Exposure and health effects pathway

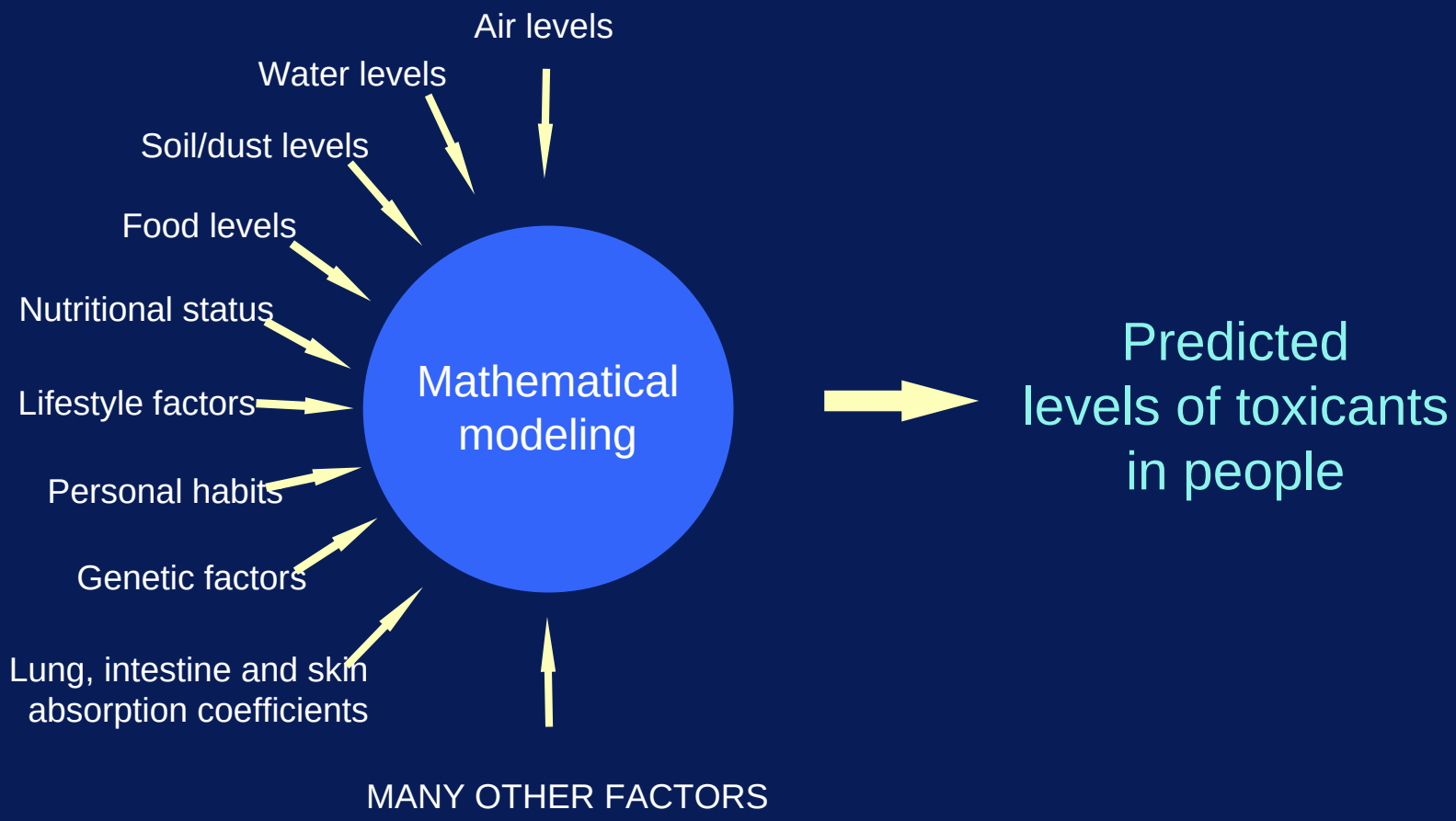
External dose: air, water, food, soil, dust

inhalation
ingestion
skin absorption

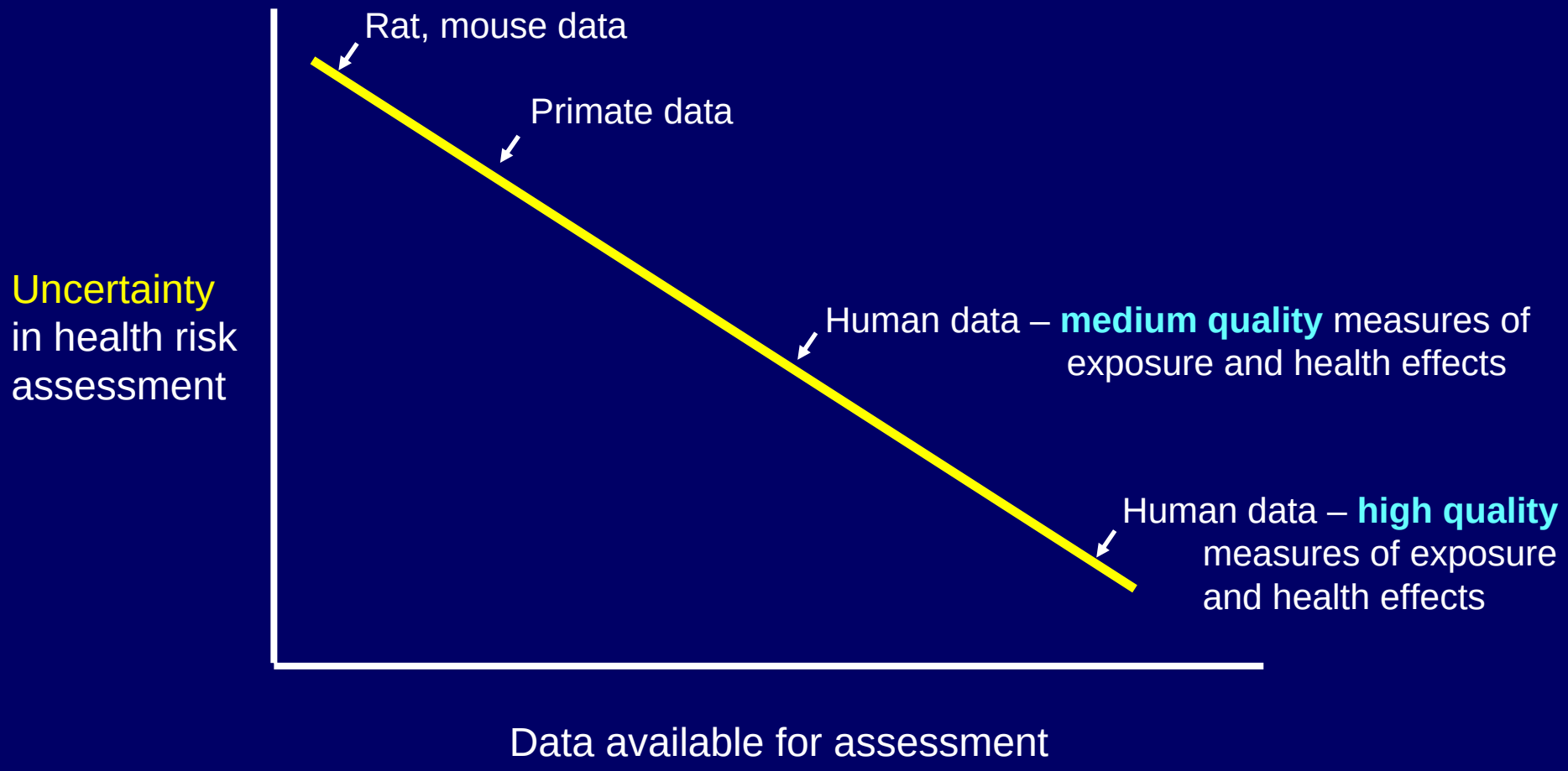
Internal dose: blood, serum, urine, tissue

Health effect

Predicting levels of toxicants in people using environmental monitoring is very difficult and includes many assumptions

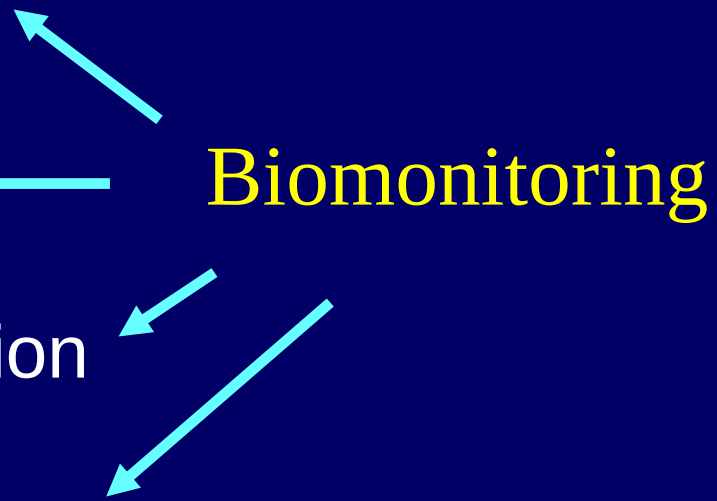


Excellent quality human data markedly reduces uncertainty in health risk assessment

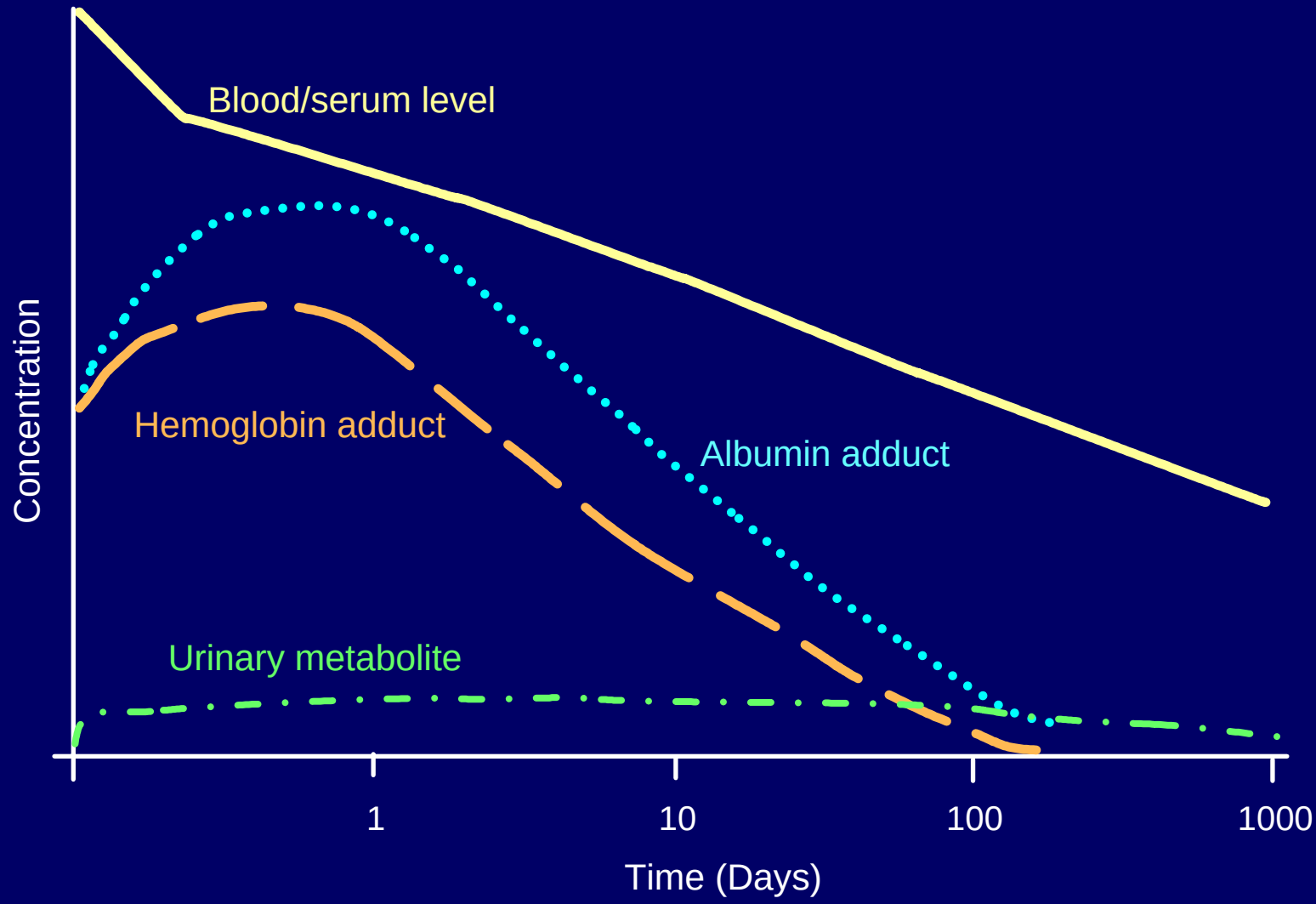


Prevention of disease from toxic exposures

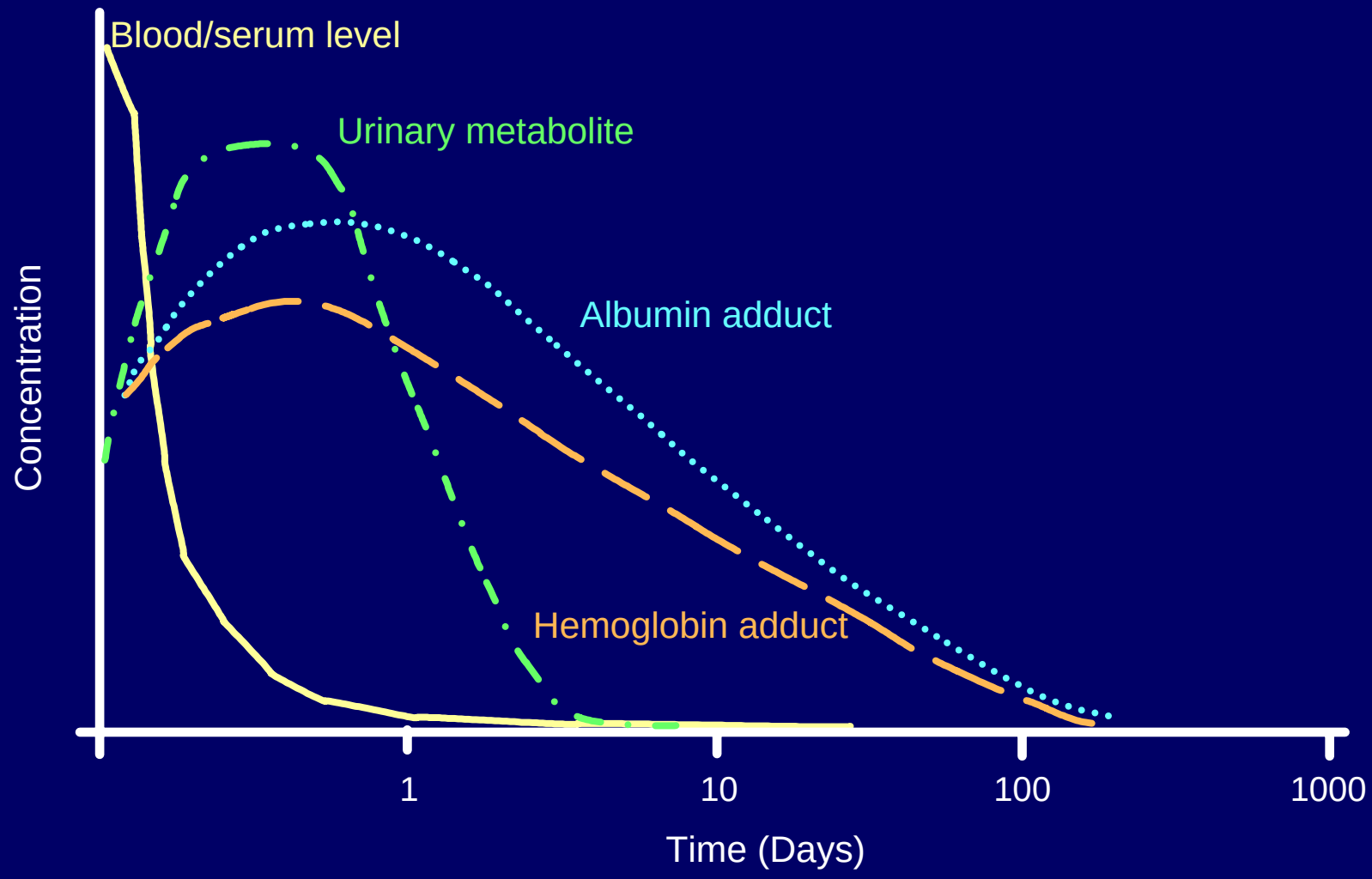
- Detect exposure or disease
- Assess health risk
- Develop and apply intervention
- Assure intervention effective



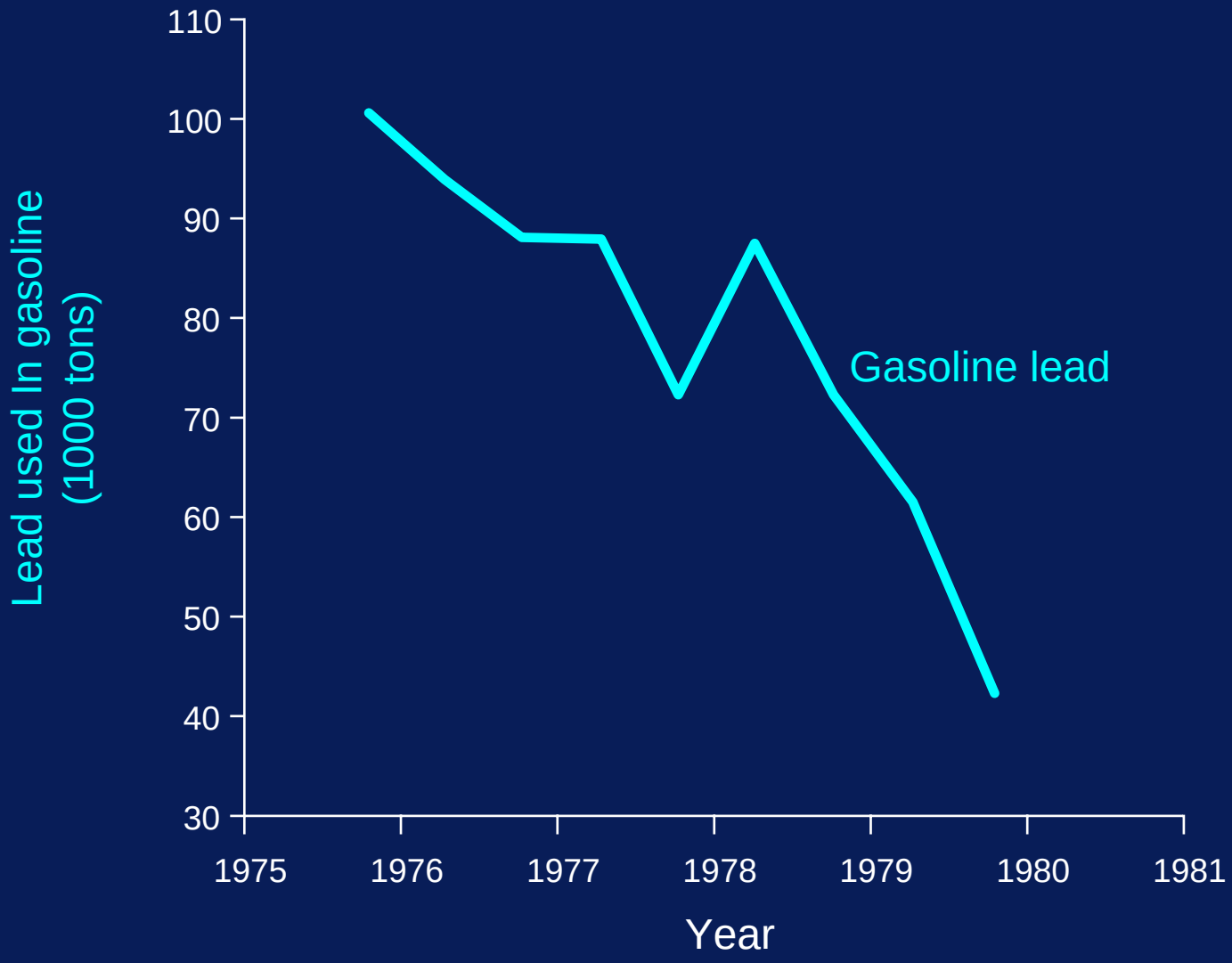
Persistent toxicant in blood and urine



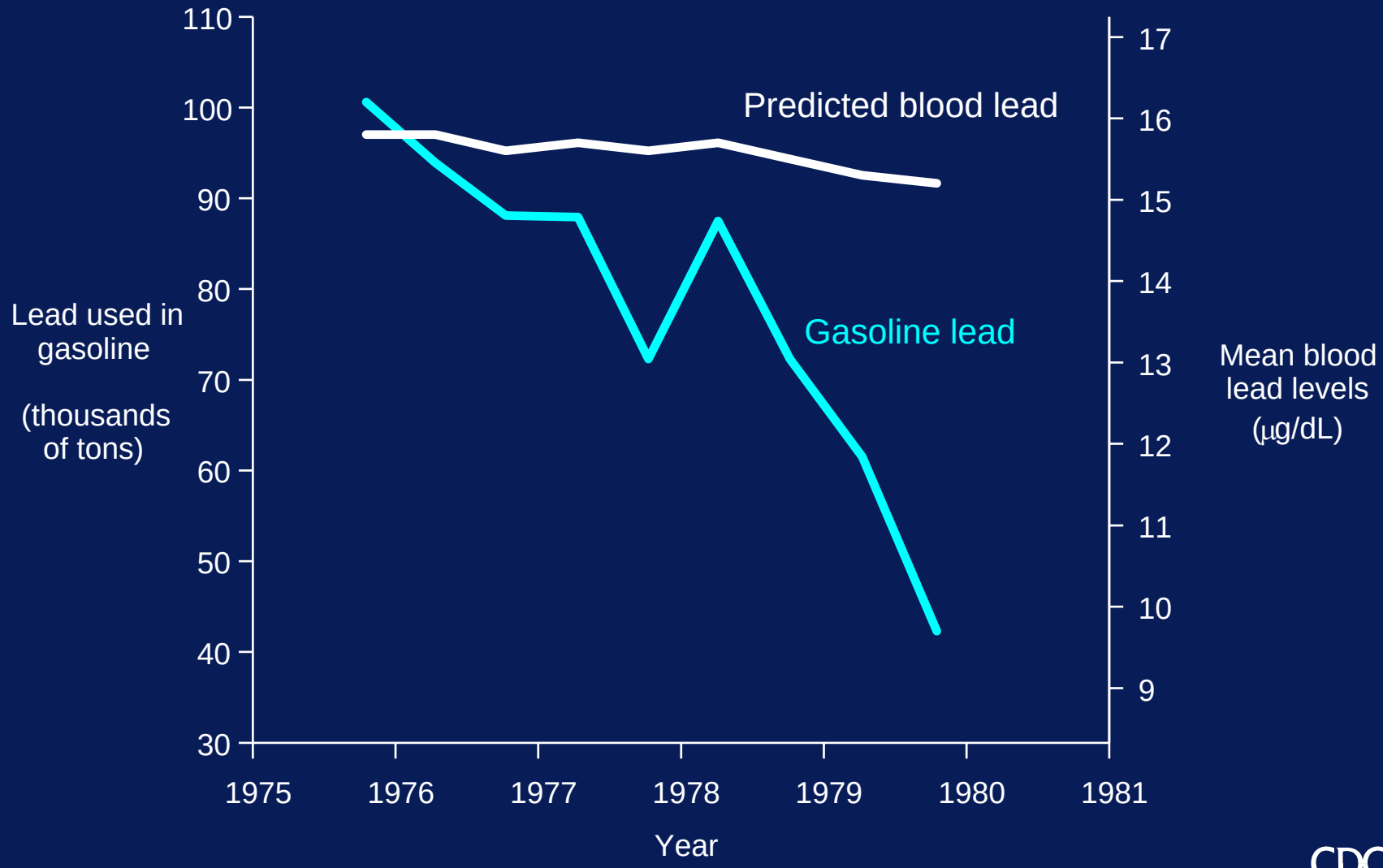
Non-persistent toxicant in blood and urine



Lead used in gasoline declined from 1976 through 1980

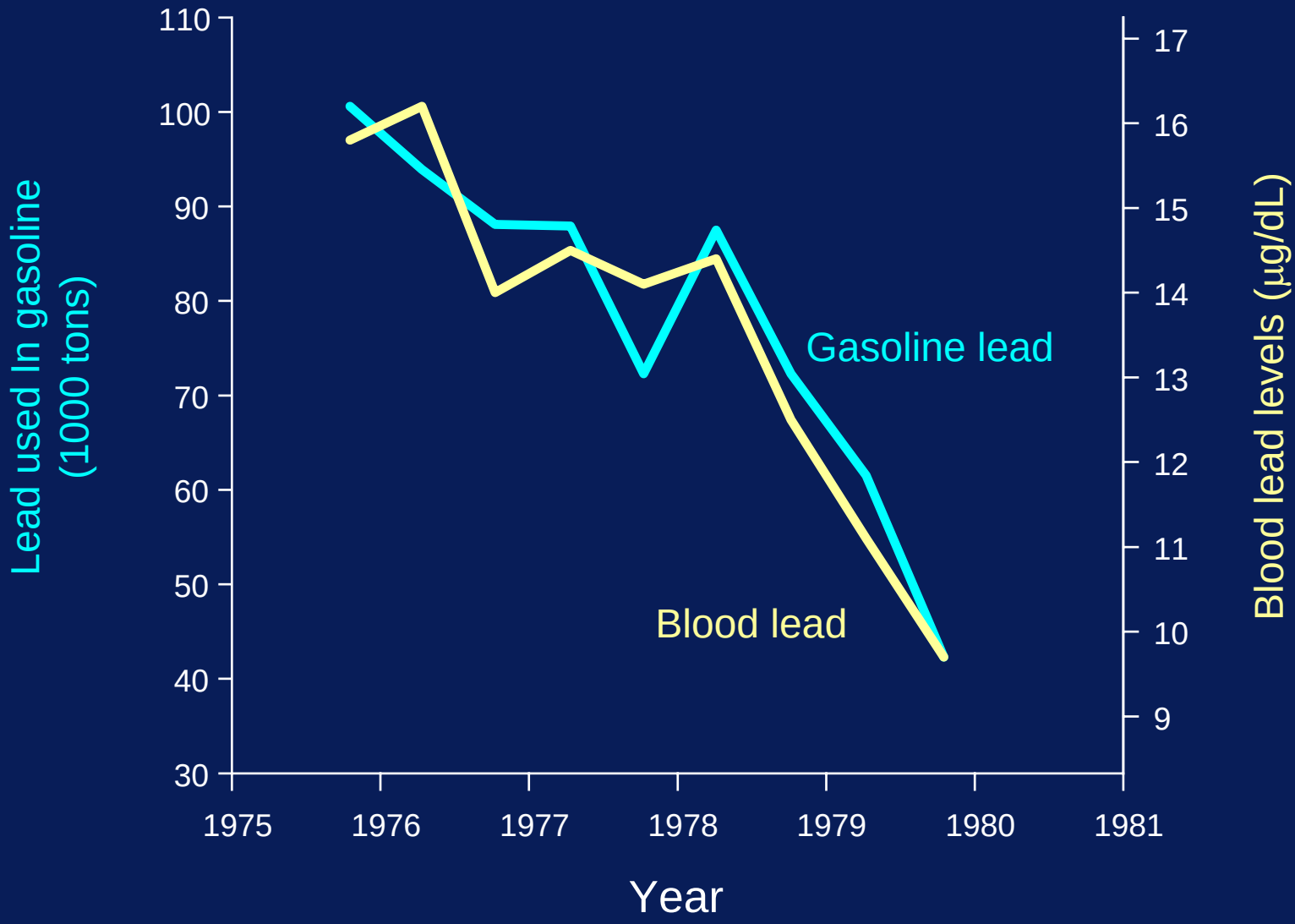


Environmental modeling predicted only a slight decline in blood lead levels in people

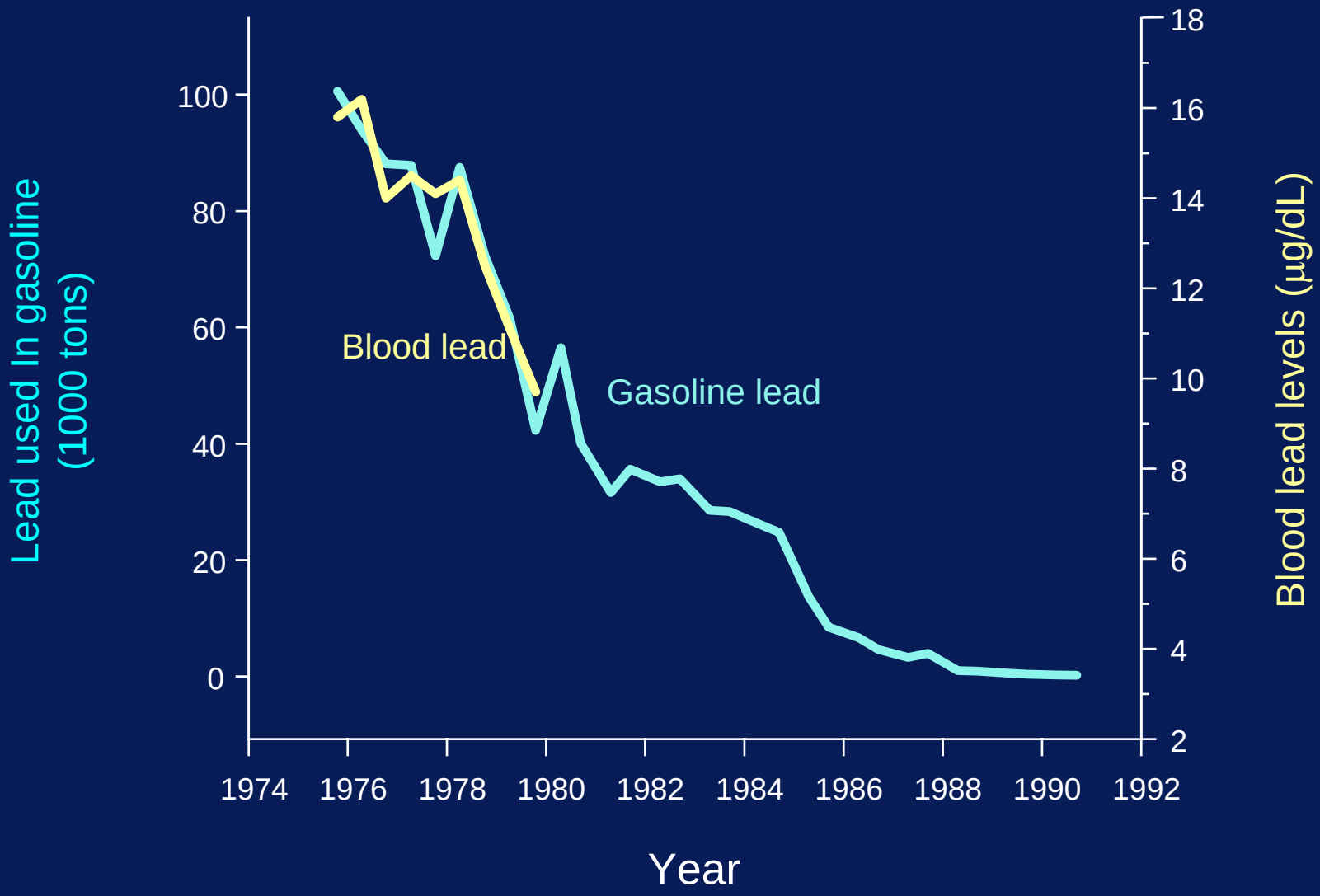


Lead in gasoline and lead in blood

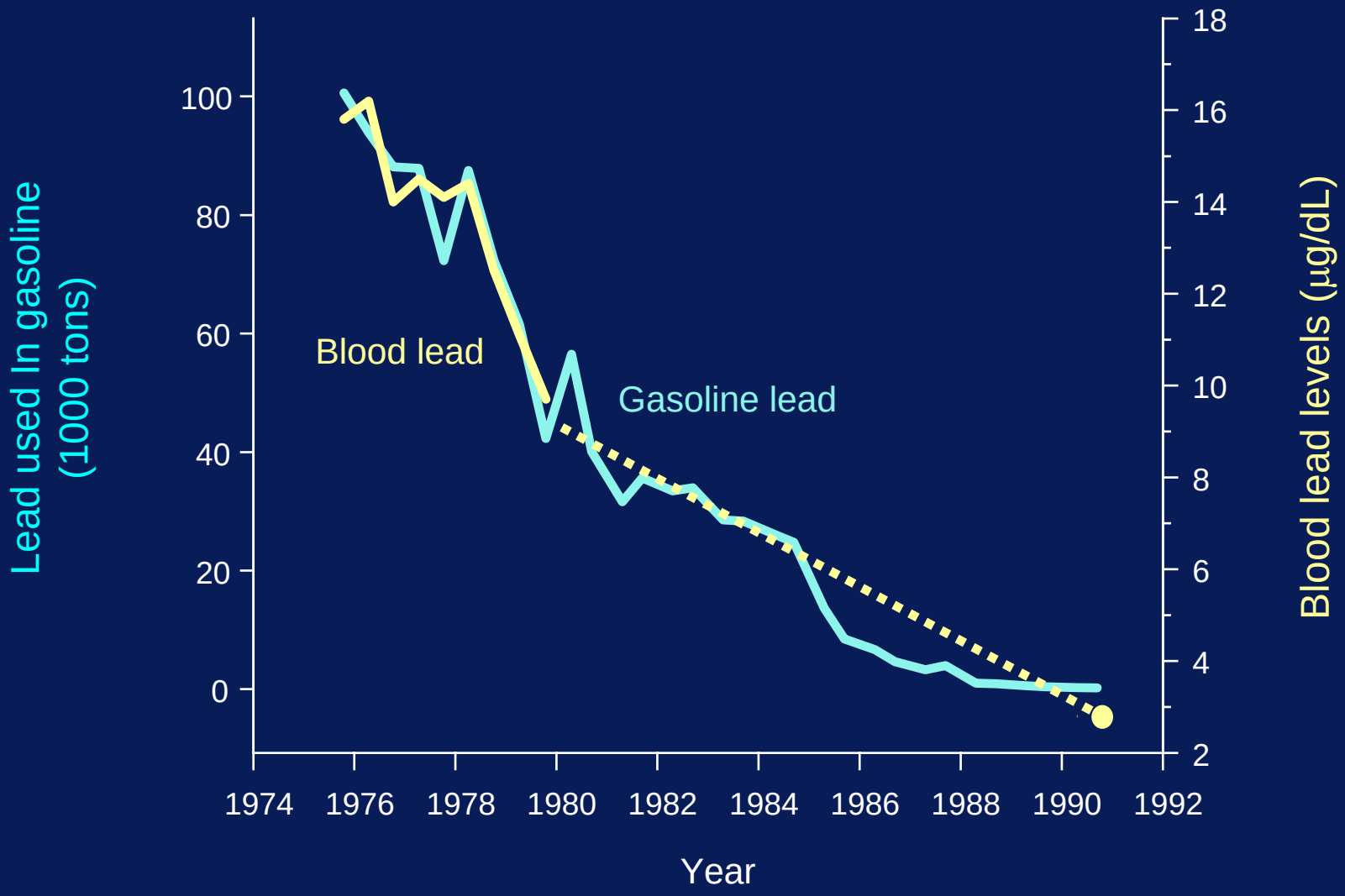
NHANES II, 1976-1980



After NHANES II, EPA further restricted leaded gasoline and gasoline lead levels continued to decline through 1991

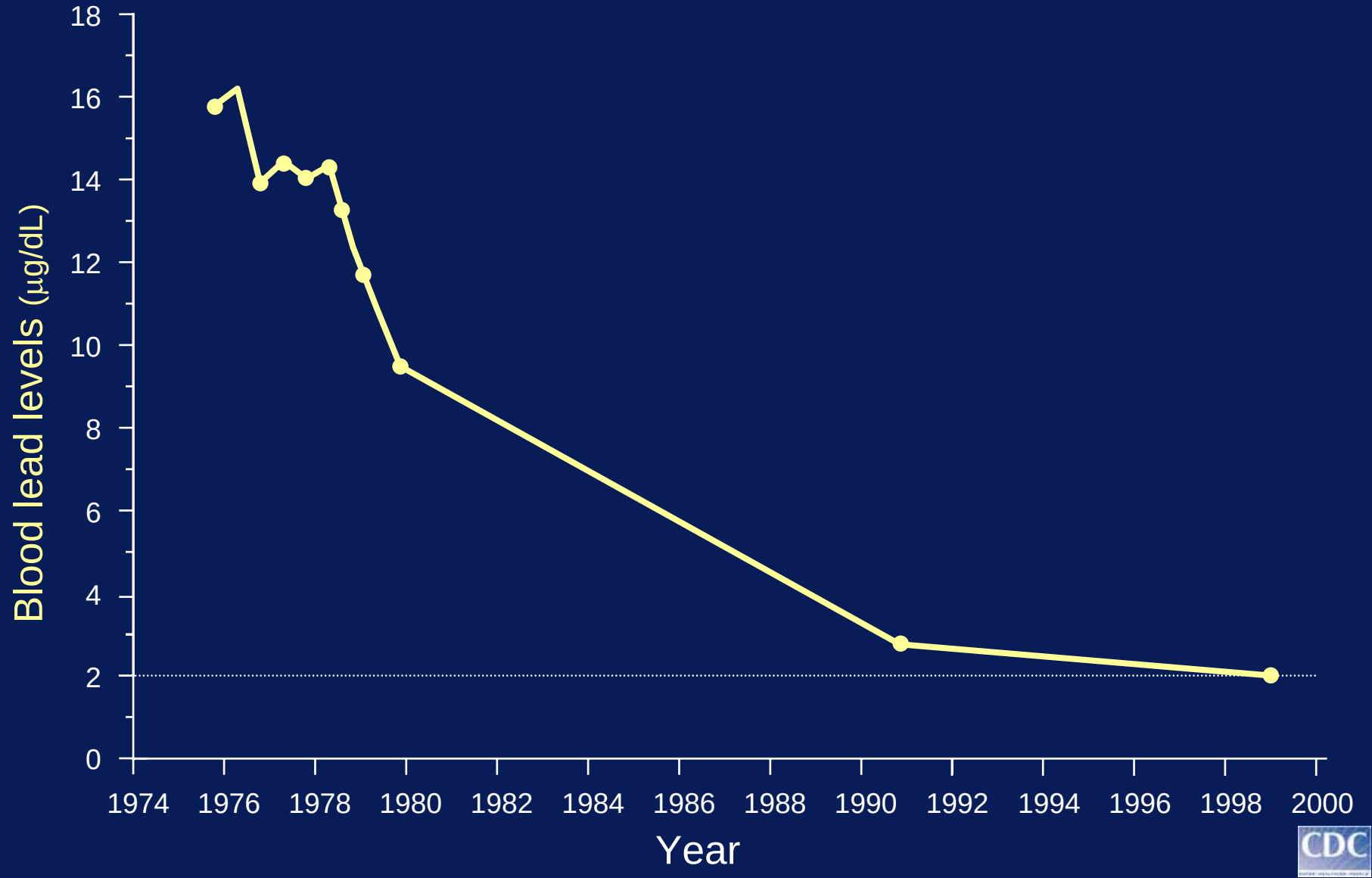


NHANES III (1988-1994) showed blood lead levels continued to decrease as gasoline levels declined



Blood lead levels in the U.S. population 1976 -1999

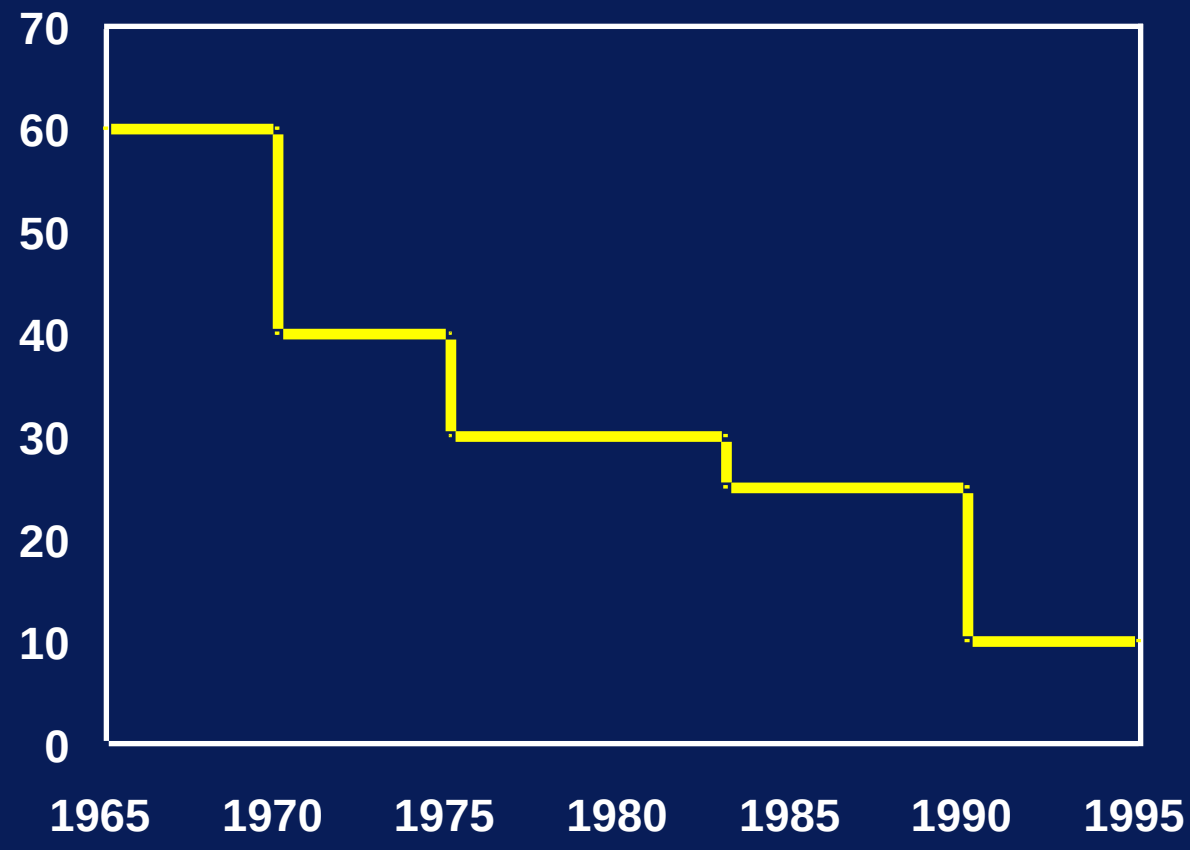
NHANES II, III, 99+



Percent of children 1-5 years of age in the United States with blood lead levels ≥ 10 μg/dL

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

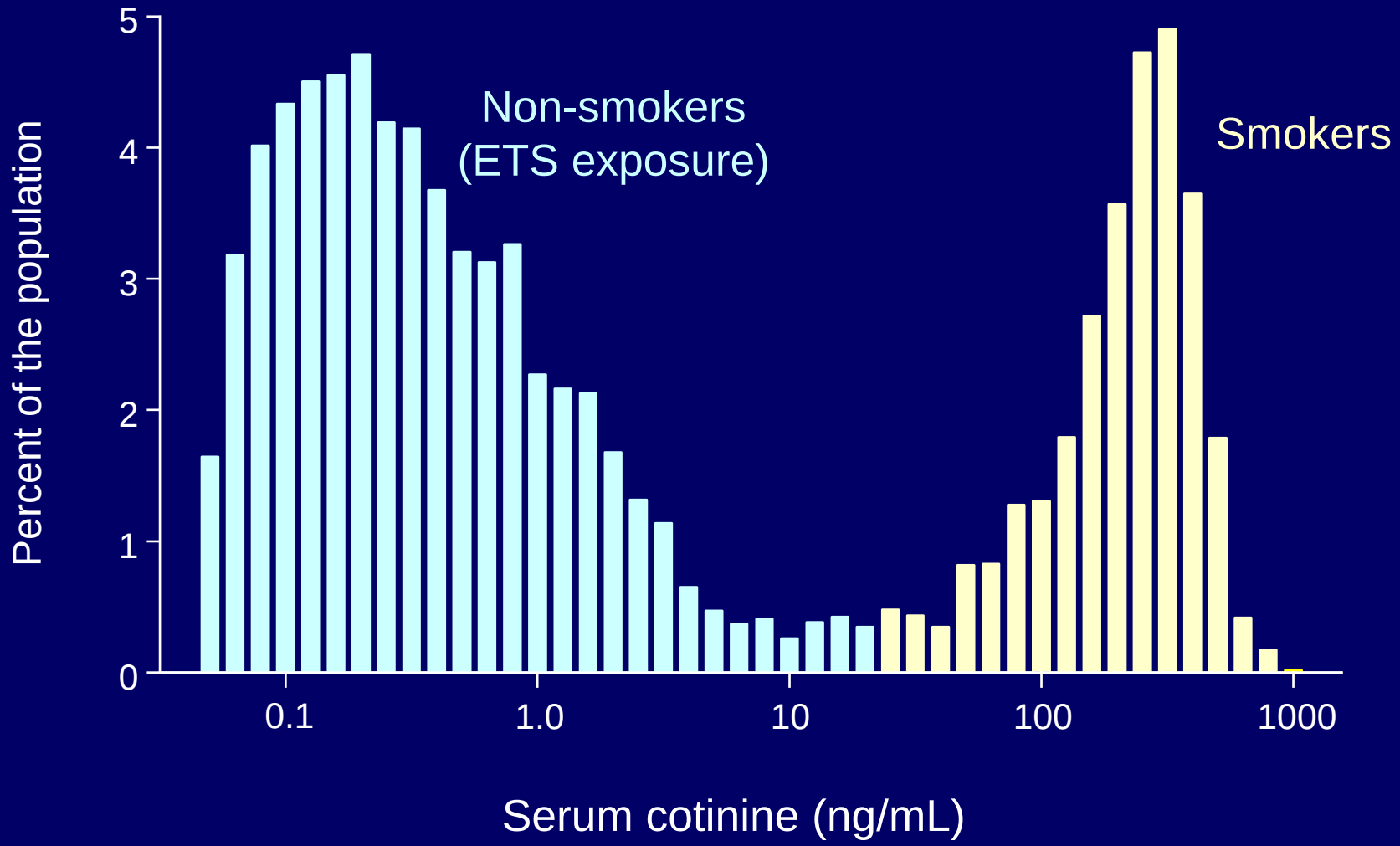
Blood lead levels defining lead poisoning (μg/dL)



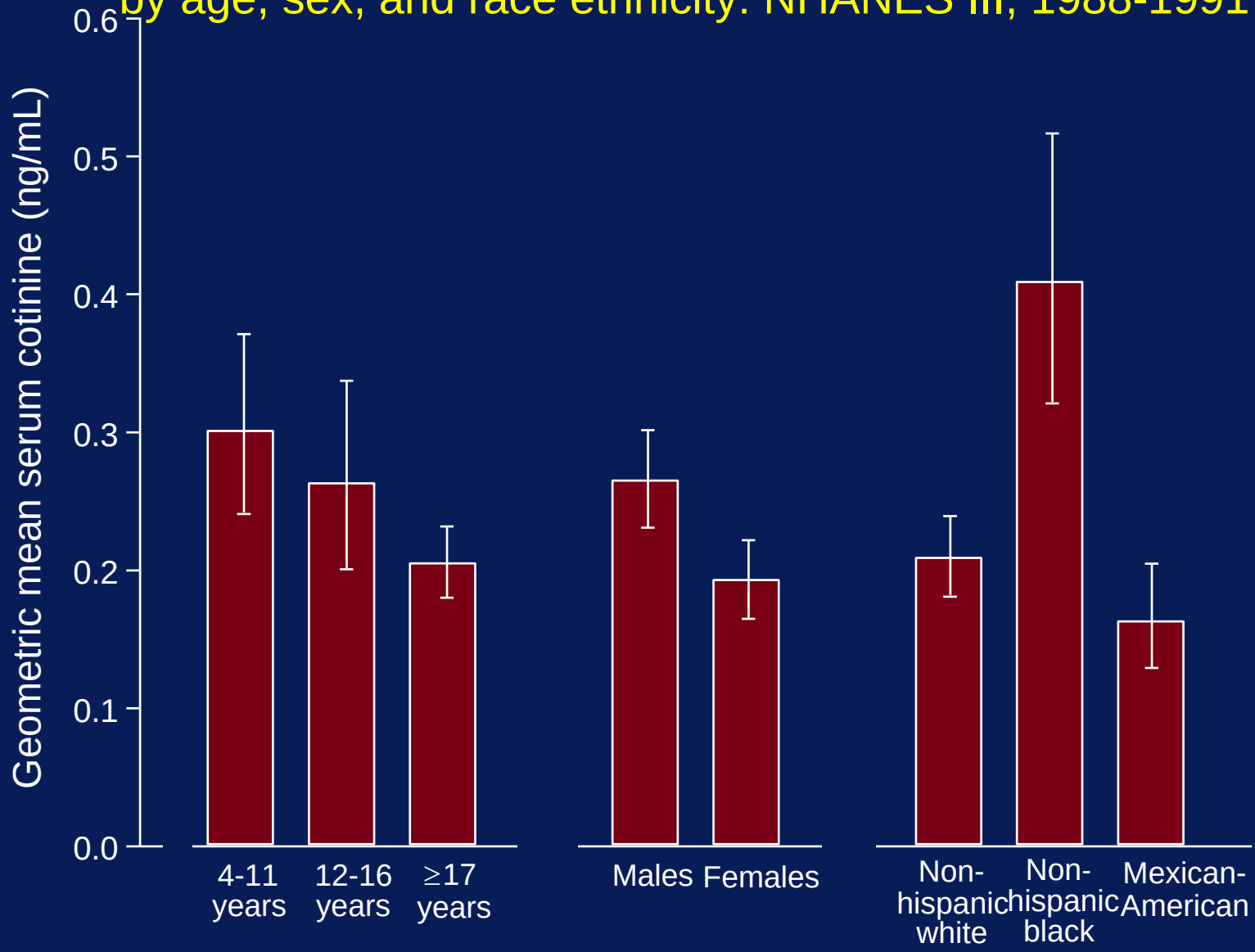
CDC

Exposure of the U.S. population to tobacco smoke:

serum cotinine levels, 1988-1991 (n=11,800)

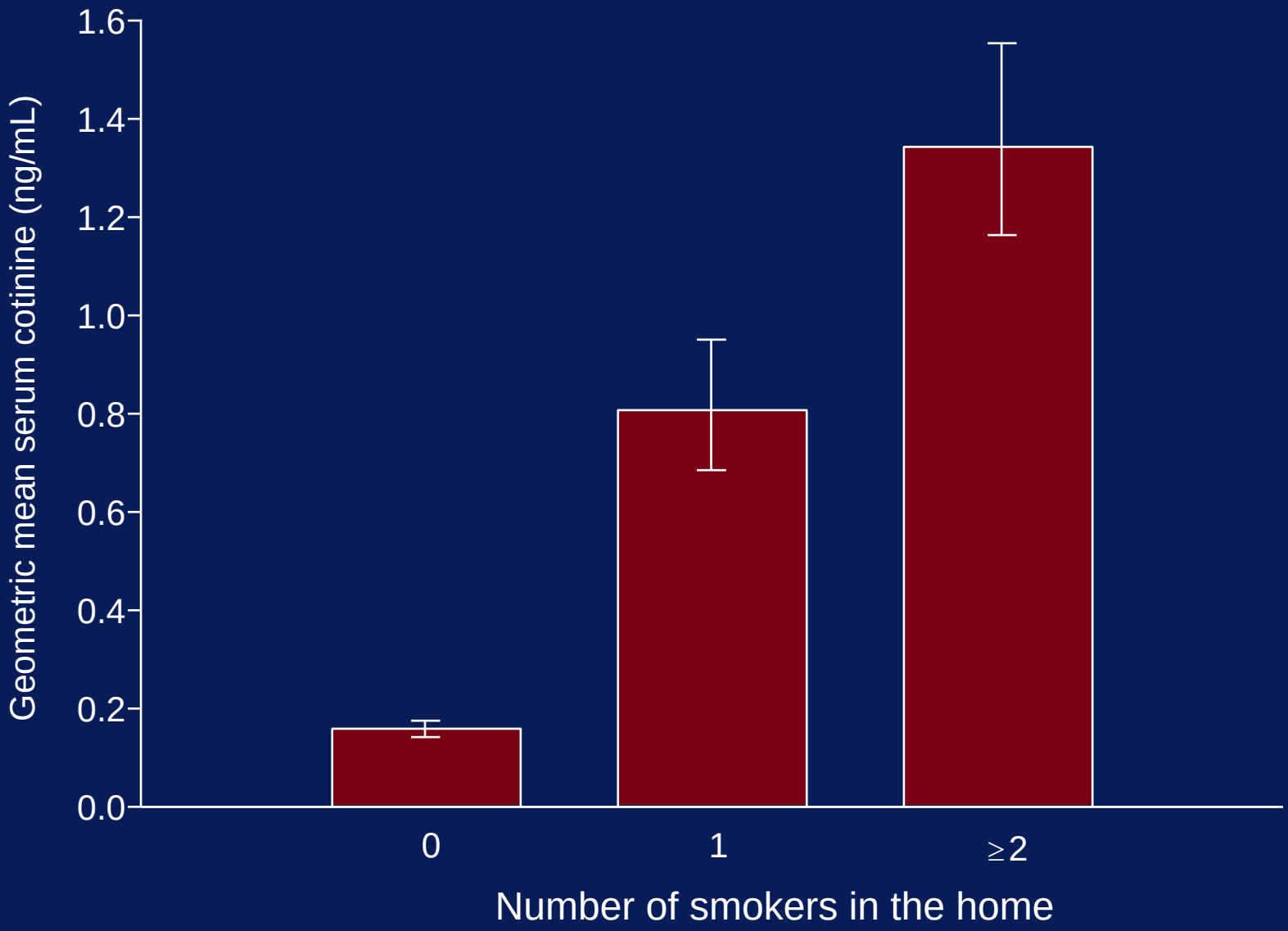


Serum cotinine levels (geometric mean and 95% confidence interval) in the U.S. population for non-tobacco users ages 4 and older by age, sex, and race ethnicity: NHANES III, 1988-1991



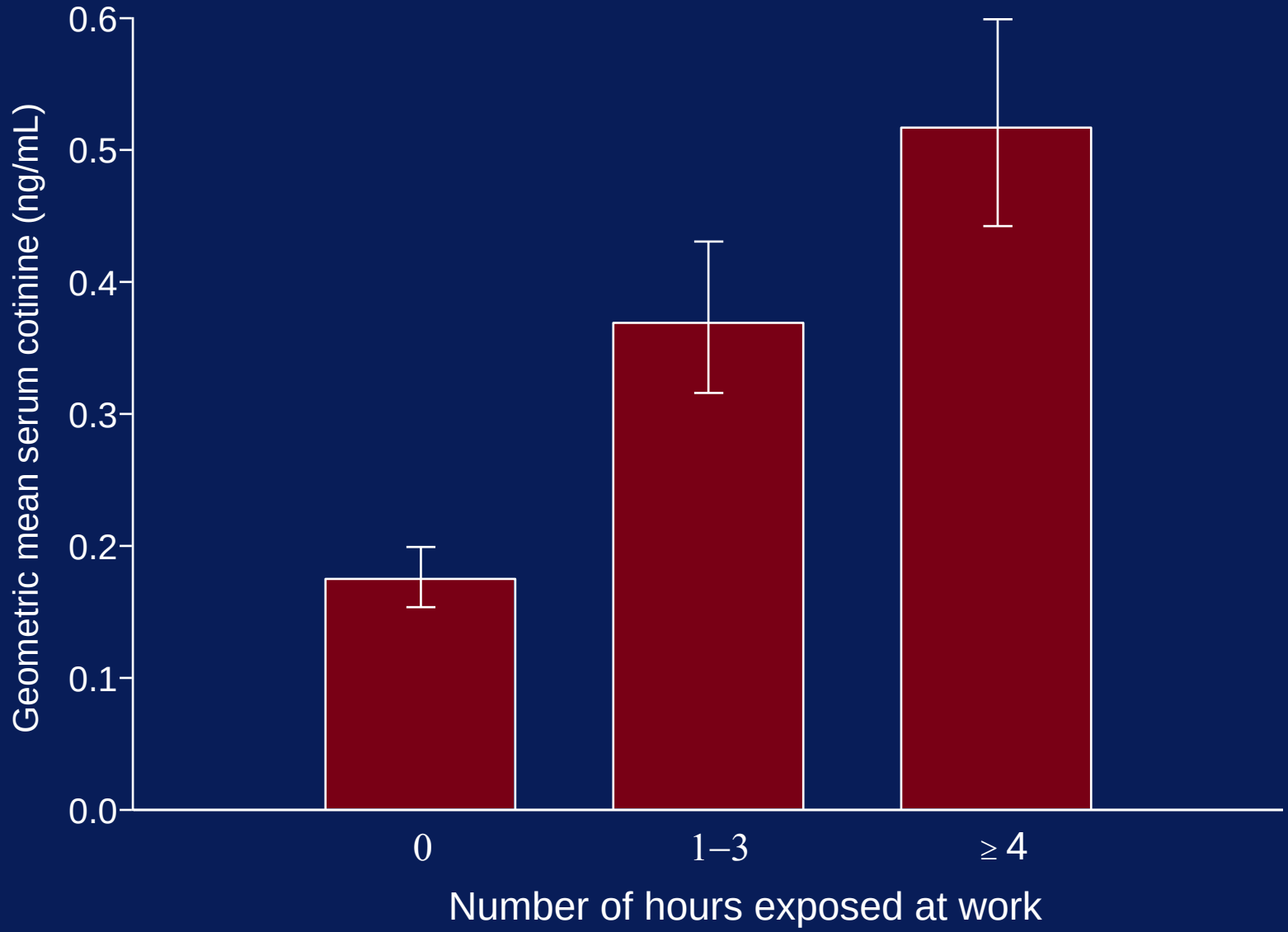
CDC

Serum cotinine levels (geometric mean and 95% confidence interval) for non-tobacco users in the U.S. population ages 4 and older by number of smokers in the home: NHANES III, 1988-1991



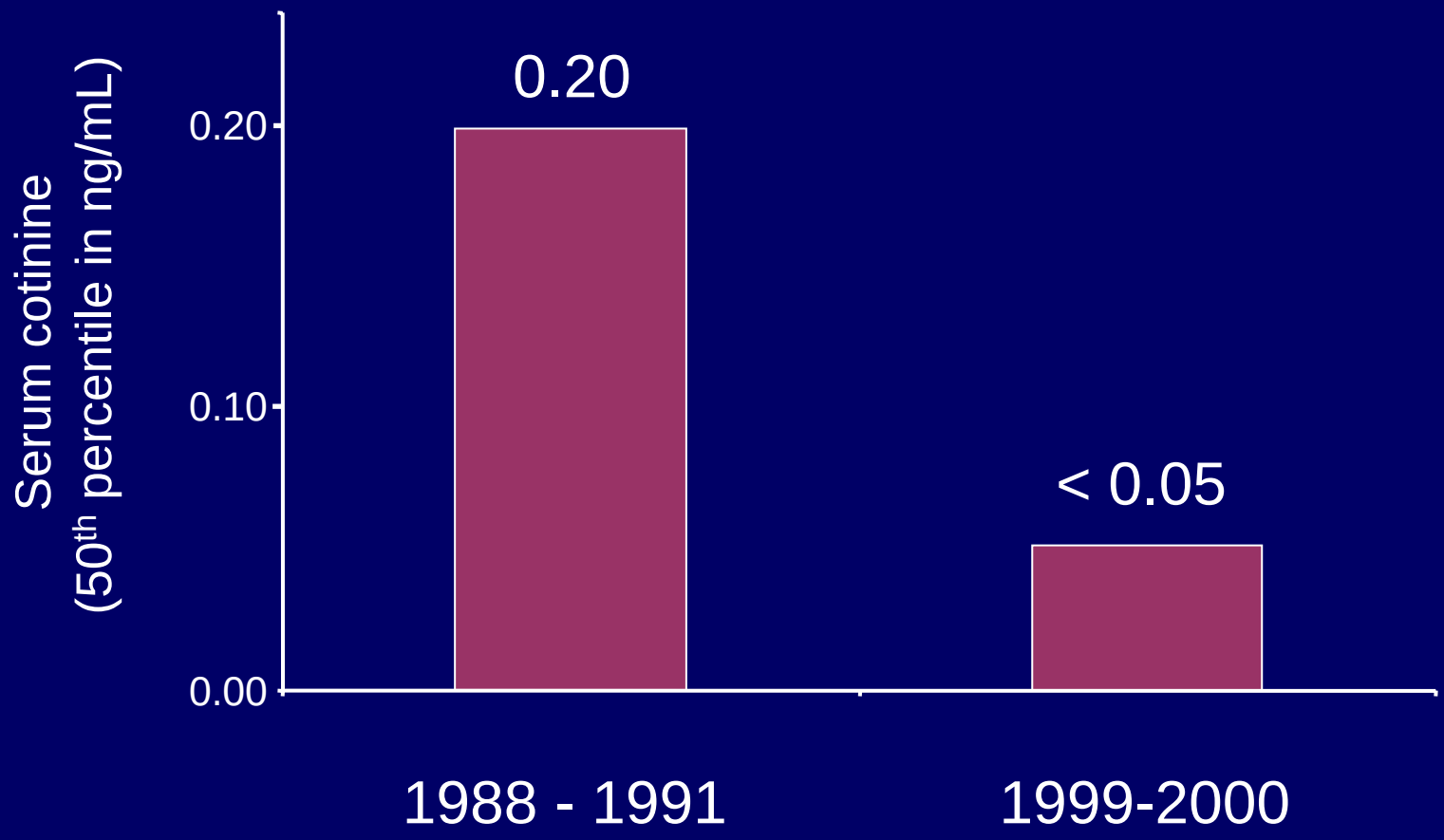
CDC

Serum cotinine levels (geometric mean and 95% confidence interval) for non-tobacco users in the U.S. population, ages 17 and older, by number of hours exposed at work: NHANES III, 1988-1991

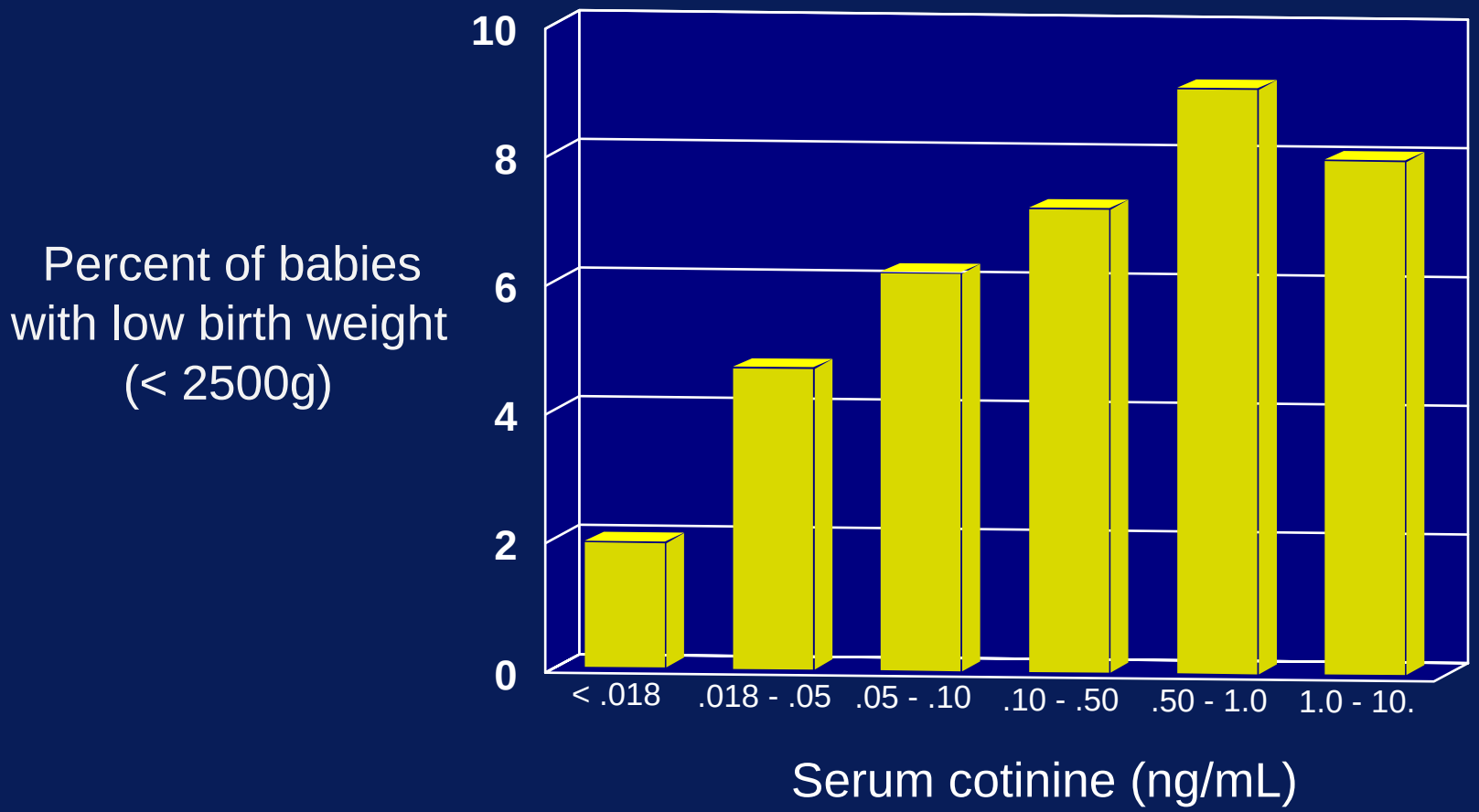


CDC

Decline in exposure of U.S. population to environmental tobacco smoke



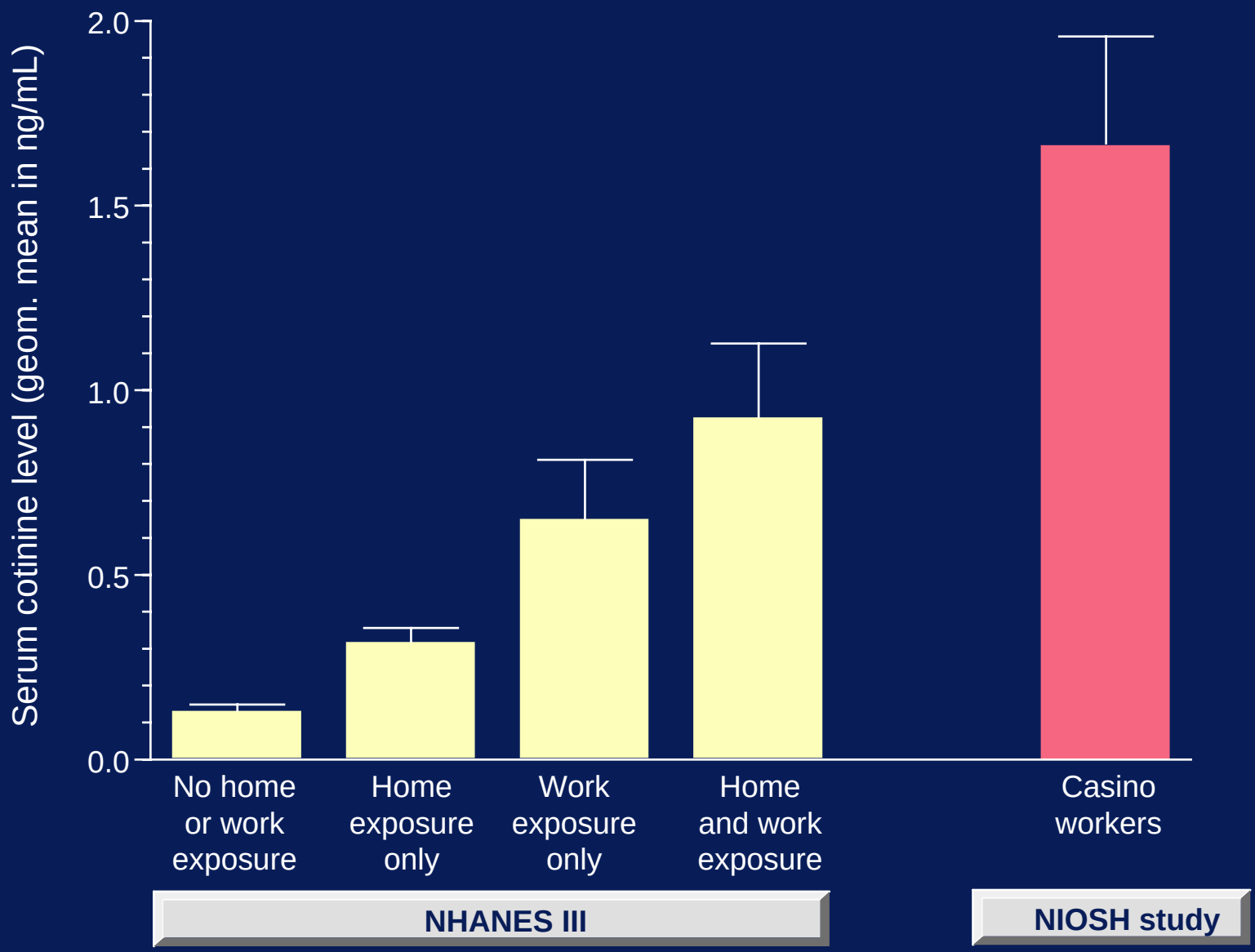
Rates of low birth weight by level of serum cotinine: Non-smoking women exposed to passive smoke (n=487)



California Dept. of Health Services and NCEH

CDC

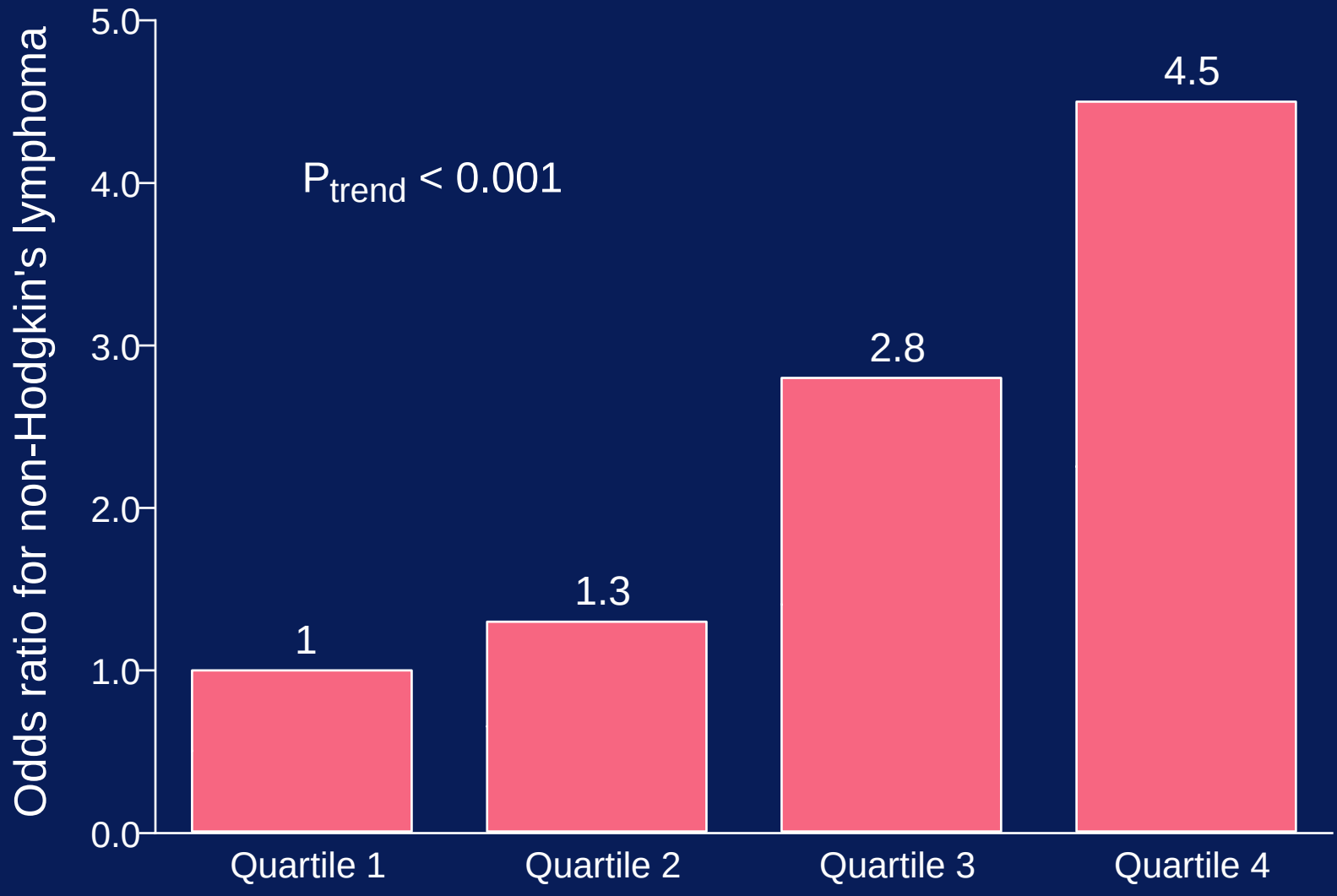
Exposure of casino workers to environmental tobacco smoke



PCBs and non-Hodgkin's lymphoma

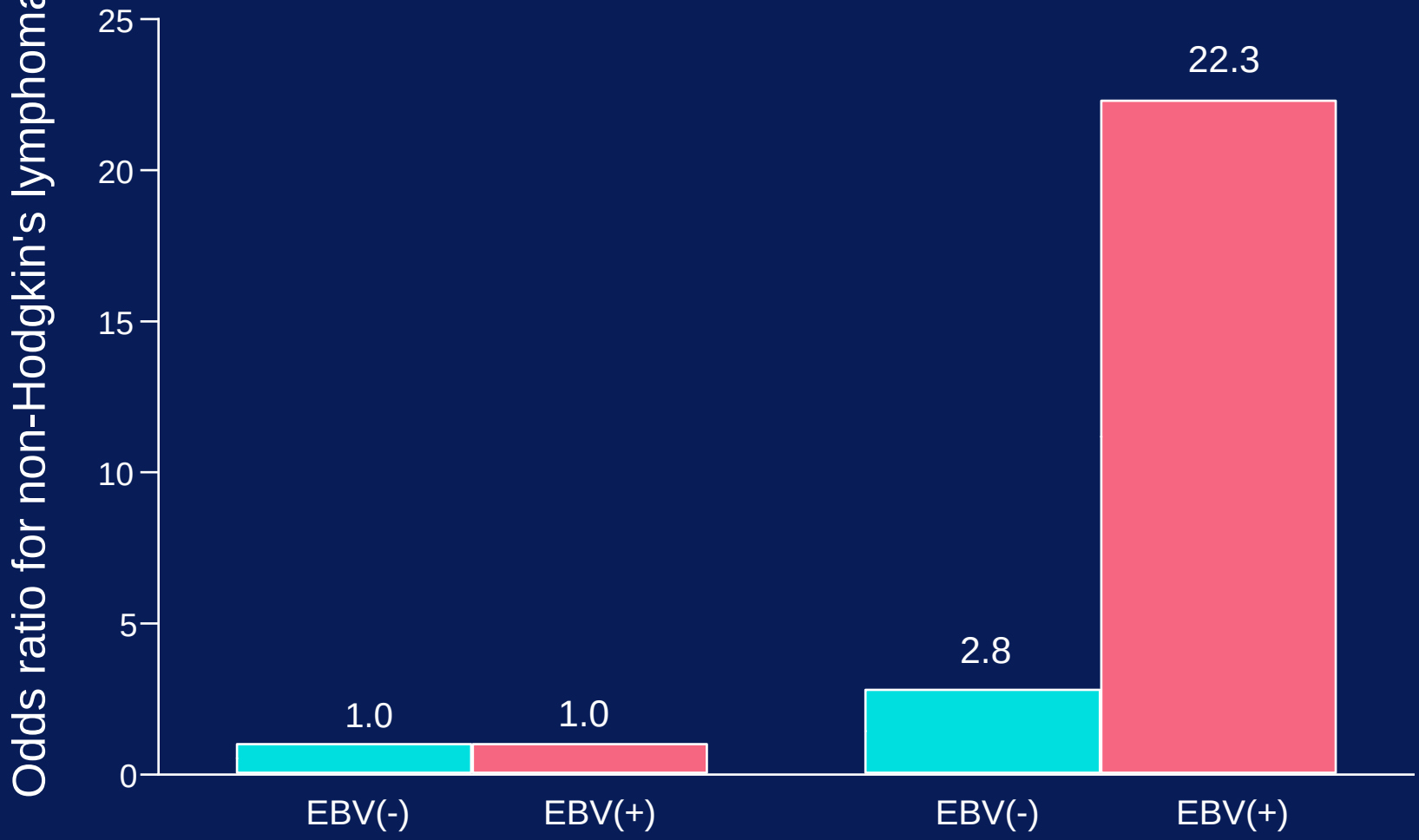
CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

Serum PCB levels and risk of non-Hodgkin's lymphoma



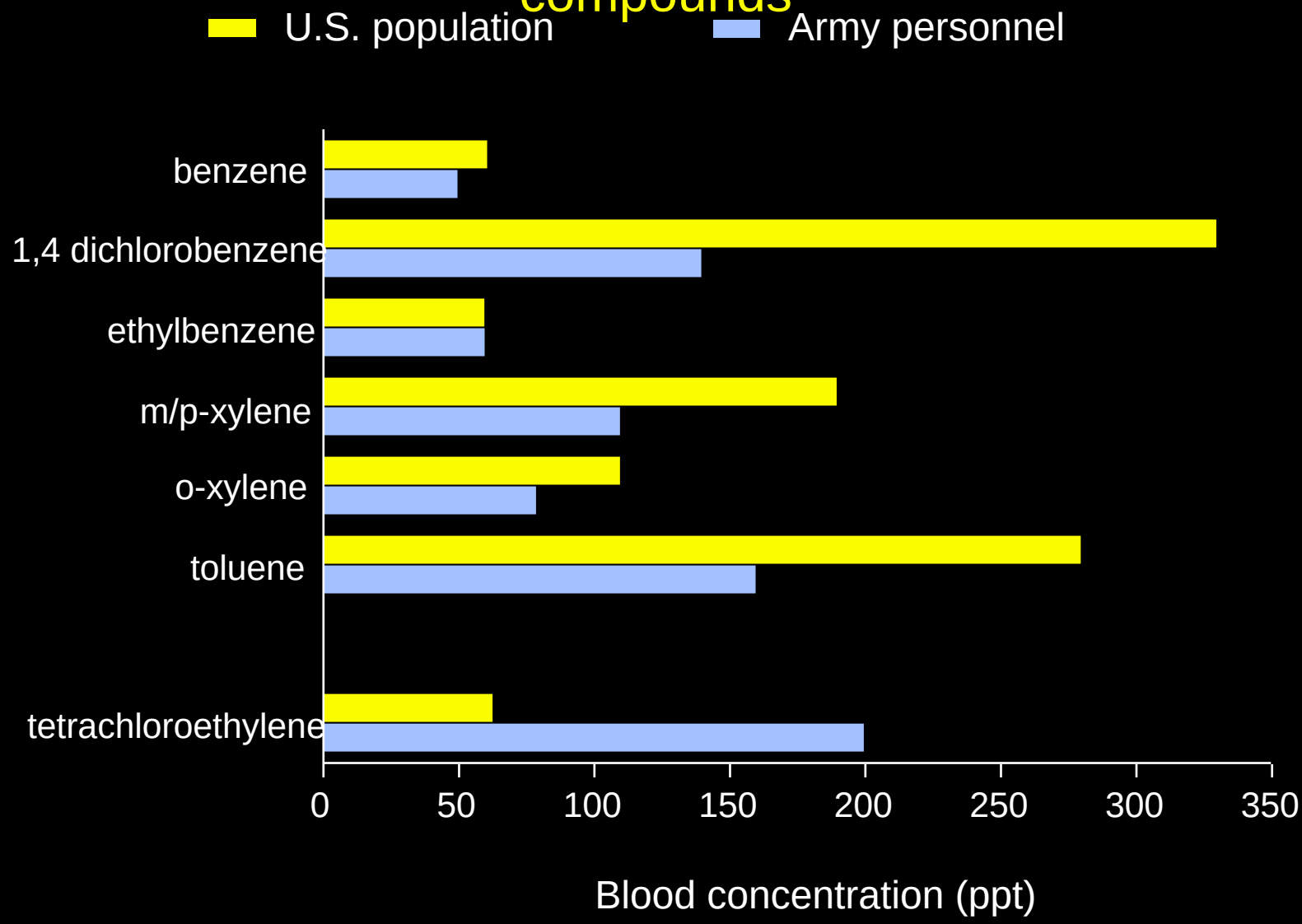
CDC

Exposure to PCBs and Epstein-Barr antigen seropositivity as risk factors for non-Hodgkin's lymphoma

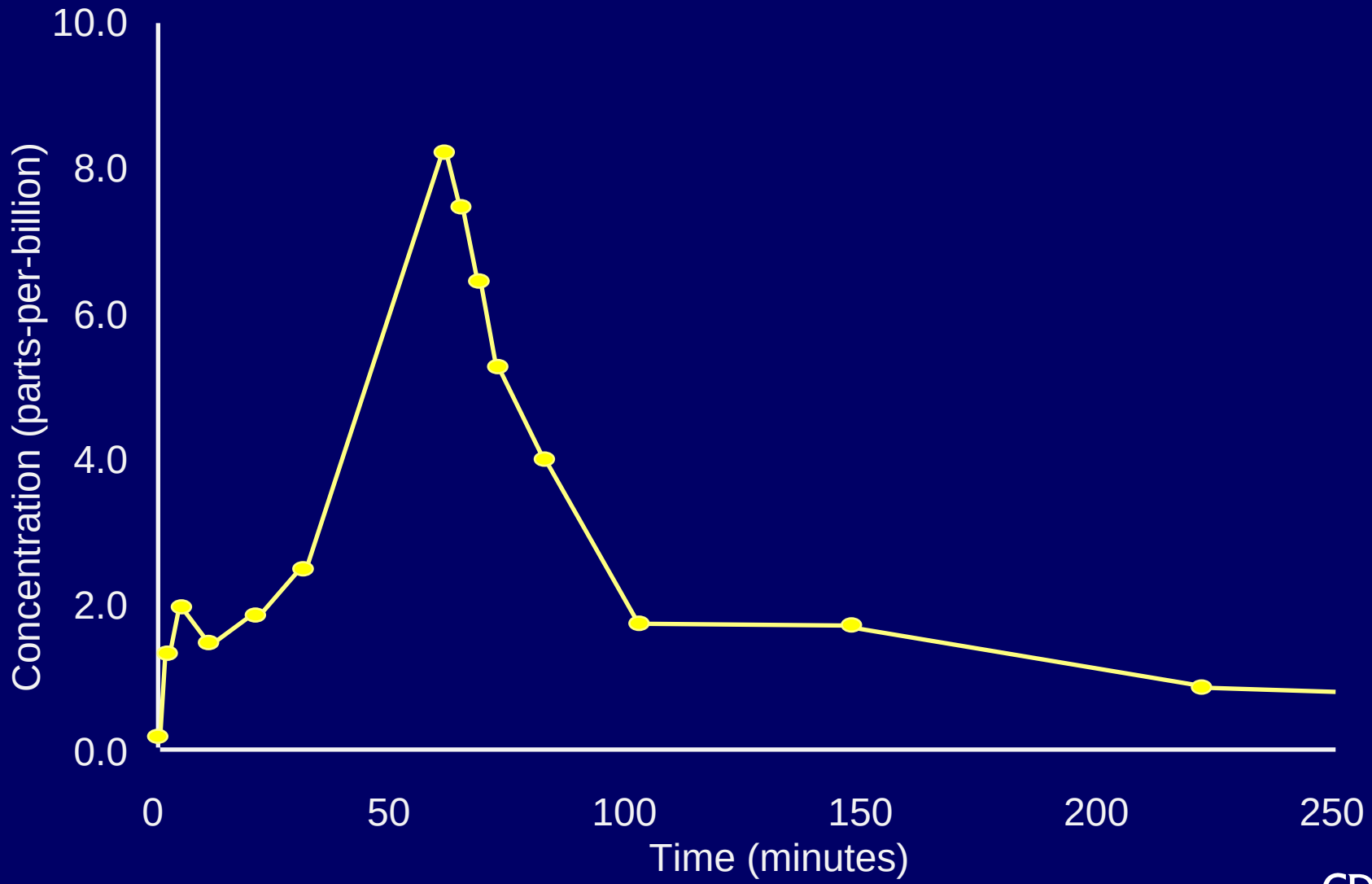


CDC

Exposure of Army personnel in Kuwait to volatile organic compounds

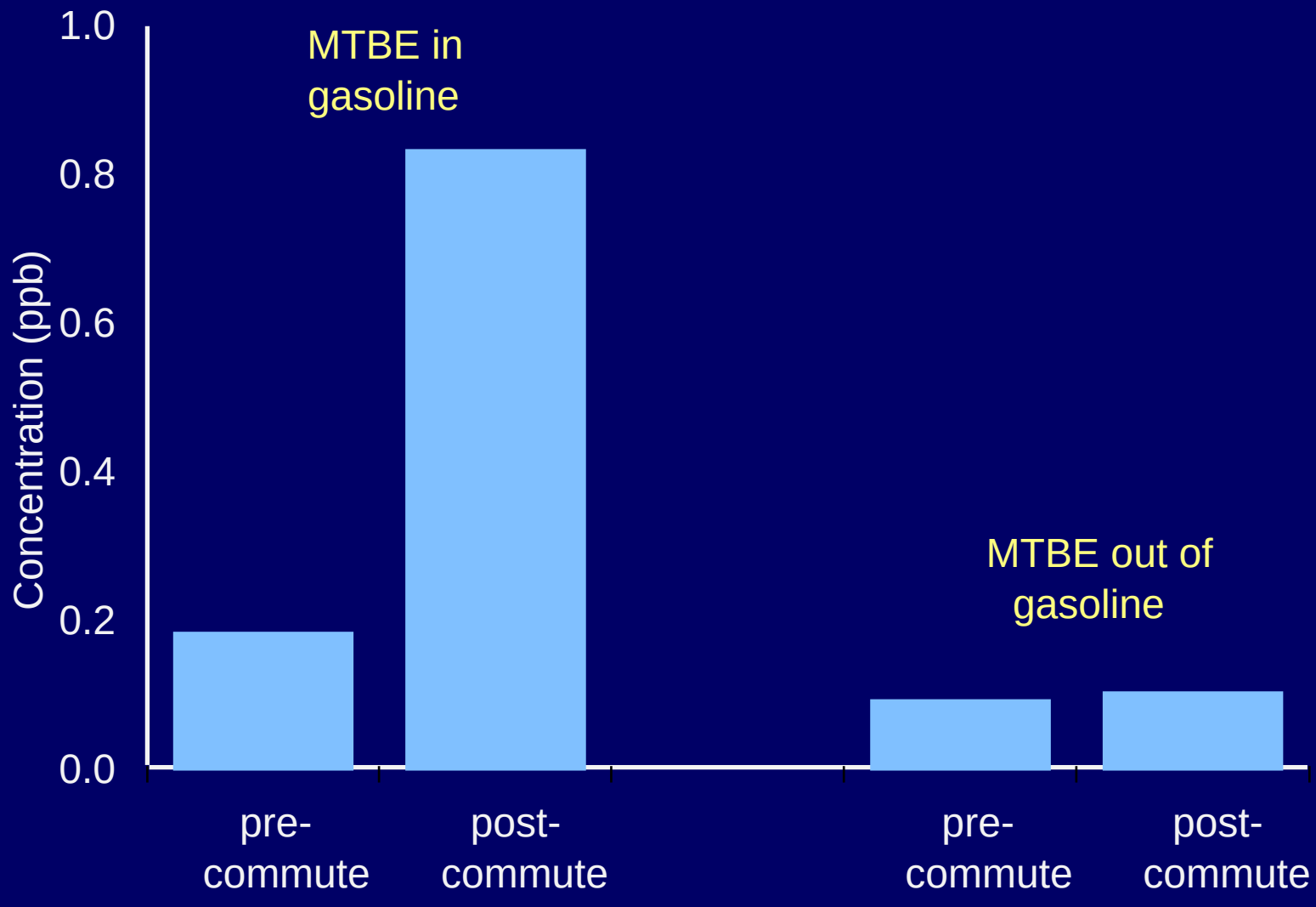


Pharmacokinetics of MTBE in blood

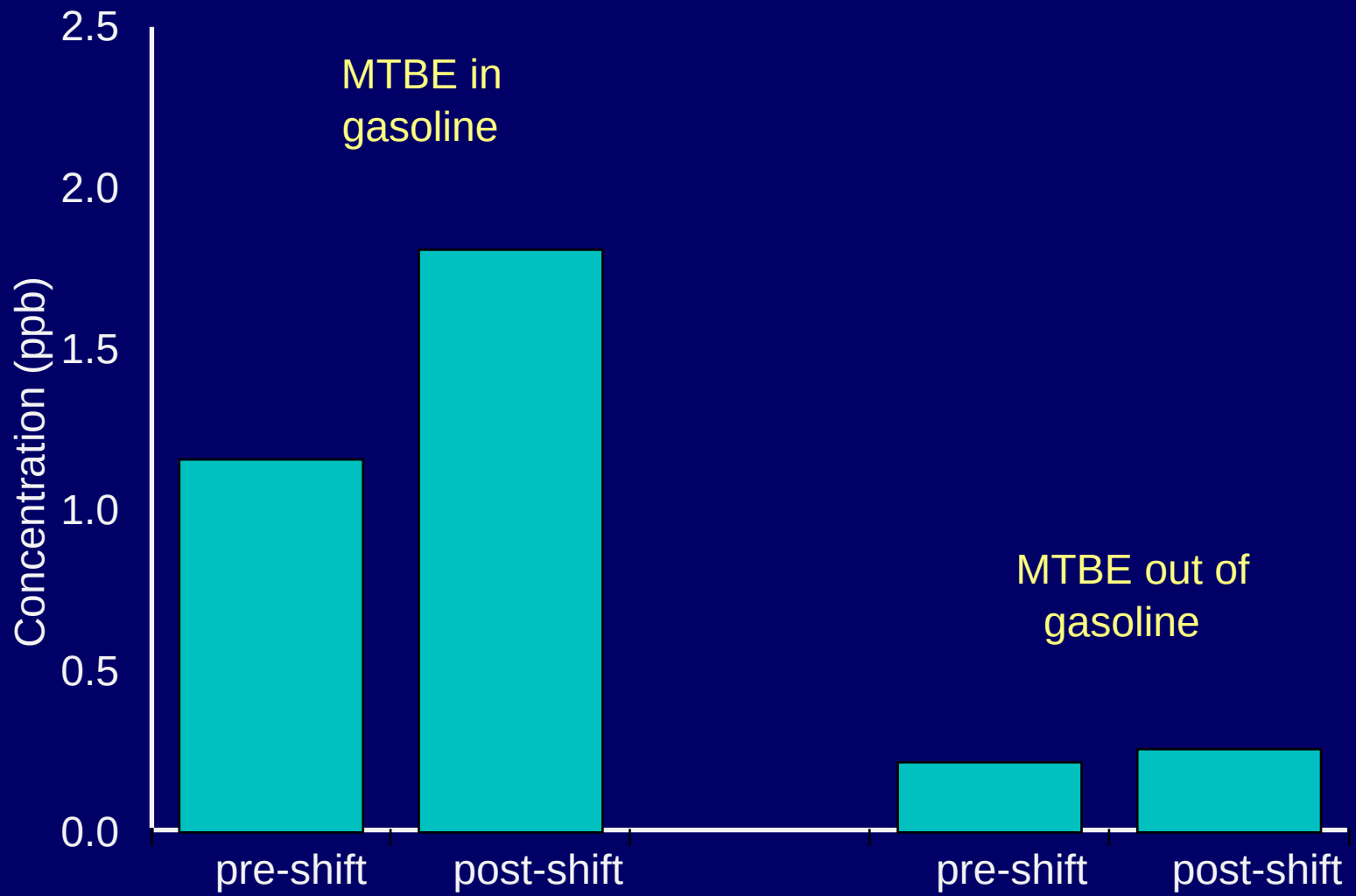


CDC

MTBE exposure in Fairbanks, Alaska: commuters

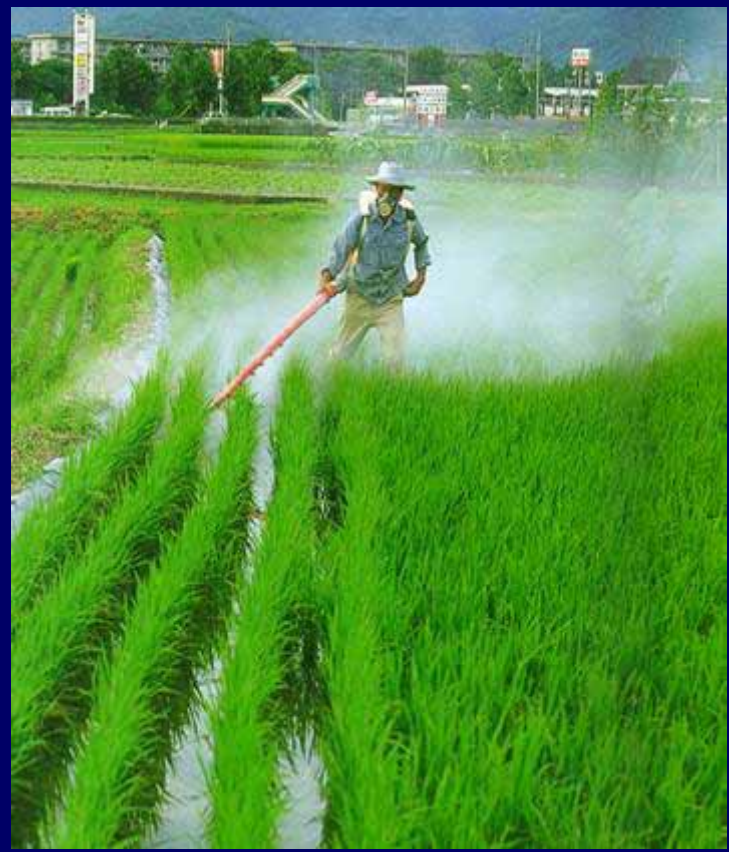


MTBE exposure in Fairbanks, Alaska: Auto workers



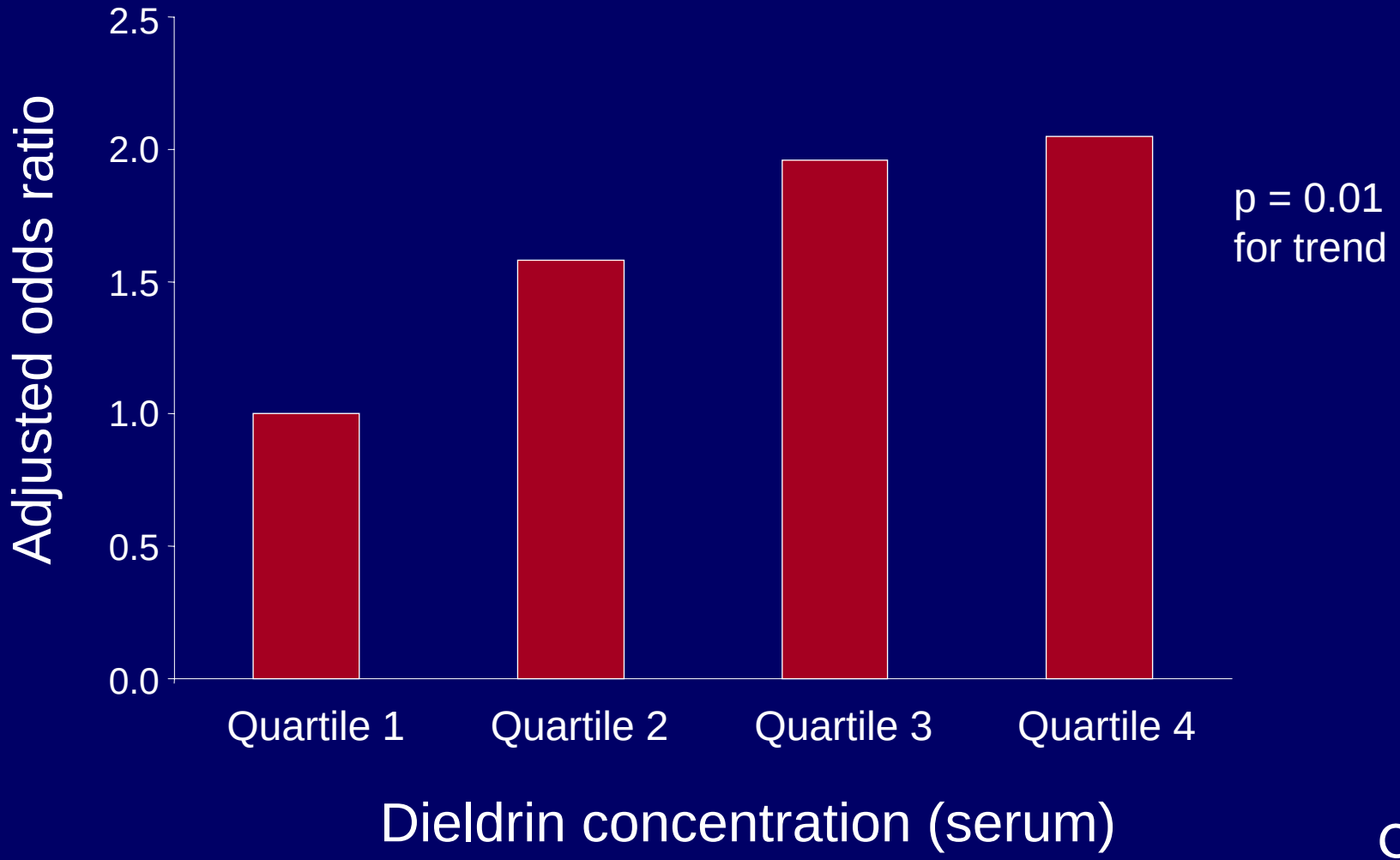
Exposure to organochlorine pesticides in Danish women and risk of breast cancer

- 14% of women in Denmark develop breast cancer
- Incidence doubled in last 30 years suggesting environmental factor(s)
- Measured 20 serum organochlorine pesticides and 28 PCBs in 240 women with invasive breast cancer



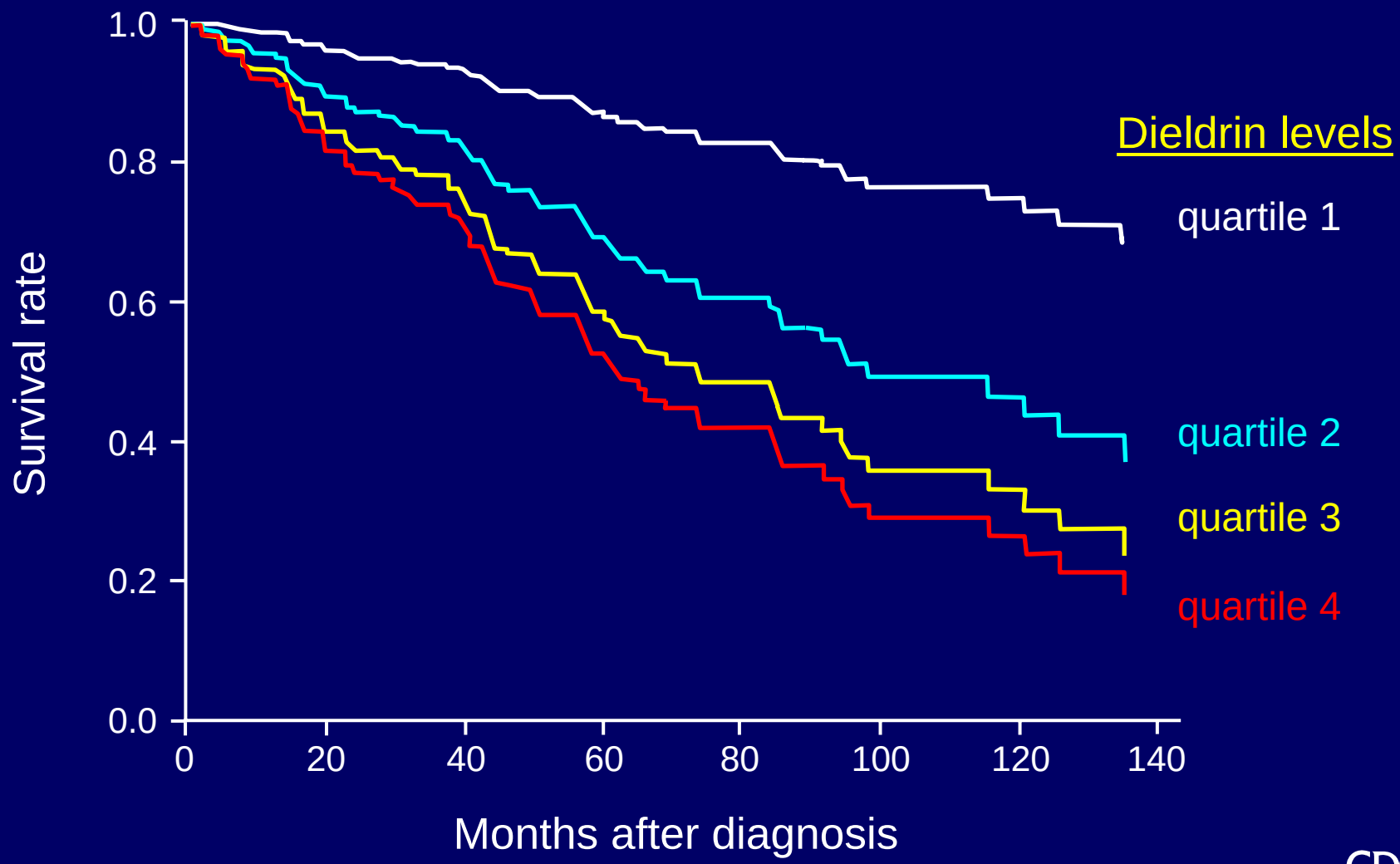
CDC

Exposure to the pesticide dieldrin and risk of breast cancer



CDC

Breast cancer survival and serum dieldrin levels



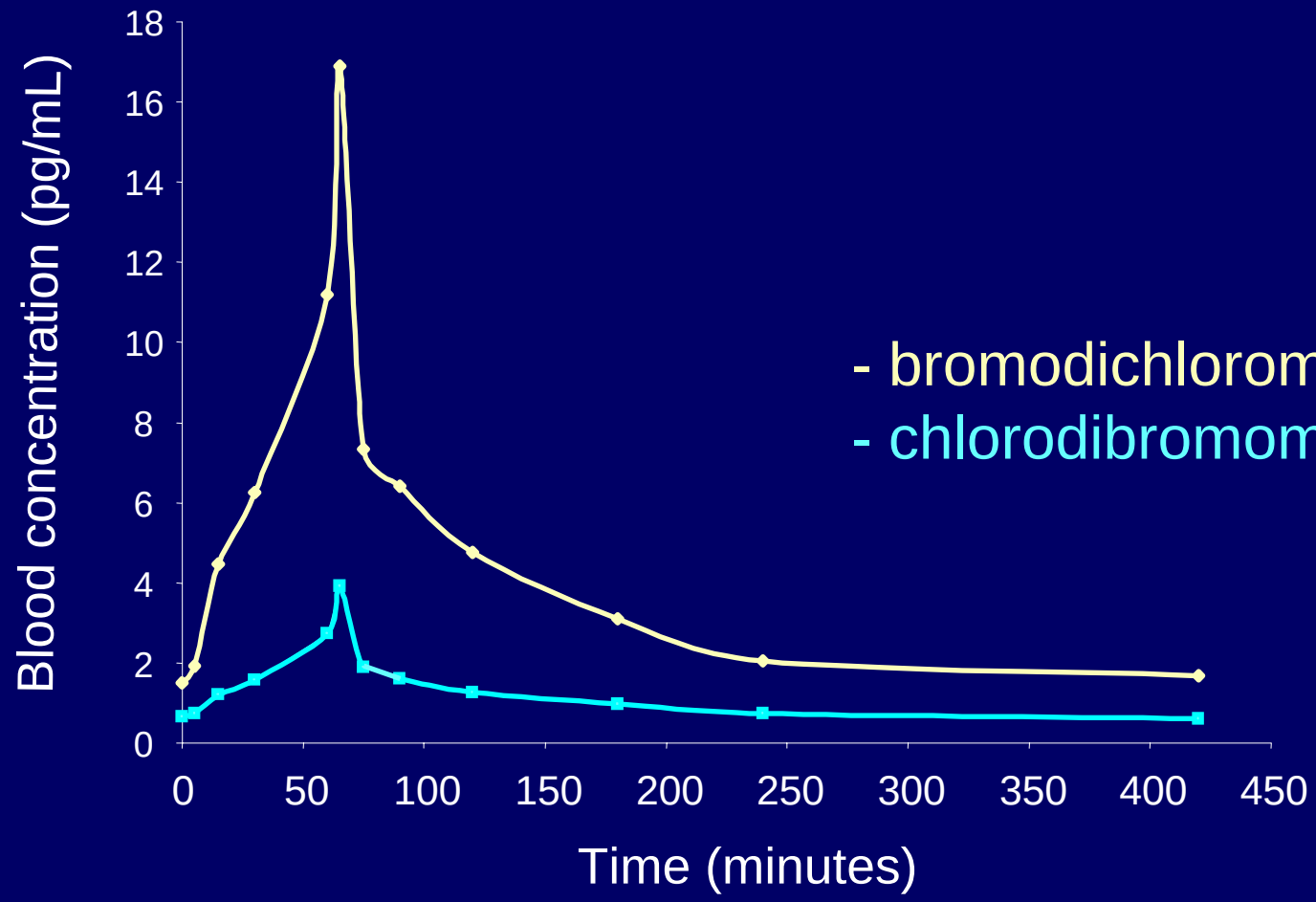
CDC

Water disinfection by-products: trihalomethanes (THMs) and trihaloacetic acids (HAAs)

- From chlorination and bromination of water
- Associated with bladder cancer, colorectal cancer, birth defects, spontaneous abortion
- Weakness of studies: exposure assessment
- Dermal exposure: almost nothing known
- Lab developed method to measure THMs and HAAs in blood

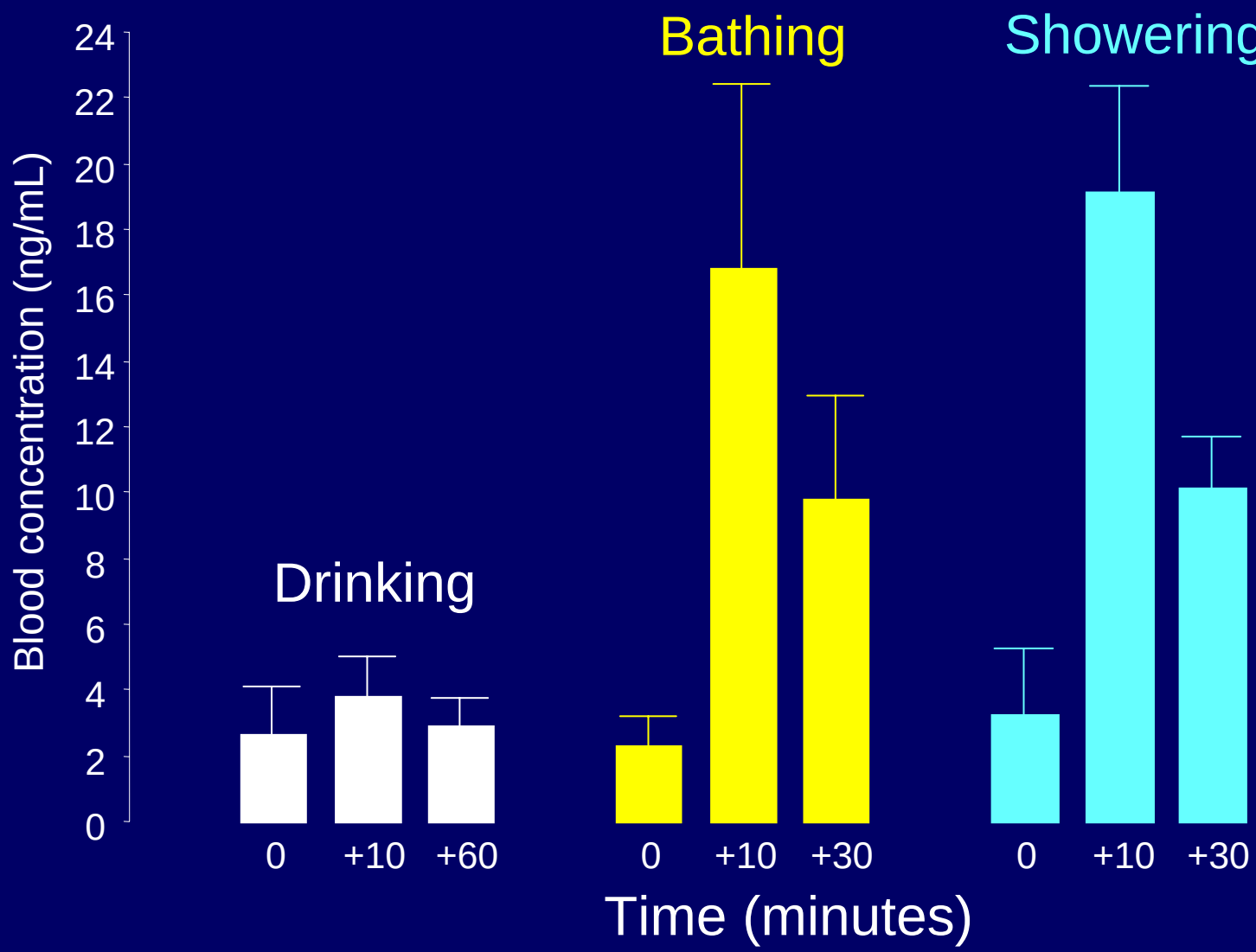
CDC

Bromodichloromethane and chlorodibromomethane levels in blood from dermal exposure to tap water

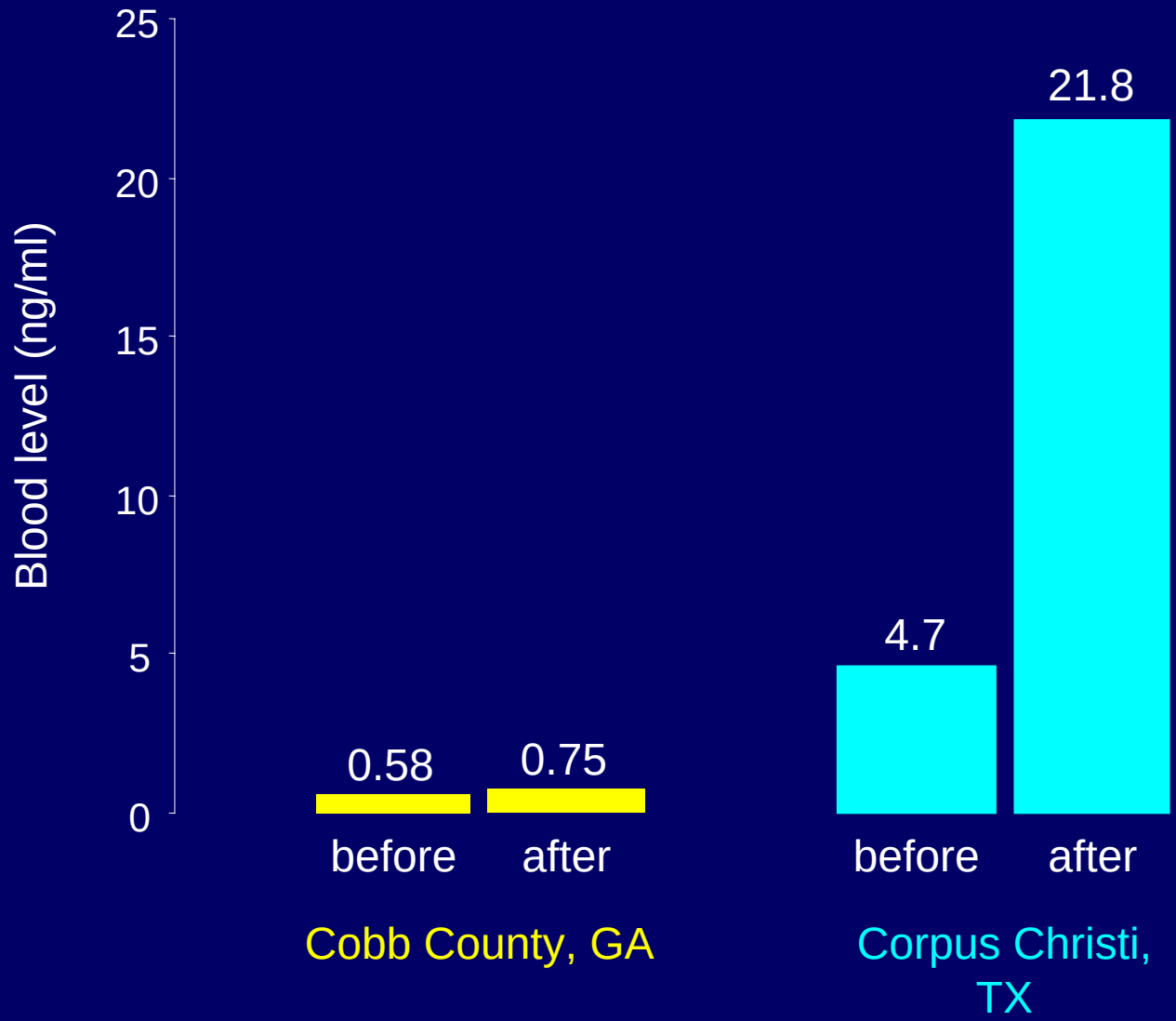


CDC

Exposure to bromodichloromethane



Blood bromoform levels before and after showering



An Insect Spray Leaves Homes Uninhabitable

By The New York Times

PASCAGOULA, Miss., Nov. 16 — Beth Hobdy did not become suspicious of the man who sprayed her house near here last month for roaches and ants until her two toddlers began vomiting and running high fevers.

When the family's doctor could not pinpoint why 2-year-old Christopher and 8-month-old Courtney were ill, Ms. Hobdy and her husband, William, began wondering about the strong odor that clung to the interior of their hous..

Unknown to the Hobdy family, the rotten-egg smell was the same odor that often hangs above the cotton fields of the Mississippi Delta, 200 miles northwest of this Gulf Coast city. The exterminator whom Mrs. Hobdy had paid $65 to spray for pests common to the humid South had coated her walls and floors with methyl parathion, a toxic farm insecticide that the Federal Agriculture Department approves only for outdoor spraying on some crops.

The New York Times

Two exterminators are accused of using a toxic weevil spray indoors.

Point, Miss. The two purchased enough methyl parathion to have sprayed at least 2,000 buildings, the investigators said.

ommended for fighting boll weevils.

The authorities would not say where the men bought the methyl parathion, although they said it was from legal sources. The homes of the two men were searched after the authorities obtained warrants.

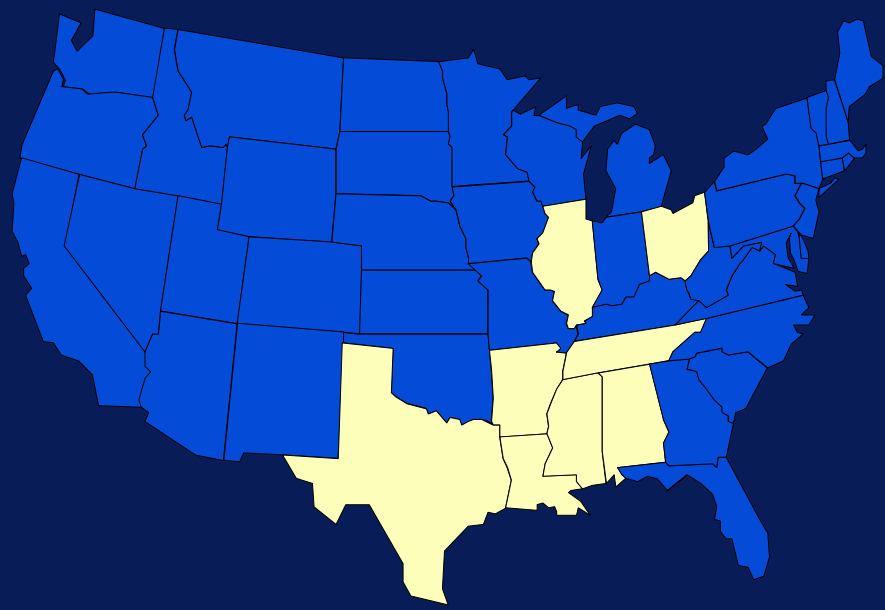
At the Hobdy house, carpet samples and wall swabbings taken by the Mississippi Department of Agriculture and Commerce "tested off the scale," E.P.A. agents said. Those tests, and later ones taken from other sites, found contamination at least five times the level that requires immediate evacuation of humans and animals, agents said.

Comparable levels of methyl parathion found in a house in Tunica, Miss., in 1984 — the result of a farmer using it as a home pesticide — led to the deaths of two young children.

A teaspoon of methyl parathion can be lethal. The manufacturer, the Shell Chemical Company, warns farmers who use the product to stay out of fields for at least 48 hours after

Methyl parathion illegally sprayed in over 2500 homes

- extremely effective insecticide, but unsafe for indoor use
- 8 states affected

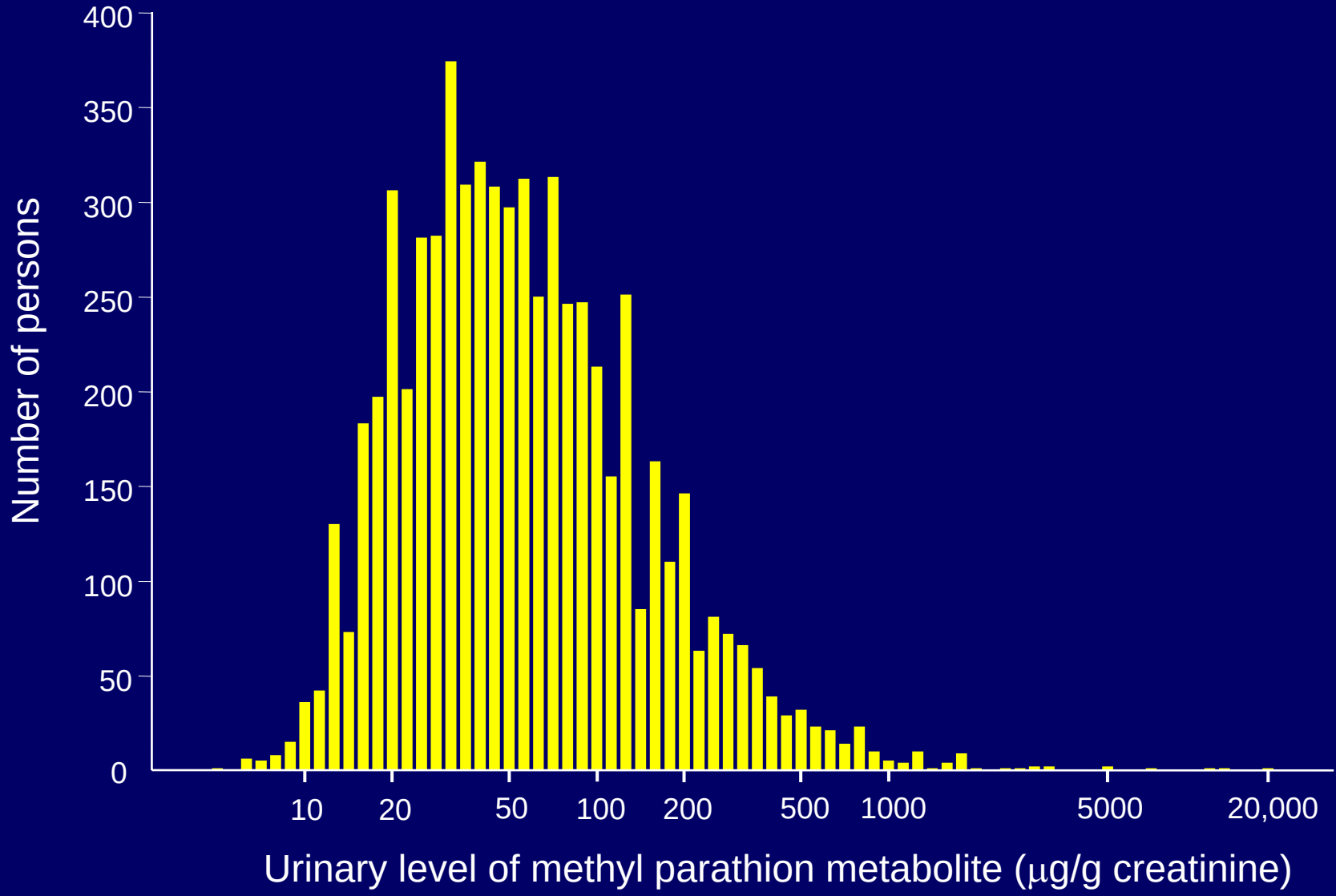


Tough public health questions

- Who is exposed?
- How much is each person exposed?
- Who needs most urgent attention?

Questions answered by measuring a methyl parathion metabolite in urine

Distribution of urine levels of methyl parathion metabolite in over 10,000 persons

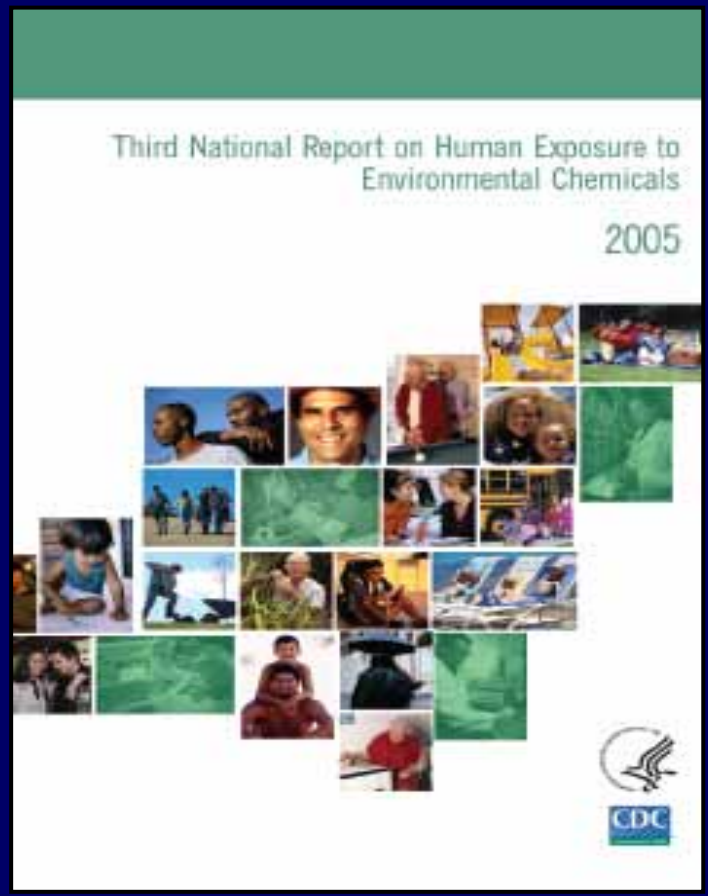


Assessment of the chemical exposures

of the U.S. population

Third National Report on Human Exposure to Environmental Chemicals

- 148 chemicals in blood and urine
- Approximately 2400 people
- Nationally representative sample
- More then 350,000 measurements
- Years: 2001-2002 and includes previous data from 1999-2000



www.cdc.gov/exposurereport

Public health uses of the *Report*

- Measures chemicals that actually get into people
- Identifies at-risk populations
- Detects trends in exposure over time
- Evaluates effectiveness of public health efforts
- Sets priorities for human health effects research

Figure 6. Lead in blood

Selected percentiles with 95% confidence intervals of blood concentrations (in µg/dL) for the U.S. population aged 1 year and older, National Health and Nutrition Examination Survey, 1999-2002.

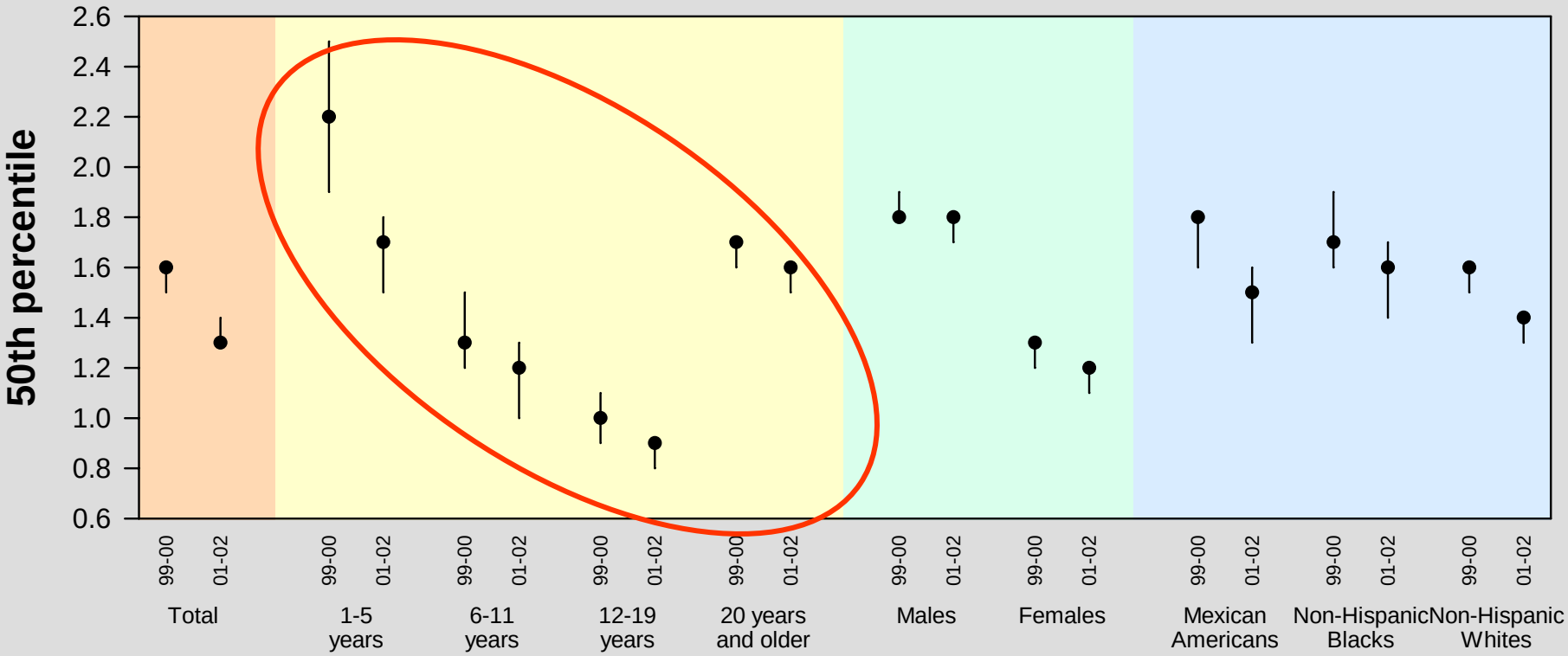


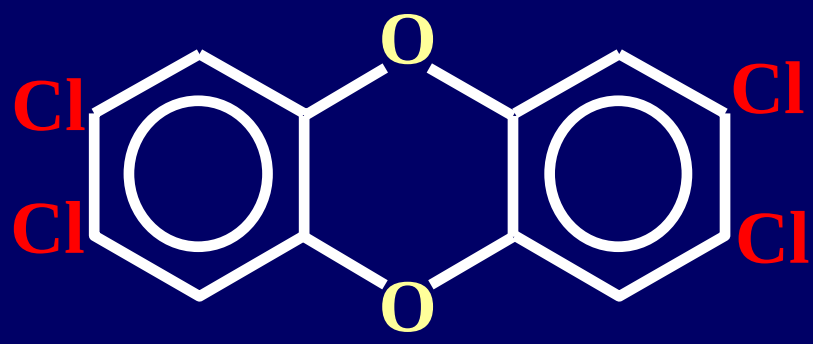
Table 11. Cadmium in urine (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

	Survey years	Geometric mean (95% conf. interval)	Selected percentiles (95% confidence interval)				Sample size
			50th	75th	90th	95th	
Total, age 6 and older	99-00	**.181** (.157-.209)	**.219** (.199-.238)	**.423** (.391-.446)	**.712** (.645-.757)	**.933** (.826-1.07)	2257
	01-02	**.199** (.181-.218)	**.212** (.194-.232)	**.404** (.377-.440)	**.690** (.630-.754)	**.917** (.813-.998)	2689
Age group							
6-11 years	99-00	*	**.085** (.063-.107)	**.147** (.123-.182)	**.210** (.171-.316)	**.300** (.184-.607)	310
	01-02	**.075** (.059-.094)	**.100** (.083-.112)	**.166** (.136-.192)	**.233** (.206-.281)	**.291** (.221-.440)	368
12-19 years	99-00	**.071** (.051-.098)	**.093** (.084-.106)	**.147** (.130-.163)	**.215** (.204-.240)	**.283** (.222-.404)	648
	01-02	**.078** (.067-.091)	**.091** (.085-.101)	**.136** (.123-.143)	**.191** (.175-.234)	**.280** (.234-.321)	762
20 years and older	99-00	**.267** (.247-.289)	**.288** (.261-.304)	**.484** (.433-.545)	**.769** (.727-.818)	**1.07** (.927-1.17)	1299
	01-02	**.261** (.236-.289)	**.273** (.247-.303)	**.481** (.426-.518)	**.776** (.691-.850)	**.979** (.874-1.12)	1559
Gender							
Males	99-00	**.154** (.131-.182)	**.174** (.158-.191)	**.329** (.293-.382)	**.617** (.537-.700)	**.788** (.696-.929)	1121
	01-02	**.159** (.143-.177)	**.168** (.157-.182)	**.334** (.304-.364)	**.532** (.491-.653)	**.757** (.690-.856)	1334
Females	99-00	**.211** (.170-.261)	**.267** (.239-.308)	**.473** (.423-.551)	**.783** (.690-.917)	**1.09** (.813-1.38)	1136
	01-02	**.245** (.216-.278)	**.263** (.228-.297)	**.479** (.414-.541)	**.792** (.687-.884)	**.985** (.876-1.16)	1355
Race/ethnicity							
Mexican Americans	99-00	**.175** (.137-.223)	**.181** (.144-.225)	**.331** (.266-.418)	**.612** (.441-.828)	**.843** (.674-1.13)	780
	01-02	**.156** (.136-.178)	**.170** (.150-.184)	**.282** (.263-.340)	**.501** (.388-.614)	**.693** (.507-.839)	682
Non-Hispanic blacks	99-00	**.183** (.140-.240)	**.201** (.168-.241)	**.414** (.343-.472)	**.658** (.516-.827)	**.873** (.722-.962)	546
	01-02	**.190** (.156-.232)	**.195** (.174-.225)	**.385** (.336-.449)	**.676** (.559-.850)	**.917** (.725-1.08)	667
Non-Hispanic whites	99-00	**.175** (.146-.209)	**.219** (.191-.250)	**.432** (.387-.470)	**.729** (.666-.783)	**1.00** (.826-1.16)	760
	01-02	**.205** (.184-.229)	**.224** (.208-.242)	**.421** (.382-.470)	**.719** (.668-.784)	**.931** (.806-1.05)	1132

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Dioxins, furans, and coplanar PCBs



- Most results below limit of detection (LOD)
- Higher chlorinated chemicals more detectable
- LOD for 2,3,78-TCDD averaged 4.5 parts-per-trillion
- Future measurements will use more serum and have lower LOD

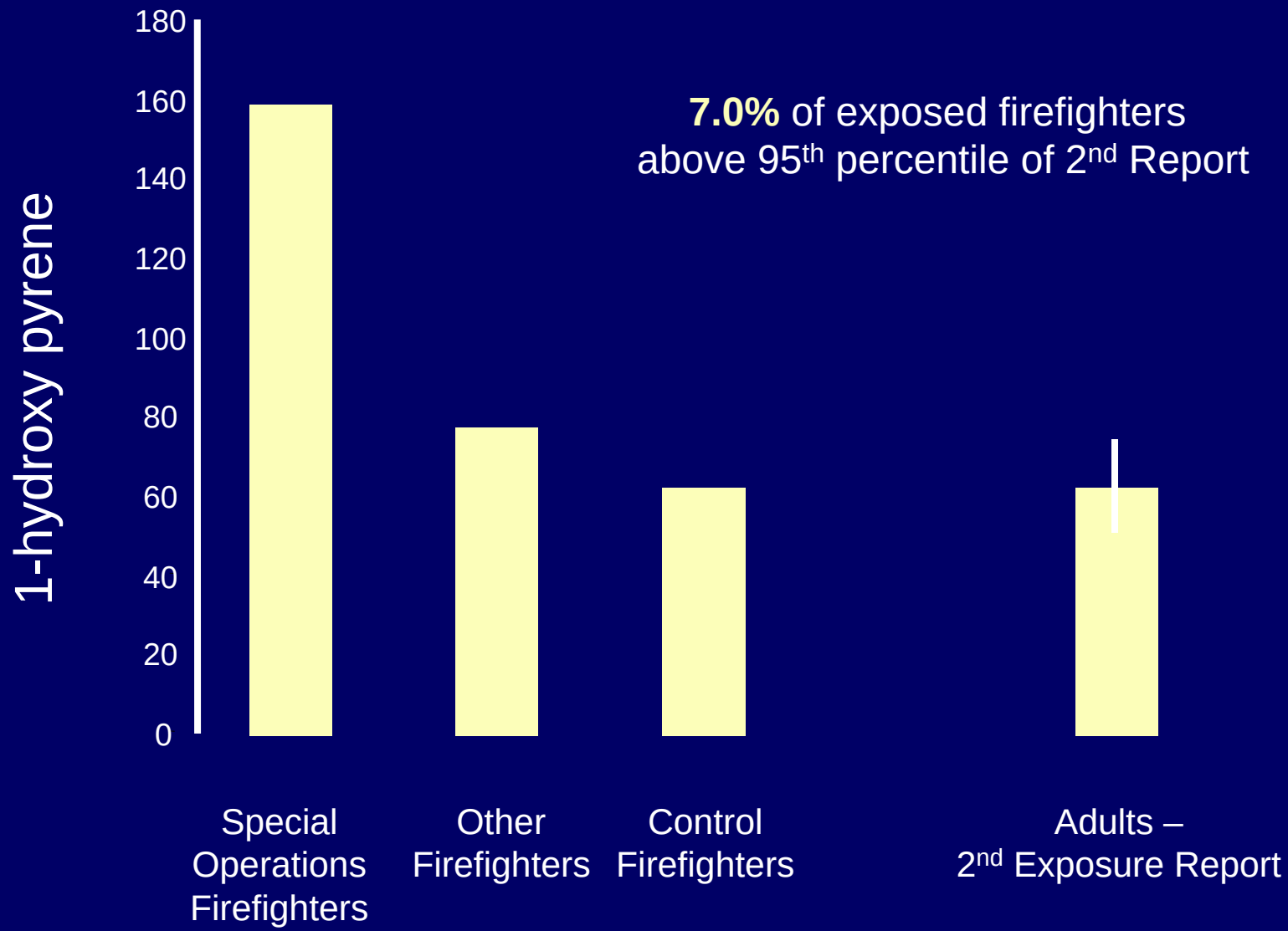
World Trade Center – detecting unusual levels of exposure

- 370 firefighters studied
- blood and urine samples collected while fires still burning
- 110 fire related chemicals tested

  PAHs
  Metals
  Cyanide
  Dioxins/furans/PCBs
  Volatile organic compounds

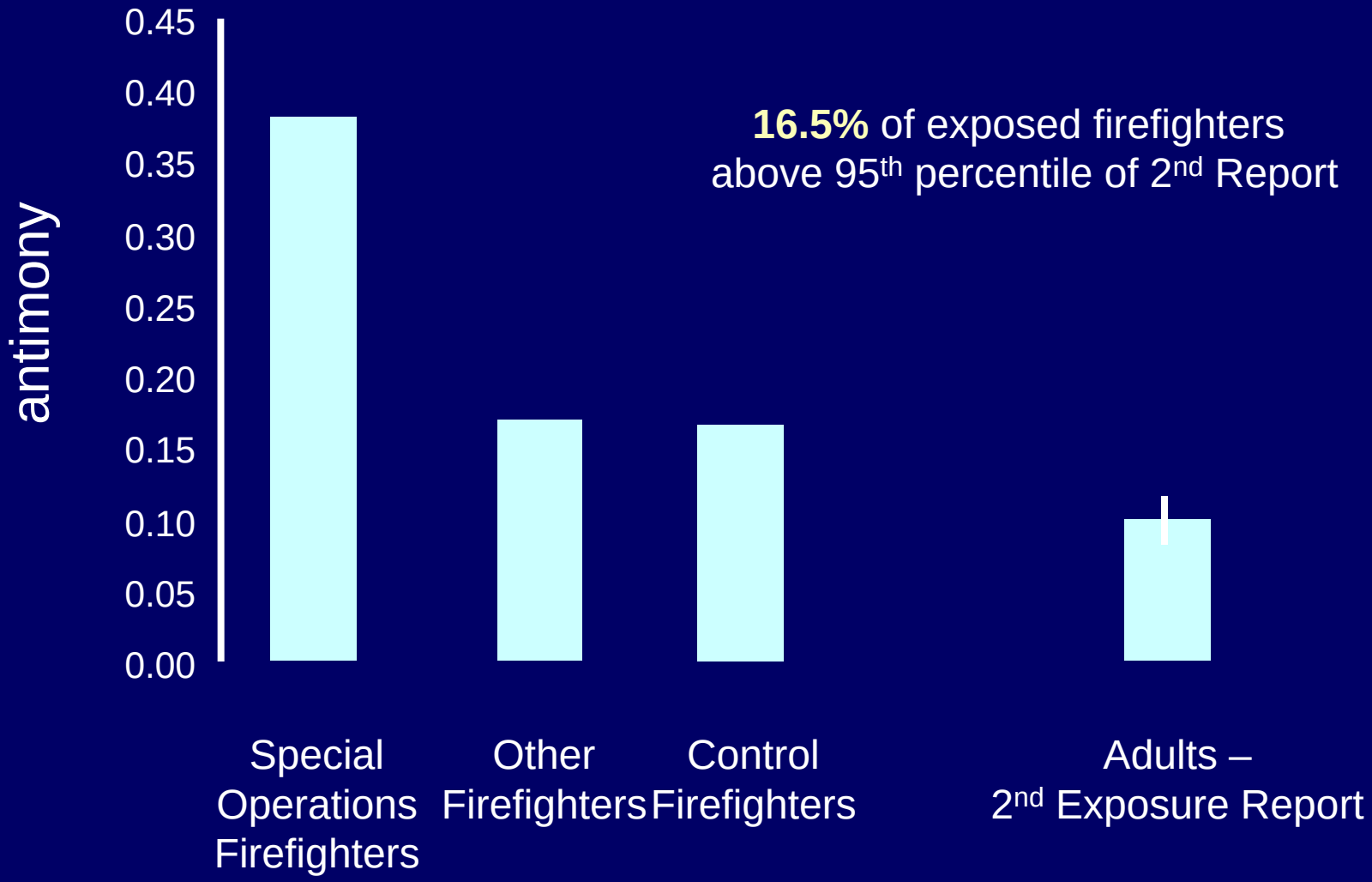
1-hydroxy pyrene levels in WTC firefighters

(geometric means in ng/L)



Antimony levels in WTC firefighters

(geometric means in μg/L)



U.S. troop exposure to depleted uranium in Iraq

- exposure from shrapnel
- exposure from battle explosions
- .045 μg/L is adult 95th percentile for urine uranium from 2nd *Report*
- to date, all soldier levels we have measured have been below

Blood mercury levels in women of childbearing age (16-49 years), 1999-2000

- EPA reference dose for blood mercury is 5.8 μg/L
- In 2nd *Report*, the 95th percentile for women 16-49 years is 7.1 μg/L
- **7.8%** of women of childbearing age exceed the EPA RfD

Future Directions for the *Report*

- More chemicals
  VOCs (benzene, MTBE, toluene, styrene, others)
  perfluorinated compounds
  polybrominated diphenyl ethers (PBDEs)
  speciated arsenic
  separate measurements for methyl mercury and ethyl mercury
  perchlorate
  acrylamide
  PAHs with 5 and 6 rings, the more carcinogenic PAHs
  more ….

- New *Report* every two years
  (2001-2002, 2003-2004, 2005-2006, etc)