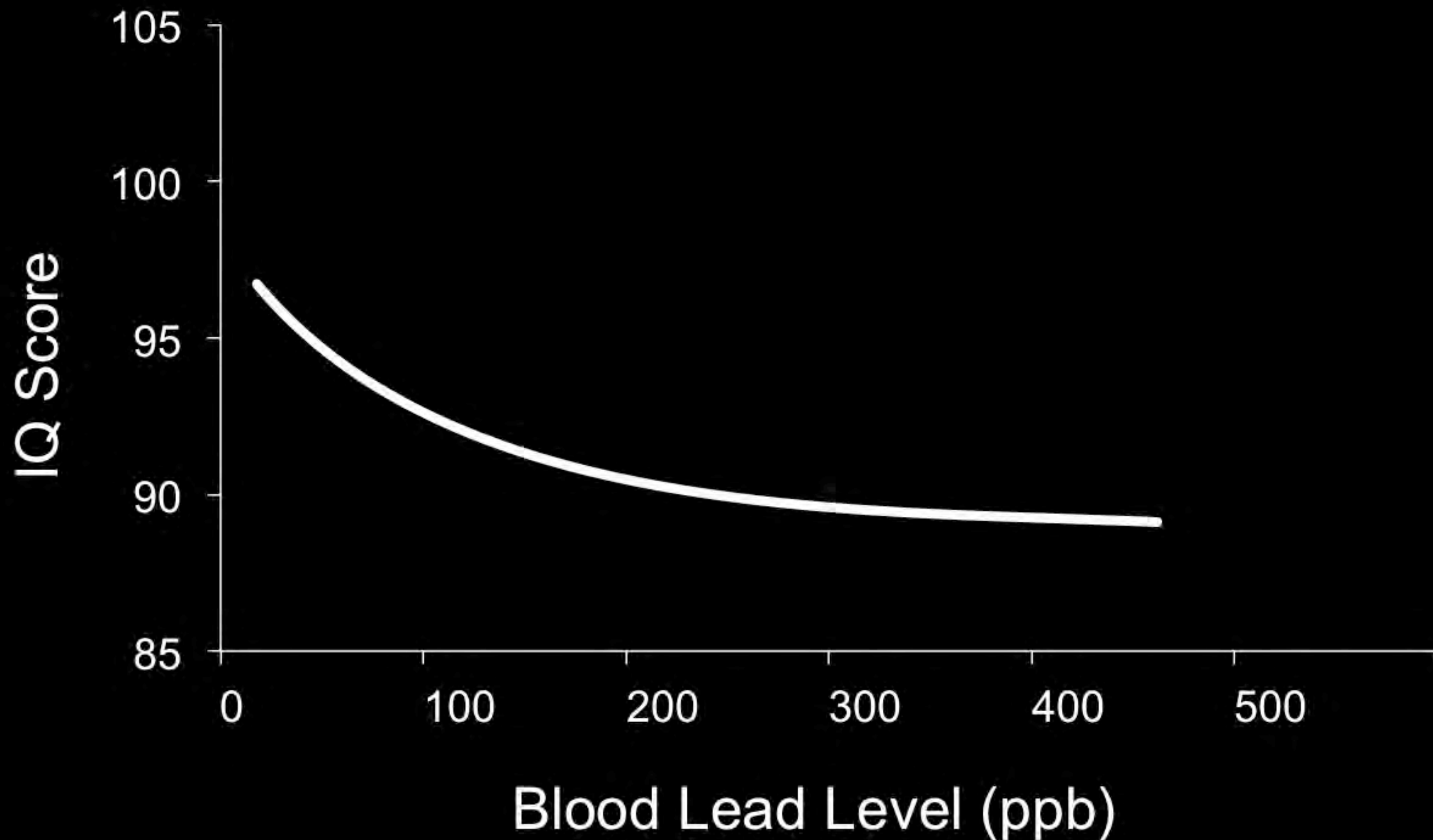
- The blood brain barrier isn't fully formed; it is more permeable to toxins
- Rapidly growing cells are often more vulnerable to toxins than slowly growing cells
- Brain growth occurs over a longer duration than other organs
- The fetus and child may lack enzymes to detoxify contaminants
- Young children often more heavily exposed to contaminants than older children and adults

Key Questions about the Impact of Toxins on the Developing Brain

- Is there evidence of a threshold?
- Do toxins differentially impact males or females?
- Are there windows of vulnerability?
- Are there cumulative or joint impact of toxins on brain development?
- Do some toxins increase the risk for developing brain-based disorders?

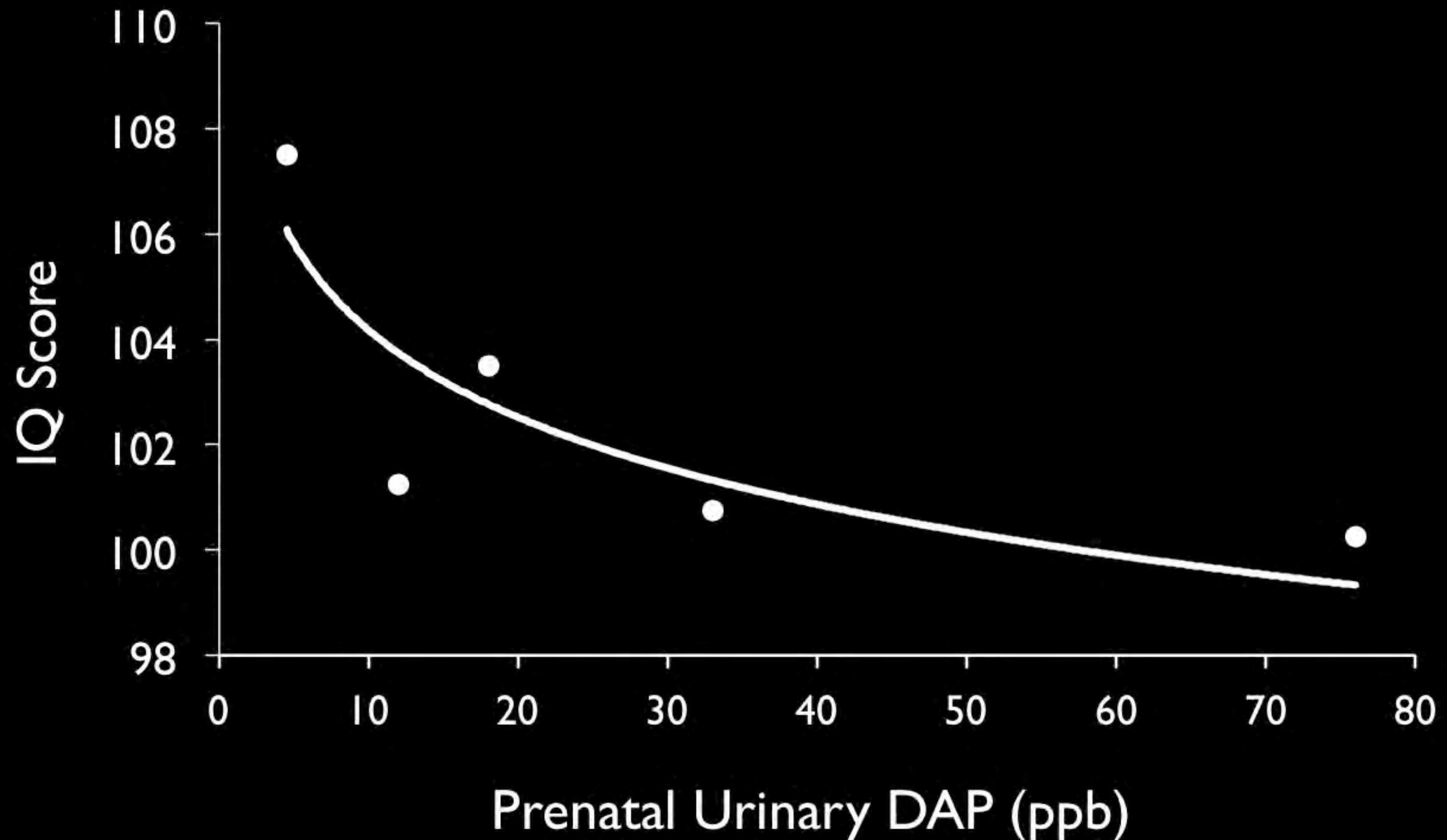
The Ongoing Search for a Threshold

Lead Toxicity and IQ Deficits

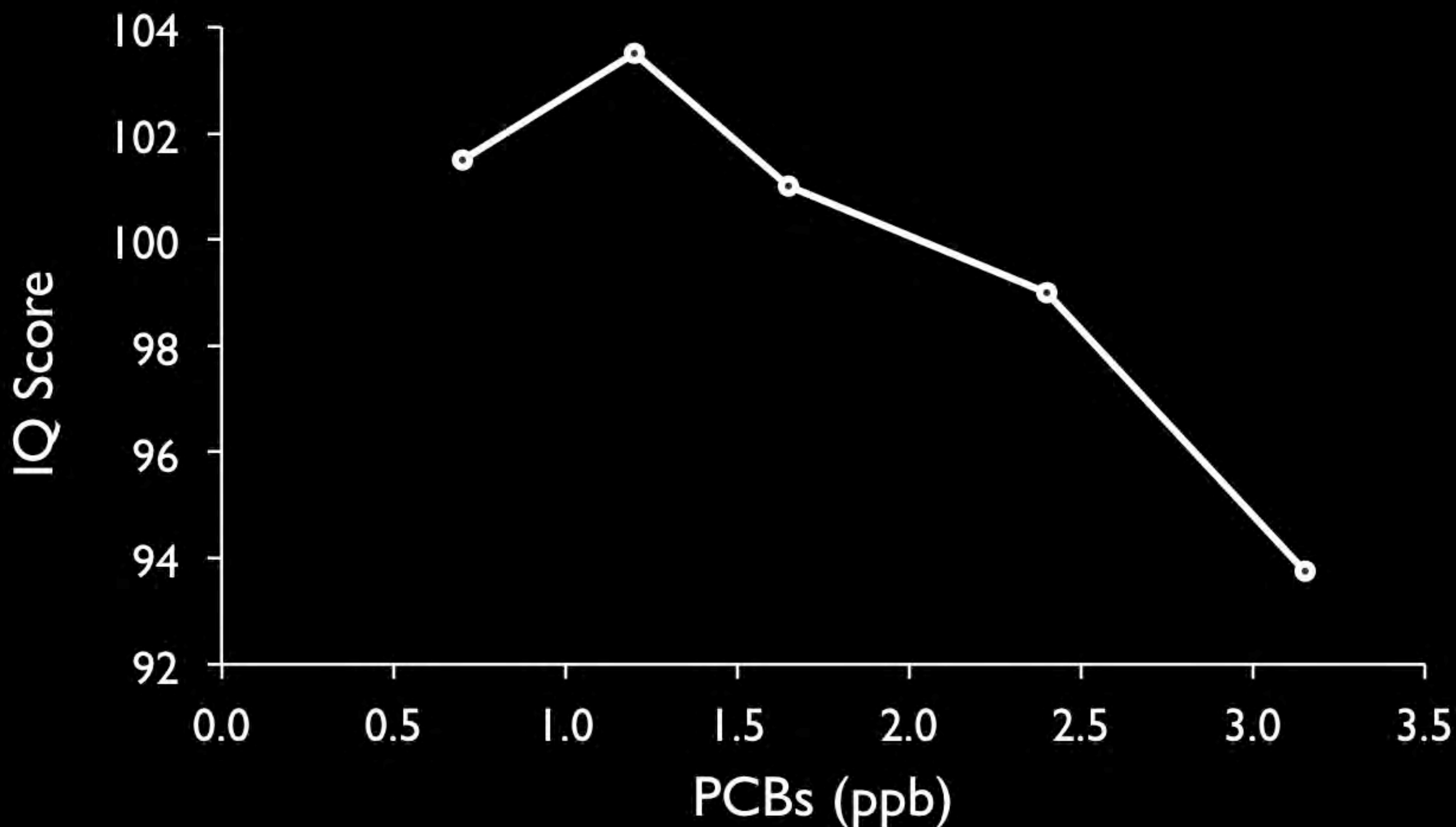


No Acceptable Level?

Prenatal OP Pesticide Exposure and IQ Scores in 7-year old Children

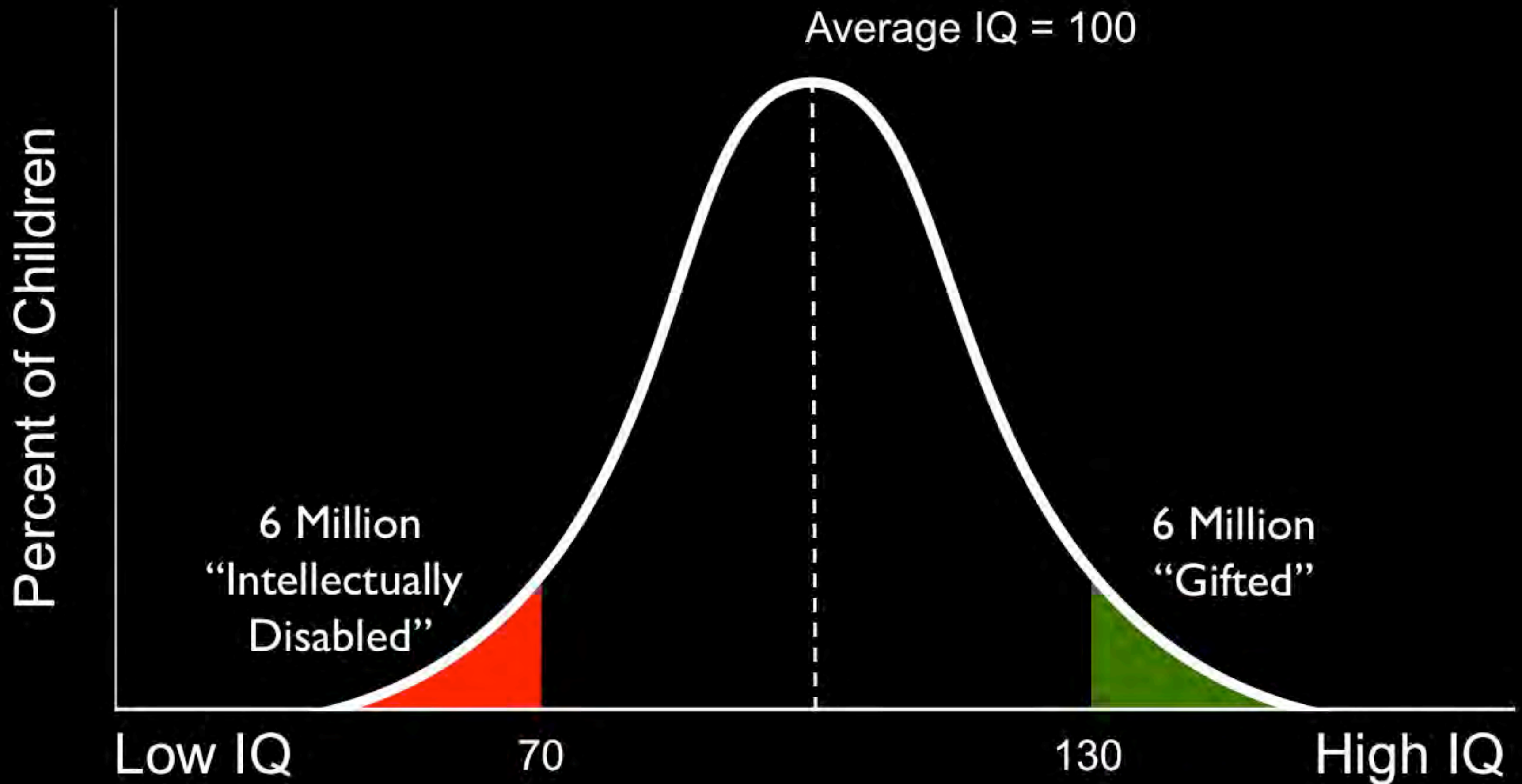


Prenatal PCB Exposure and IQ Scores in 9-year old Children



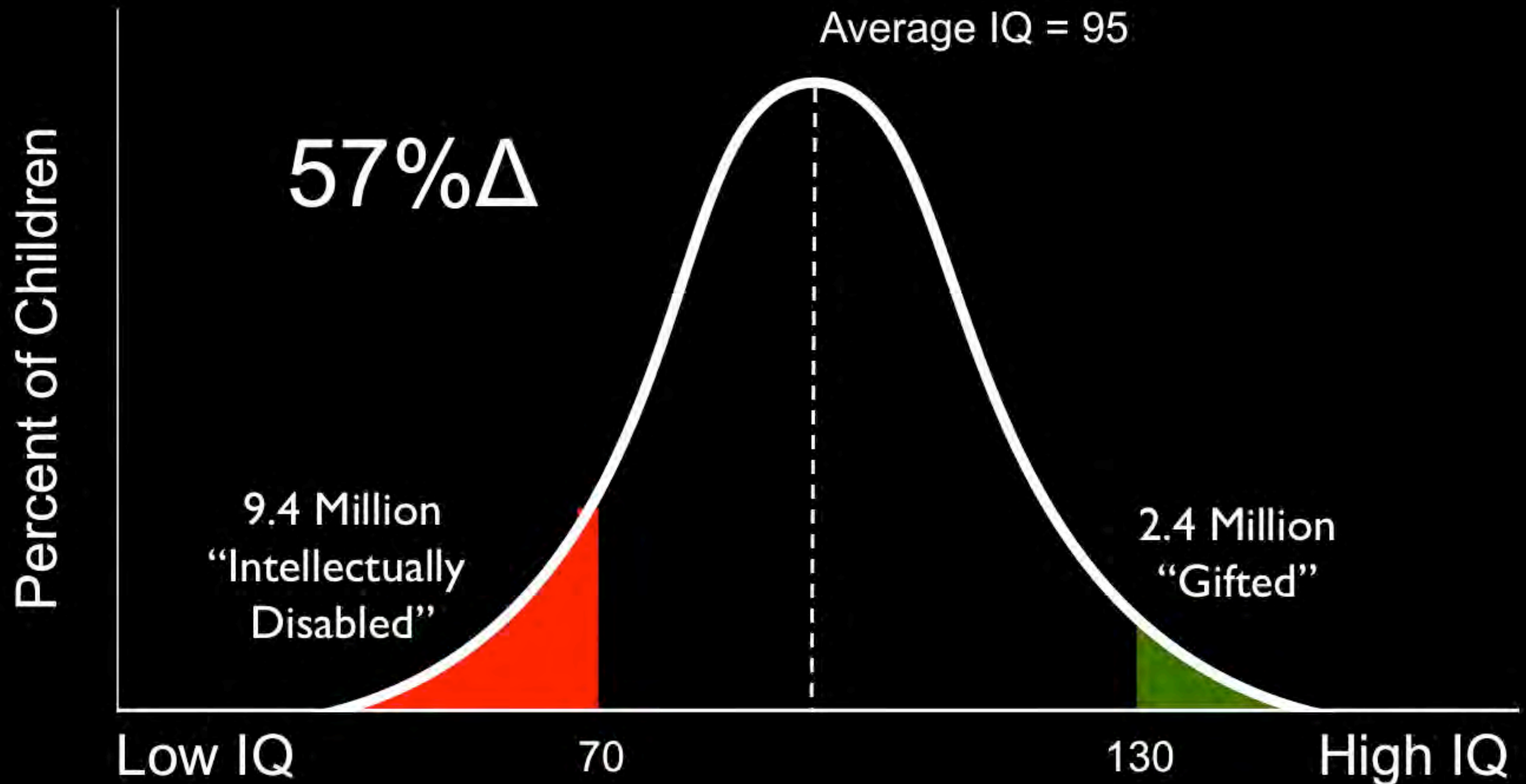
Little Shifts Matter

Little Shifts Matter



Adapted from Gilbert S, Weiss B. Neurotoxicology 2006;27:693-701

Little Shifts Matter

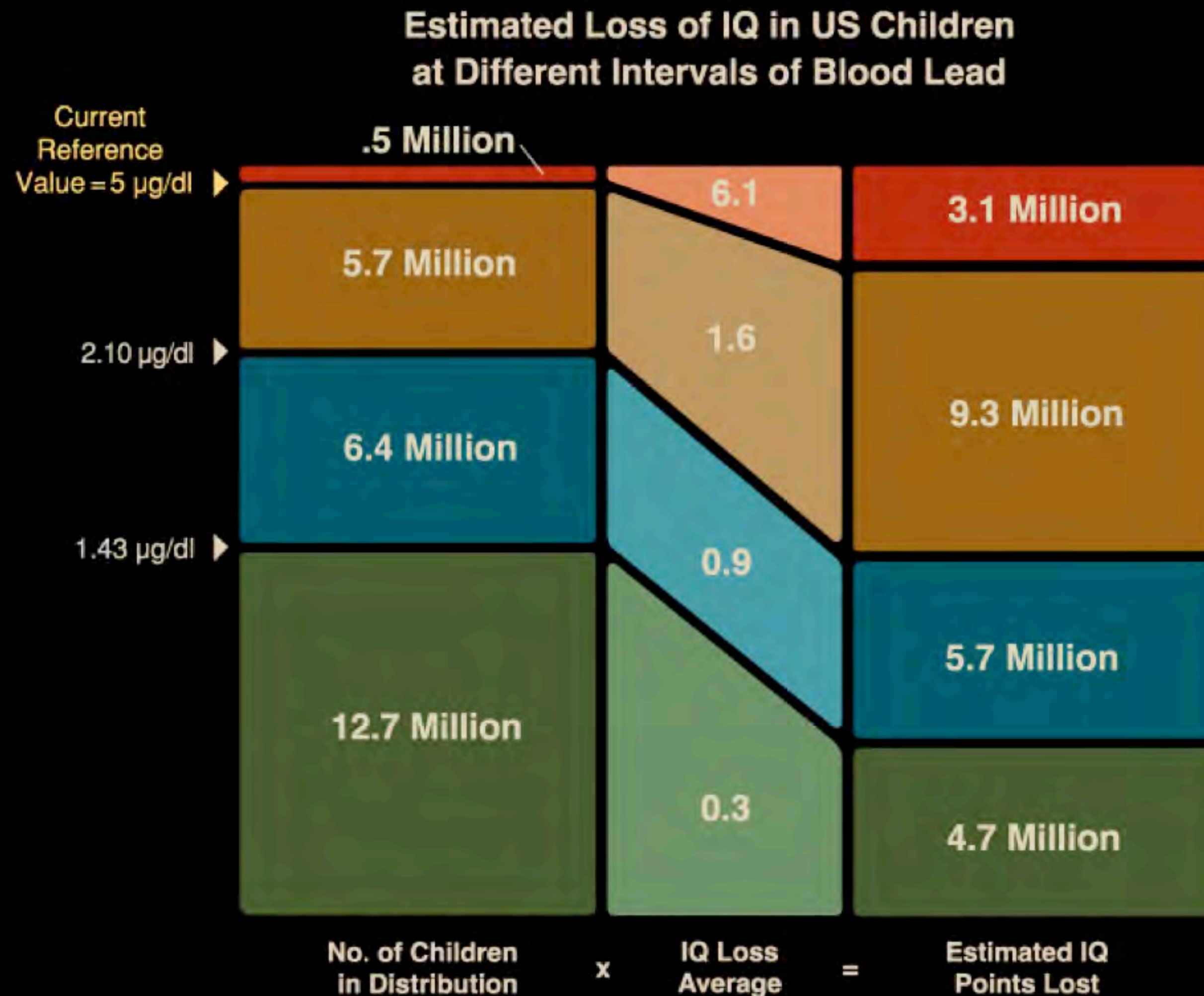


Adapted from Gilbert S, Weiss B. Neurotoxicology 2006;27:693-701

The Prevention Paradox

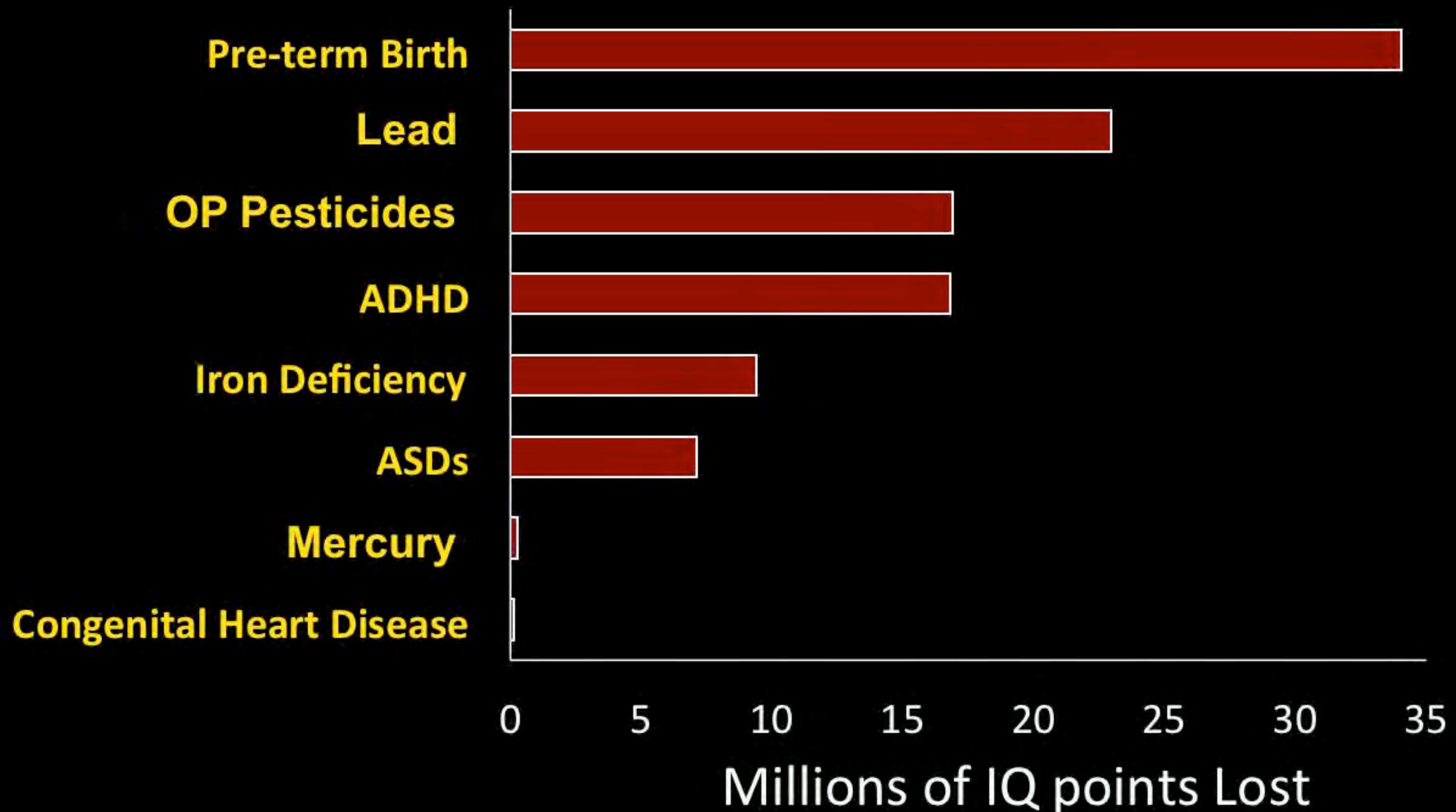
The majority of disease and disability occurs in those who are at low to moderate risk

The Prevention Paradox



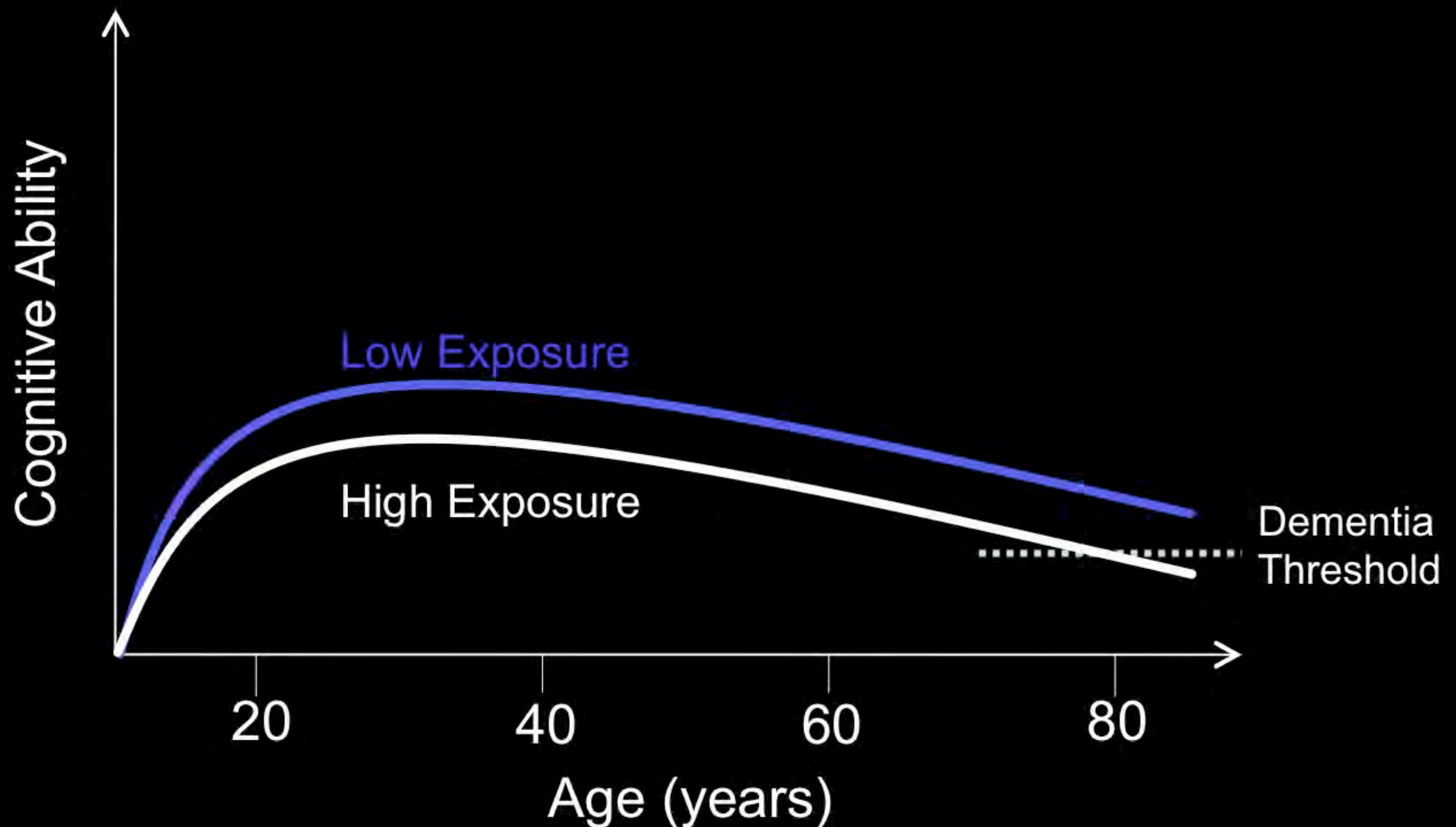
Using the current reference value of 5 g/dl we will only protect 3.1 million IQ points (about 18% of the total). Adapted from Bellinger D. EHP 2011;120:501-507.

IQ Loss for Various Risk Factors

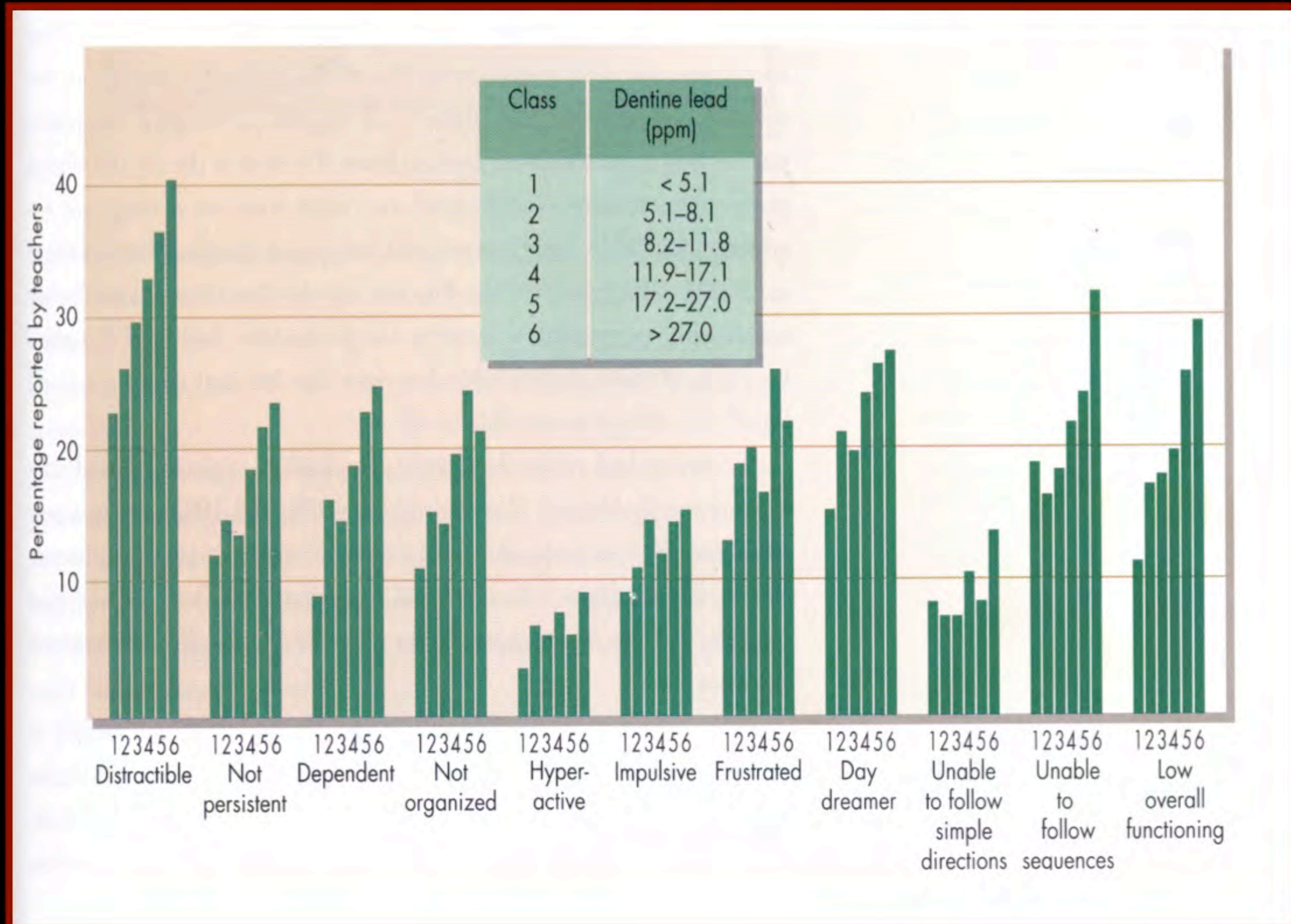


Disease over the Life Course

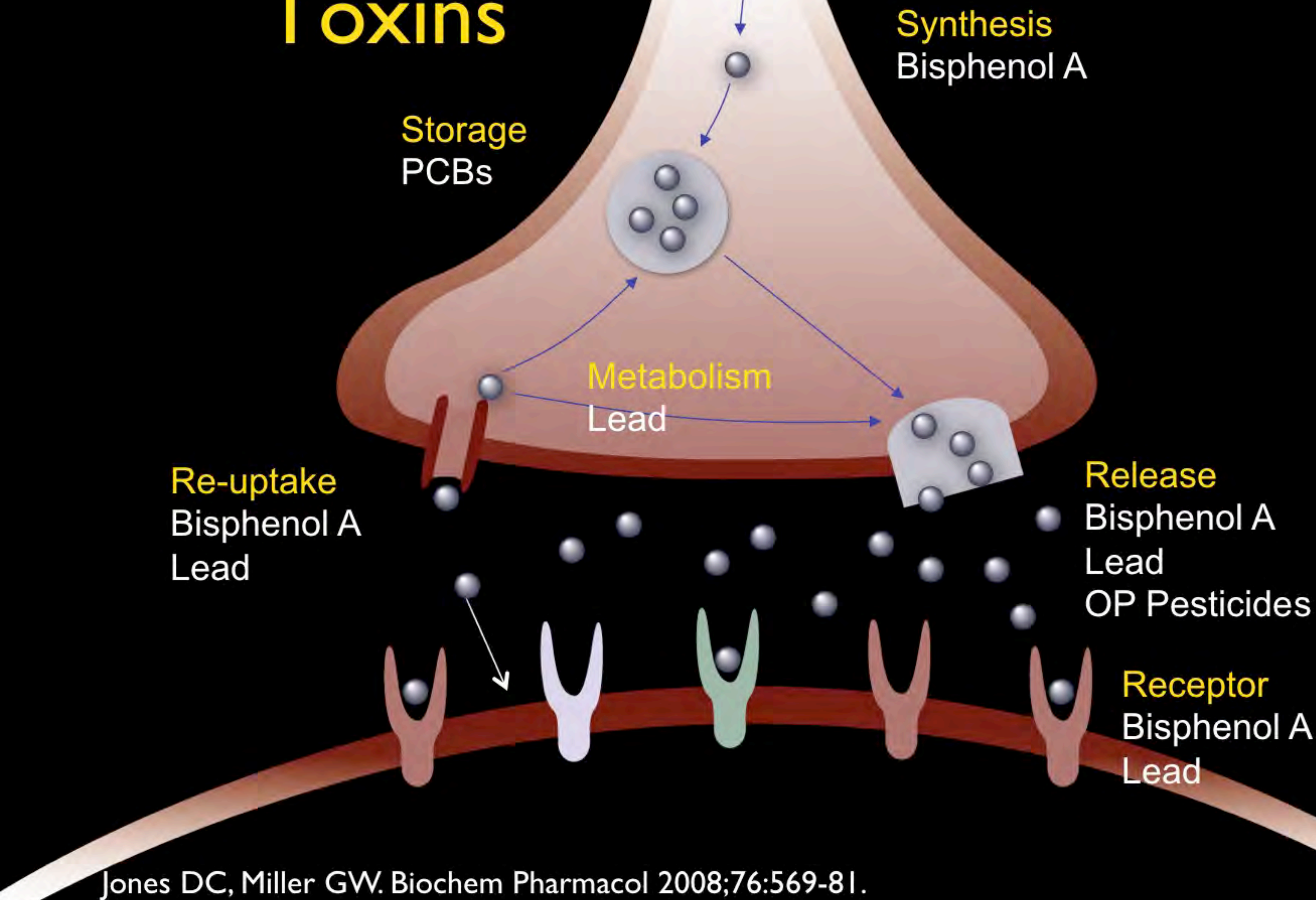
Lead Exposure, Cognition and Age



Lead-associated Mental Health Problems in School Children by Tooth Lead Levels



Dopaminergic Toxins

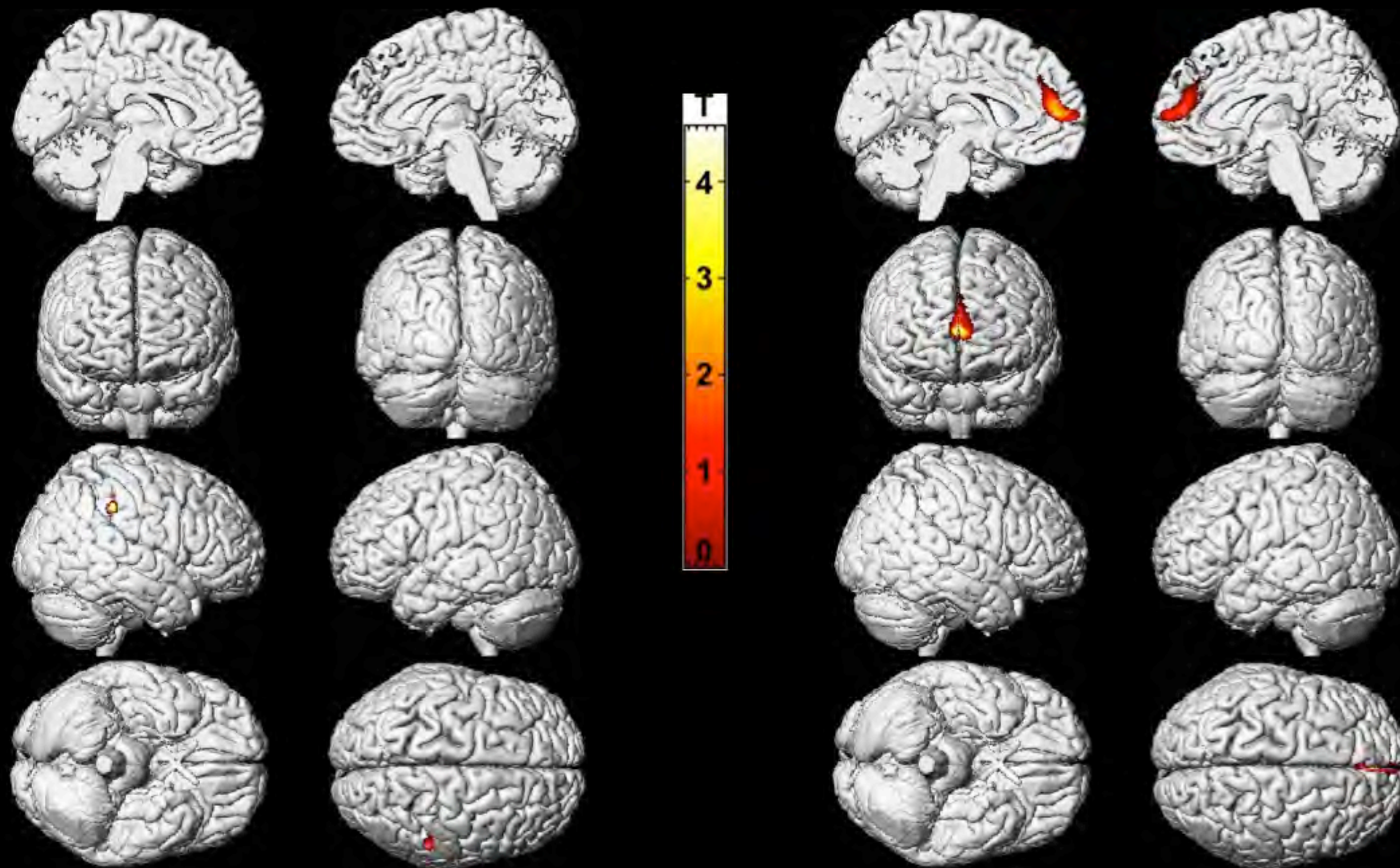


Windows of Vulnerability

Developmental Trajectory of Lead Exposure by Gray Matter Deficits

Year 1

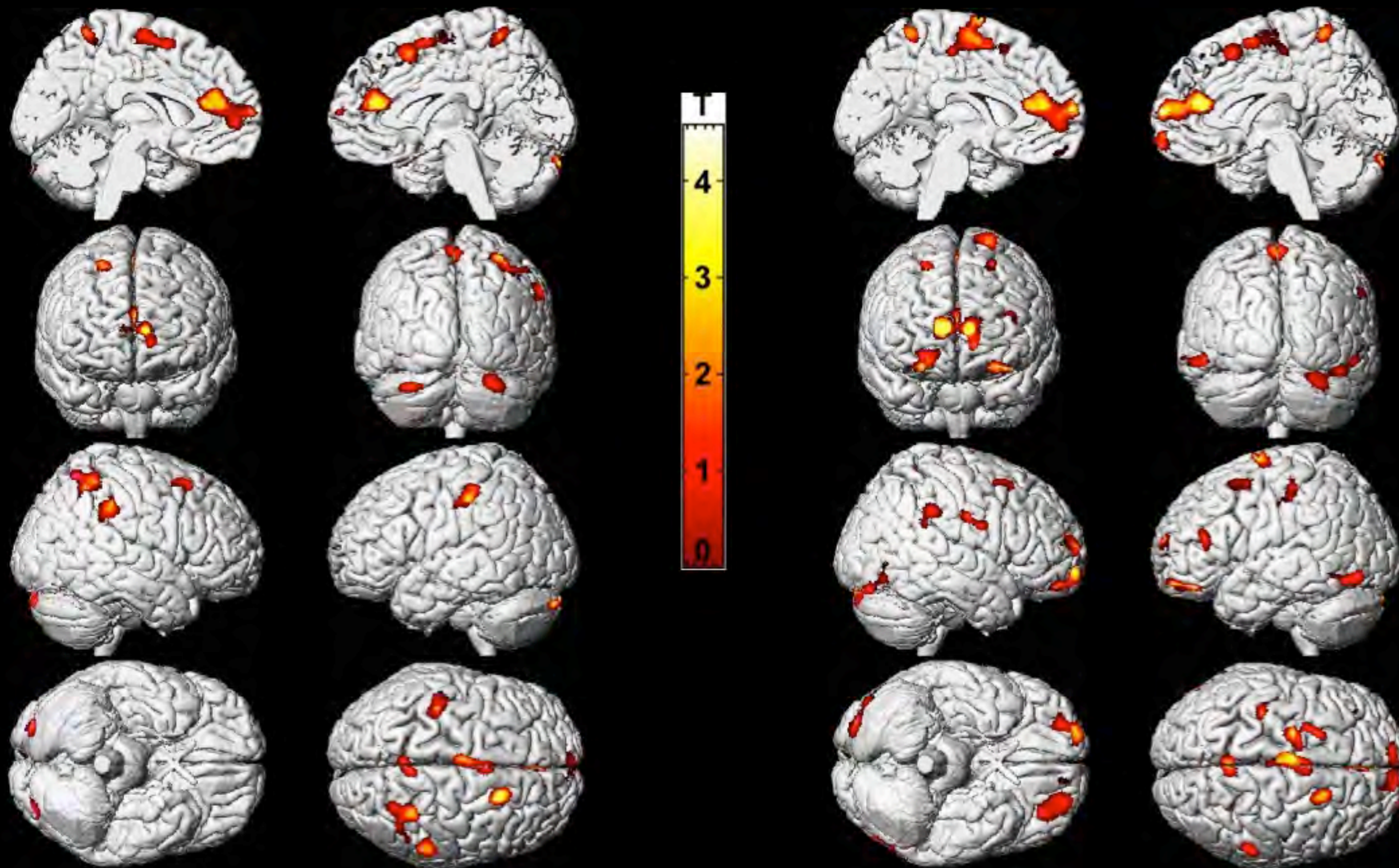
Year 2



Developmental Trajectory of Lead Exposure by Gray Matter Deficits

Year 3

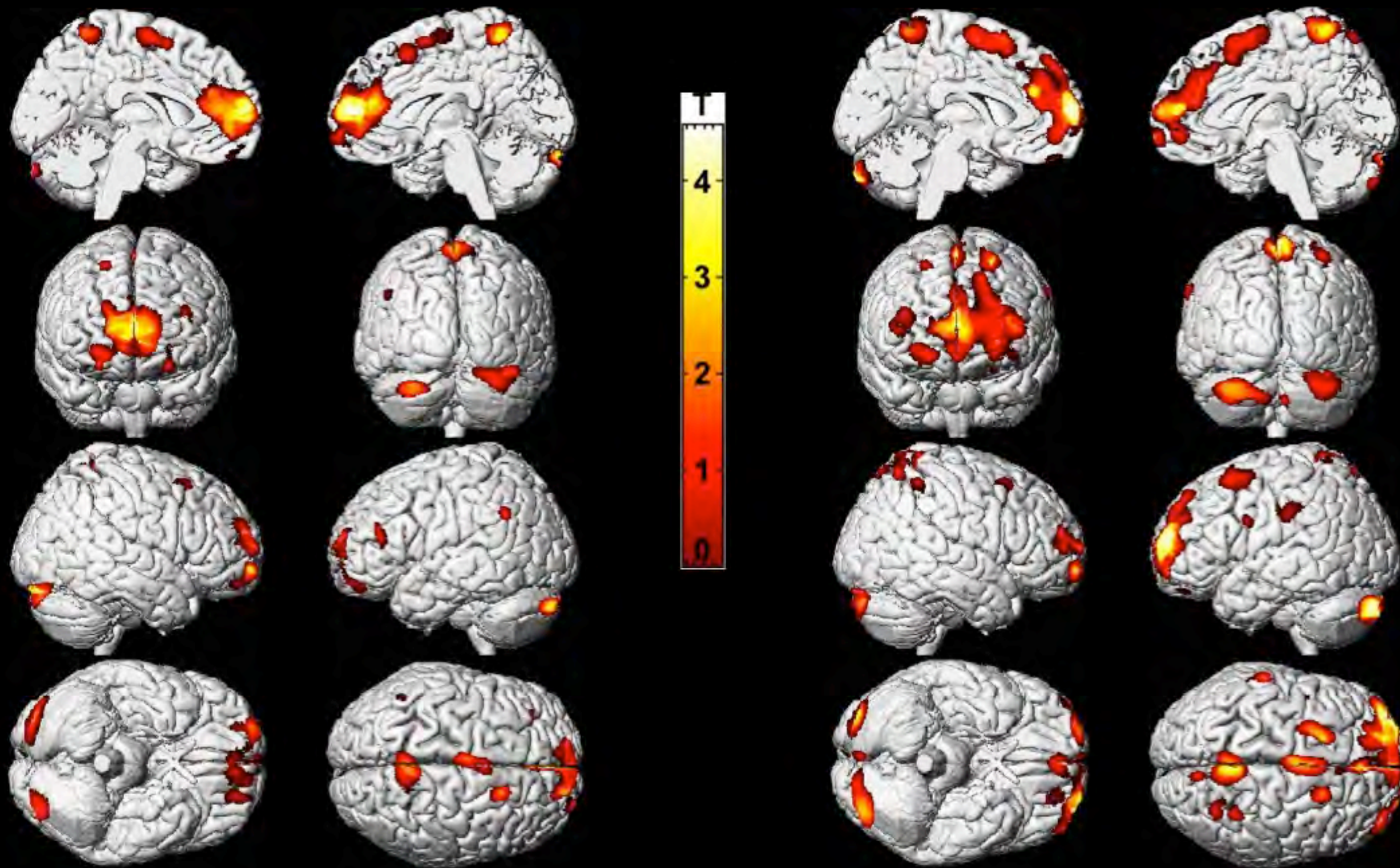
Year 4



Developmental Trajectory of Lead Exposure by Gray Matter Deficits

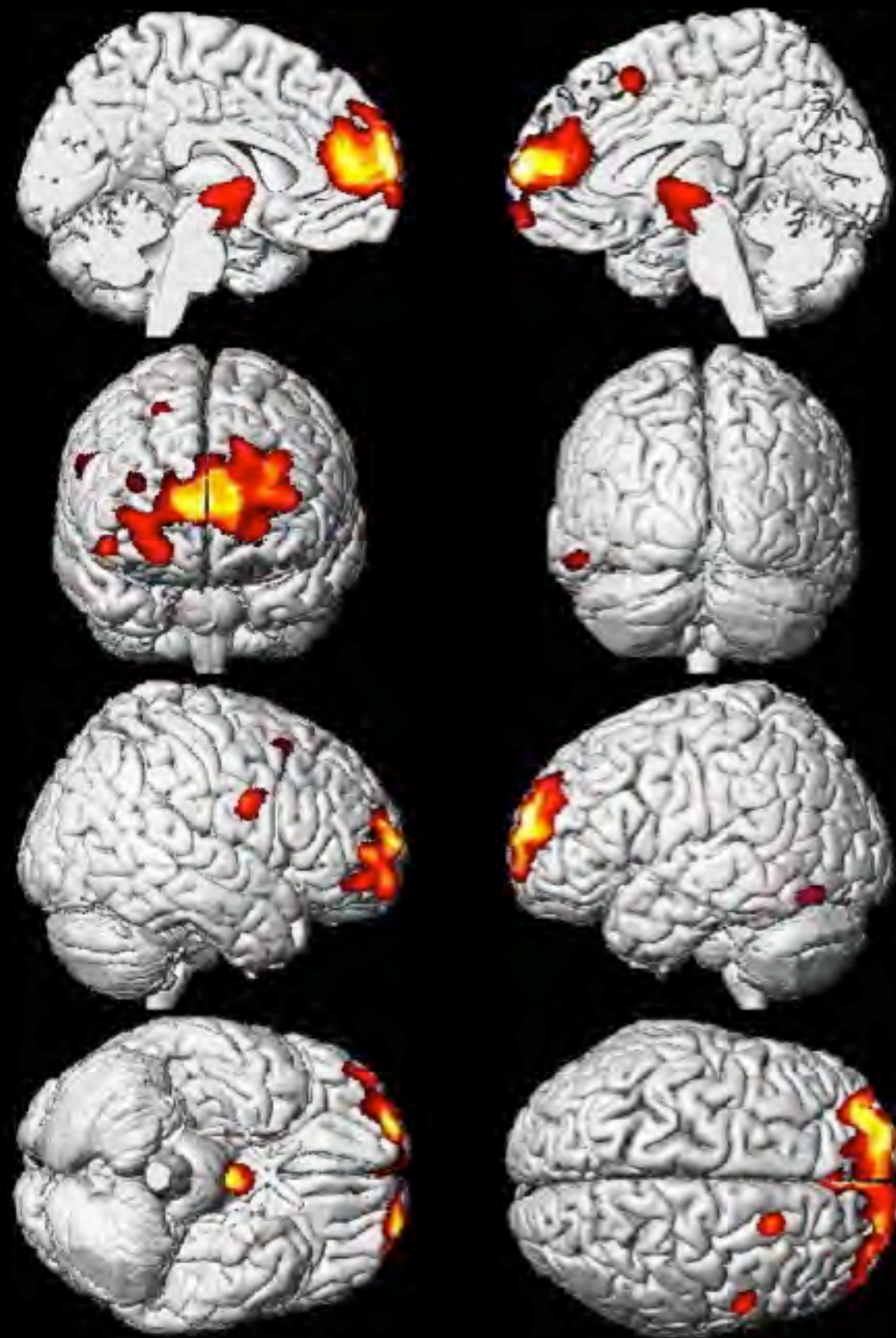
Year 5

Year 6

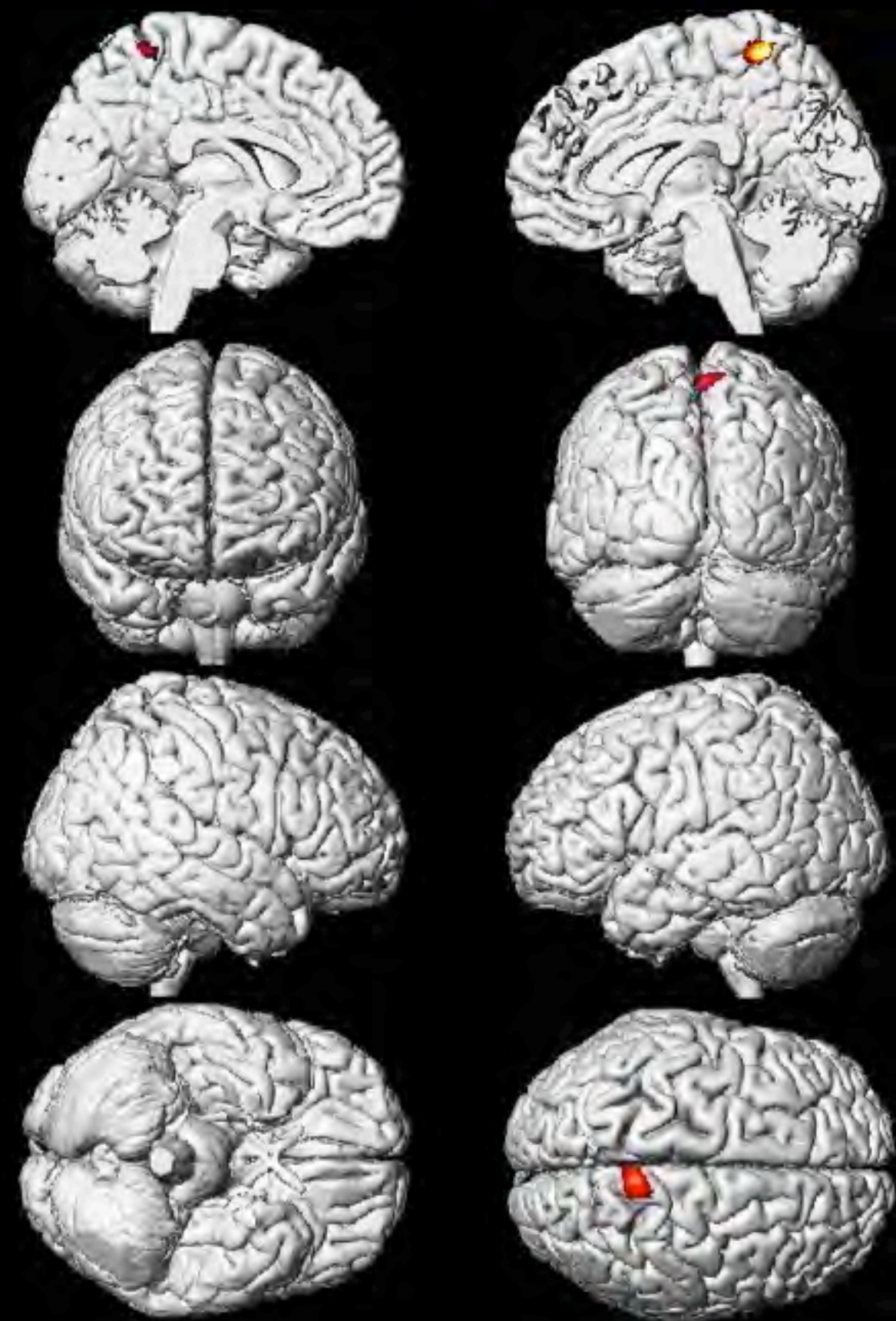


Reduction in Gray Matter by Childhood Blood Lead Levels and Subject's Sex

Men (n=83)



Women (n=74)



TOO FAST TO FAIL THE COMING WALL STREET MELTDOWN
PLUS CAN YOU CATCH PTSD?

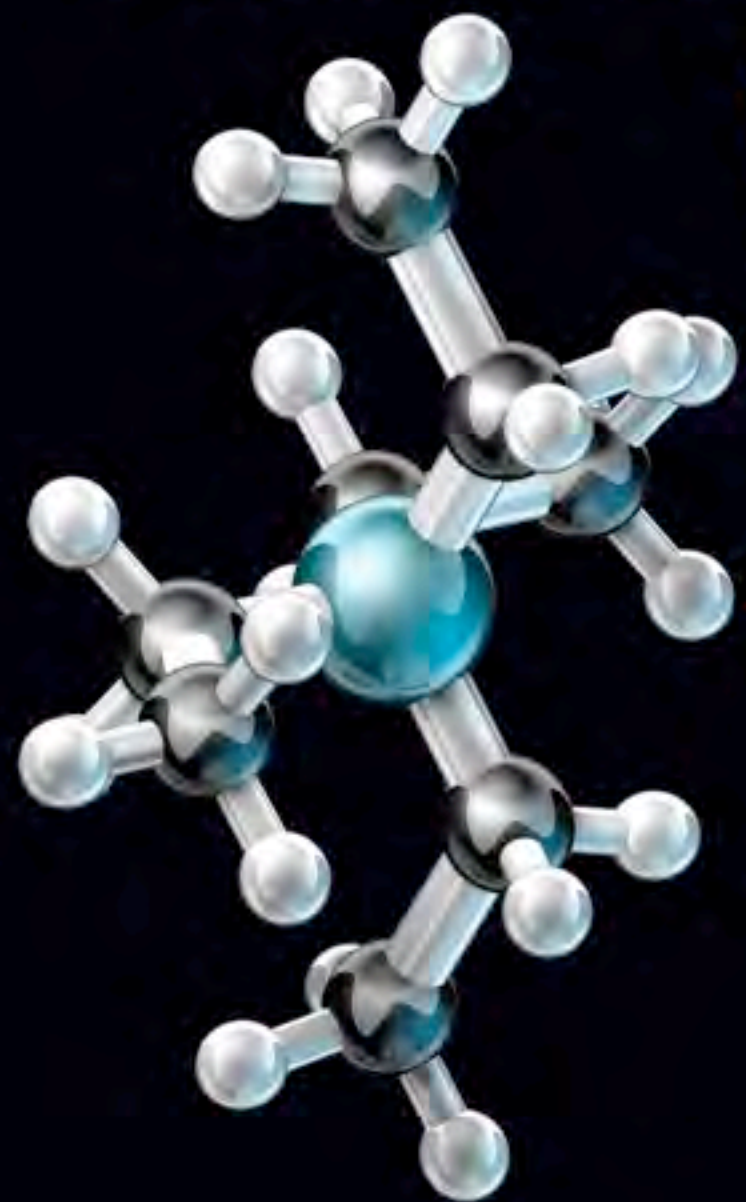
PREPPING
FOR THE
BARACKALYPSE

Mother Jones

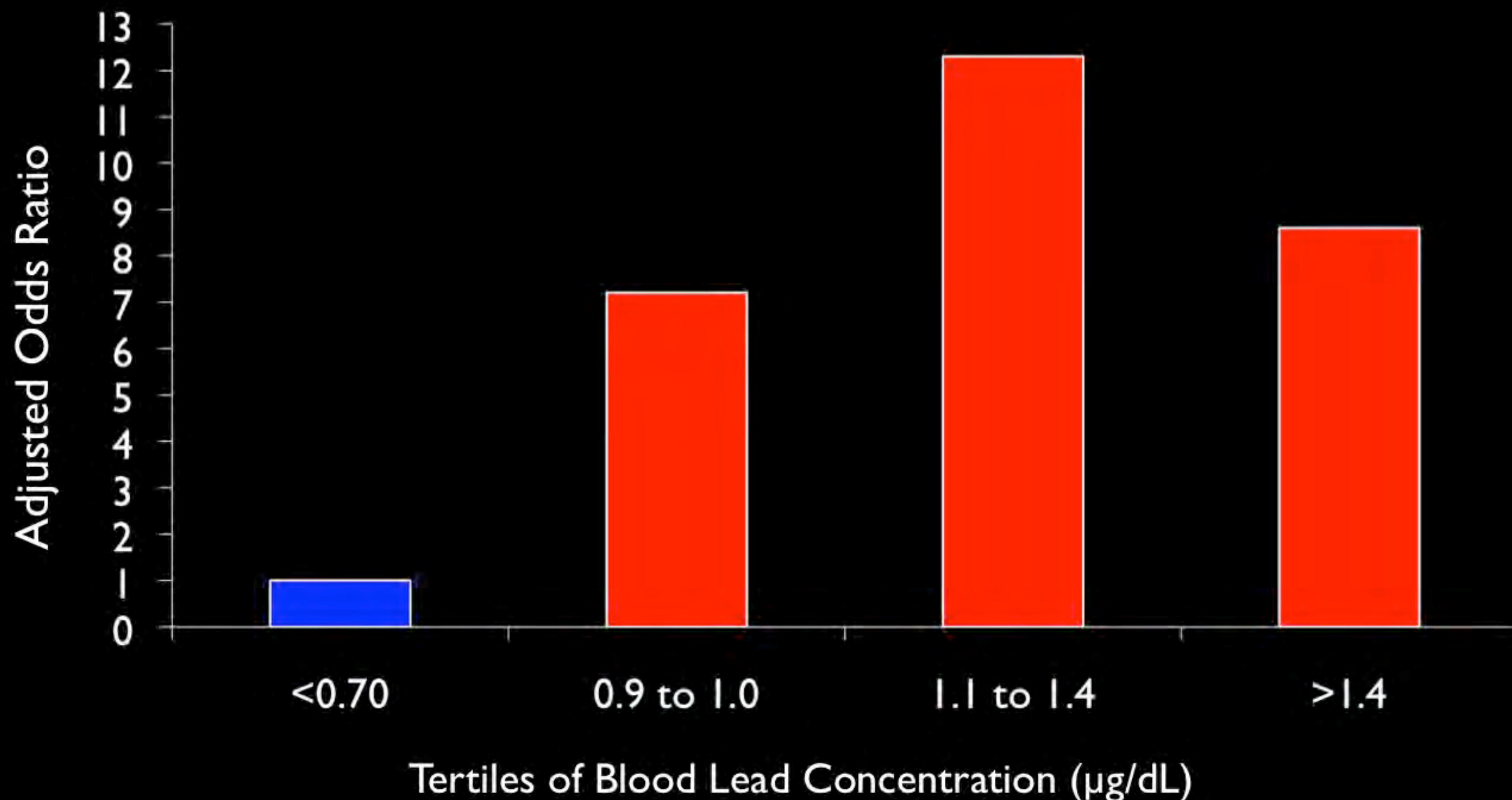
SMART, FEARLESS JOURNALISM

January + February 2013

Lower Crime.
Raise IQs.
Cut the Deficit.
WITH THIS?

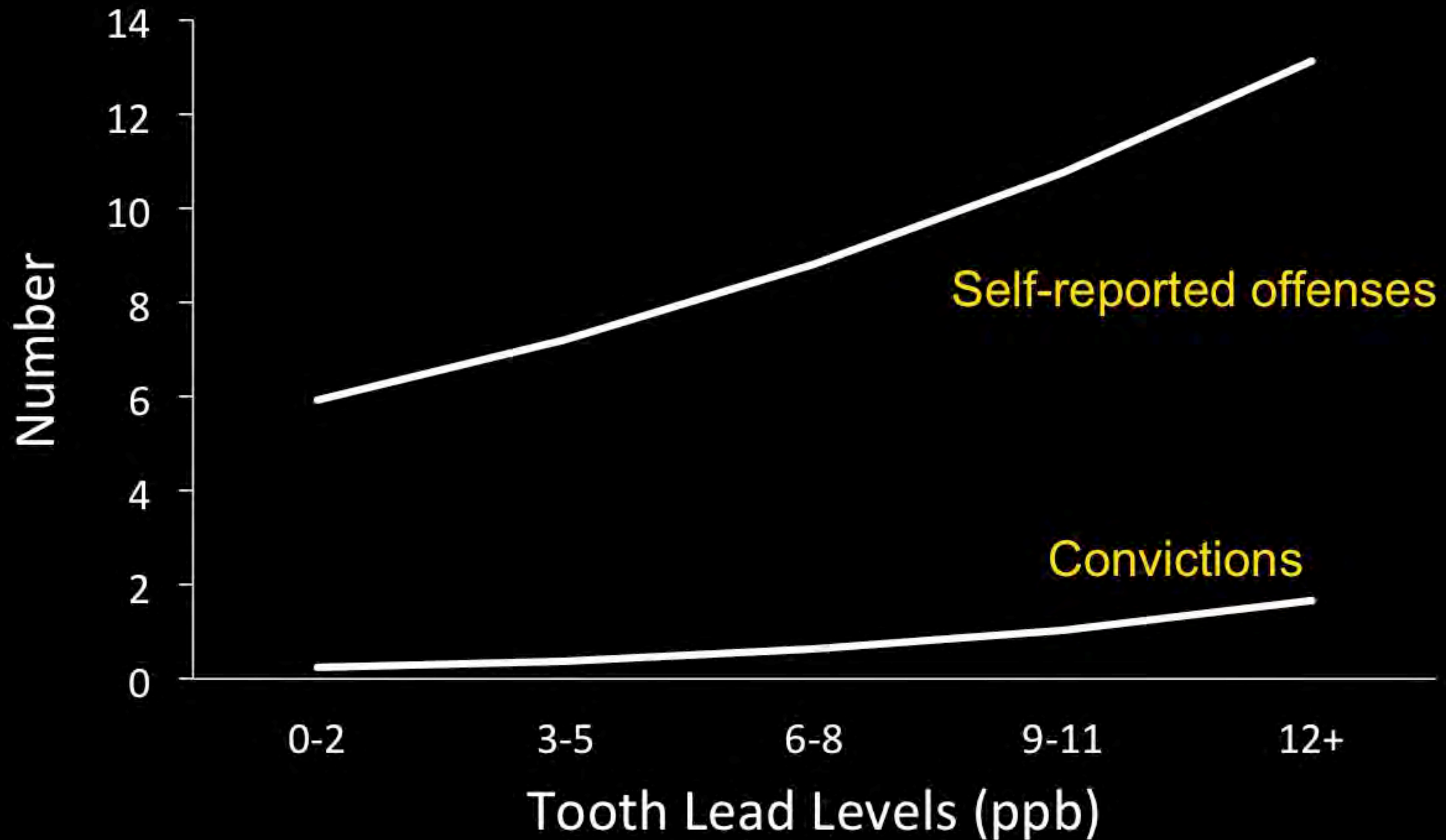


Risk of Conduct Disorder by Blood Lead Concentration in US Children, 8 to 15 years, NHANES 2001-2004



Braun J, et al. Environ Health Perspect. 2008;116:956-62. Adjusted for child's age, sex, race and ethnicity, preschool attendance, serum ferritin, prenatal tobacco exposure and health insurance status.

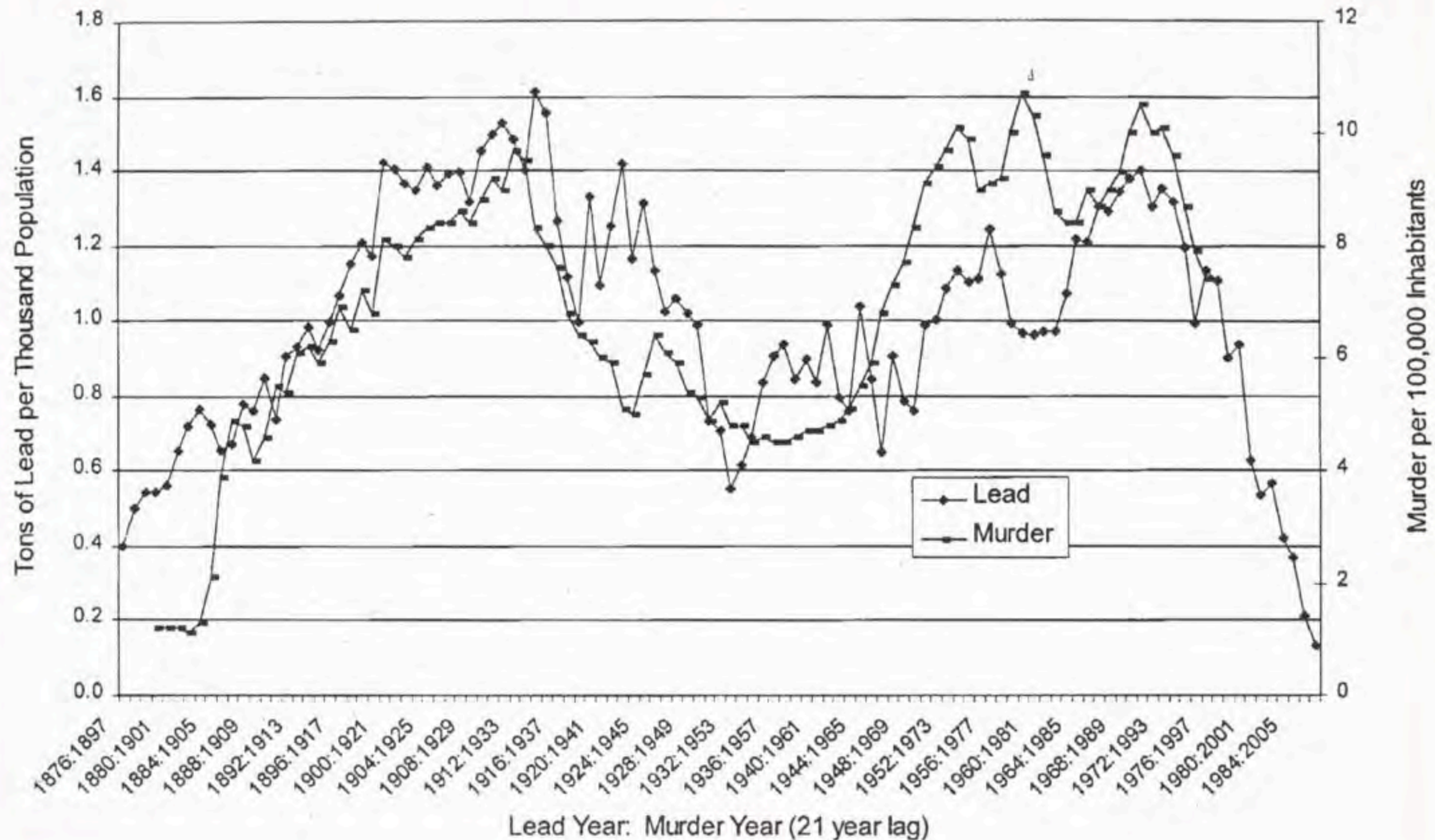
Tooth Lead Levels and Criminality



Fergusson D, et al. J Epidemiol Community Health 2008;62:1045-1050. Adjusted for SES, maternal education, ethnicity, family conflict, maltreatment, maternal smoking during pregnancy, parental criminal offending and parental alcoholism.



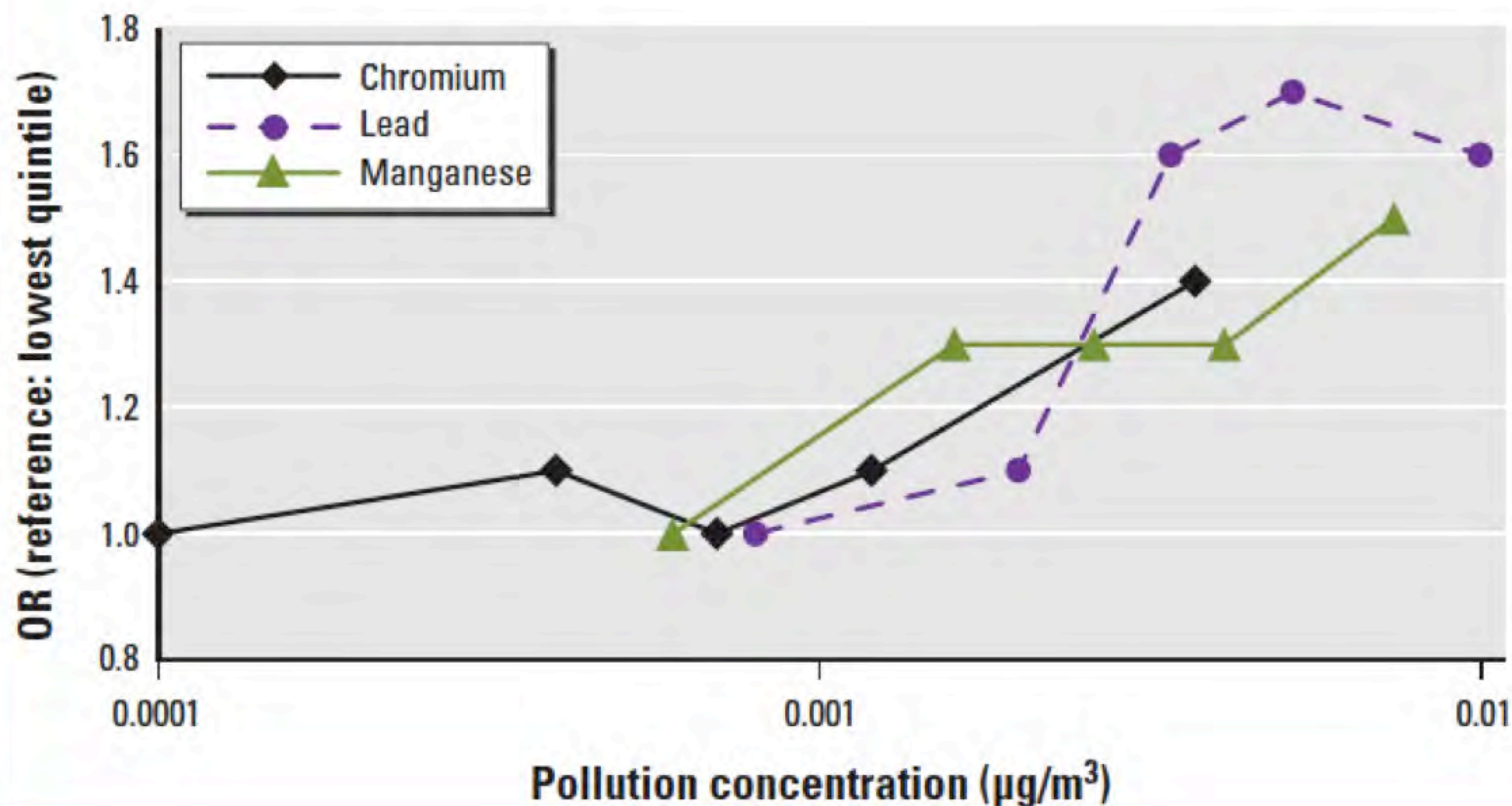
Lead Exposure and Homicide Rate (/100,000) in the United States, 1876 to 2000



\$1 = \$17 to 220

Gould E. EHP 2009;117:1162-1167.

Risk of Autism Spectrum Disorder by Exposures to Airborne Metals



Roberts et al. EHP 2013. Adjusted for maternal age, year of birth, census tract.

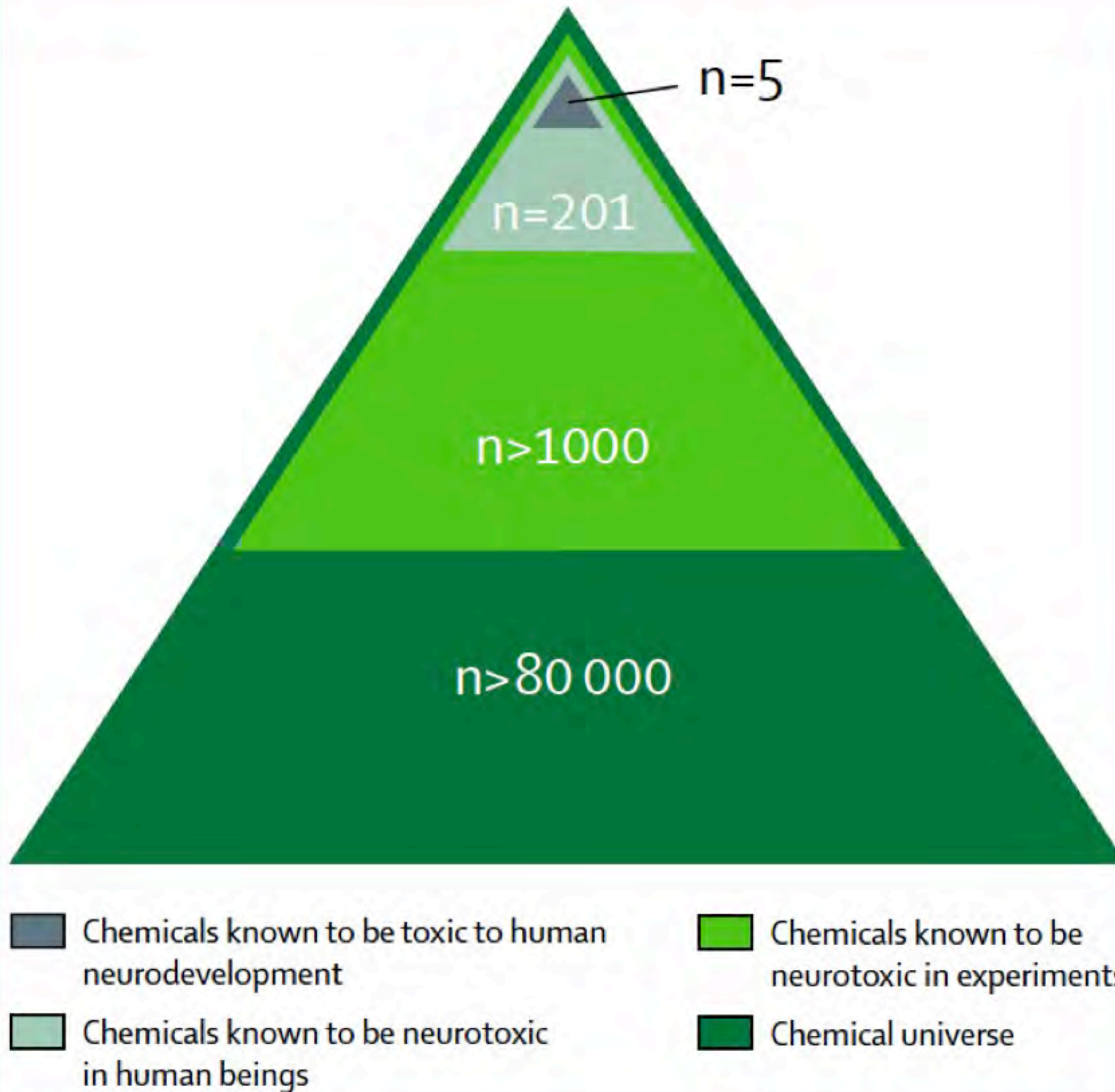
A Pattern of Toxicity



The Impact of Toxins on the Developing Brain

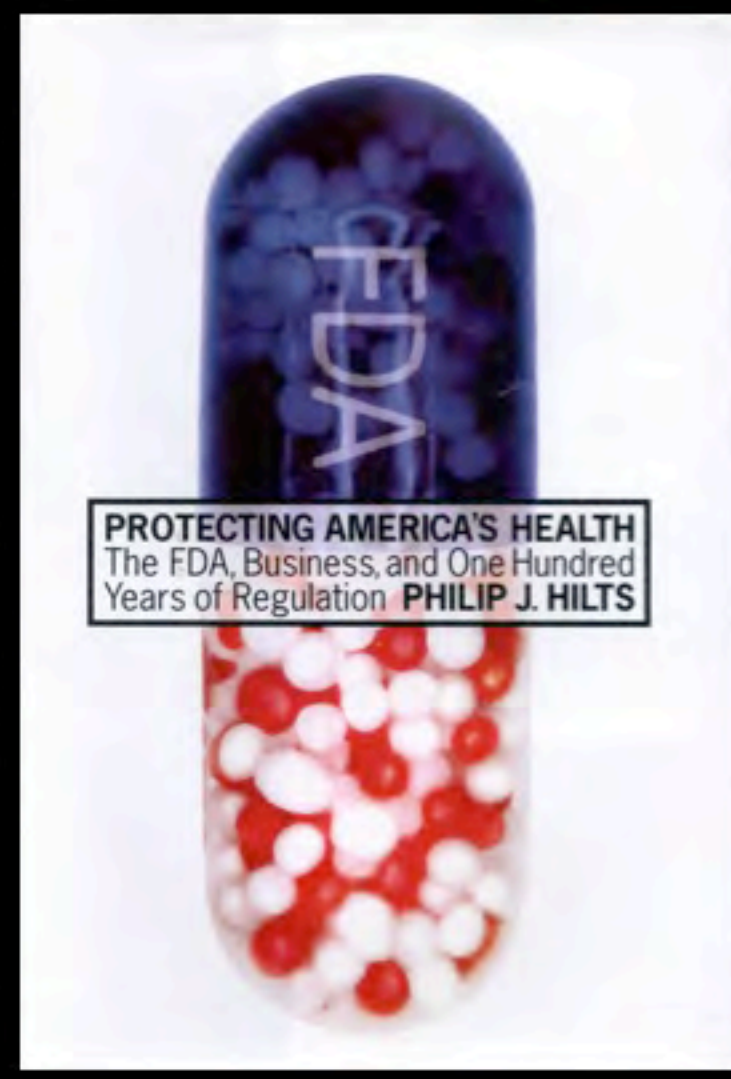
- Environmental toxins are toxic at levels previously thought to be safe or innocuous
- Subtle shifts in cognition, behavior or physiologic parameters are antecedents of disease and disabling disorders in older children and adults
- Disease and disability linked with environmental toxins are preventable

Neurotoxicity of Industrial Chemicals





Lessons from the FDA





If we didn't evolve
with it ...

avoid it.

How to Avoid Exposures to Toxins

- Eat fresh, organic and unpackaged foods; avoid canned foods
- Minimize use of pesticides around the home
- Avoid cosmetics, fingernail polish and lotions
- Support bans on smoking in public places and cosmetic pesticides
- Support efforts to update chemical management policies and reduce industrial pollutants

Organic Diets Lower Children's Dietary Exposure to OP Pesticides

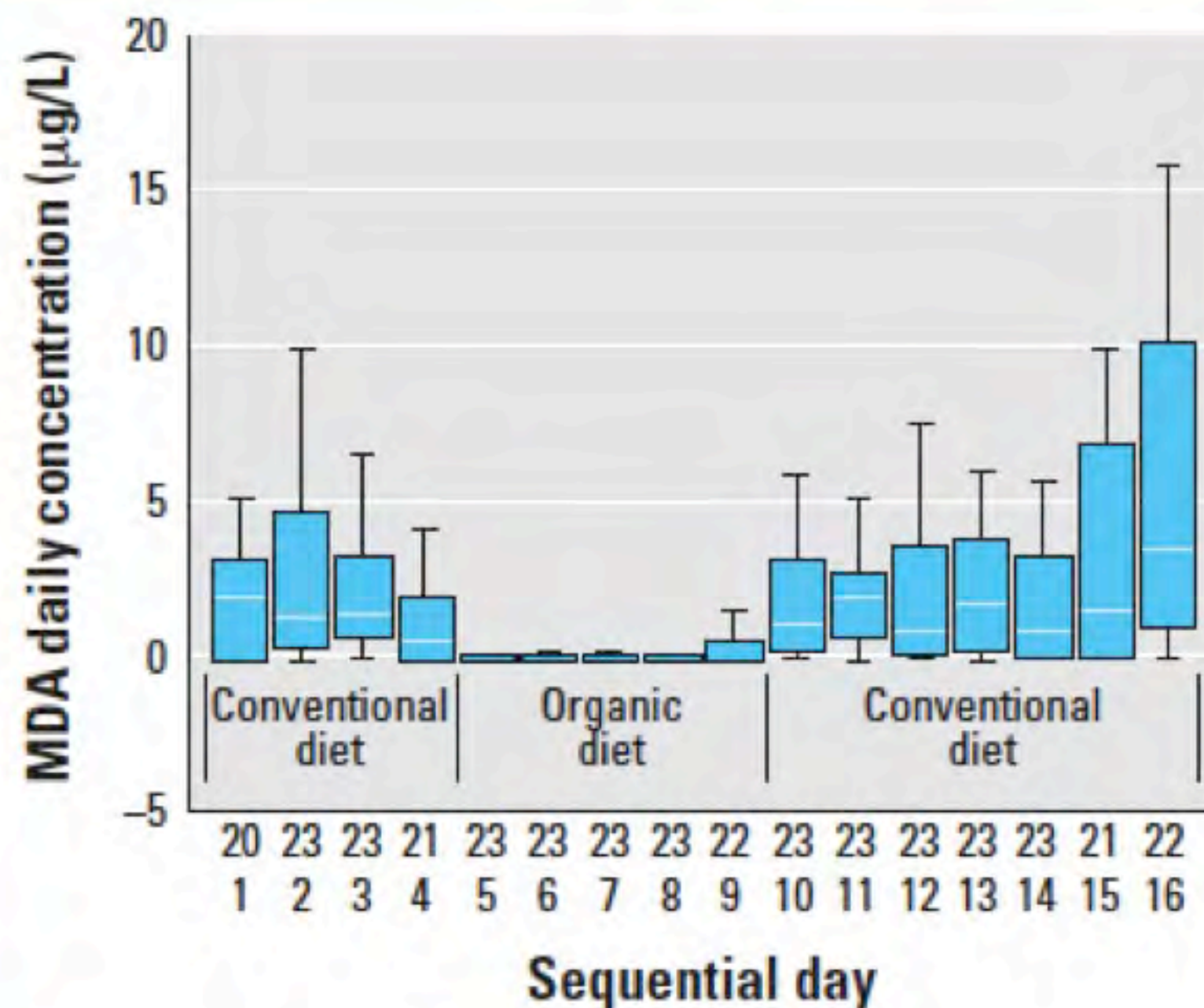


Figure 1. Box plots of DVWA of MDA concentrations in 23 children 3–11 years of age for 15 consecutive days in which conventional and organic diets were consumed. The top row of numbers on the x-axis represents numbers of children.

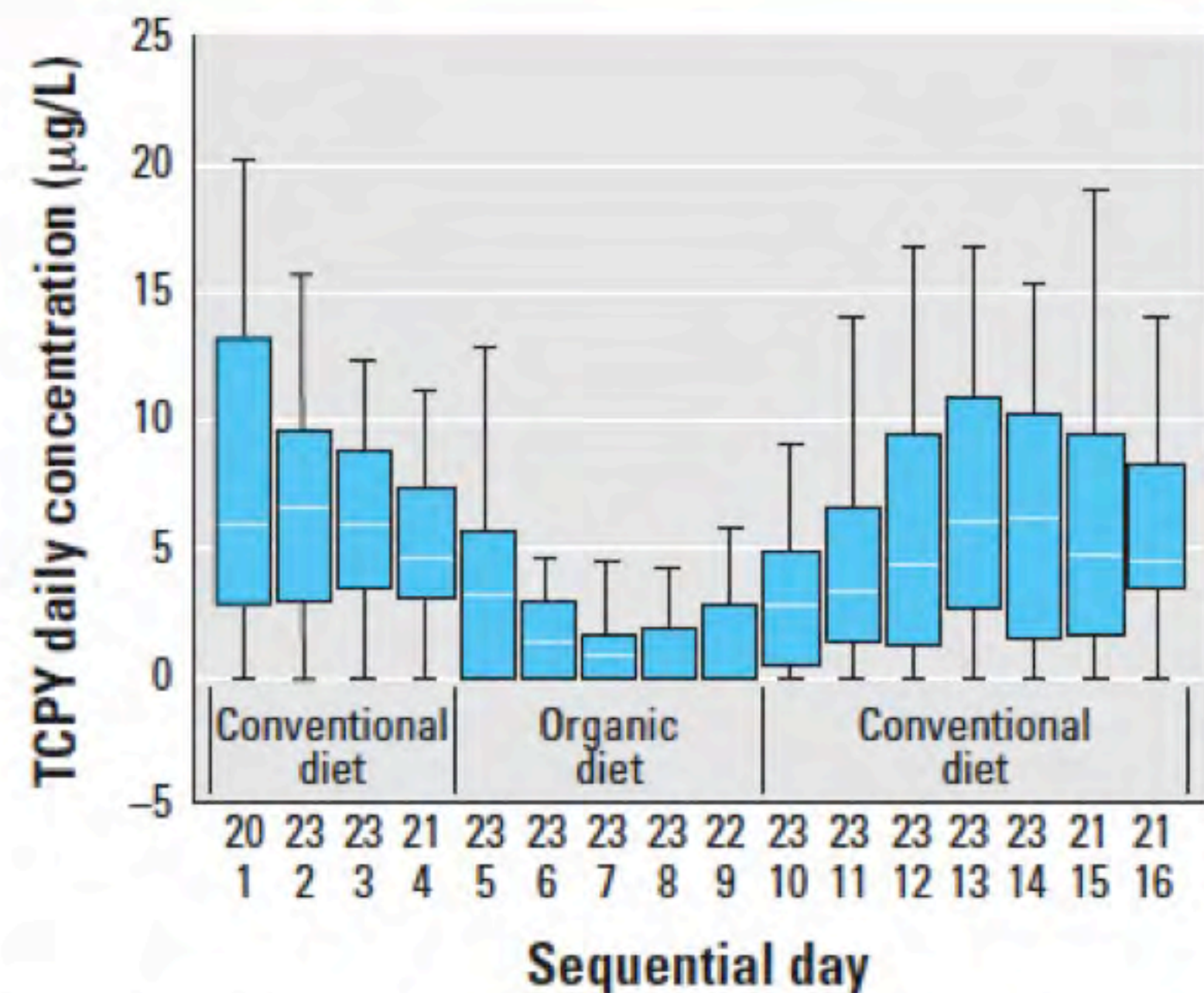
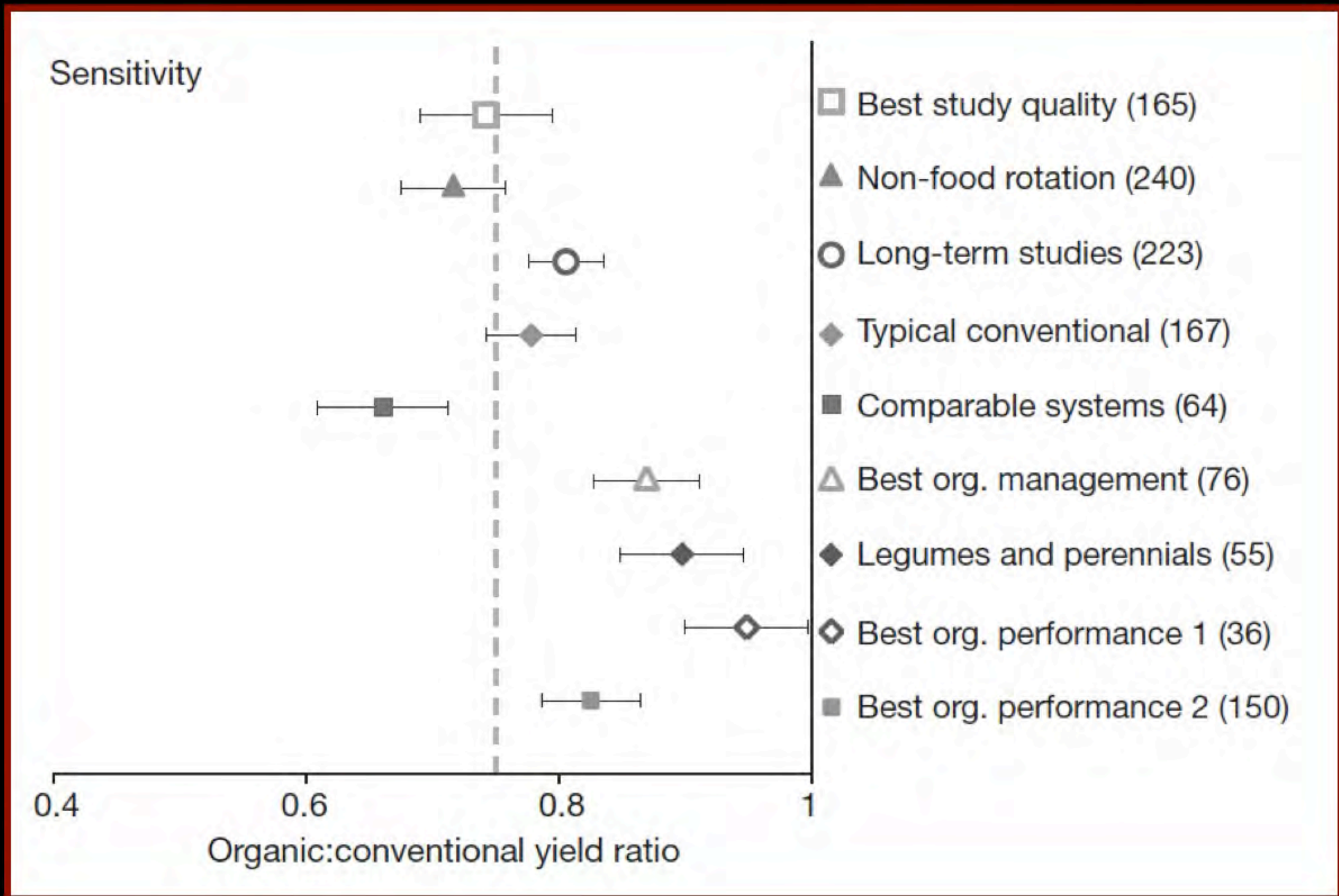


Figure 2. Box plots of DVWA of TCPY concentrations in 23 children 3–11 years of age for 15 consecutive days in which conventional and organic diets were consumed. The top row of numbers on the x-axis represents numbers of children.

Organic to Conventional Yield Ratios





“Few tragedies can be more extensive than the stunting of life, few injustices deeper than the denial of an opportunity to strive or even to hope, by a limit imposed from without, but falsely identified as lying within.”

Stephen Jay Gould