Prenatal PCB & Mercury Exposures & Subsequent Neurobehavioral Development

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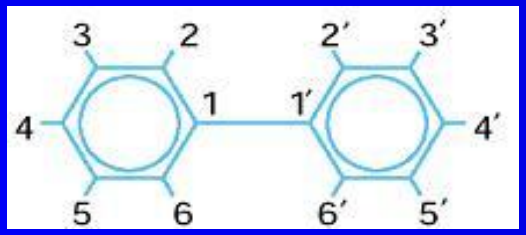
February 7, 2013

Polychlorinated Biphenyls

PCBs

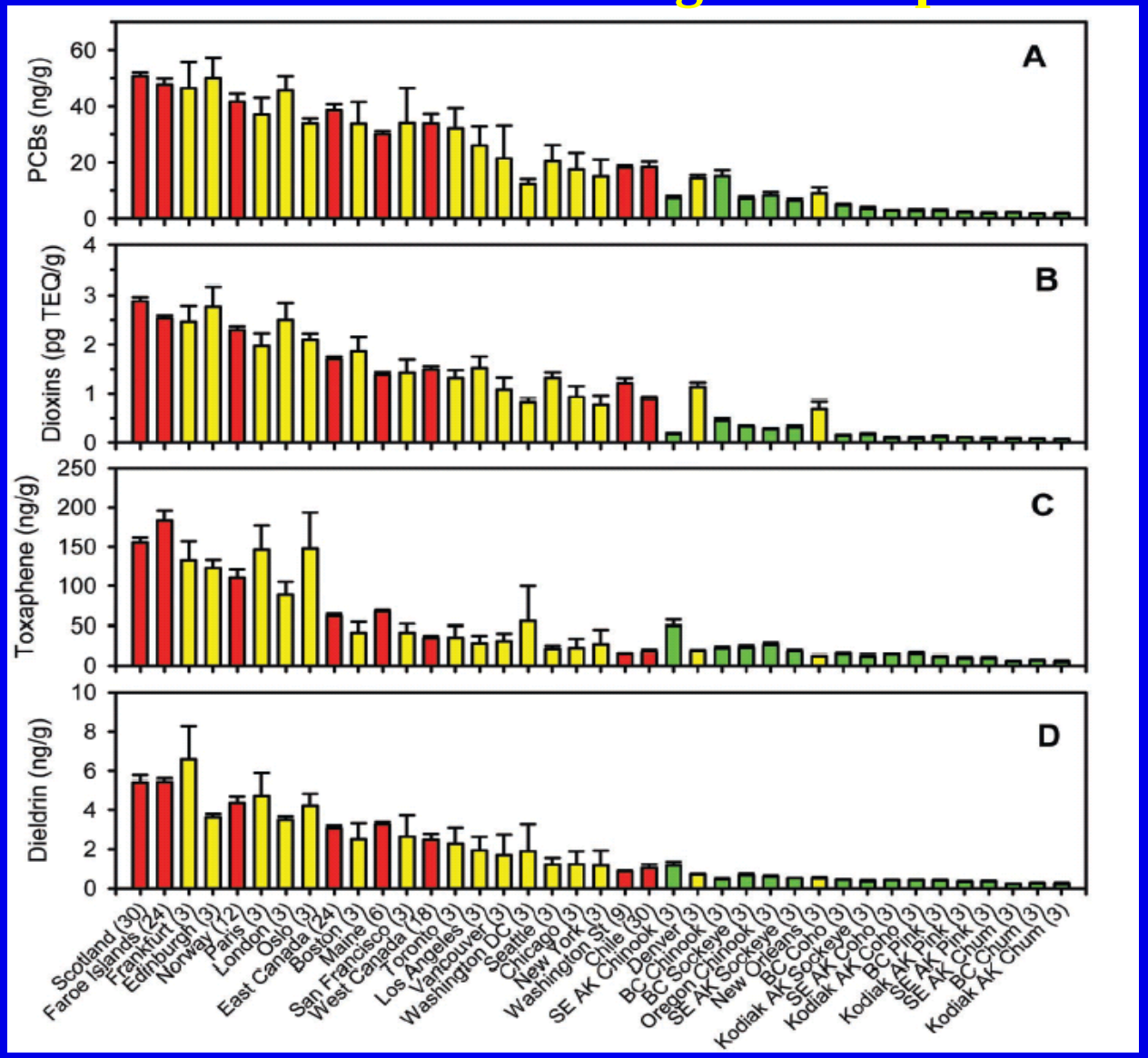
- Lipophillic, slowly metabolized
- U.S. ban in 1977 but persistent
- Exposure: food, soil/sediment, air
- Concentrate in fatty tissue (breast milk)



Health Effects:

- Probable human carcinogen
- Structural teratogen
- Growth impairment
- Neuromuscular & psychomotor development
- Cognition
- ***Behavior***
- Other:
  - Thyroid function
  - Immune function

Concentrations of PCBs, dioxins, and pesticides versus location where salmon were grown or purchased



Red = Farmed, Green = Wild, Yellow = Supermarket

(Hites et al. Science 2004)

Mercury (Hg)

- Multiple forms: elemental, inorganic, organic (**methylmercury, MeHg**)

- Sources of mercury:
  - Natural
  - Industrial
    - Waste incineration
    - Burning of fossil fuels
    - Smelting
    - Medical/lab instrumentation
  - Methylated by bacteria in aquatic environment
- Toxicities of mercury:
  - **Neurotoxicity (MeHg)**
  - Renal
  - Immune

Study Goals

Assess relation of low level *in utero* PCB and MeHg exposures with prospectively measured:

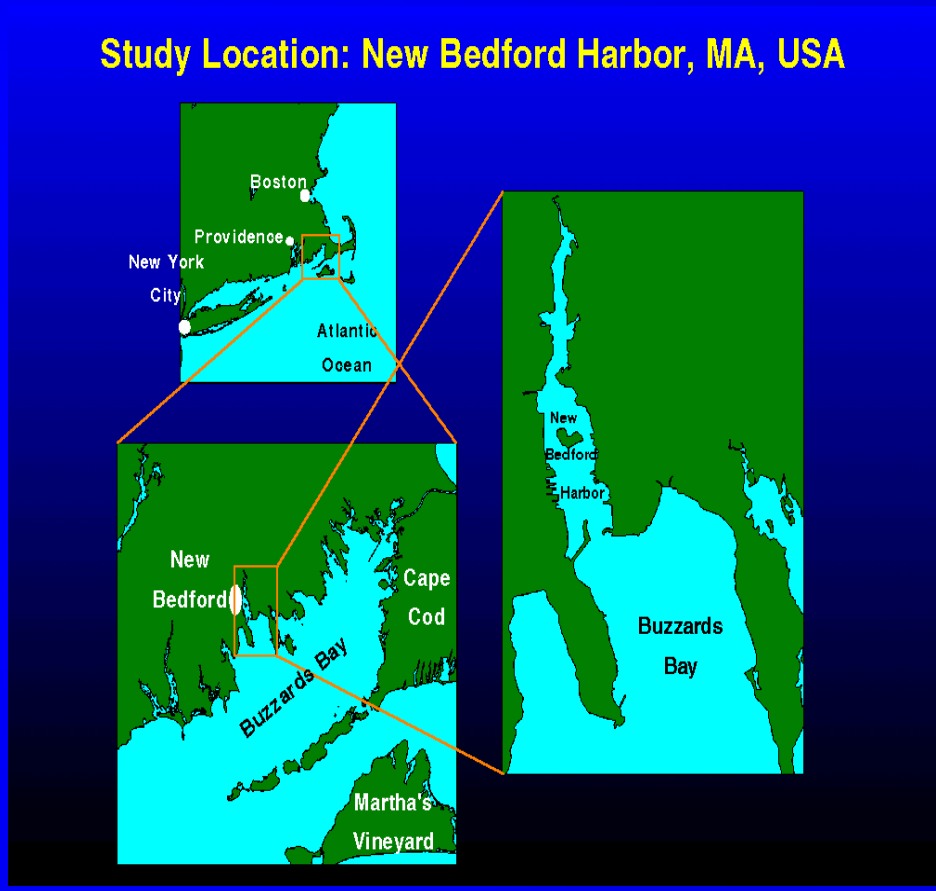
(1) Growth and maturation

(2) Cognition

(3) Behavior

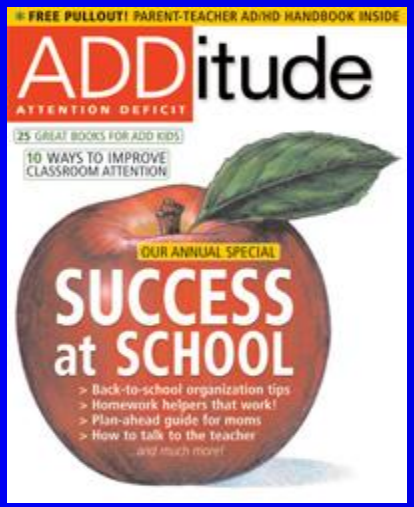
History of New Bedford Study Site

- 1940s-70s: Discharge of PCB-laden waste
- 1970s: Contamination discovered in Harbor
- 1977: PCB production banned in U.S.
- 1979: Harbor closed to fishing
- 1982: Harbor on EPA National Priority List

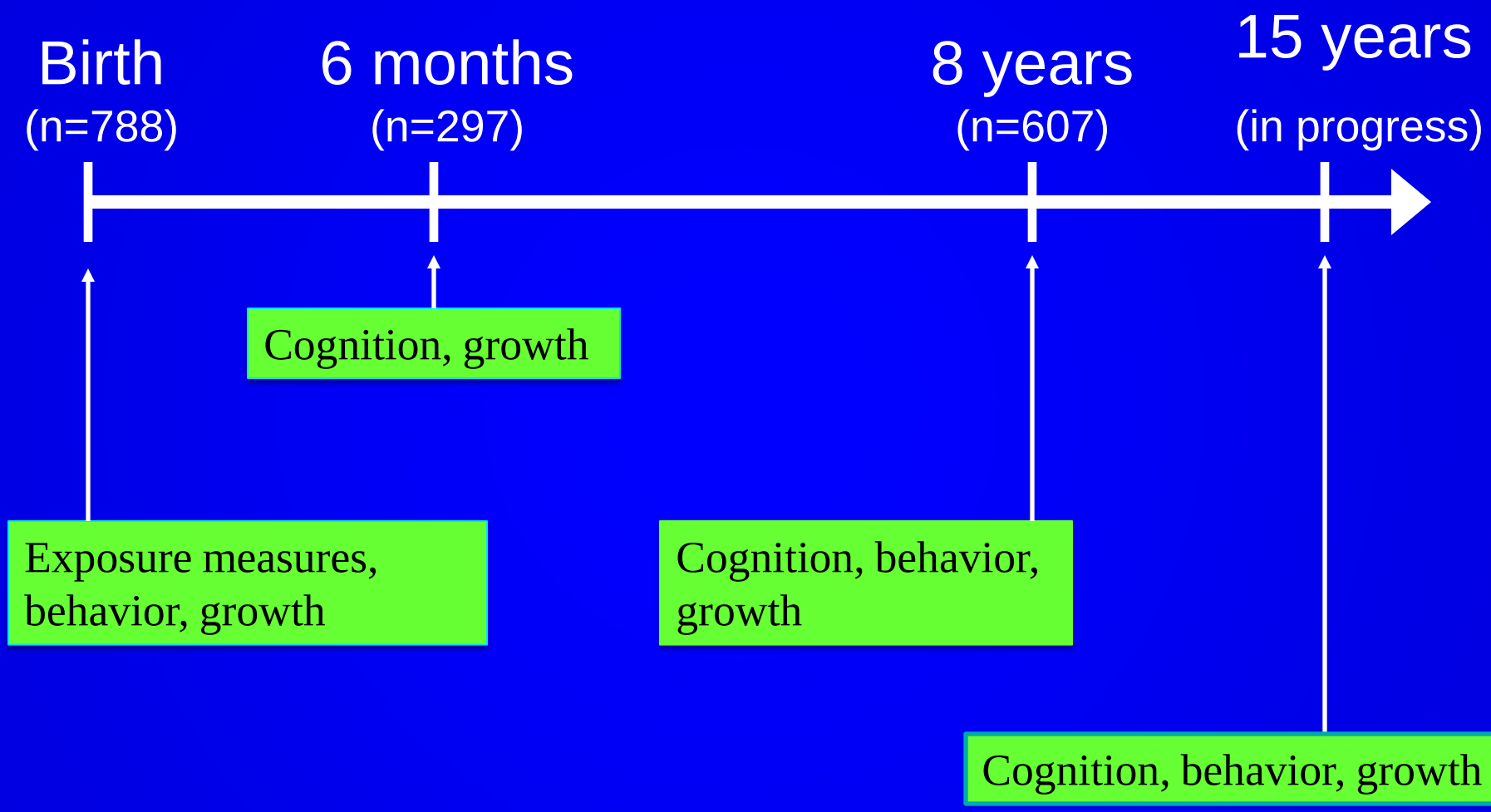


Attention Deficit-Hyperactivity Disorder

- Most common neurobehavioral disorder of children (6-12% worldwide)
- Risk factors poorly understood
- Clinical diagnosis (no specific test)
- Neuroimaging: ↓brain volume
- Mechanism: “dopamine deficit”
- Deficiencies:
  - vigilance-attention
  - cognitive control (working memory, impulse ctrl)
  - motivation



Study Design

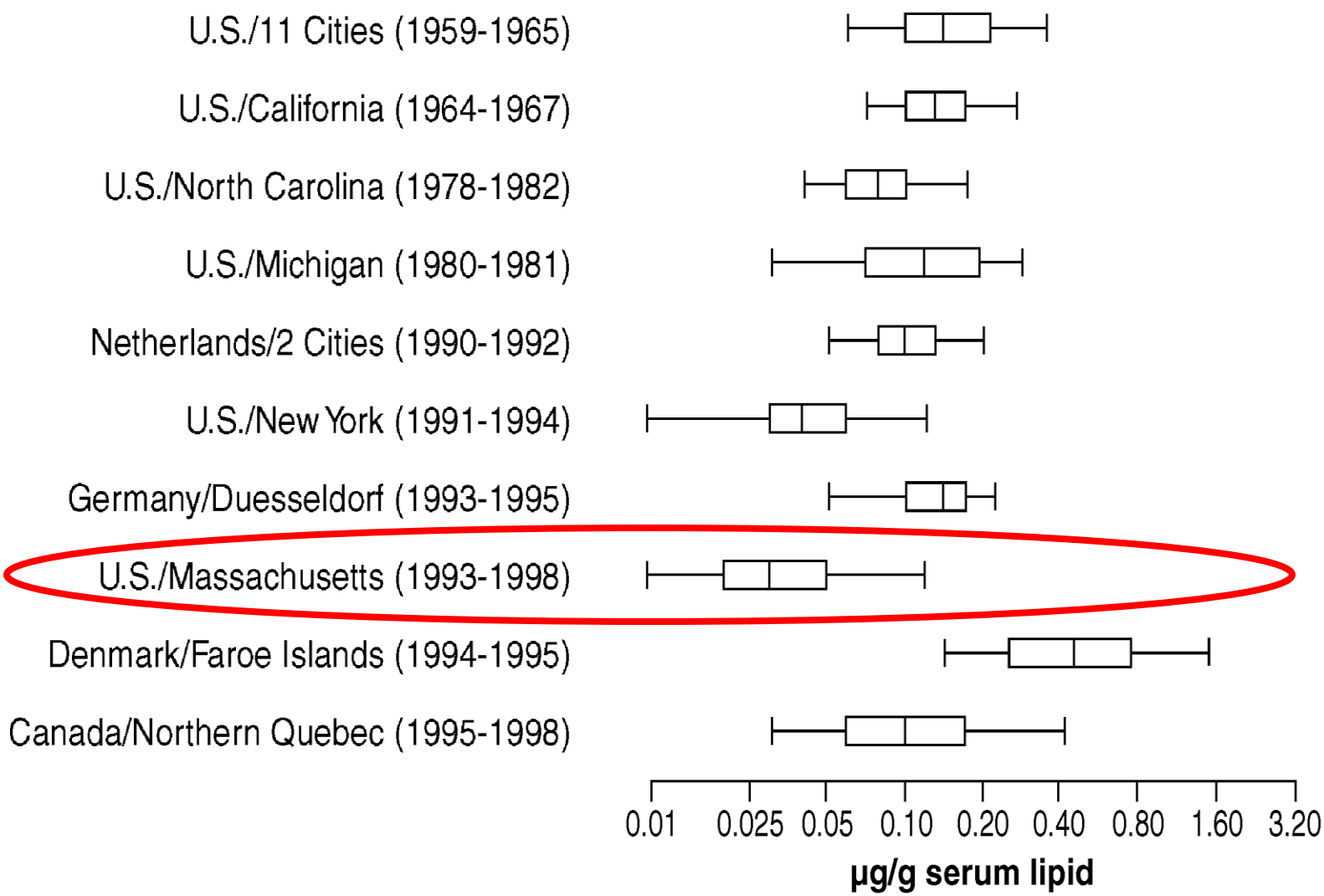


Study Population

CHILD CHARACTERISTICS	%	Mean (range)
Age at exam (yrs)		8 (7-11)
Male	51	
Race		
Caucasian	69	
Cape Verdean	11	
Other	20	

MATERNAL CHARACTERISTICS	%	Mean (range)
Age at infant birth		27 (17-41)
Smoked during pregnancy	30	
Married when child is school aged	59	
Some college	57	
Breastfed	36	
Household income <20,000	21	

Distribution of PCB 153 concentration in serum, 10 studies



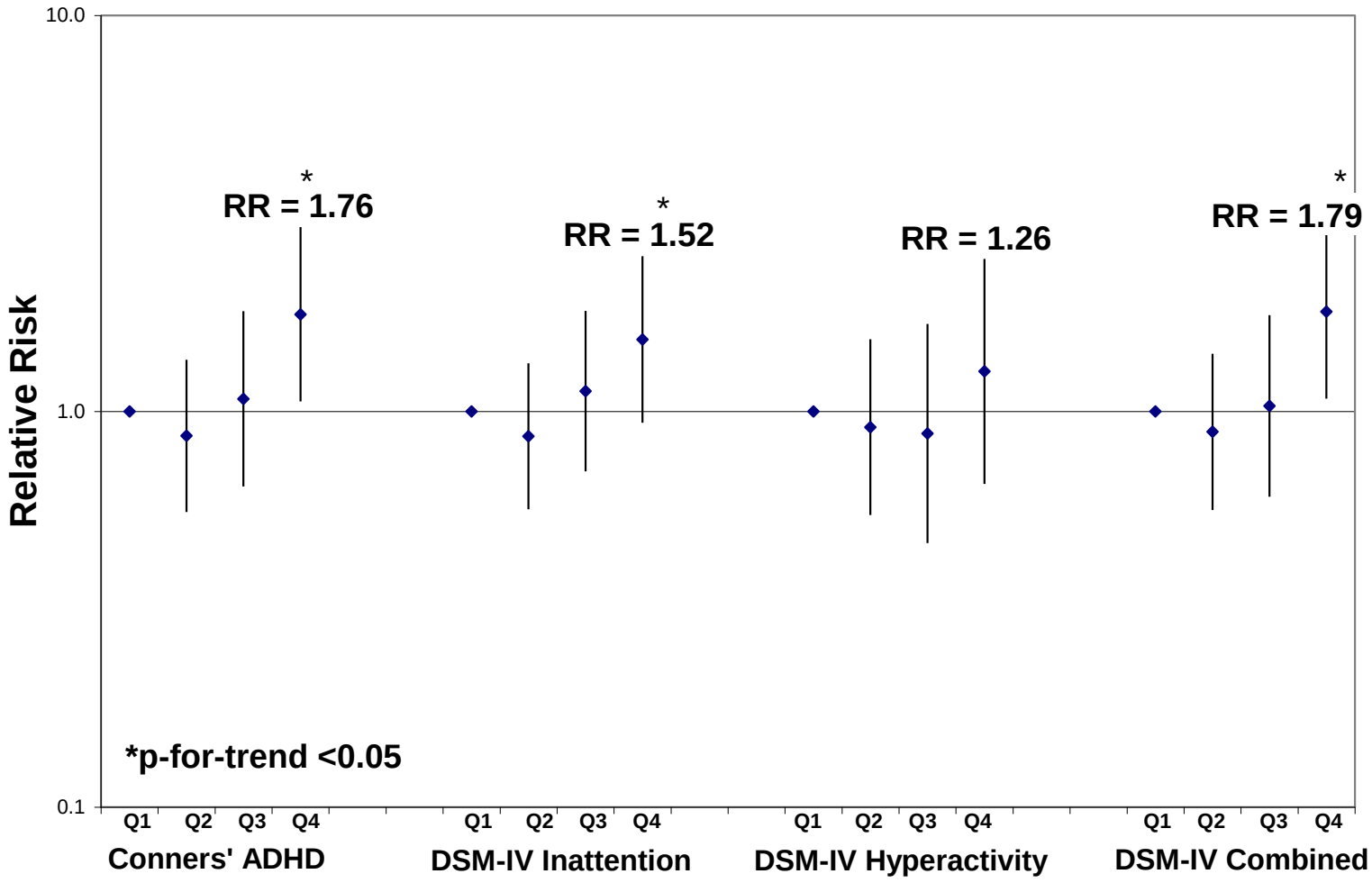
Longnecker et al., Environ Health Perspect, 2003

Outcome: Behavioral Rating Scale

- **Conners Rating Scale – Teachers (CRS-T)**
  - 59 item questionnaire, problem behaviors
  - Used in clinical dx, monitoring, research
  - Analyzed 4 subscales:
    - Conners' ADHD Index
    - DSM-IV Inattention
    - DSM-IV Impulsivity-Hyperactivity
    - DSM-IV Combined

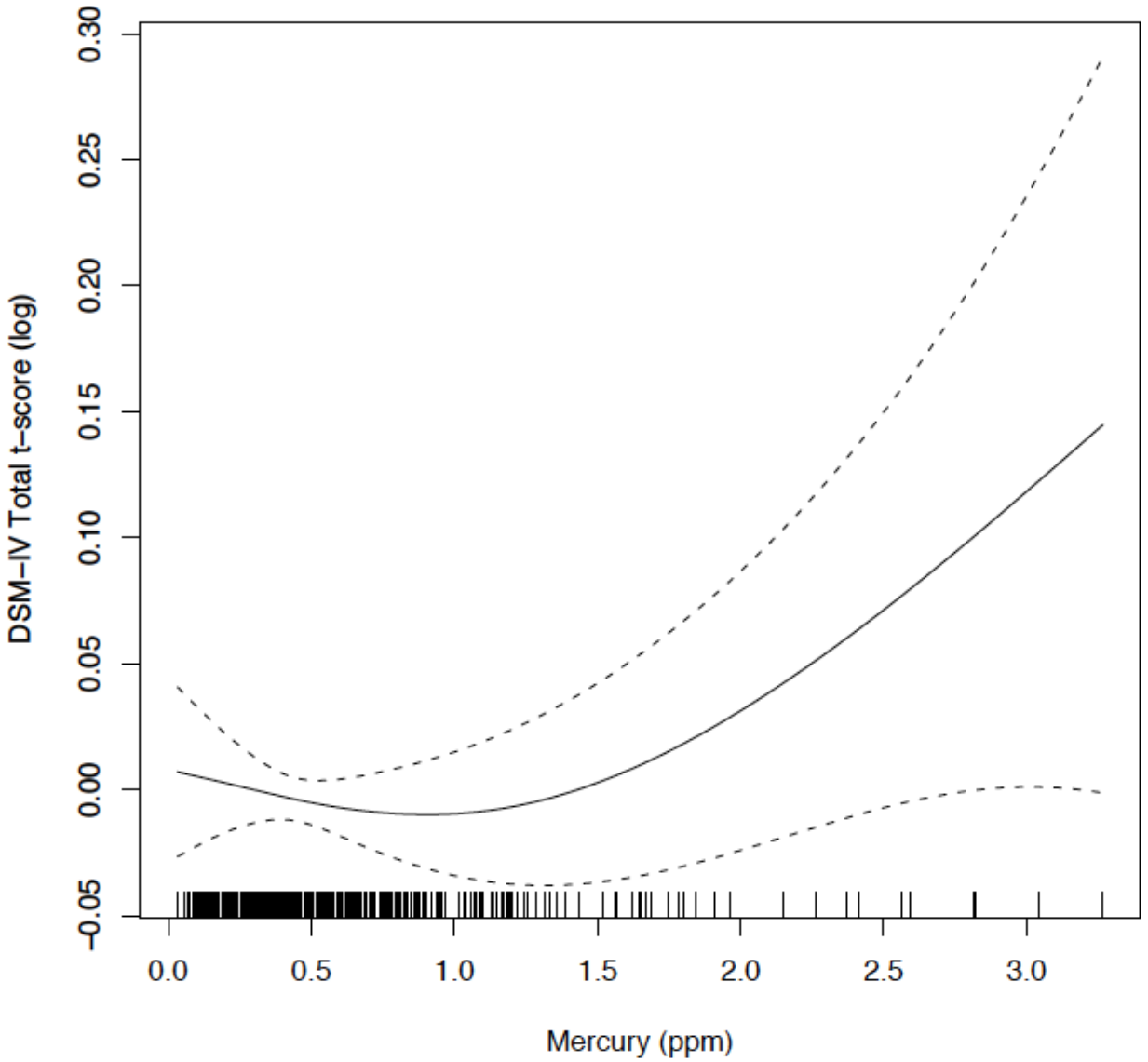
PCBs & Conners' Rating Scale (teachers)

Sagiv et al. Am J Epidemiol 2010



Maternal Hair Hg & ADHD Behavior at age 8

Sagiv et al. Arch Pediatr Adolesc Med 2012



Summary: Environmental Contaminants & Behavior in the New Bedford Cohort

↑ADHD-associated behaviors were associated with:

Prenatal PCBs

Prenatal MeHg (> 1ppm)

of note

↓ADHD-associated behaviors were associated with > 2 servings fish/wk in pregnancy

Collaborators

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