

Control of Residential Exposures to Environmental Neurotoxins



Environmental Toxins

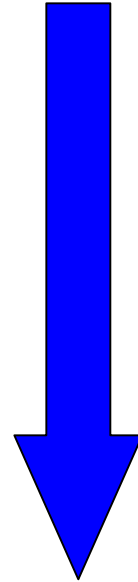
- Most recognized toxins discovered only after widespread environmental contamination.
- Increasing evidence for adverse effects at levels previously thought to be low.
- Neurotoxicity animal tests may not be sensitive.
- Toxicity tests not done for majority of chemicals, including those recognized as potential neurotoxins.

Residential Hazards

- **Lead**
- **Tobacco Smoke**
- **Pesticides**

Types of Prevention

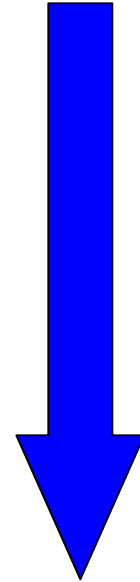
- **Education**
- **Enforcement**
- **Engineering**



**Greater
Effectiveness**

Types of Prevention

- **Education**
- **Enforcement**
- **Engineering**



Higher Cost

Levels of Prevention

- **Primary**
- **Secondary**
- **Tertiary**

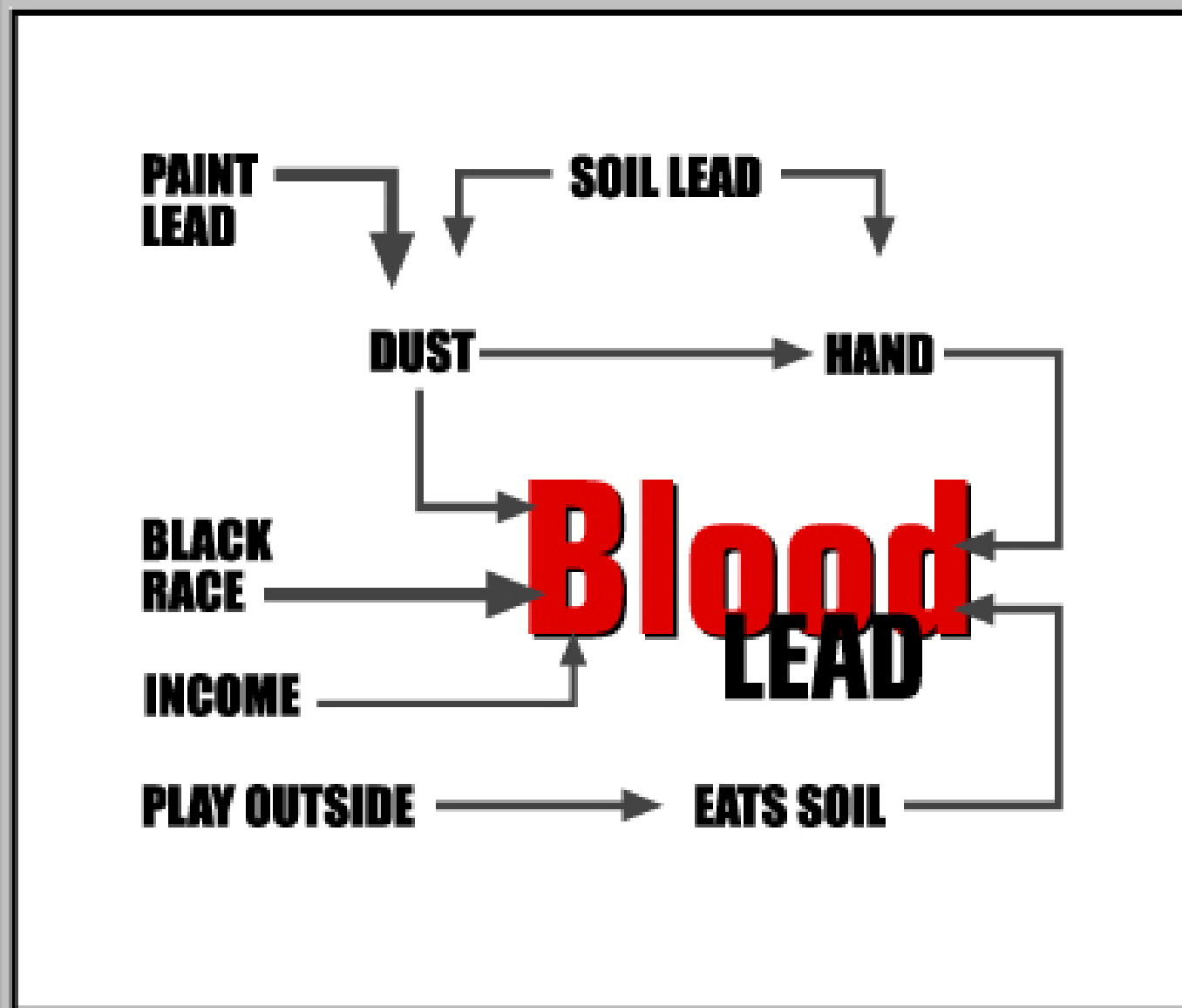
Steps to Prevent Childhood Exposure to Residential Neurotoxins

- **Identify sources of exposure**
- **Identify unacceptable levels of exposures from contributing sources**
- **Test efficacy and safety of interventions to reduce environmental exposure**
- **Develop regulations and screening programs**

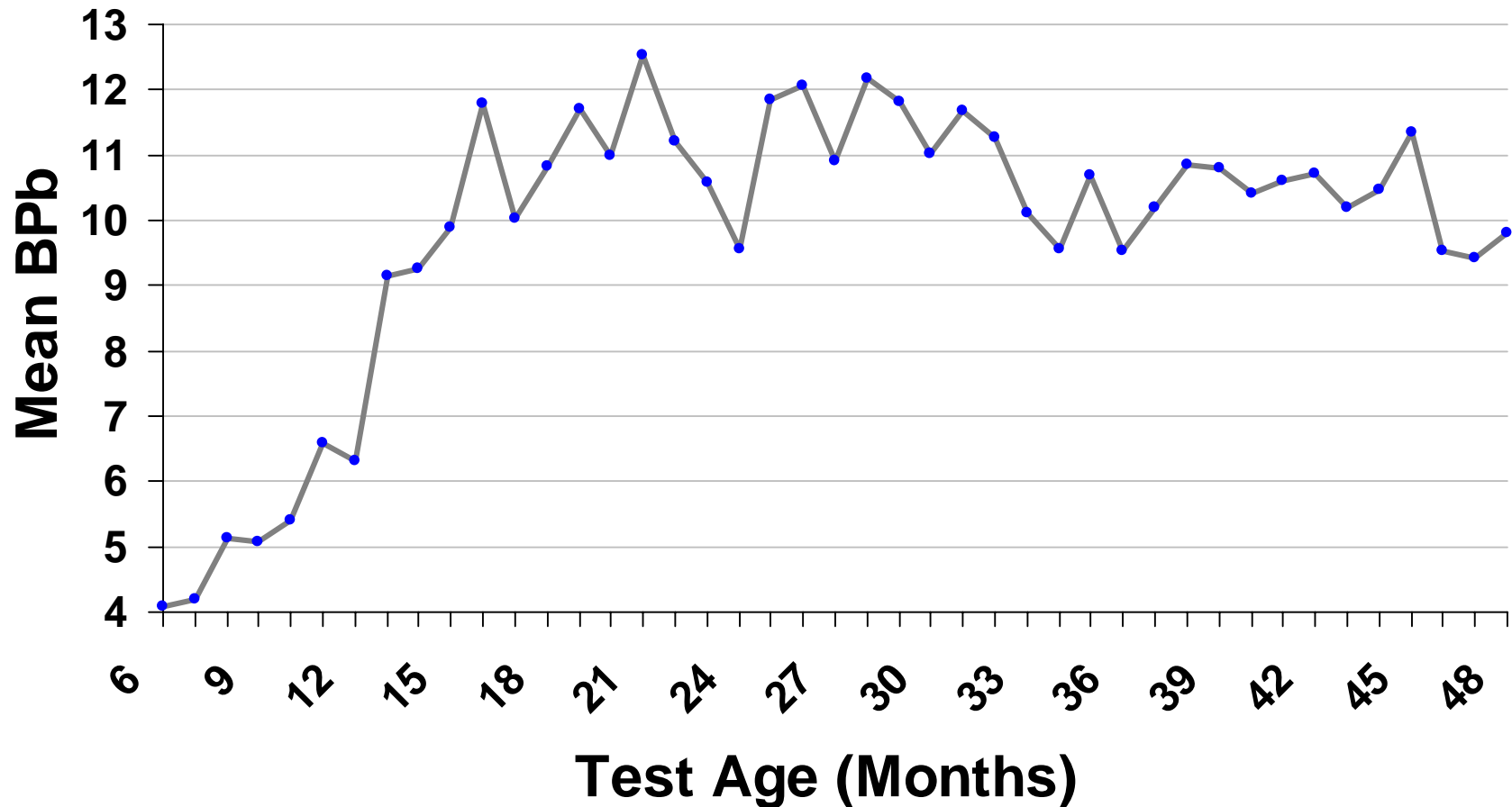


Prevention of Childhood Lead Exposure

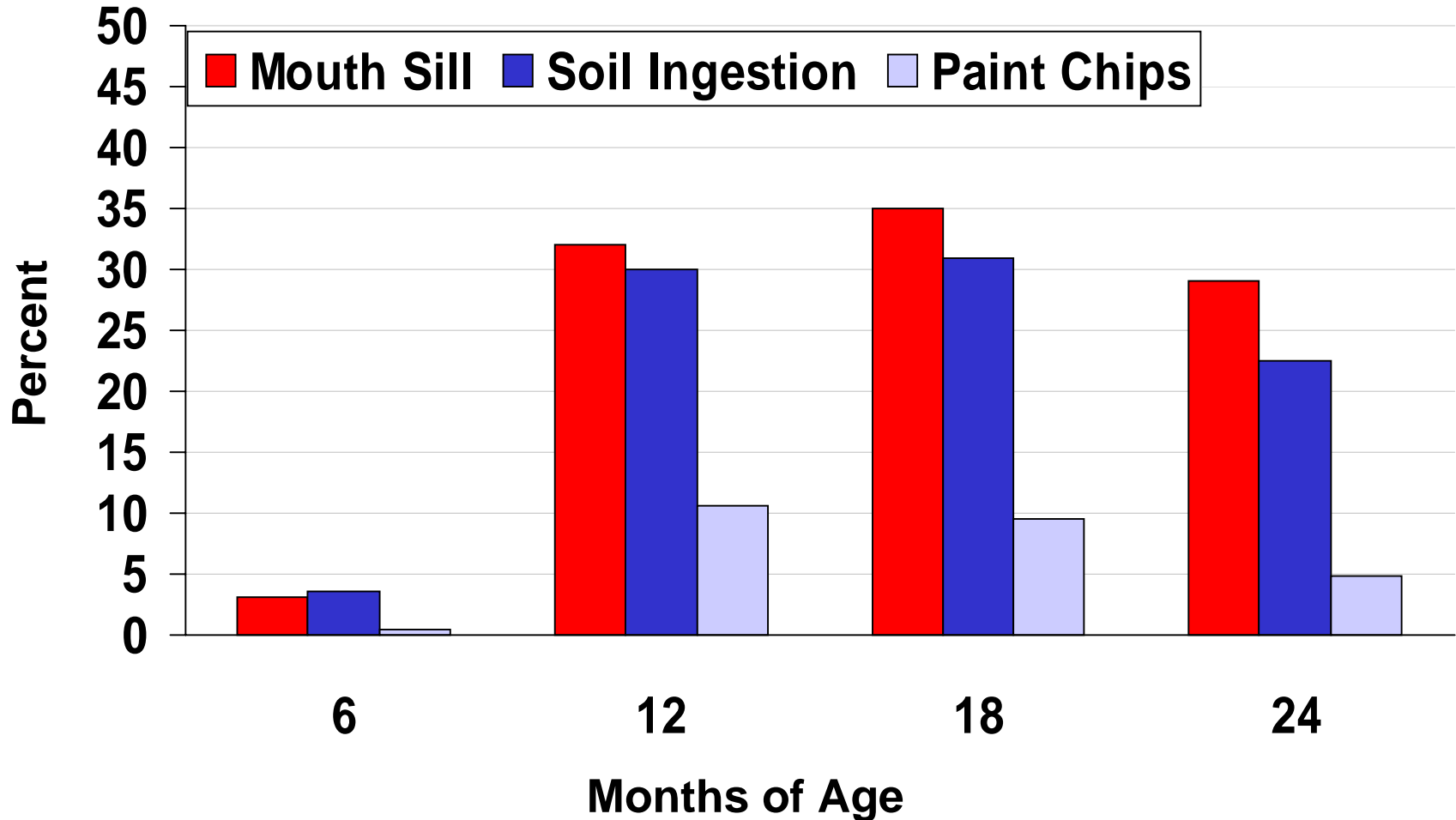
Pathways of Childhood Lead Exposure



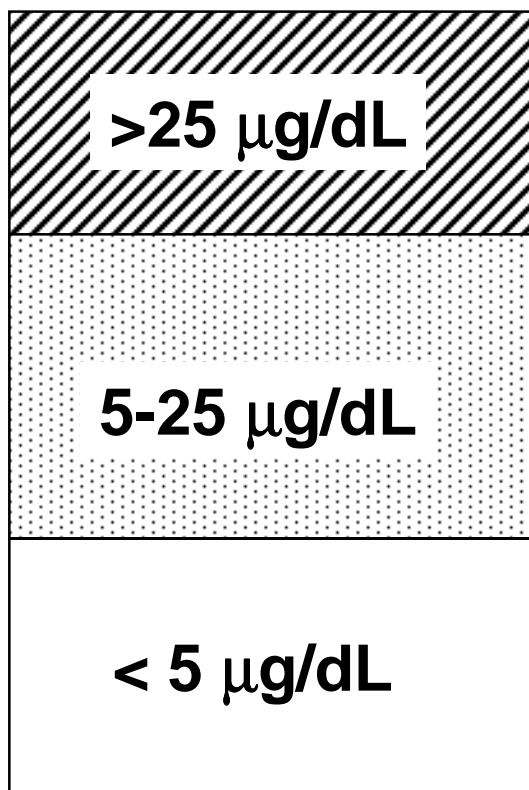
Blood Lead Levels of Children in Monroe County (NY), by Age of Child, 1993



Frequency of Mouthing Behaviors during Early Childhood



Contribution of Various Sources of Lead to Urban Children's Blood Lead Levels

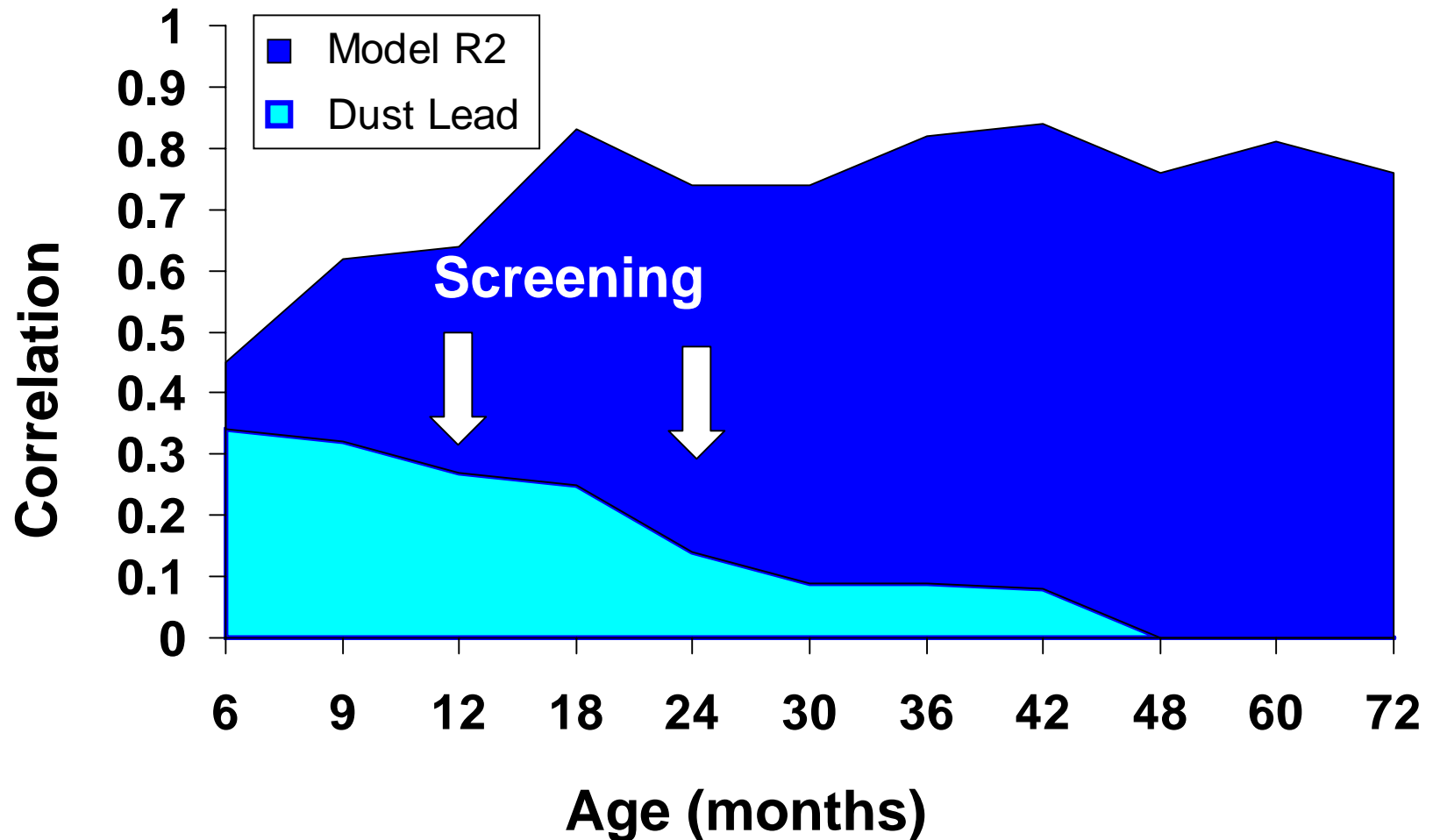


Paint Chips

Lead-contaminated House Dust

**Lead ingestion from soil, water
and diet**

Contribution of Lead-contaminated Floor Dust to Blood Lead Level by Age



Bornschein R. (unpublished data).

Standards and Interventions for Residential Dwellings



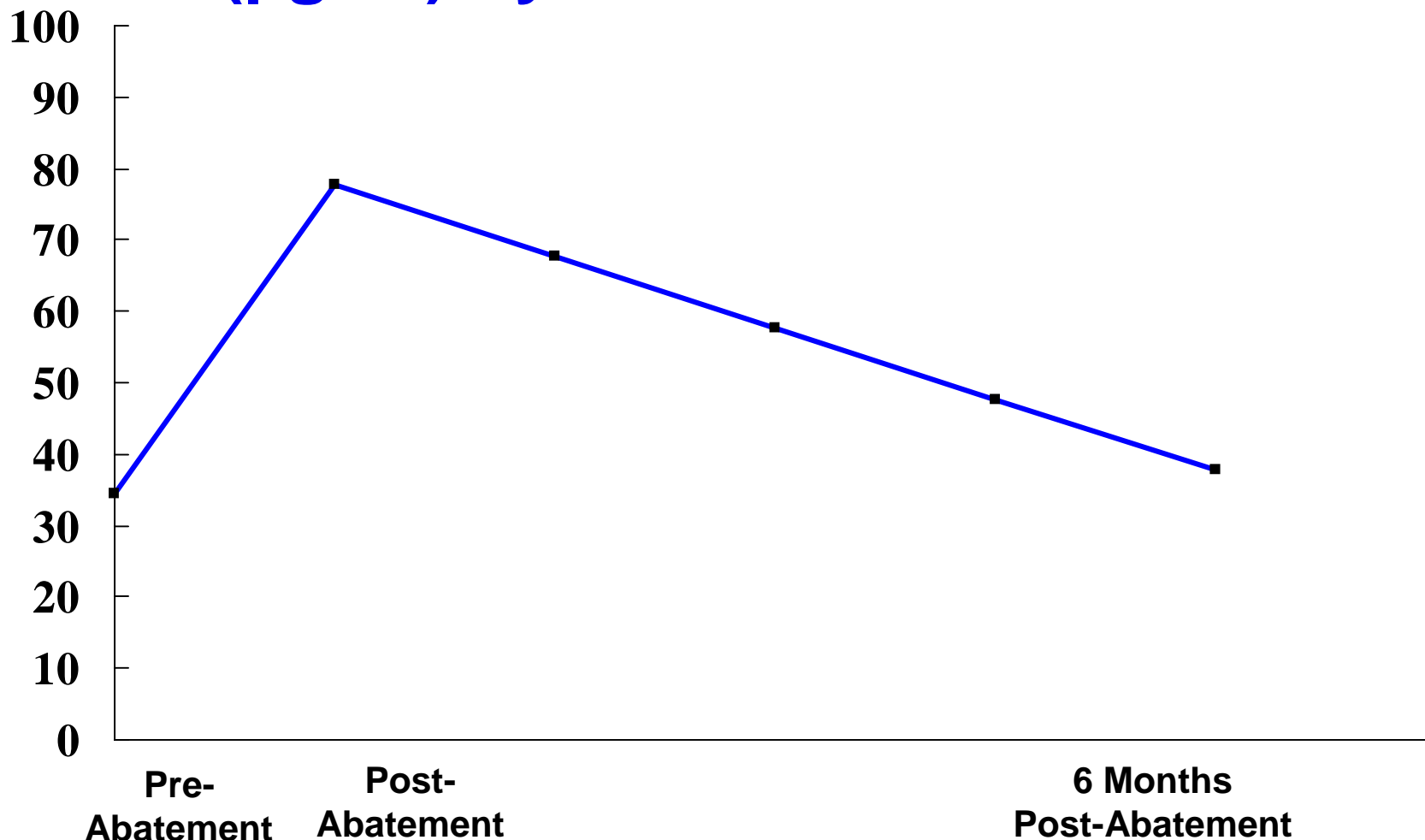
Effect of Lead Hazard Controls

Results of Controlled Trials

	Hazard Control	BPb * (µg/dl)	Age (months)	Change (µg/dl)
Charney	Dust Control	≥ 30	15 - 72	- 6.9
Farfel	Abatement	> 29	9 - 72	- 1.9
Staes	Stabilization	≥ 25	< 72	- 4.0
Aschengrau	Abatement	3- 22	< 48	+ 6.5

* Blood lead levels at baseline

Geometric Mean Floor Dust Lead Levels ($\mu\text{g}/\text{ft}^2$) by Abatement Status*



*Farfel AJPH 1990: 80; 1240-1245

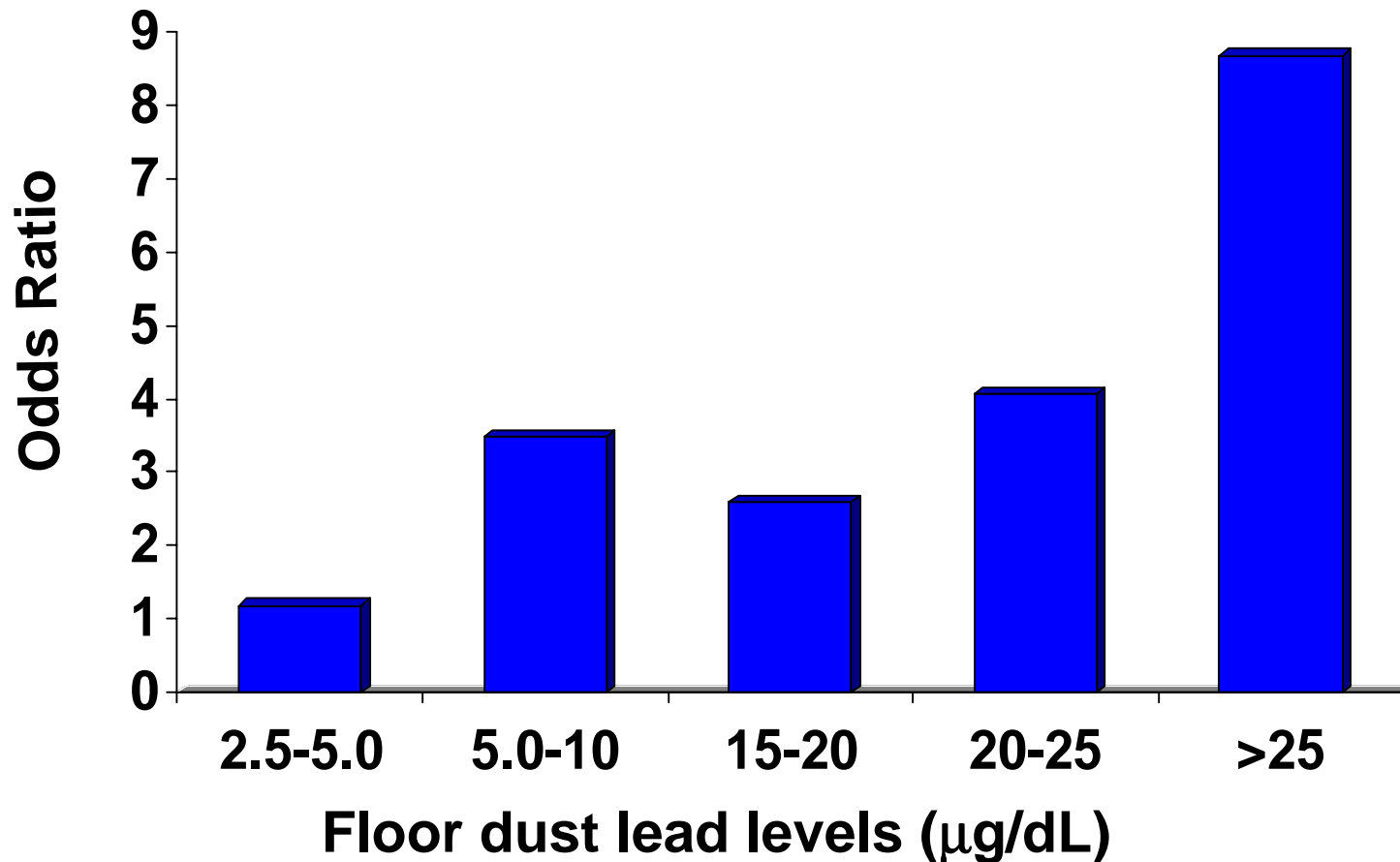
HUD Post Abatement Standards for Lead-Contaminated House Dust

- **Floors** **200 $\mu\text{g}/\text{ft}^2$**
 - **Sills** **500 $\mu\text{g}/\text{ft}^2$**
 - **Troughs** **800 $\mu\text{g}/\text{ft}^2$**
-

EPA Residential Standards for Lead-Contaminated House Dust

- **Floors** **40 $\mu\text{g}/\text{ft}^2$**
 - **Sills** **250 $\mu\text{g}/\text{ft}^2$**
 - **Troughs** **800 $\mu\text{g}/\text{ft}^2$**
-

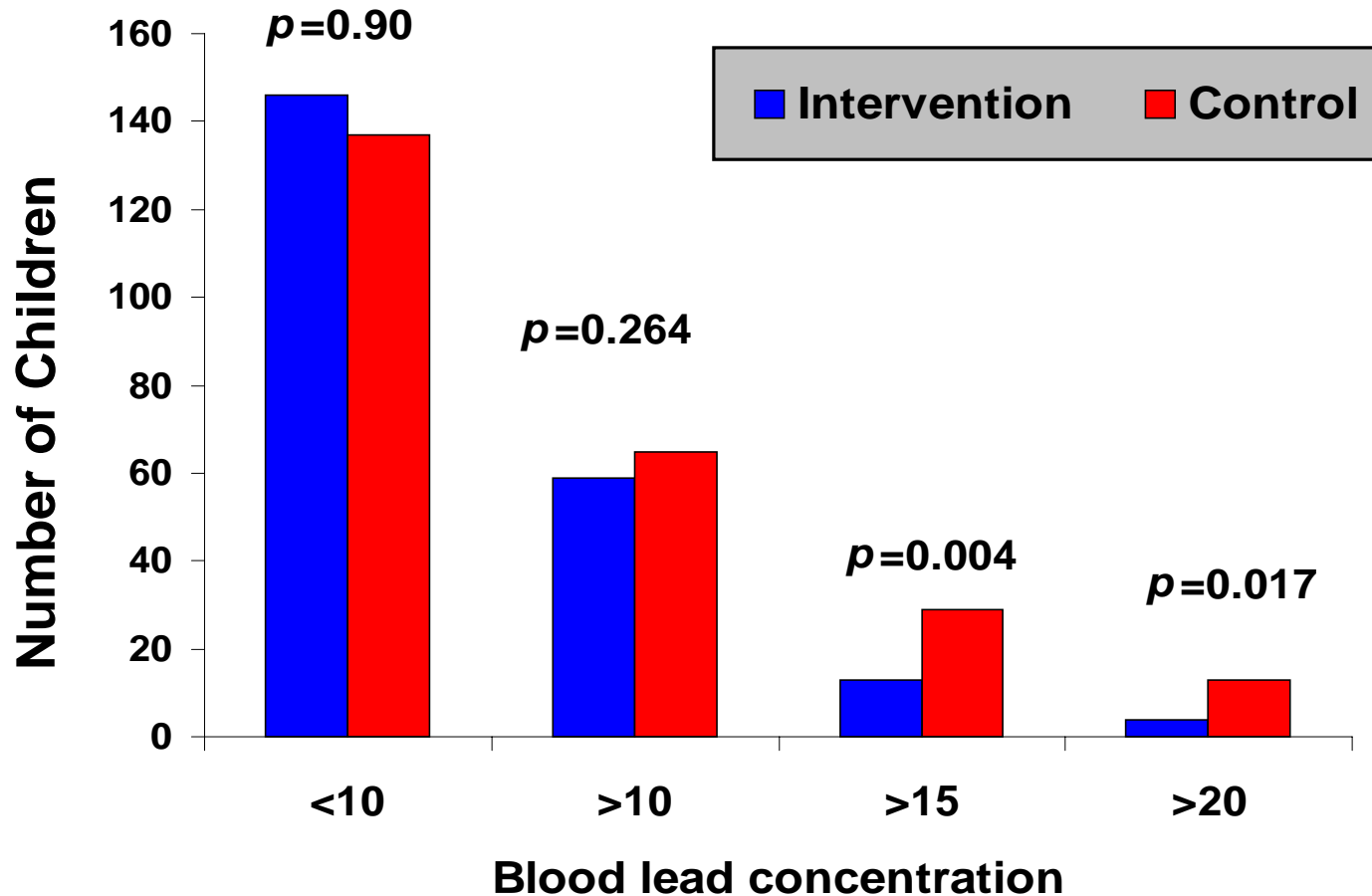
Risk of blood lead levels $\geq 10 \mu\text{g/dl}$ by floor dust lead levels ($\mu\text{g}/\text{ft}^2$)



Effect of Dust Control on Children's Blood Lead Levels

	Hazard Control	BPb * (µg/dl)	Age	Change (µg/dL)
Lanphear	Education	6.7	12 - 31	- 0.55
Hilts	Professional	11.6	32.4	+0.3
Aschengrau	Paint & Repair	16.9	24.5	+ 1.1
Rhoads	Professional	12	20	- 1.9
Lanphear	Education	2.8	6	- 0.2

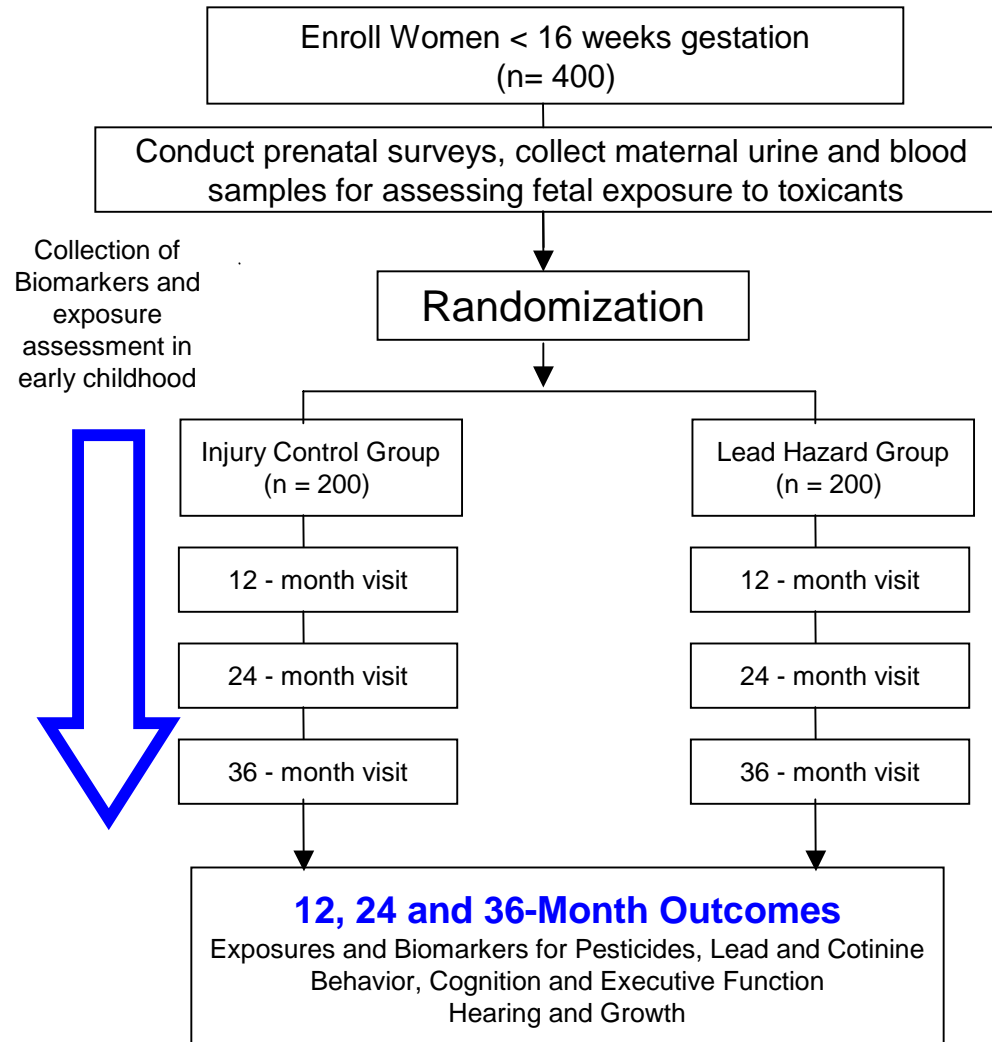
Effect of Dust Control on Blood Lead Concentration by Group Assignment



Limitations of Studies Evaluating Lead Hazard Controls

- Not adjusted for age or seasonal variation
- Often not randomized or lack control group
- Underestimate effect of intervention
- May not be relevant for children who have blood lead levels $< 25 \mu\text{g/dL}$.

HOME Study of Prevalent Toxins



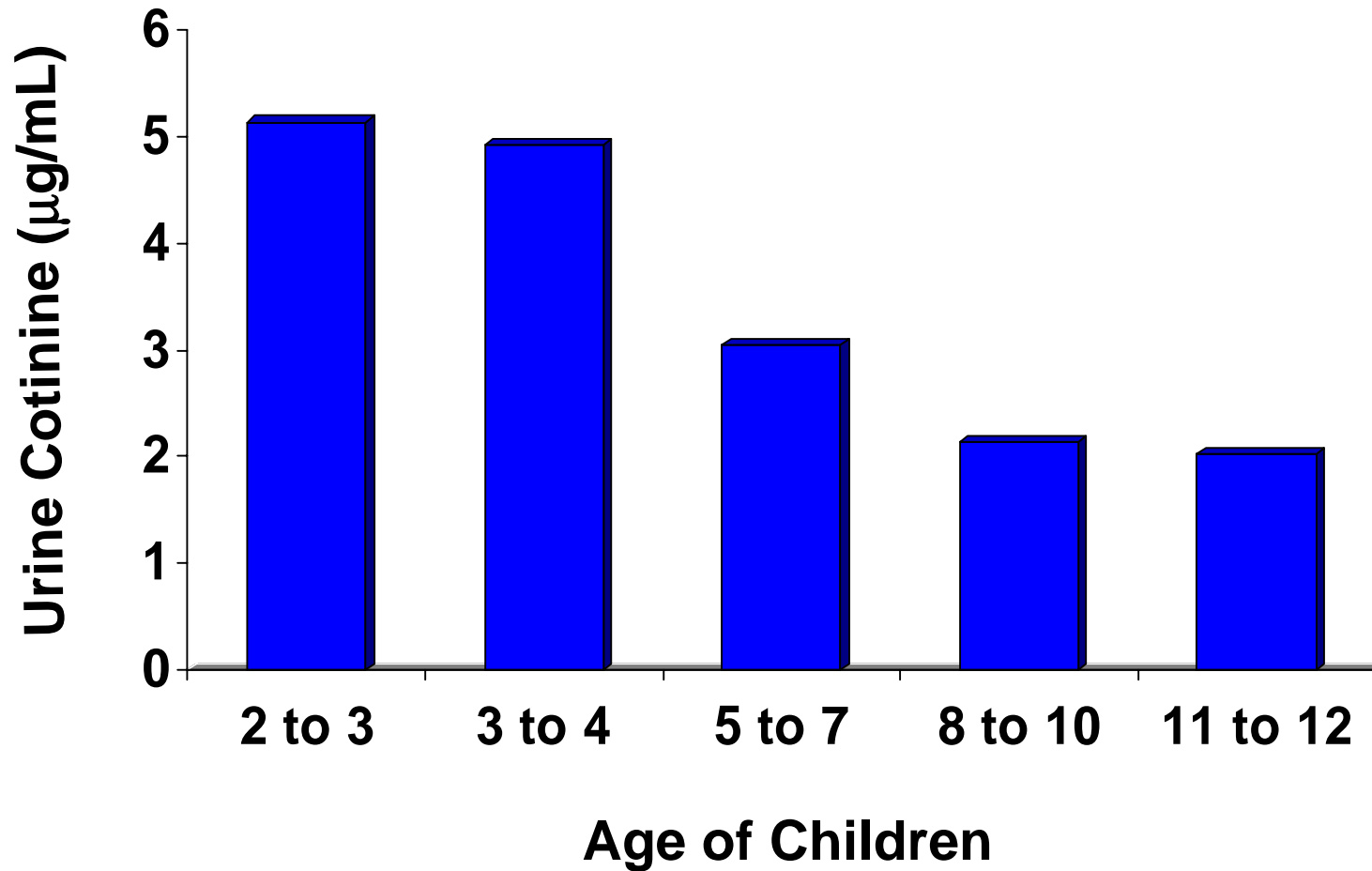
Tobacco Exposure in Children



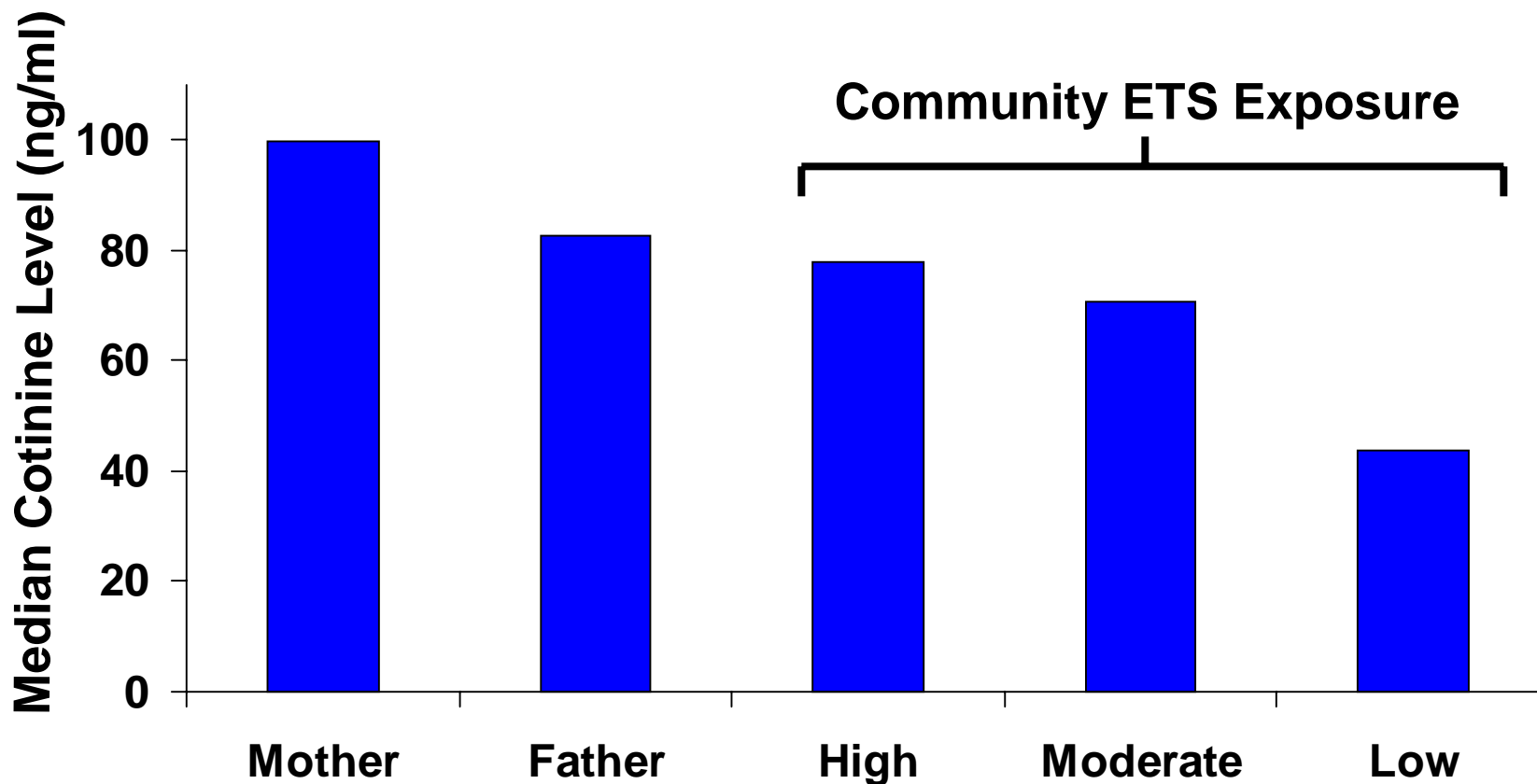
Routes of Exposure

- Fetal transfusion
- Respiration
- Ingestion

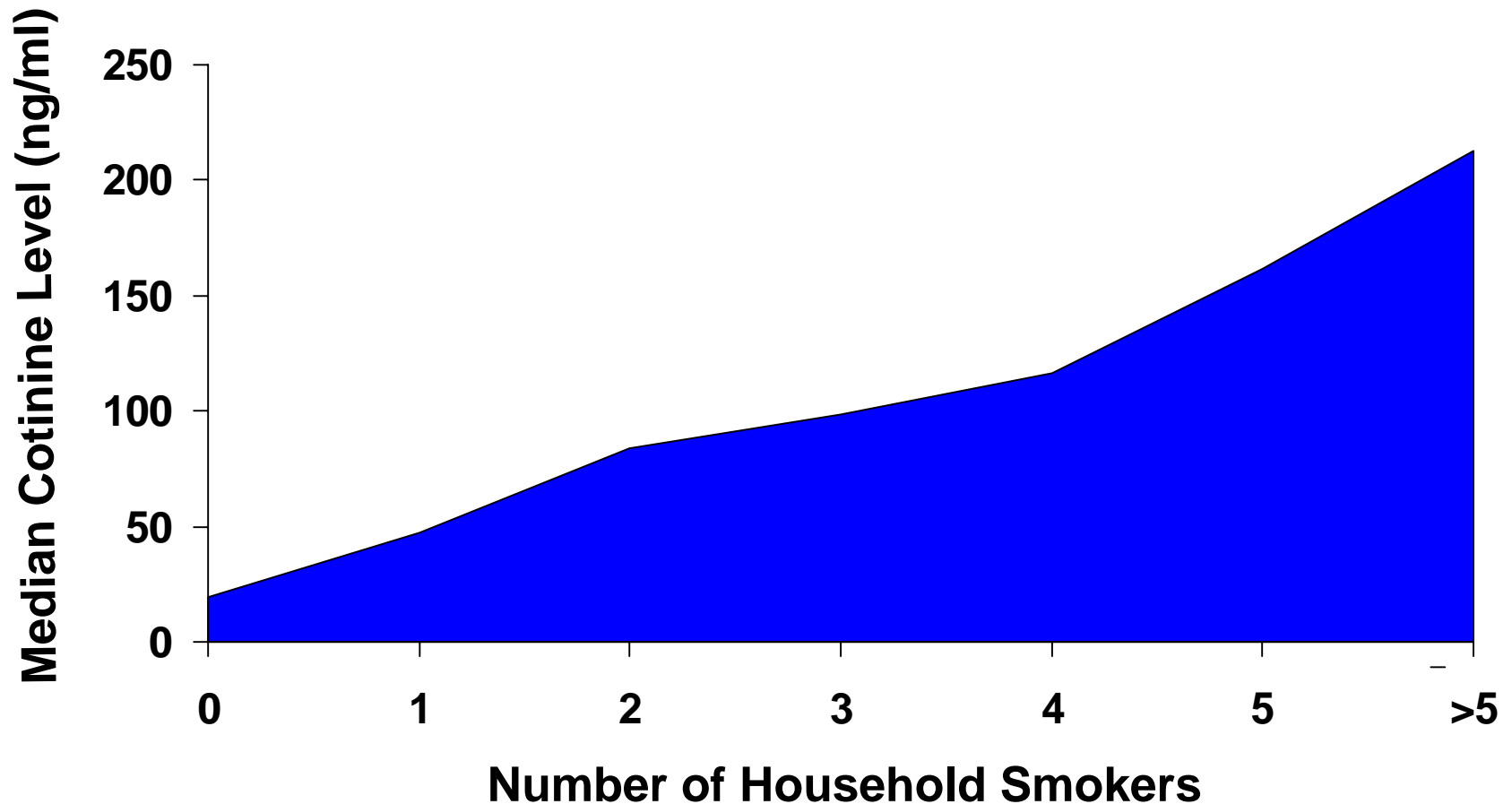
Salivary Cotinine levels ($\mu\text{g/mL}$) by Children's Age



Cotinine Levels by Exposure Source



Cotinine Levels by Number of Household Smokers



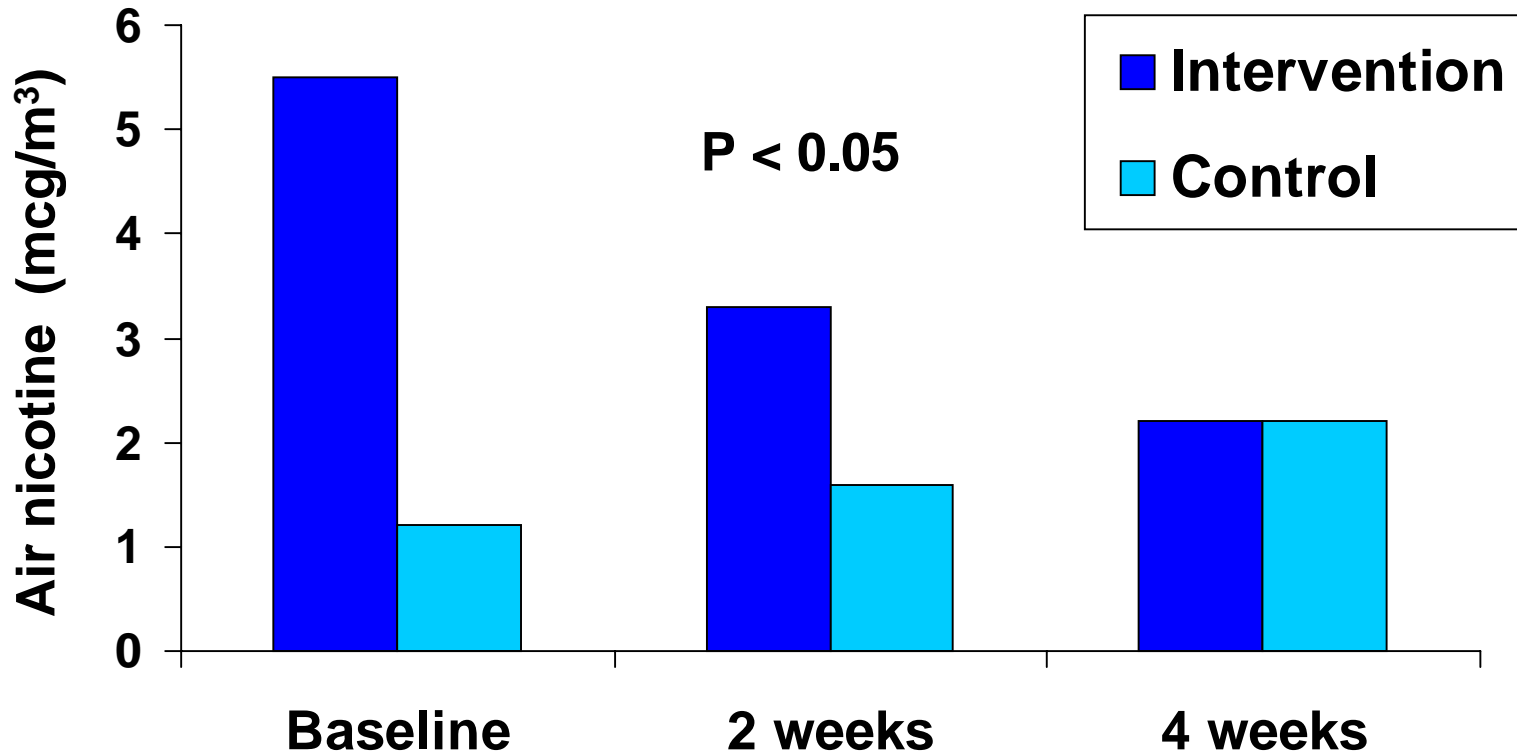
Methods of Control

- Source Elimination
- Source Reduction
 - Filtration
 - Ventilation
 - Containment

Reducing ETS Exposure

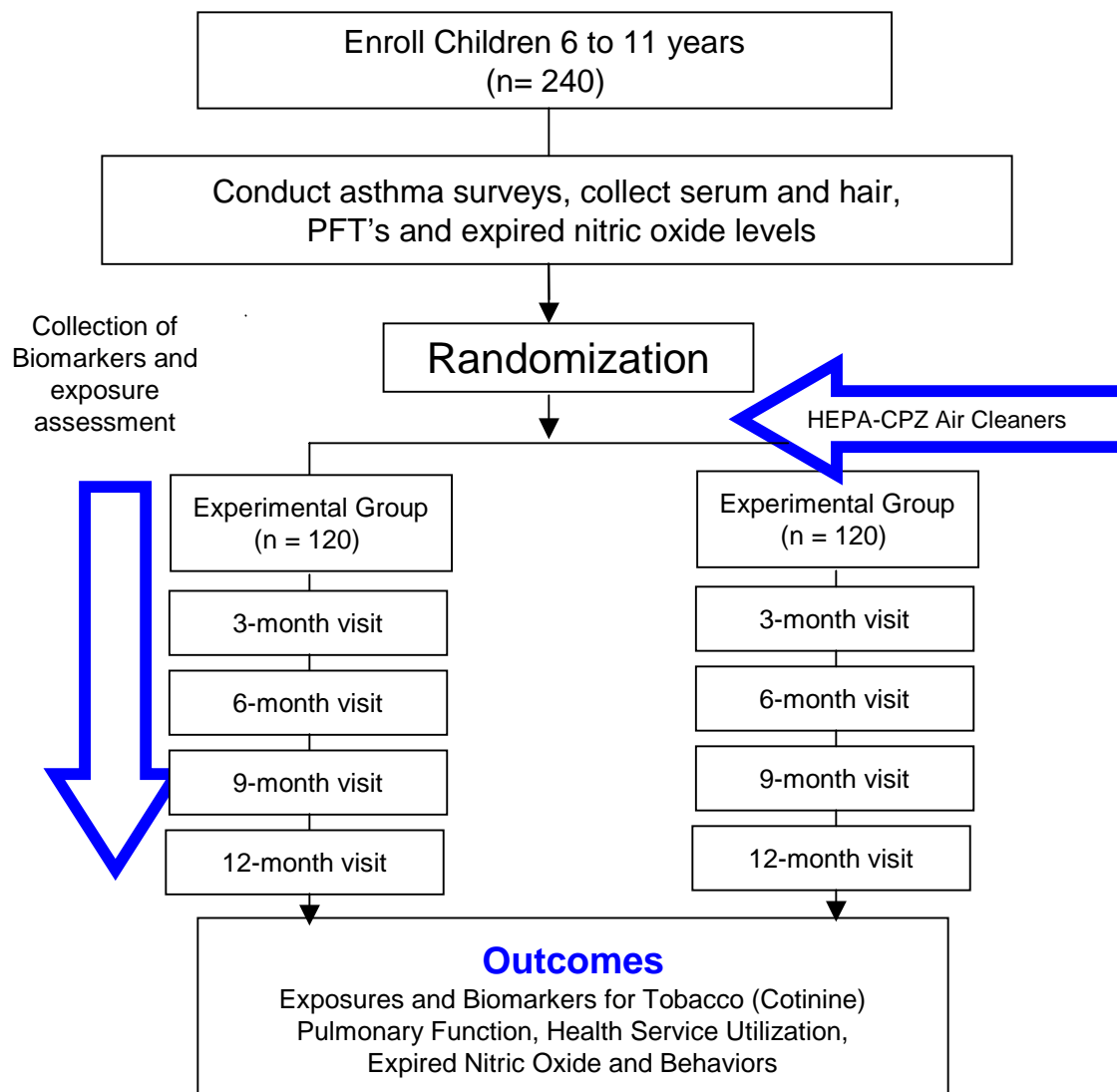
Author	Year	No.	Age	Cotinine Level
Woodward	1987	184	< 3 months	NC
Chilmonzyk	1992	103	Infancy	NC
Greenberg	1994	121	< 6 months	NC
McIntosh	1994	91	1-17 years	NC
Hovell	2000	108	< 4 years	p = 0.008

Effect of HEPA-CPZ Air Cleaners on Air Nicotine (n=12 per group)



Aligne CA (unpublished data).

Cincinnati Asthma Prevention (CAP) Study



The New York Times

One Maryland County Moves To Regulate In-Home Smoking

By The New York Times

BALTIMORE, Nov. 21 — A suburban Washington county has approved a strict antismoking measure that would impose \$750 fines against residents if the odor of their smoking irritates neighbors.

Douglas M. Duncan, a Democrat who is the county executive in Montgomery County, Md., said today that he planned to sign the measure, which the County Council approved 6 to 2 on Tuesday. Mr. Duncan originally proposed a bill to regulate indoor air quality that had exempted tobacco smoke, but the council added it to the measure.

Under the bill, tobacco smoke would be treated the same as pollutants like asbestos, radon, molds and pesticides. Smokers could face fines of as much as \$750 a violation, and landlords or condominium associations could also face fines for failing to equip buildings with adequate ventilation.

"Montgomery County has been a leader on air-quality issues for many years, so it is fitting that we once again are breaking new ground by enacting tough indoor air-quality standards," Mr. Duncan said.

But opponents, including civil libertarians and some council members, called the antismoking provision an infringement on the rights of residents who smoke in their homes.

"It certainly does smack of Big Brotherism and invasion of privacy," said Michael L. Subin, a Democratic council member who voted against the measure. "Government has now entered the four walls to your home to say you can be fined for doing something that your neighbor doesn't like."

Patrick Lacefield, a council spokesman, defended the measure, saying it was intended to protect the health of the county's residents.

"We were looking to revise a 25-year-old clean-air law, and 25 years ago, people were smoking in hospitals, and train stations and airports," he said. "Second-hand tobacco smoke is very dangerous and is a known health hazard. The idea was if somebody could complain about someone sending dioxide or benzene their way, why shouldn't they also be able to complain about smoke?"

Under terms of the bill, county environmental inspectors would investigate complaints. Fines would be imposed, the measure's supporters said, only after warnings and suggestions to resolve complaints through steps that might be as simple as opening a window.

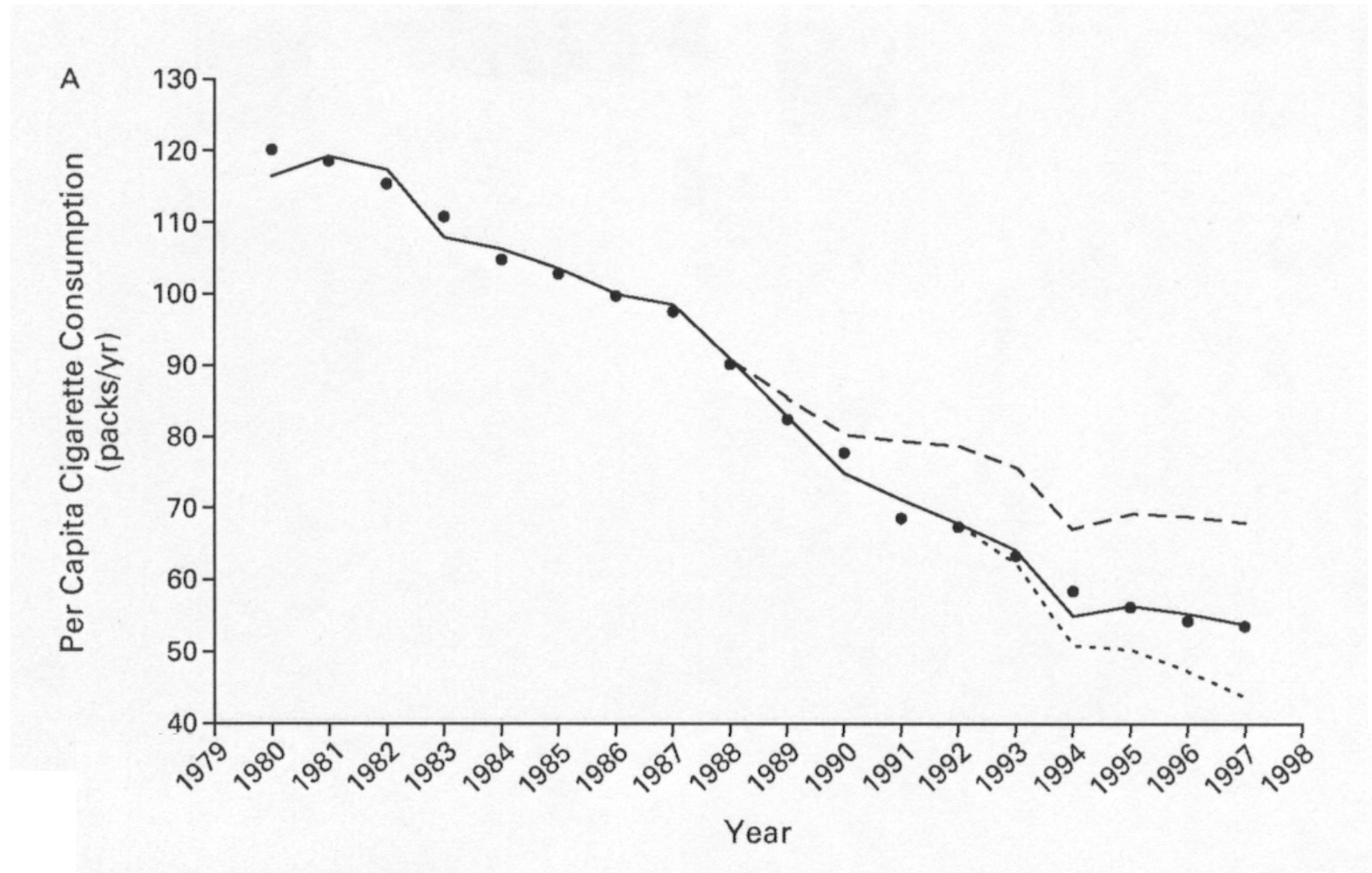
Critics argued that no evidence exists showing that smoke from a neighboring home poses a risk.

"The government shouldn't be able to come in and say you can't use lots of garlic or perfume in your own home, and the government shouldn't be able to say you can't smoke in your own home because of the smell," said Arthur Spitzer, the legal director of the American Civil Liberties Union's area branch.

Brendan McCormick, a spokesman for Philip Morris USA, called the measure the most restrictive he had ever heard of.

"We understand that people are bothered by being around smoke and, in public places, we support reasonable restrictions," Mr. McCormick said. "But when the legislation restricts smoking in your own home, that's going too far."

Rates of Cigarette Consumption and Predicted Rates without the Tobacco Control Program



Limitations of Research on ETS Exposure

- Inconsistent measures of exposure.
- Often relied on parental report for ETS exposure and behavioral outcomes.
- Small sample size
- Limited to educational interventions.

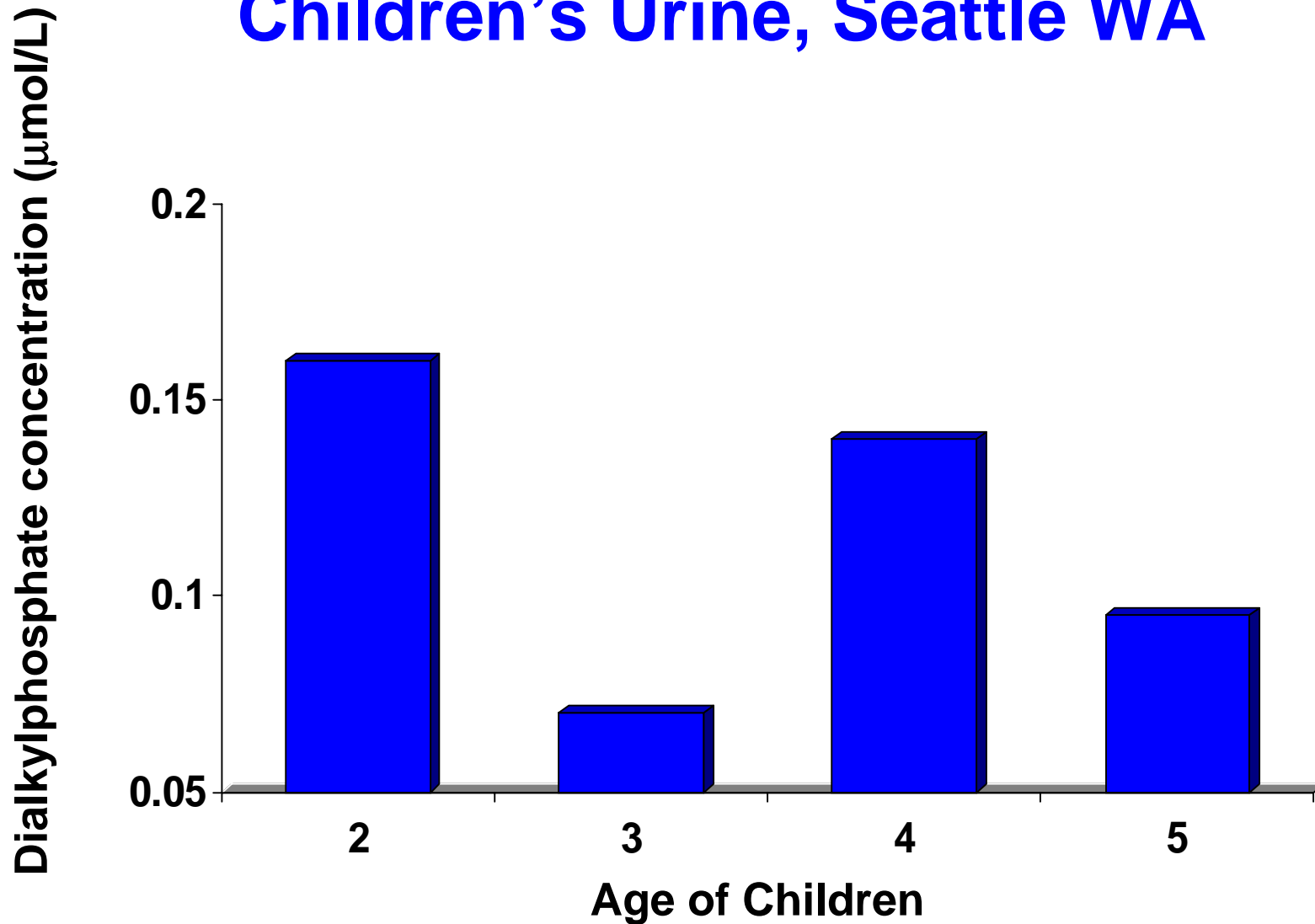
Implications For Prevention

- Emphasis to broaden beyond treatment and education to include passive reduction of exposure to environmental tobacco smoke.
- Empirically-derived health-based standards are needed for environmental tobacco smoke.
- Randomized trials to assess if hazard controls are effective in reducing children's exposure to environmental tobacco smoke, including improvements in neurobehavioral outcomes.

Pesticides



Organophosphate Metabolites in Children's Urine, Seattle WA



Failure of Toxicity Testing

- Of the 3,000 high production volume chemicals, 75% lack even the most basic toxicity tests. ¹
- Of the 140 registered pesticides EPA considers to be neurotoxic, the majority have not been tested for developmental neurotoxicity. ¹
- Animal testing may not be sensitive enough to protect humans. ²
- We lack animal models for important human skills, such as reading.

1. Claudio L. Toxicol Appl Pharm 2000;164:1-14.

2. Rice D. Env Health Persp 1996;104:205-215.

Steps to Prevent Childhood Exposure to Residential Pesticides

- Developmental neurotoxicity tests for all new chemicals or pesticides.
- Test children's exposure to new agents by measuring biomarkers and potential adverse effects prior to marketing.
- Post-marketing surveillance of pesticide toxicity.

Implications for Prevention of Children's Exposure to Residential Toxins

- Emphasis to shift from screening or diagnosing children with disease to preventing exposure.
- Empirically-derived health-based standards for settled dust and indoor air are needed.
- Randomized trials to assess if controls are effective in preventing children's exposure and any adverse effects.
- Studies to examine adverse effects of toxins at lower levels and for pesticides.

“Until effective standards for the domestic environment are devised, it is likely that children will continue to be employed as biological indicators of substandard housing.”

Donald Barltrop, 1974

A black and white photograph of a wooden cage, possibly a rat cage, with a rope handle. The cage is made of light-colored wood and has a grid-like structure. It is set against a dark, textured background. The text is overlaid on the image in a white, serif font.

“Until effective standards for the domestic environment are devised, it is likely that children will continue to be employed as biological indicators of substandard housing.”