The Lingering Legacy of Lead Toxicity

Why Even a Little Lead is Still Too Much

Measuring Brain Function

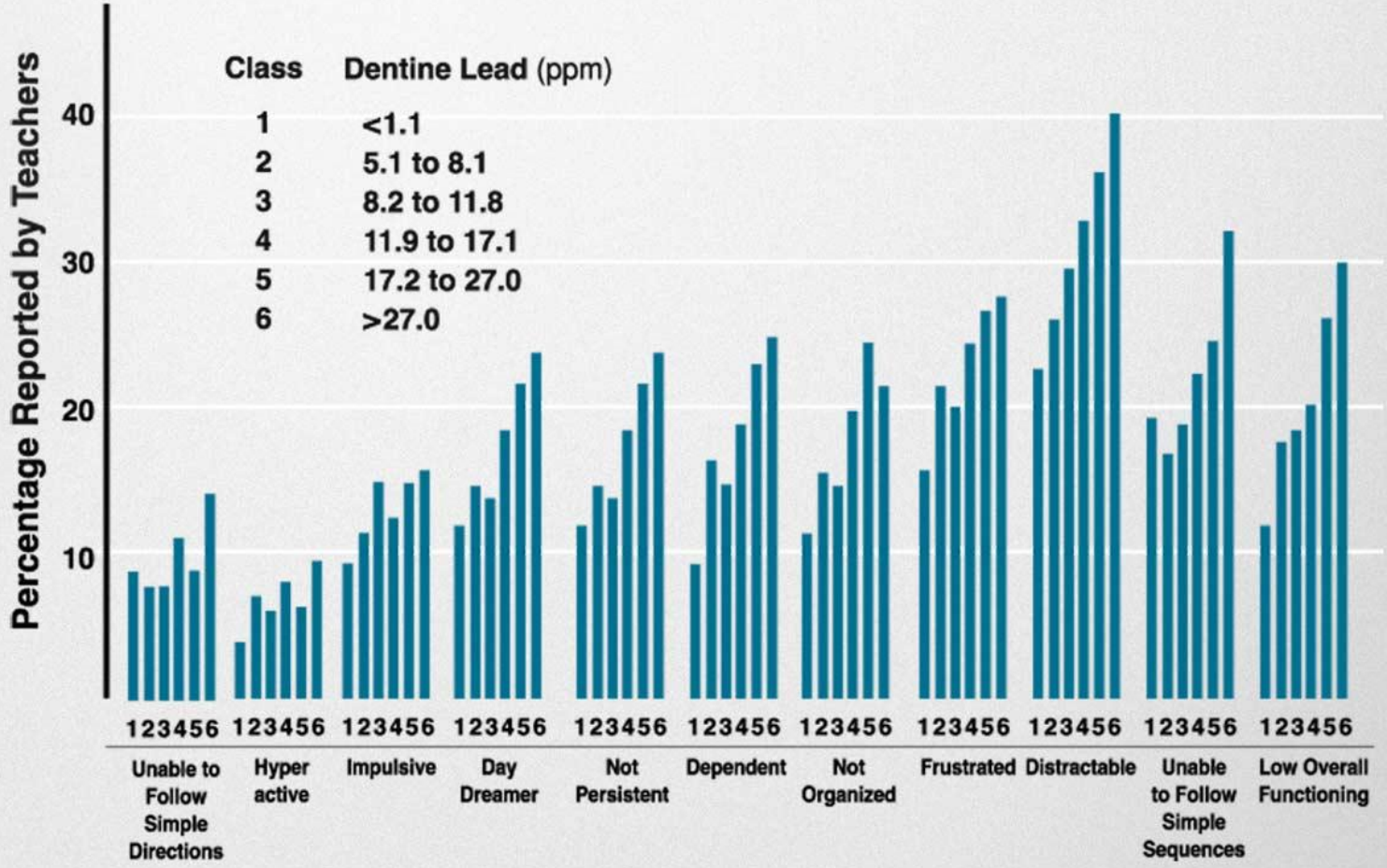
IQ

Cognition

Behaviors

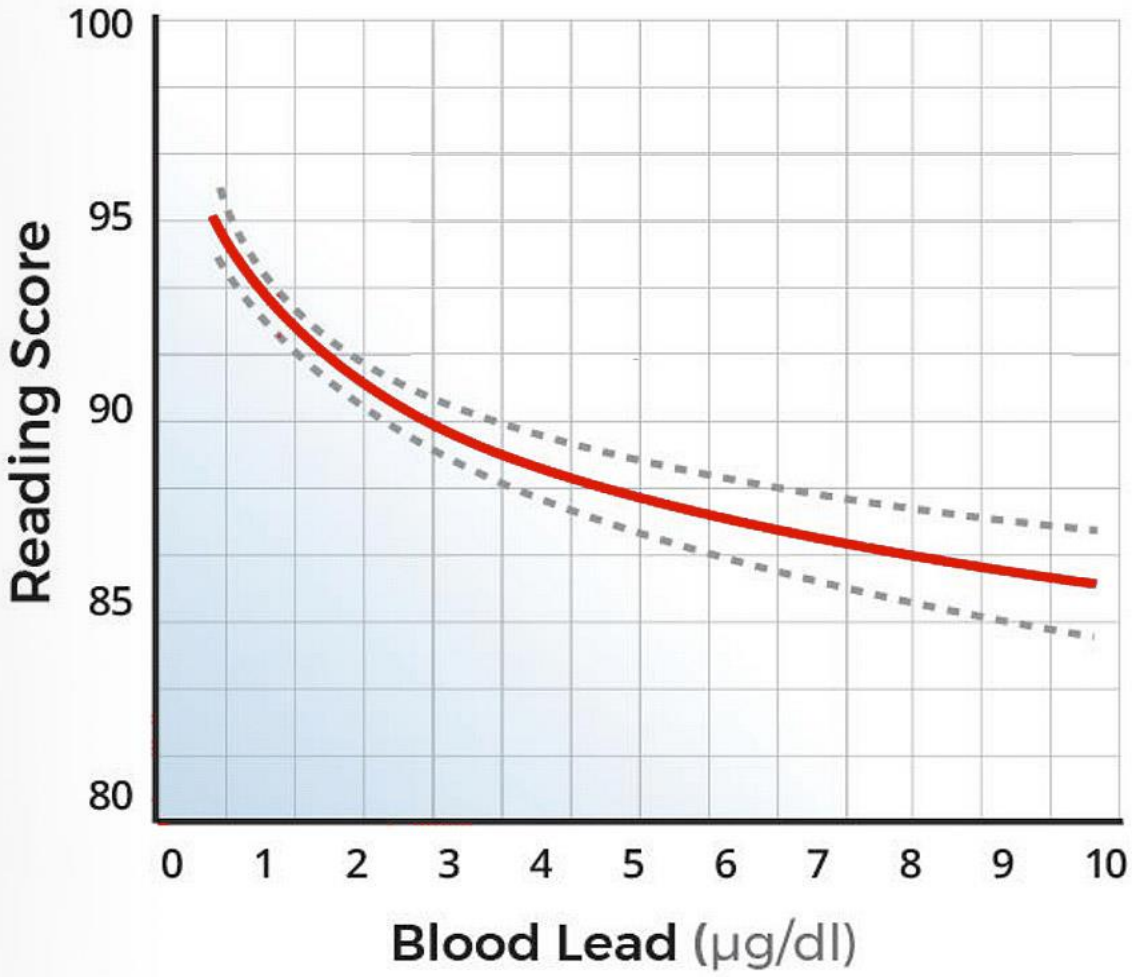
Brain Imaging

Behavioral and Emotional Problems of Lead Exposure

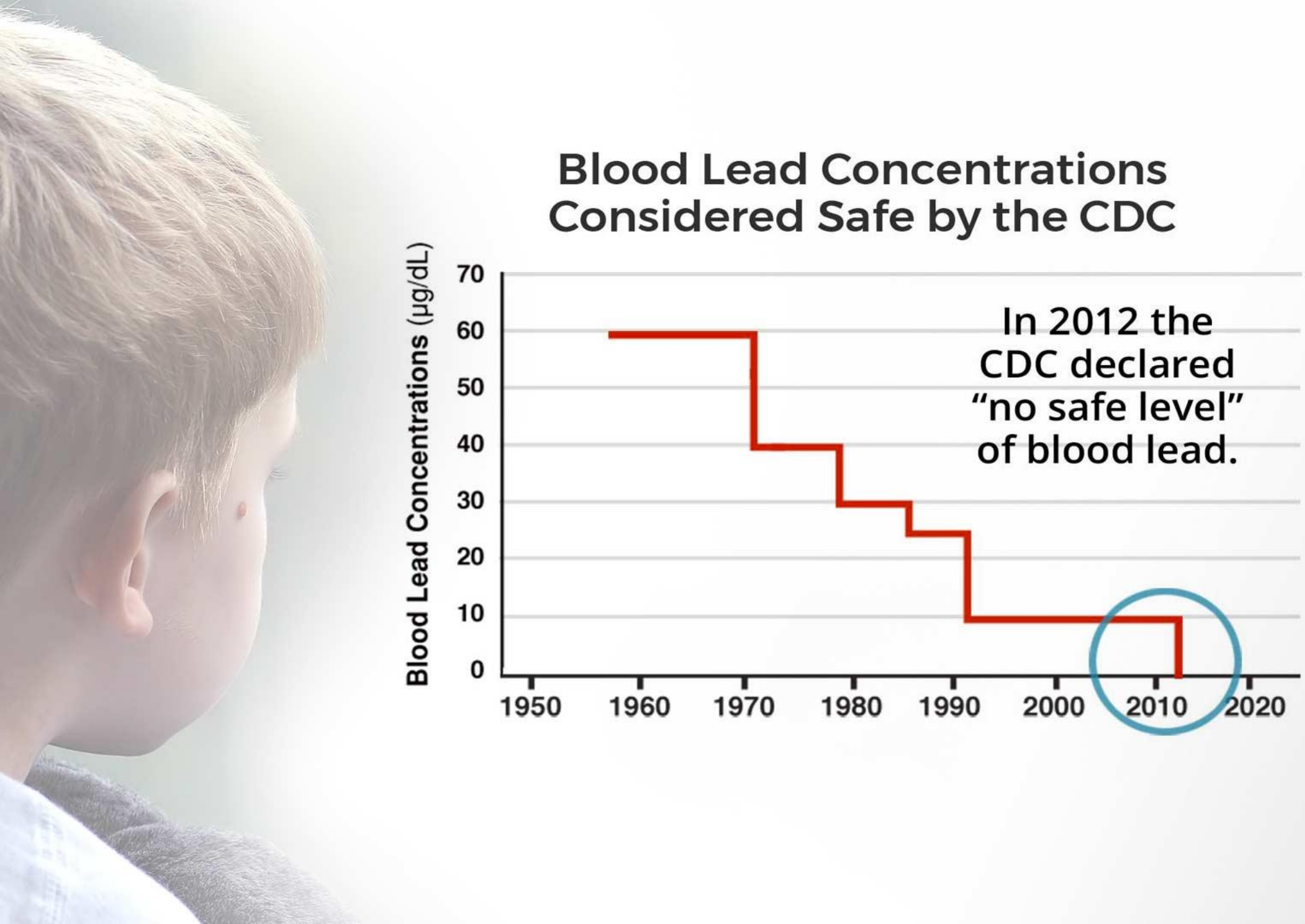


Reading Scores by Blood Lead Levels

US Children • NHANES III, 1998-1994

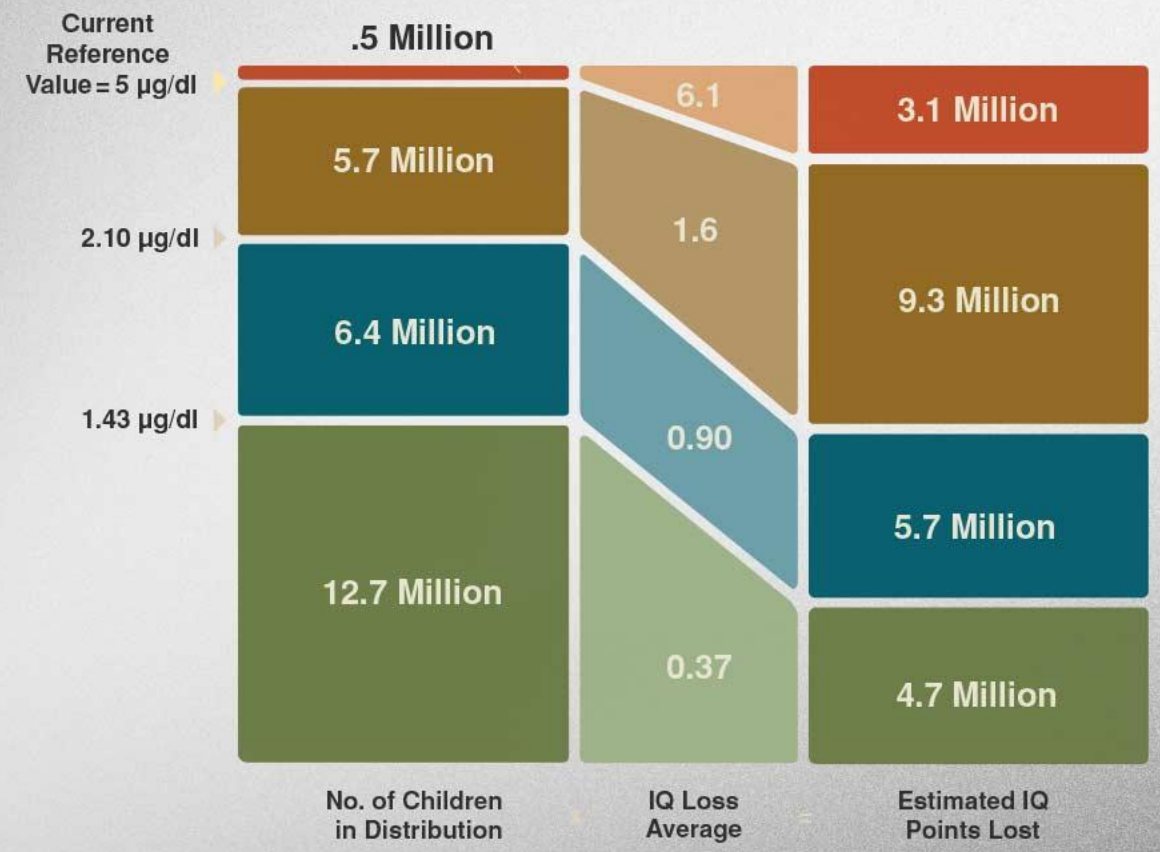


LEAD EXPOSURE,
even at very low levels,
diminishes IQ.


Blood Lead Concentrations
Considered Safe by the CDC
Blood Lead Concentrations (µg/dL)
70
60
50
40
30
20
10
0
1950
1960
1970
1980
1990
2000
2010
2020
In 2012 the
CDC declared
“no safe level”
of blood lead.

The Disasterous Impact of Toxic Chemicals On IQ

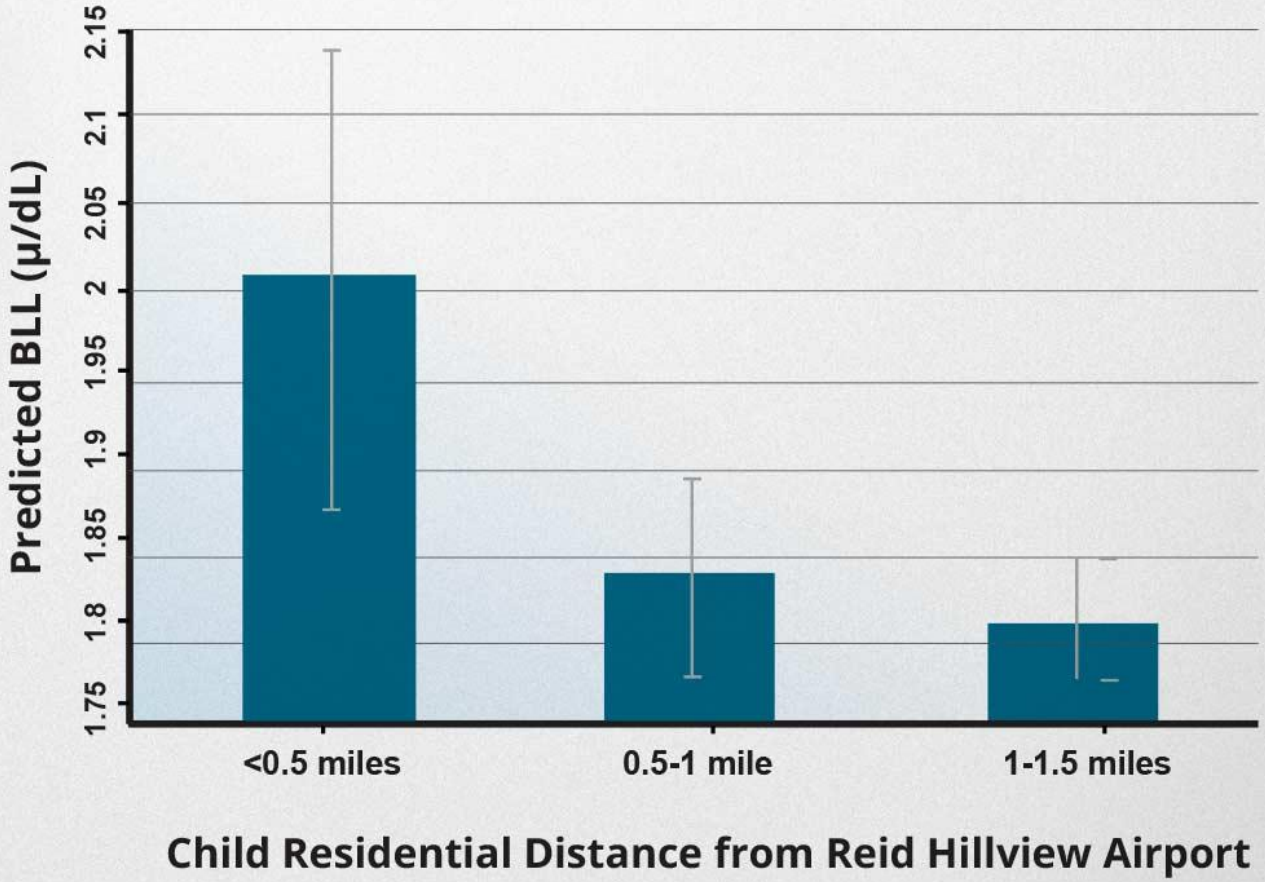
The Prevention Paradox



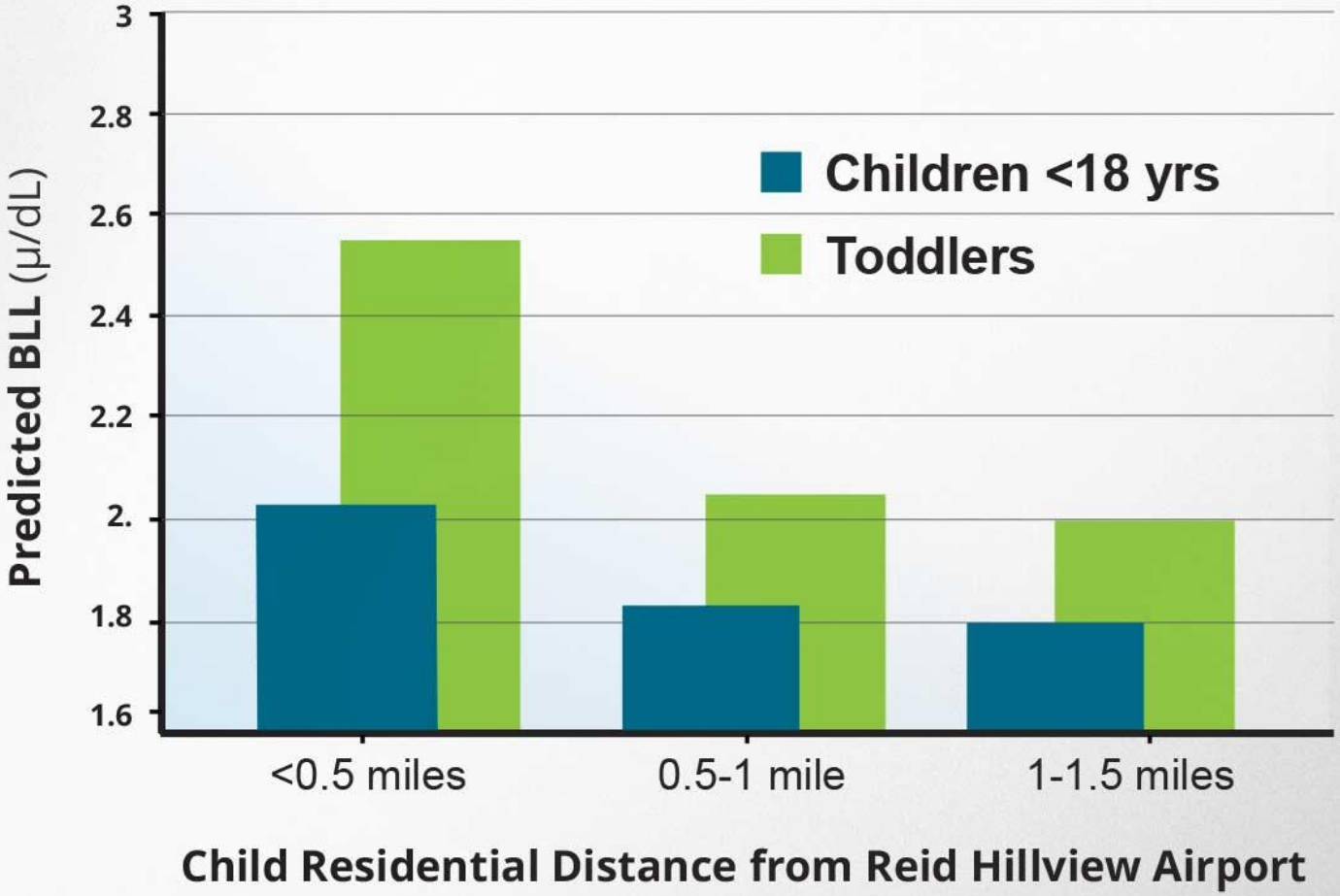
Estimated Loss of IQ in US Children at Different Intervals of Blood Lead

The Impact of Lead on Intellectual Ability

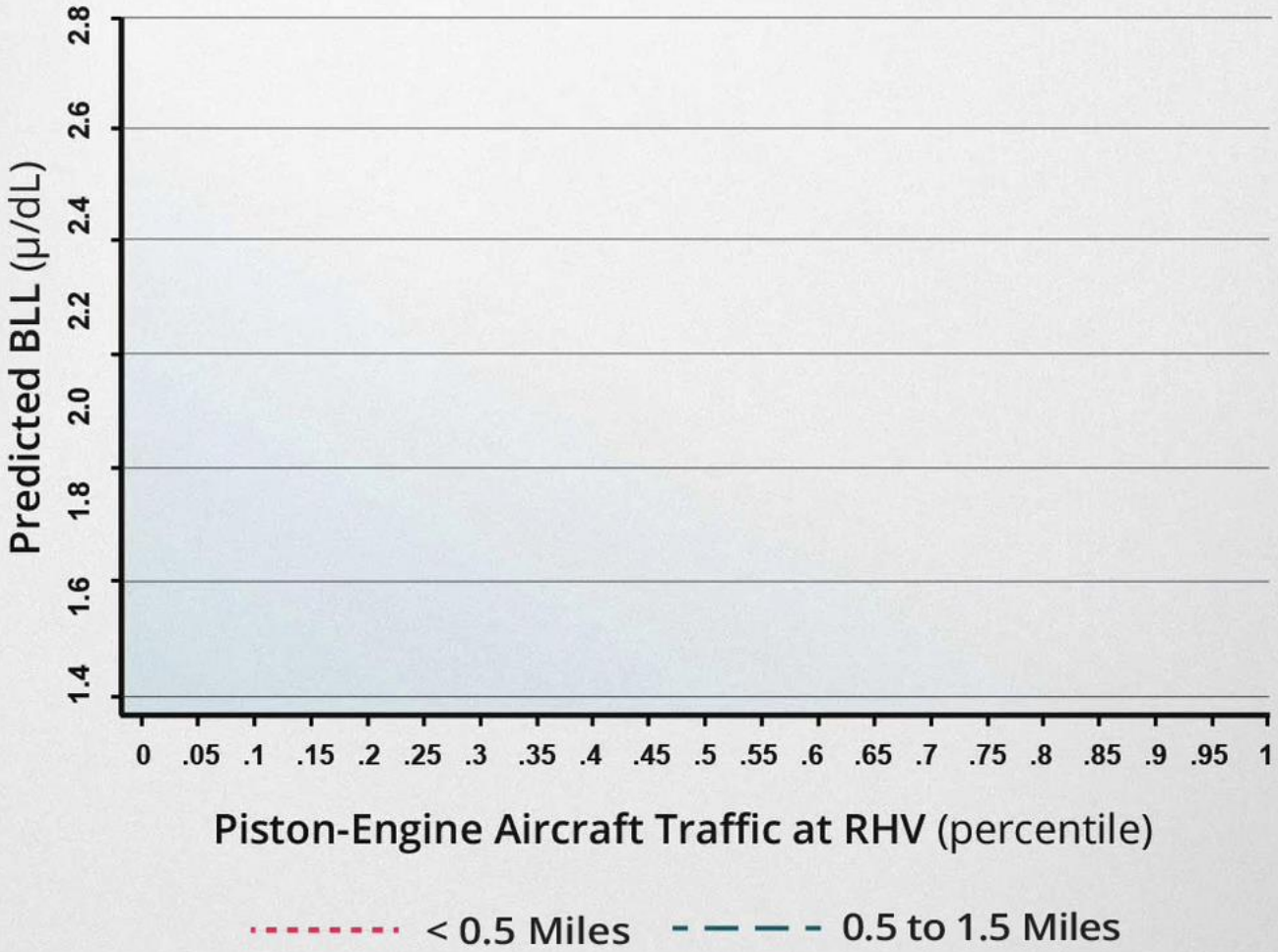
Residential Distance and Blood Lead Levels in Children <18 yrs



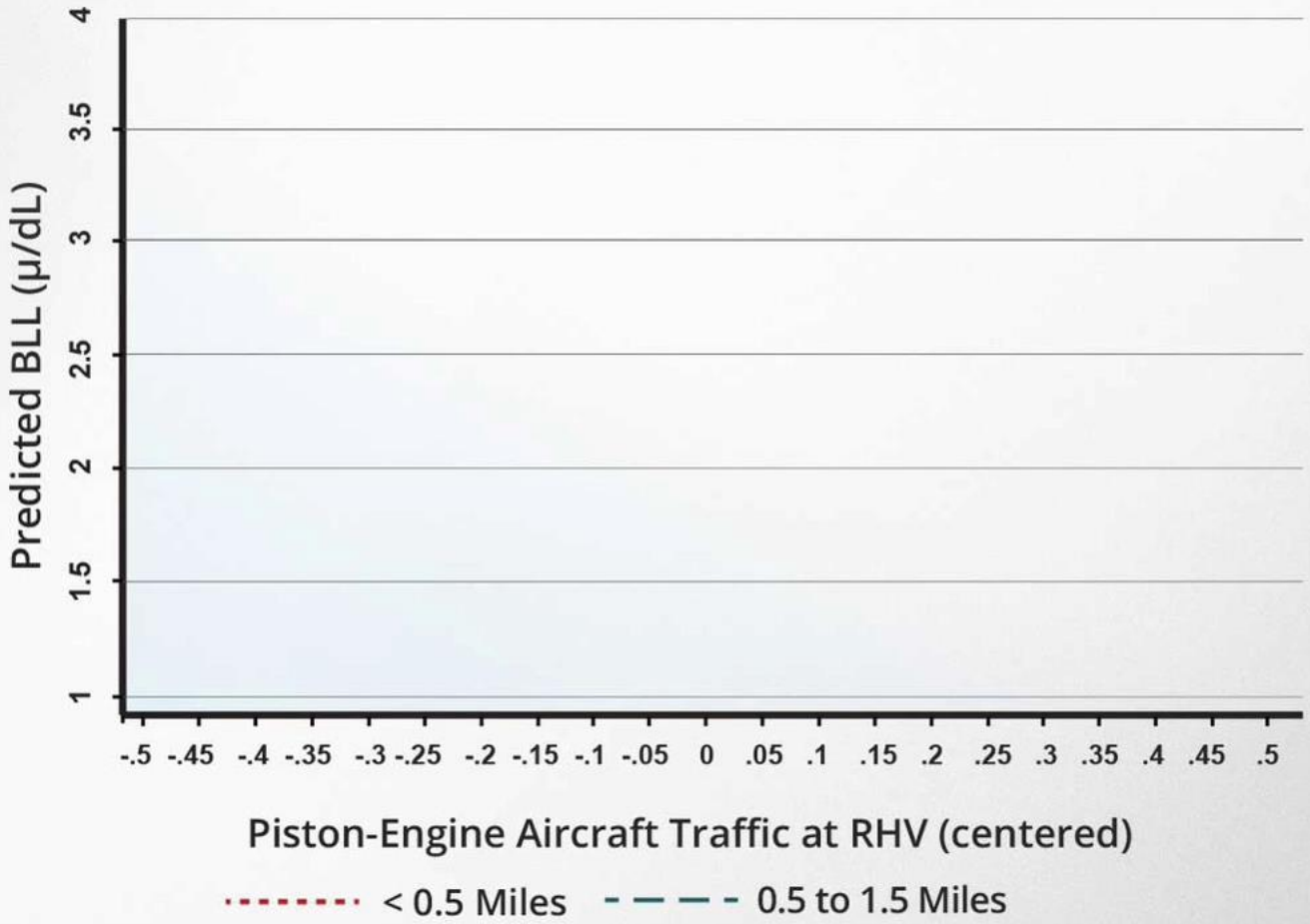
Residential Distance and Blood Lead Levels in Toddlers and Children <18 years

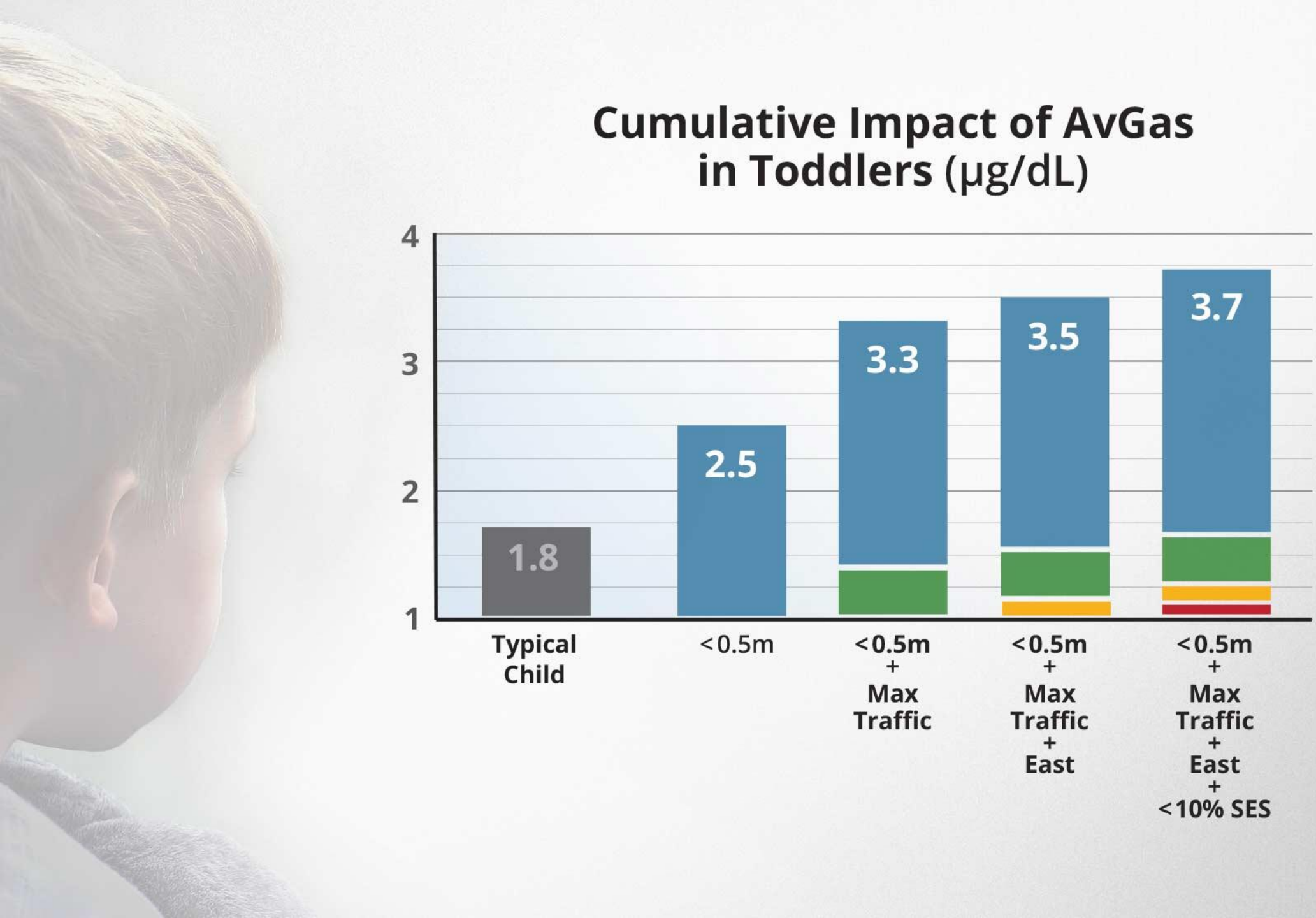


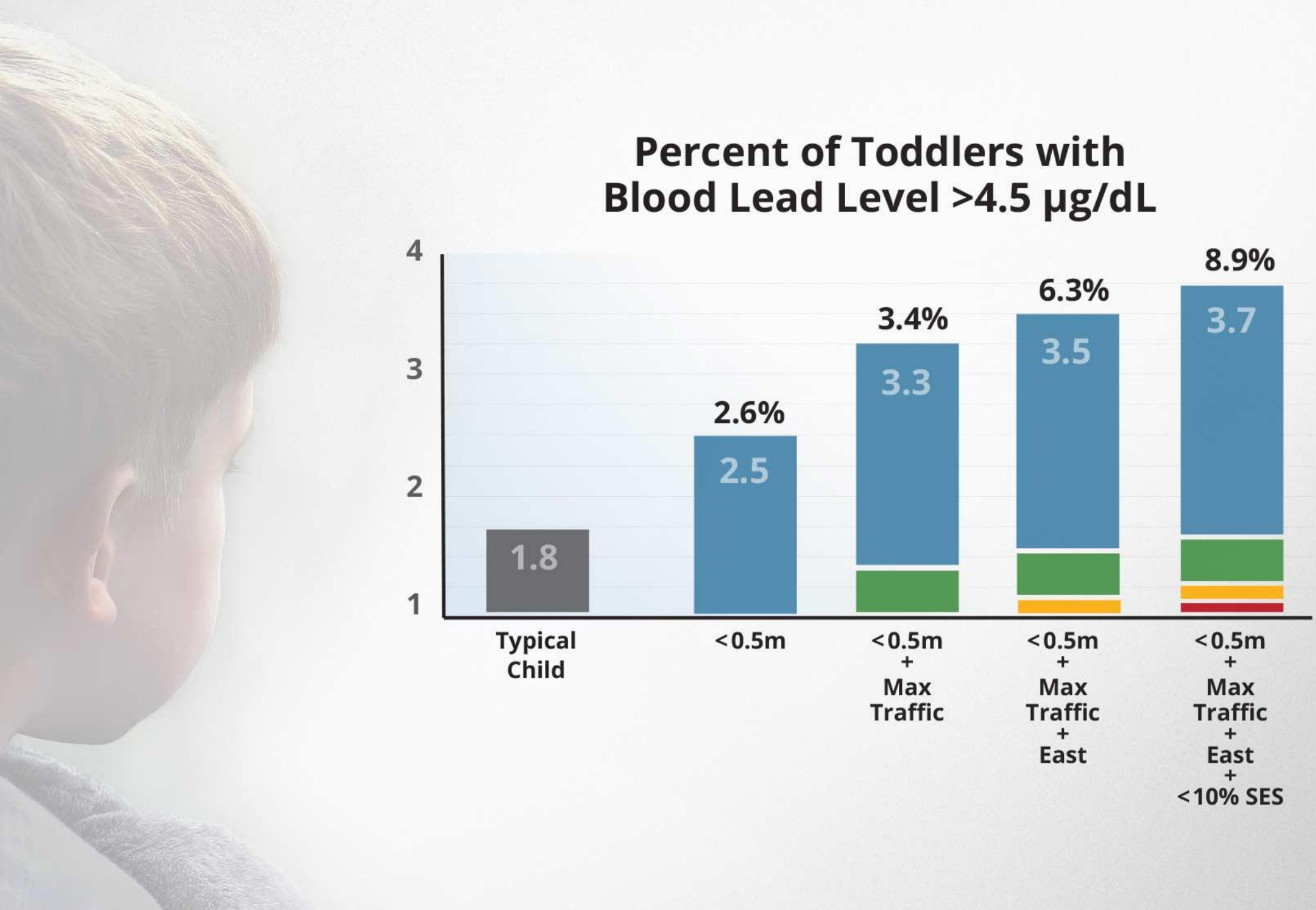
Piston Engine Aircraft Traffic x Residential Distance and Blood Lead Levels in Children < 18 yrs.

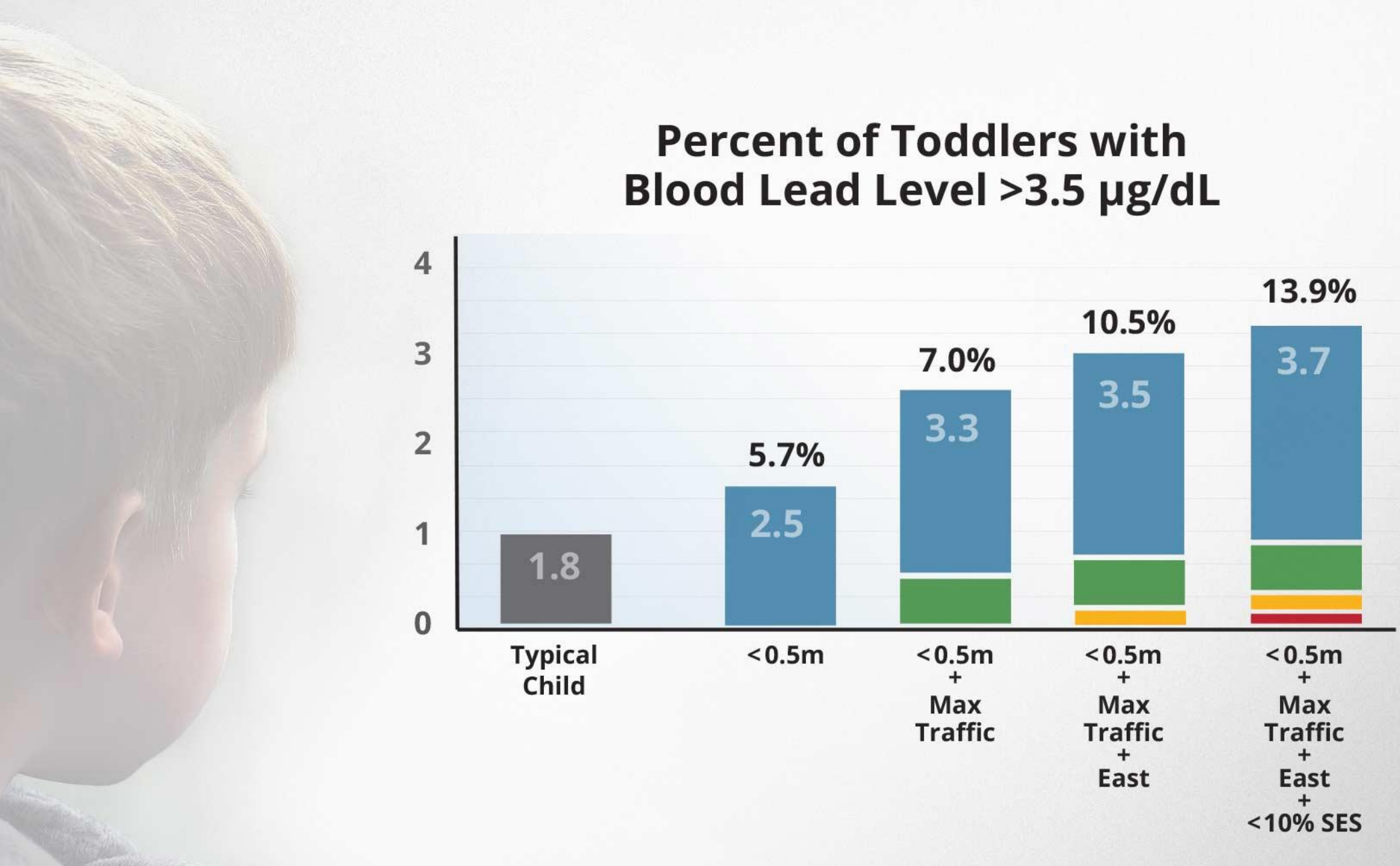


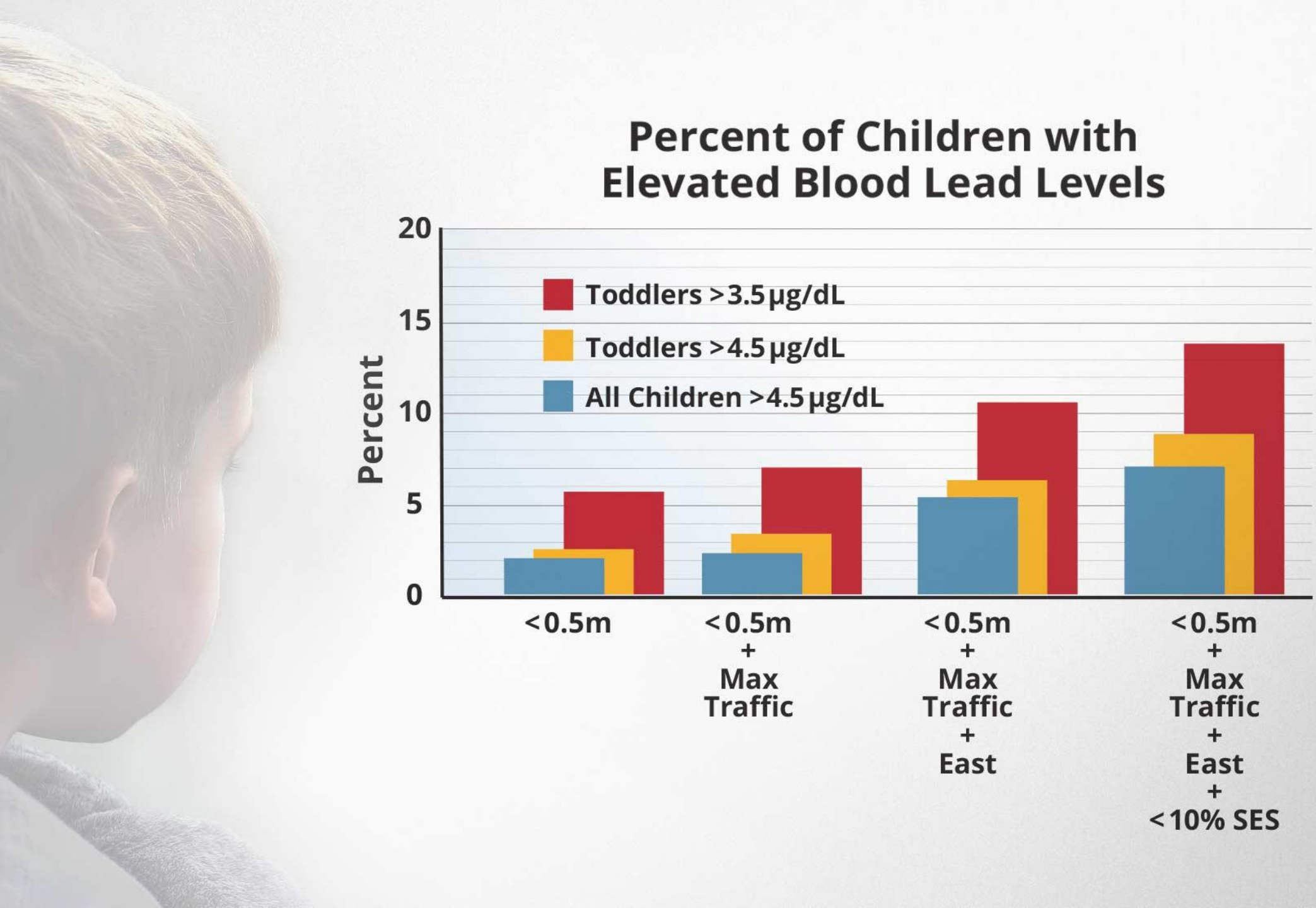
Piston Engine Aircraft Traffic x Residential Distance and Blood Lead Levels in Toddlers



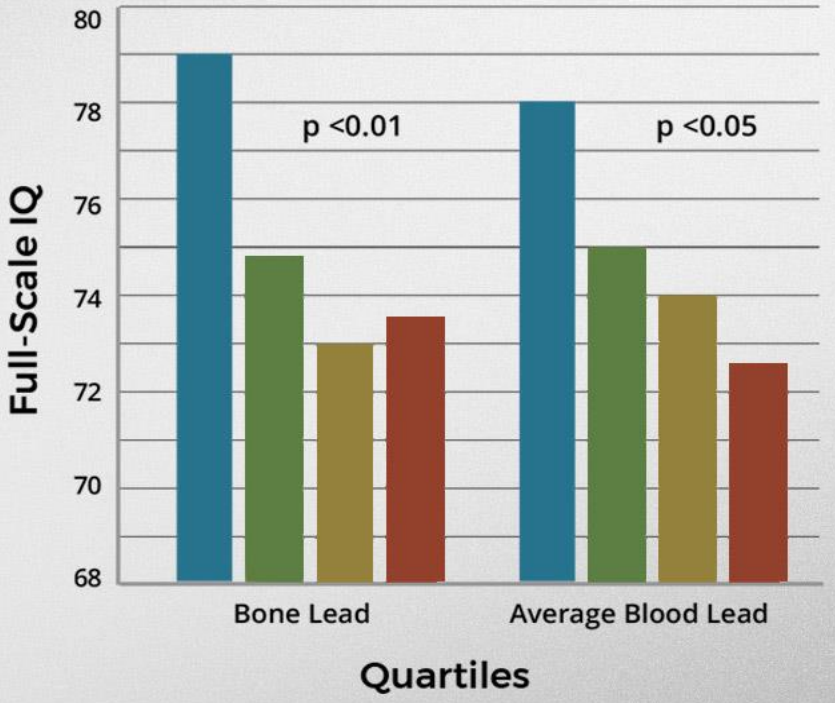

Cumulative Impact of AvGas in Toddlers (µg/dL)
4
3
2
1
1.8
2.5
3.3
3.5
3.7
Typical Child
<0.5m
<0.5m + Max Traffic
<0.5m + Max Traffic + East
<0.5m + Max Traffic + East + <10% SES


Percent of Toddlers with
Blood Lead Level >4.5 µg/dL
4
3
2
1
1.8
2.6%
2.5
3.4%
3.3
6.3%
3.5
8.9%
3.7
Typical Child
<0.5m
<0.5m + Max Traffic
<0.5m + Max Traffic + East
<0.5m + Max Traffic + East + <10% SES

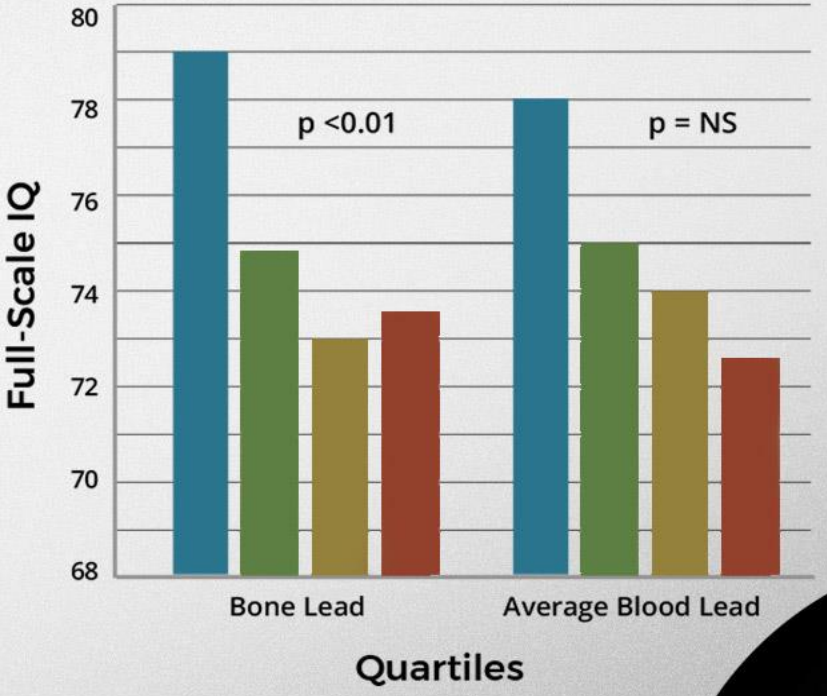

Percent of Toddlers with
Blood Lead Level >3.5 µg/dL
4
3
2
1
0
1.8
5.7%
2.5
7.0%
3.3
10.5%
3.5
13.9%
3.7
Typical Child
<0.5m
<0.5m + Max Traffic
<0.5m + Max Traffic + East
<0.5m + Max Traffic + East + <10% SES


Percent of Children with Elevated Blood Lead Levels
Percent
20
15
10
5
0
Toddlers >3.5 µg/dL
Toddlers >4.5 µg/dL
All Children >4.5 µg/dL
<0.5m
<0.5m + Max Traffic
<0.5m + Max Traffic + East
<0.5m + Max Traffic + East + <10% SES

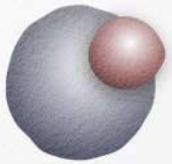
IQ Scores for Tibial Bone Lead **AND** Mean Lifetime Blood Lead Levels



IQ Scores for Tibial Bone Lead **OR** Mean Lifetime Blood Lead Levels



Lead Particles in Aircraft Emissions and Paint



Lead Particles in aircraft exhaust

20 nm

Lead in paint pigment

500 nm

NASEM 2021

Risk Factors for Chronic Heart Disease

- Sex
- Obesity
- Smoking
- Diabetes
- Salt Intake
- Toxic Metals
- Physical Activity
- Air Particles (PM2.5)
- Genetic Susceptibility

Lead is a Risk Factor for Coronary Heart Disease

Crisis /krisis/

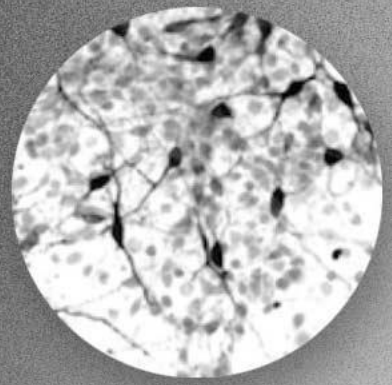
a time of intense difficulty, trouble, or danger

a time when a difficult or important decision must be made

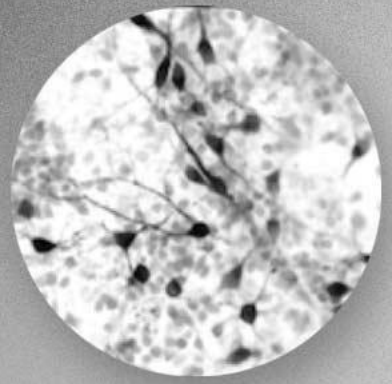
Air Lead vs Blood Lead

Richmond-Bryant J, et al. EHP 2014;122:754-760.

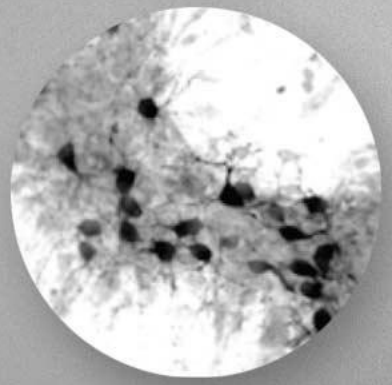
Lead Reduces Neurite Length in Dopaminergic Neurons



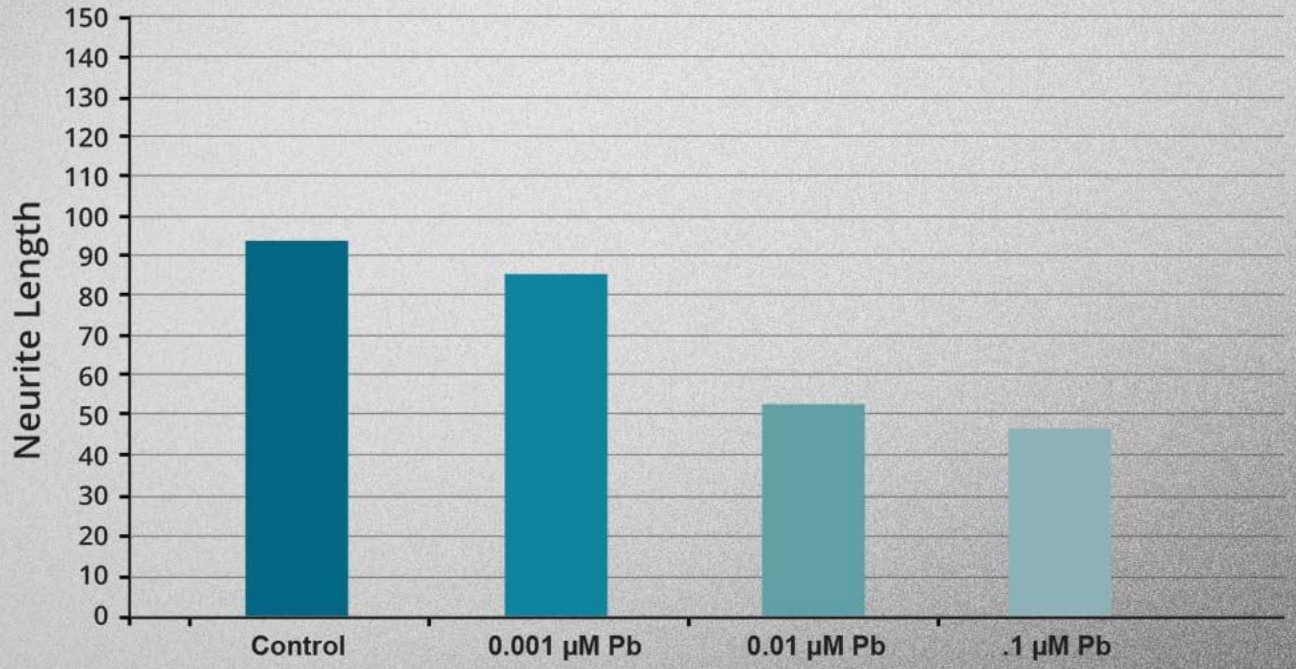
No Lead



0.001 µM
0.024 µg/dl

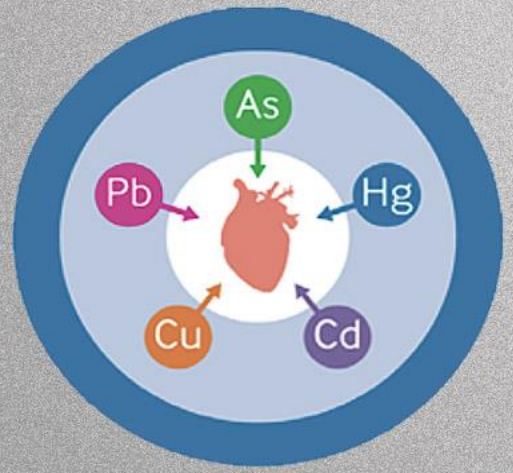


0.01 µM
0.24 µg/dl



The lowest concentration of lead acetate used (.001 µM) caused a significant decrease in neurite length that was exacerbated by incubation in higher concentrations of lead (0.01 and o.10 µM).

Toxic Metals and CVD Mortality



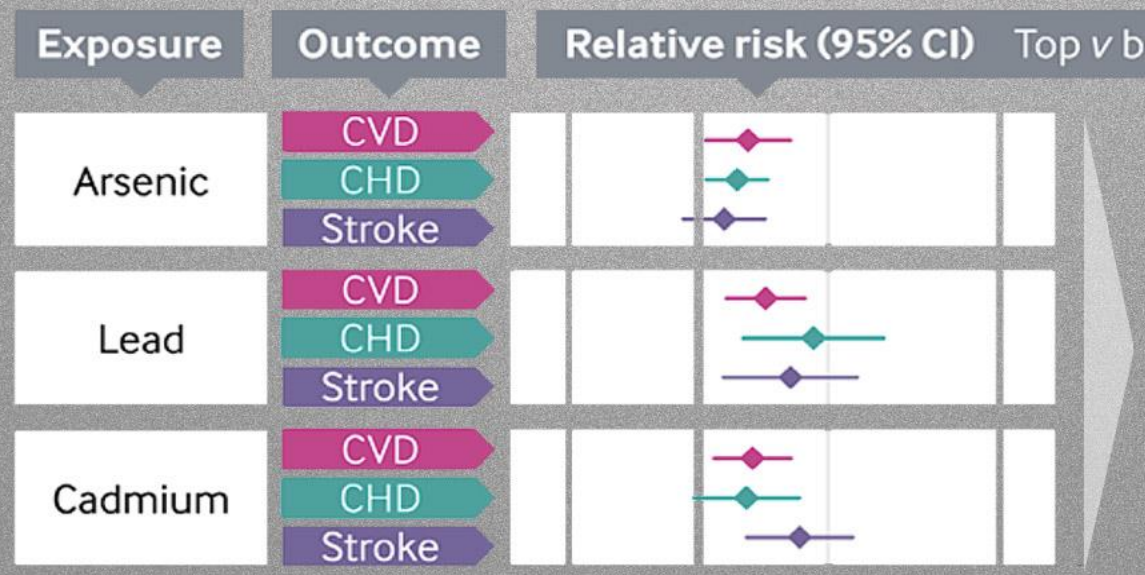
37 unique studies

26 cohort studies

11 case-control studies

348 259 non-overlapping participants

Study quality
Newcastle-Ottawa score
0–9, high scores better



Exposure is associated with an increased risk of coronary heart disease (CHD) and overall cardiovascular disease (CVD).

A linear dose-response association was also observed.