

Linking Environmental Lead Exposure with Psychopathology in Children and Adolescents

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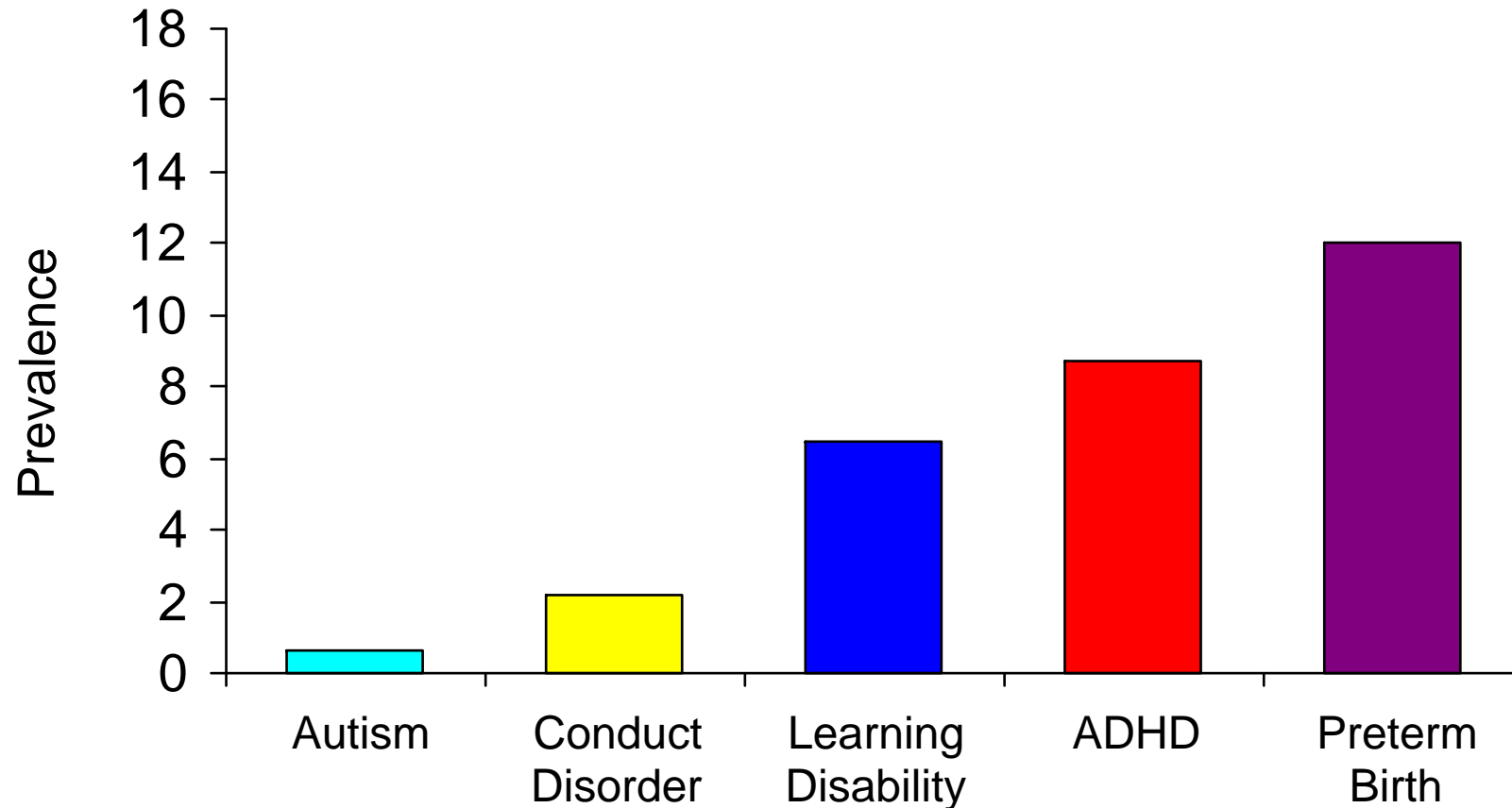
Cincinnati Children's Hospital Medical Center

The University of Cincinnati

Ramazzini Jubilee Celebration

October 25th to 28th, 2007

New Morbidities of Childhood



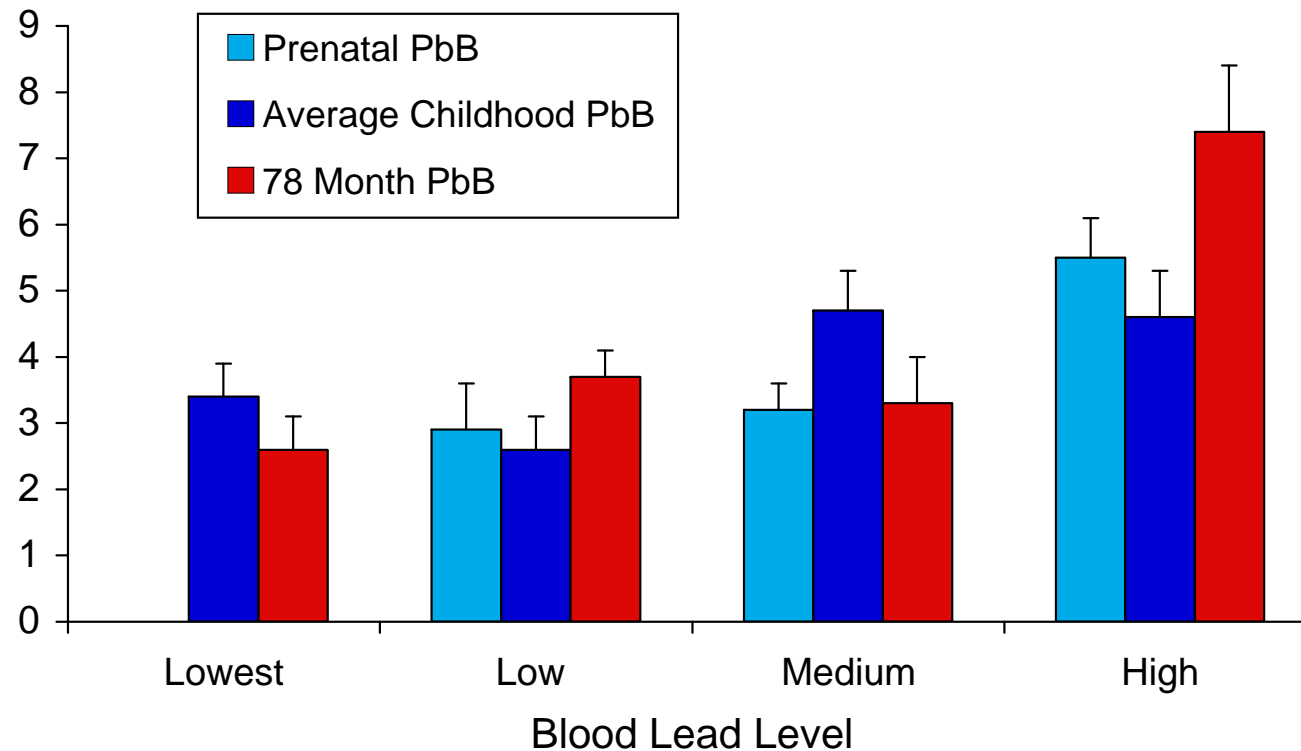
Boyle C, et al. Pediatrics 1994;93:399-403; Branum AM, et al. Paediatr Perinat Epidemiol 2002;16:8-15; Hedley AA, et al. JAMA 2004;291:2847-50. Froehlich T, et al. Arch Pediatrics Adolesc Med 2007;161:857-864. Braun J, et al. (in preparation).

Background

- Childhood lead exposure has been associated with delinquency, but questions remain about its association with criminal behaviors
- Childhood lead exposure has been associated with features consistent with ADHD, but the relationship with diagnosis of ADHD is poorly defined
- The estimated contribution of environmental lead exposure to child and adolescent psychopathology is poorly defined on a national level

Needleman HL, et al. N Engl J Med 1979;300:689-95. Dietrich KN, et al. Neurotox & Teratol 2001;23:511-518.

Association of Blood Lead Levels and Self-Reported Delinquent Behaviors in Adolescents

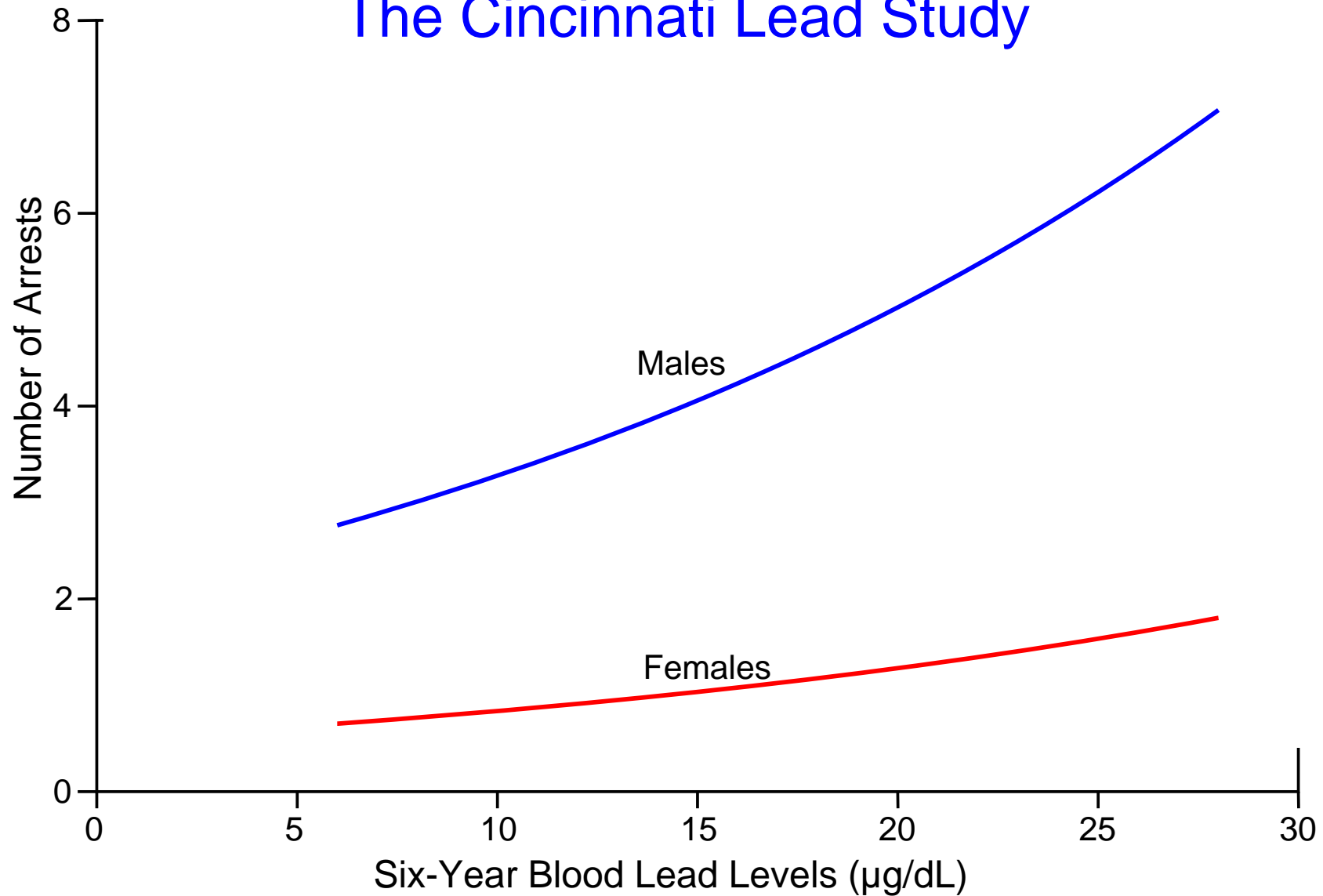


Linking Environmental Lead
Exposure With Criminal
Behaviors

Methods

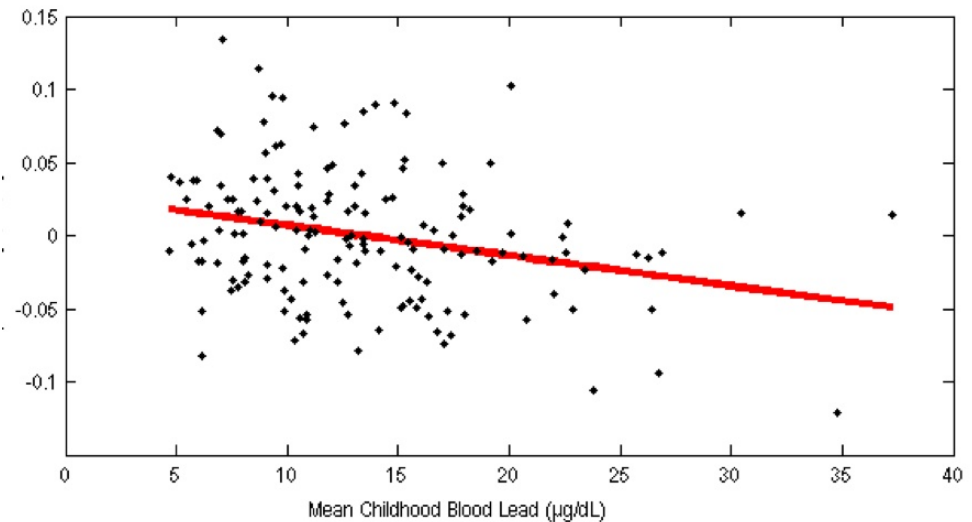
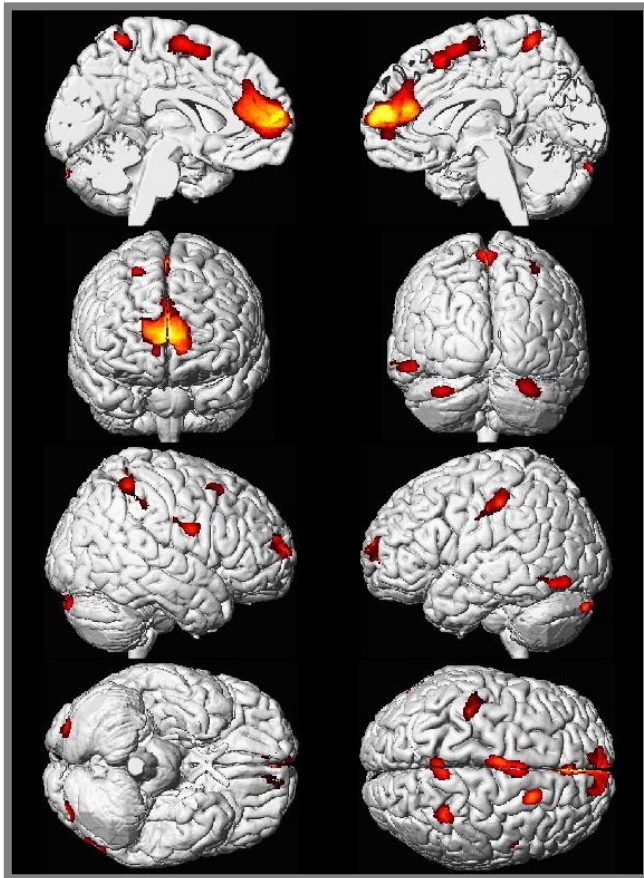
- Prospective birth cohort recruited from impoverished Cincinnati community from 1979 to 1984
- Women were excluded if addicted to drugs of abuse, diabetic or had recognized psychiatric disorder
- 250 children, age 18 to 24 years, were examined in these analyses
- Criminal arrests were obtained from criminal justice records and coded by two independent reviewers
- Minor offences, such as speeding or driving without a license, were excluded from these analyses

Number of Arrests by Childhood Lead Exposure: The Cincinnati Lead Study



* Accounting for birthweight, age, prenatal tobacco exposure, maternal age at delivery, maternal IQ, HOME Score. (Wright J, Dietrich KN, et al. submitted).

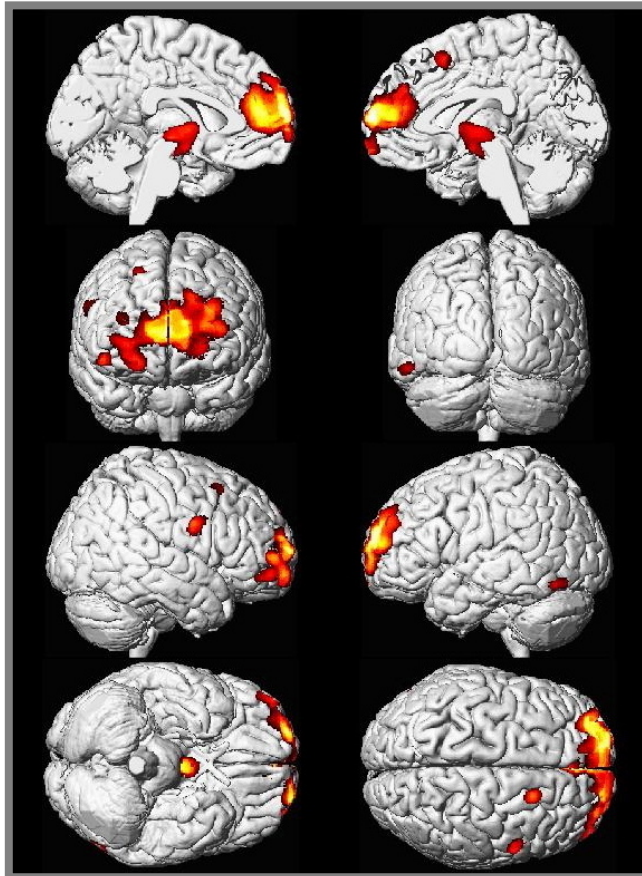
Reduction in Gray Matter by Mean Childhood Blood Lead Levels (n=157)



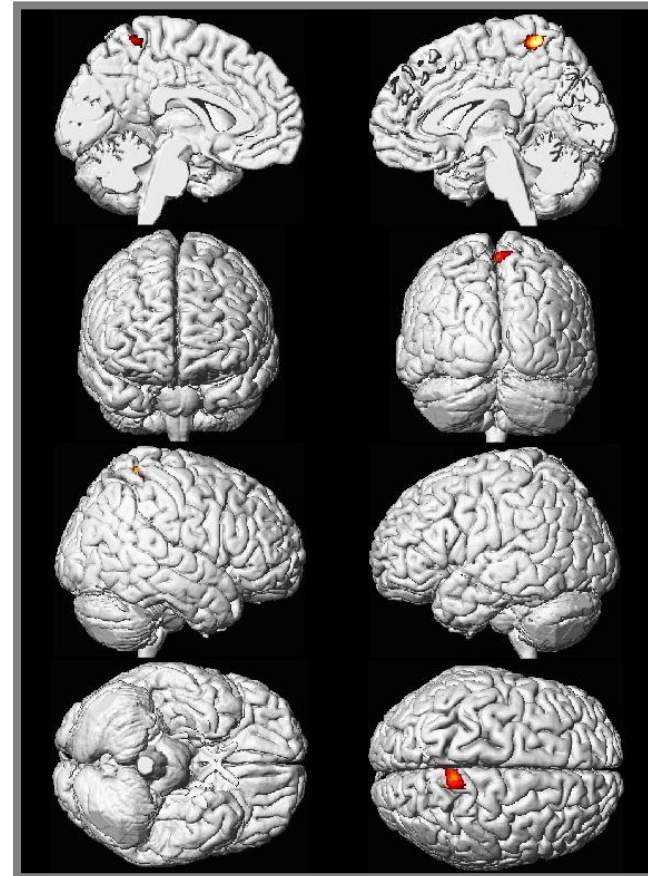
Adjusted for child's age, birth weight. Sex, gestational age, prenatal tobacco, prenatal alcohol, prenatal marijuana exposure, total intracranial volume, SES and HOME Inventory did not alter results (Cecil K, Brubaker C, Dietrich KN, et al. in preparation).

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

Men (n=83)



Women (n=74)

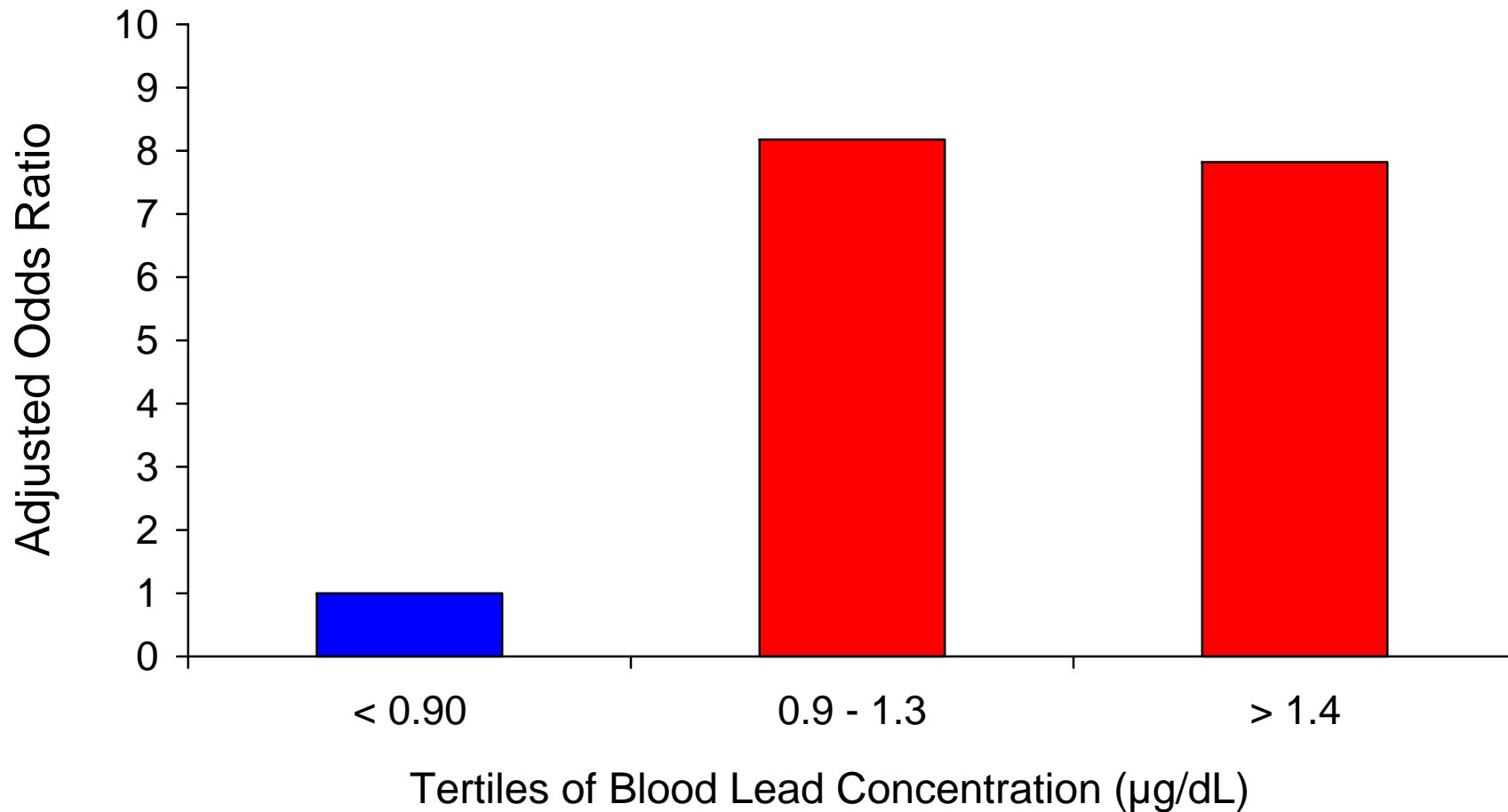


Adjusted for child's age, birth weight. Sex, gestational age, prenatal tobacco, prenatal alcohol, prenatal marijuana exposure, total intracranial volume, SES and HOME Inventory did not alter results (Cecil K, Brubaker C, Dietrich KN, et al. in preparation).

Methods

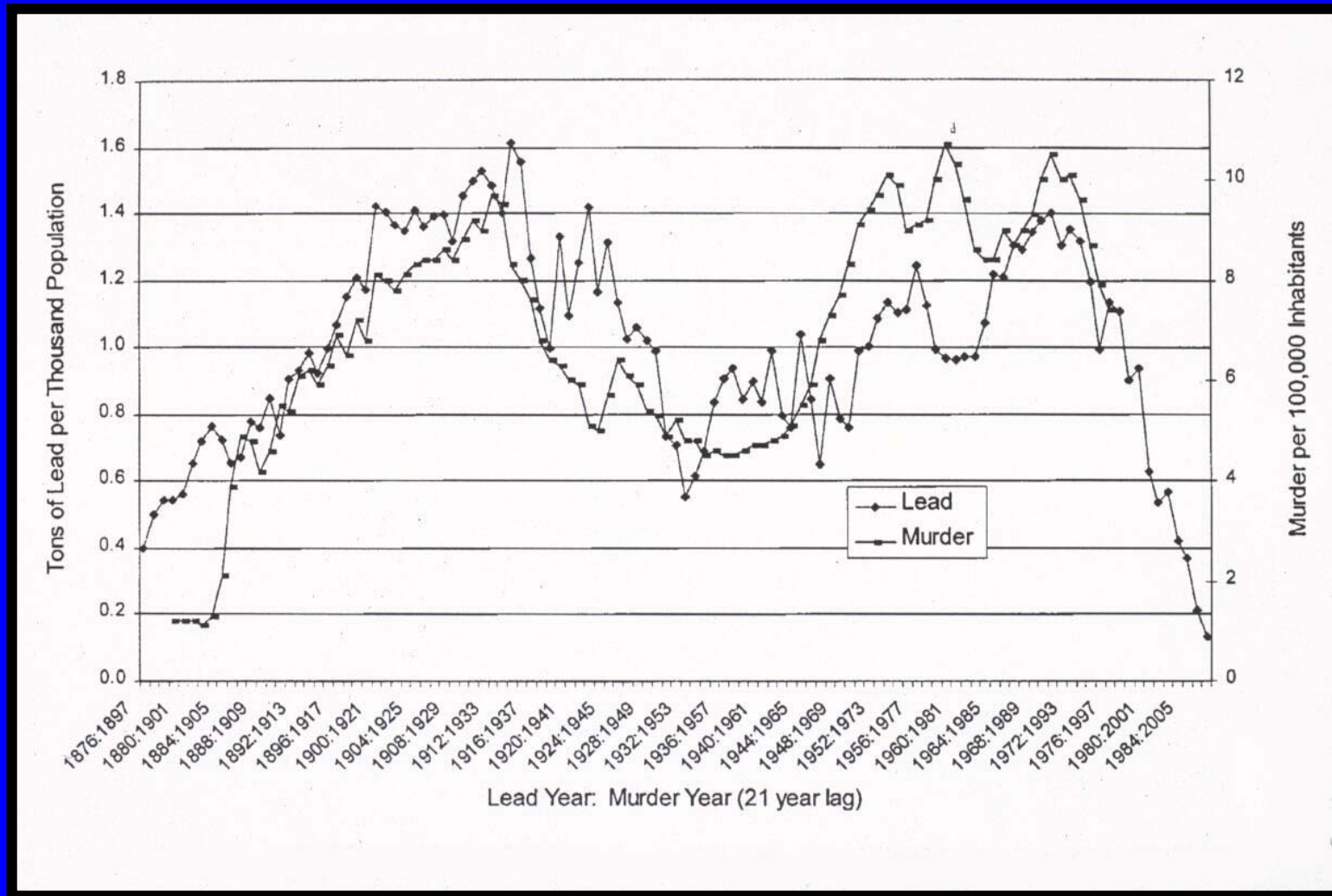
- National Health and Examination Survey, 2001-2004
- The NHANES is a cross-sectional household survey of the non-institutionalized civilian population
- 3,081 children, age 8 to 15 years, were used in these analyses
- The Diagnostic Interview Schedule for Children (DISC) was used to assess for the presence of CD in the last year based on DSM-IV criteria. Parents were asked to report symptoms via telephone interview.

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



Adjusted for child's age, sex, race and ethnicity, preschool attendance, serum ferritin, prenatal tobacco exposure and health insurance status. (Braun, et al. submitted)

Trends in Environmental Lead Exposure and Homicide Rate (per 100,000), United States

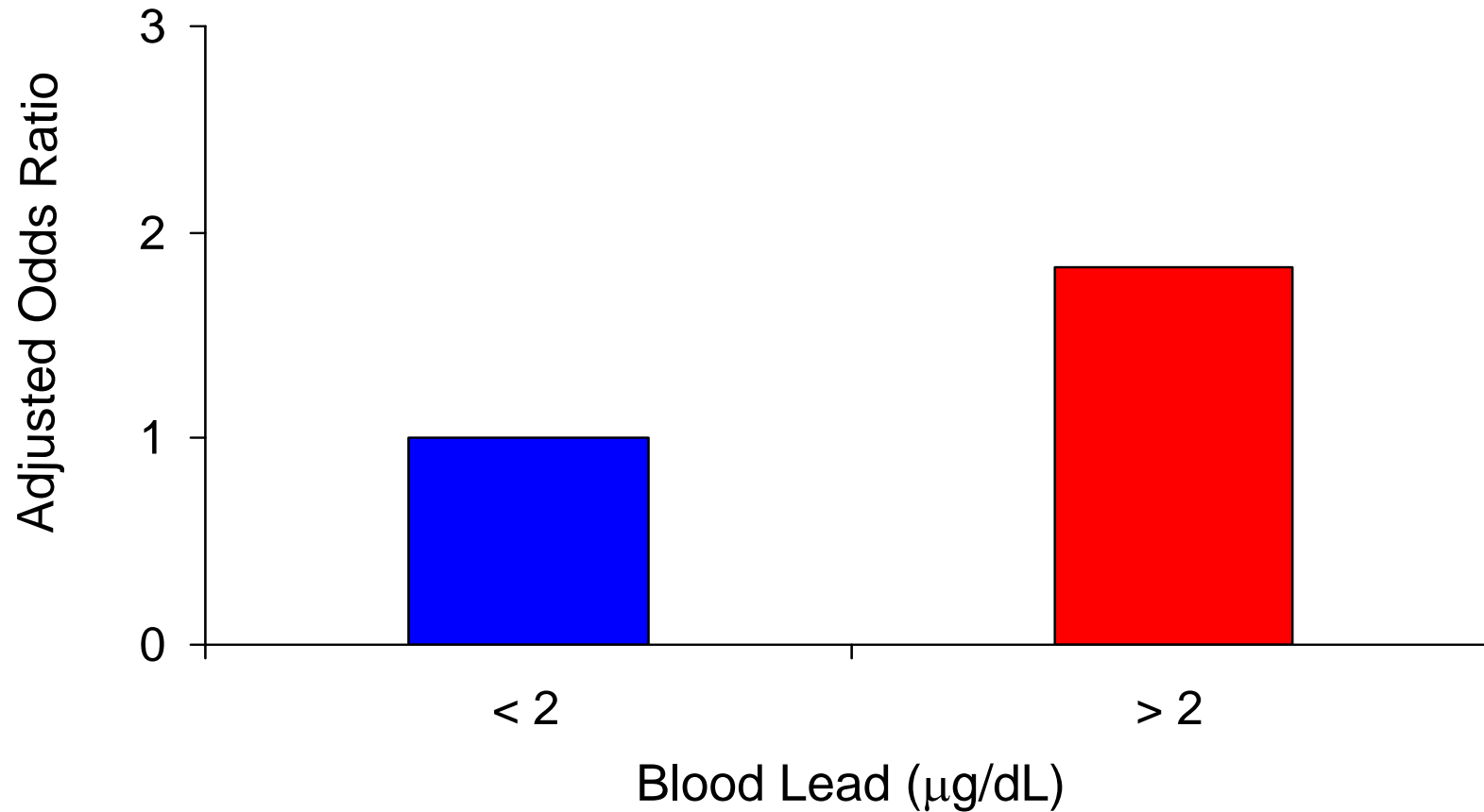


Linking Environmental Lead Exposure with ADHD

Methods

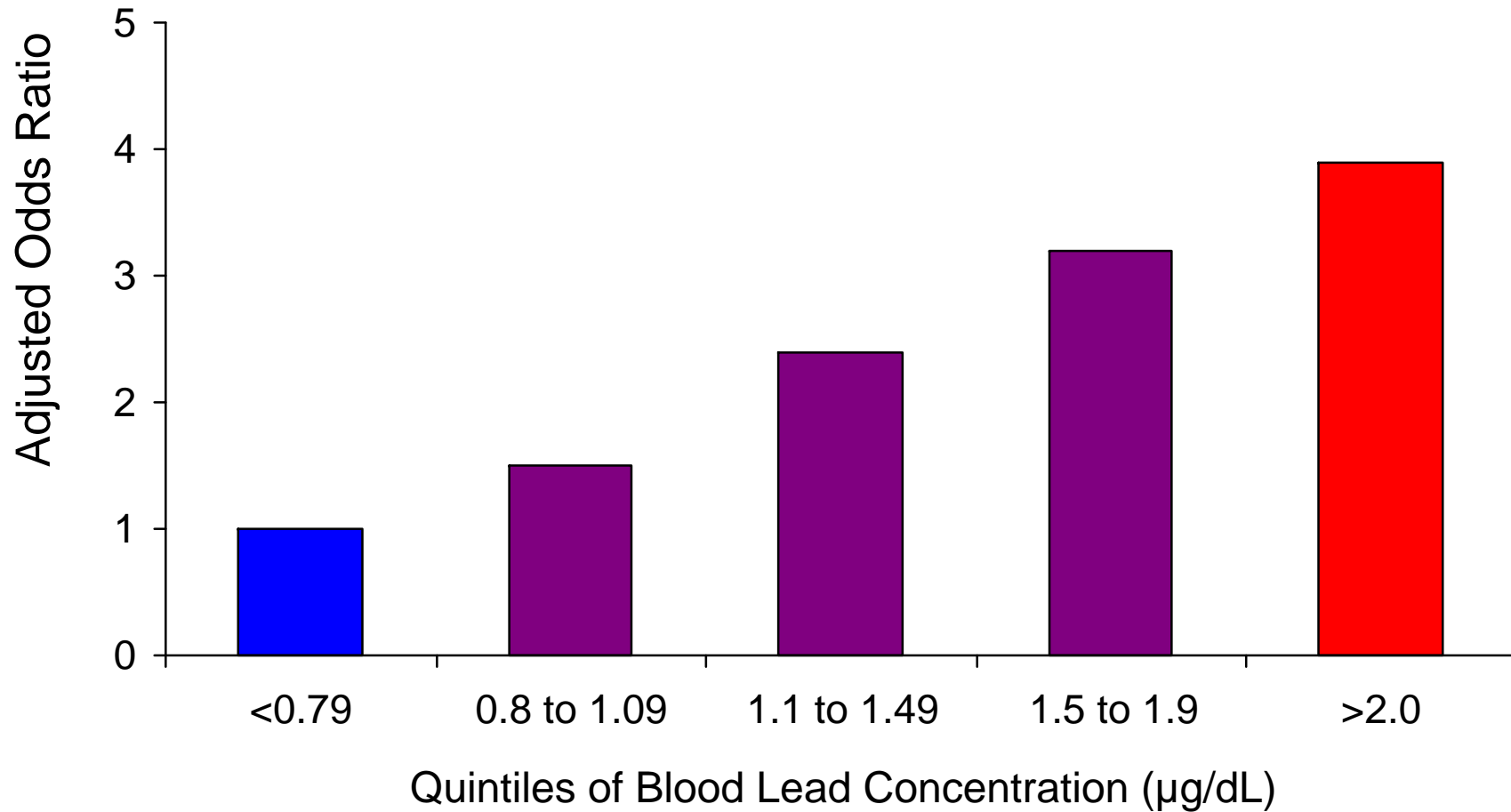
- National Health and Examination Survey 1999-2002
- The NHANES is a cross-sectional household survey of the non-institutionalized civilian population
- 4,704 children, age 4 to 15 years, were used in these analyses
- The case definition of ADHD was based on parent report of doctor-diagnosis of ADHD by a physician or psychologist and ADHD medication use

Risk of ADHD by Blood Lead Levels in US Children, 4 to 15 years, NHANES 1999-2002



Adjusted for child's age, sex, race and ethnicity, preschool attendance, serum ferritin, prenatal tobacco exposure and health insurance status. Braun J, et al. EHP 2006;17:500-505.

Risk of ADHD by Blood Lead Levels in US Children, 4 to 15 years, NHANES 1999-2002



Adjusted for child's age, sex, race and ethnicity, preschool attendance, serum ferritin, prenatal tobacco exposure and health insurance status.

Population Attributable Fraction of Environmental Lead Exposure for Conduct Disorder and ADHD in US Children

	Exposed (%)	AOR	Population Attributable Fraction	Excess Cases
Conduct Disorder	48%	7.8	.41	230,000
ADHD	28%	4.1	.21	290,000

Limitations

- Studies did not account for all relevant risk factors or (e.g., parental psychopathology)
- Diagnosis of ADHD and conduct disorder were based on parent report
- Exposure misclassification, especially for prenatal tobacco and alcohol, which typically relied on maternal report

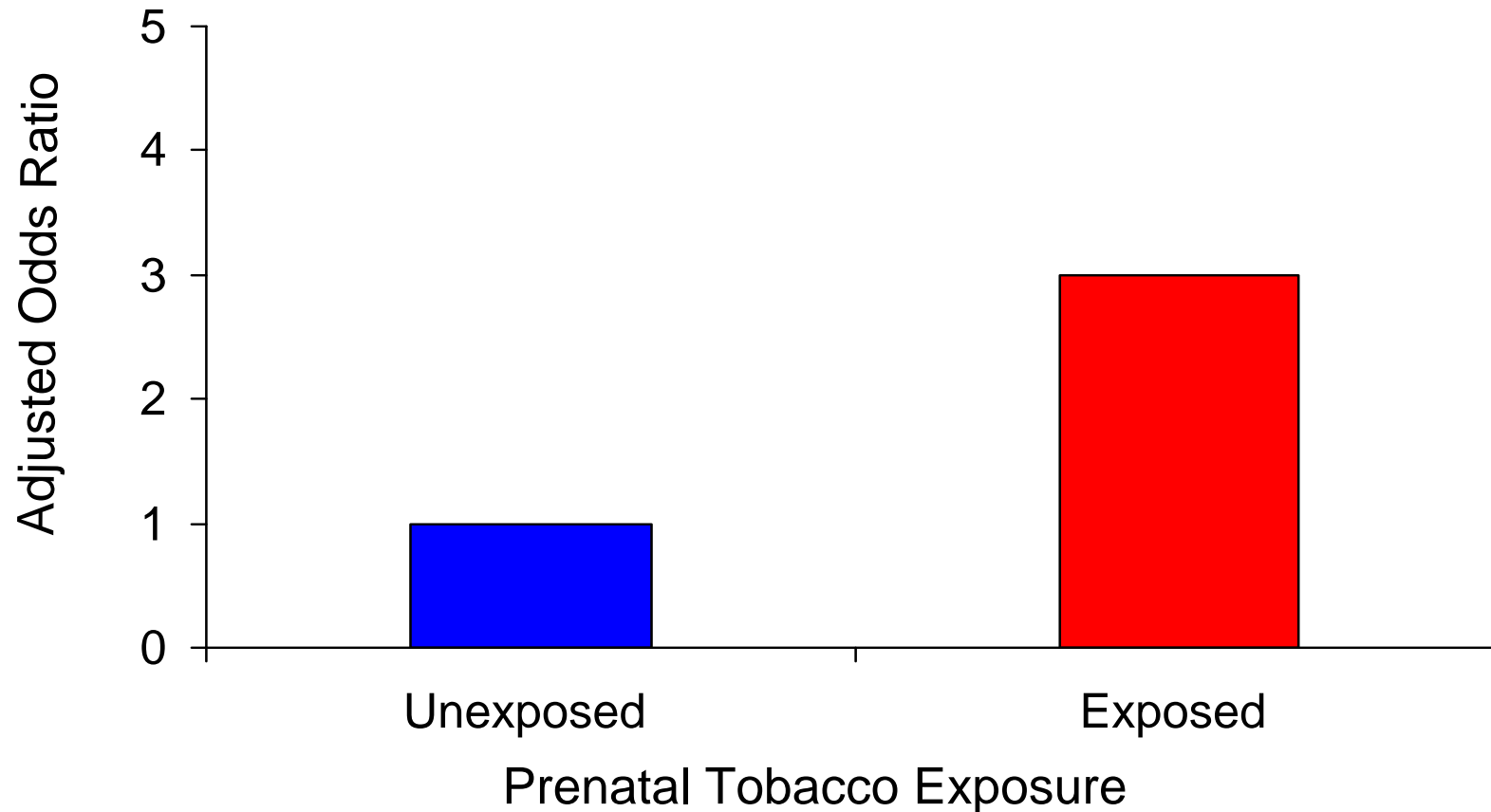
Summary

- Mounting evidence linking low-level toxicant exposure with child and adolescent psychopathology
- Large prospective birth cohort studies are needed to confirm results and explore GEi
- Contemporary studies are needed to explore relationships at increasingly lower exposures
- Need studies to examine specific environmental risk factors for endophenotypes and variants of ADHD, autism spectrum disorders and antisocial behaviors

Relative Risks of Arrests for Violent Crimes by Childhood Blood Lead Concentration

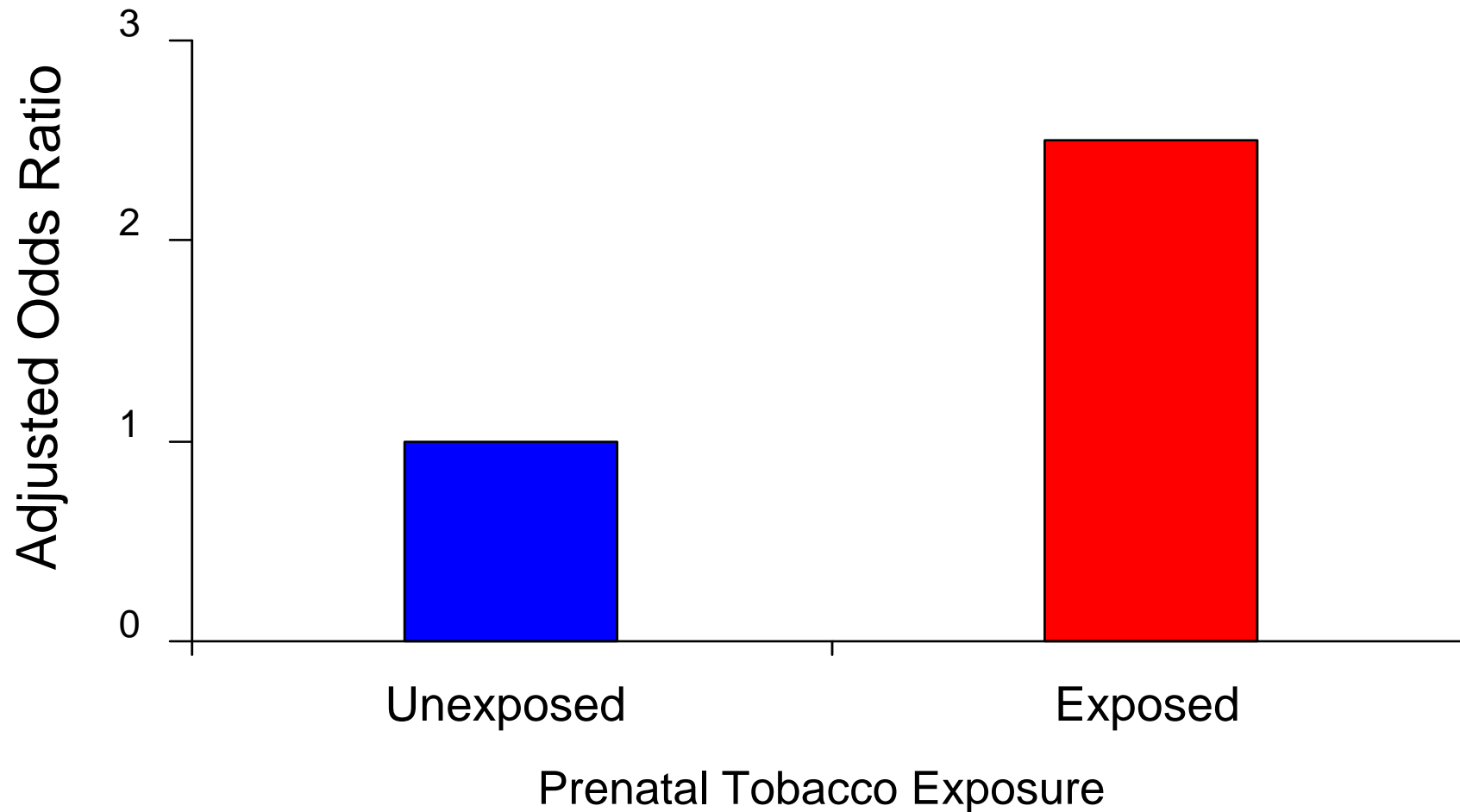
Blood Lead Variable	n	Relative Risk for each 5 $\mu\text{g}/\text{dL}$ (95%CI)
Average Childhood	250	1.30 (1.03-1.64)
Six-Year	250	1.48 (1.15-1.89)

Risk of Conduct Disorder by Prenatal Tobacco Smoke Exposure in US Children, 4 to 15 years, NHANES 1999-2002



Adjusted for child's age, sex, race and ethnicity, preschool attendance, serum ferritin, blood lead concentration and health insurance status. Braun J, et al. EHP 2006;17:500-505.

Risk of ADHD by Prenatal Tobacco Exposure in US Children, 4 to 15 years, NHANES 1999-2002



Adjusted for race/ethnicity, sex, age, blood lead level, ferritin level, presence of a smoker in the home, preschool attendance, and insurance. Source: Braun J, et al. EHP 2006;114:1904-1909.