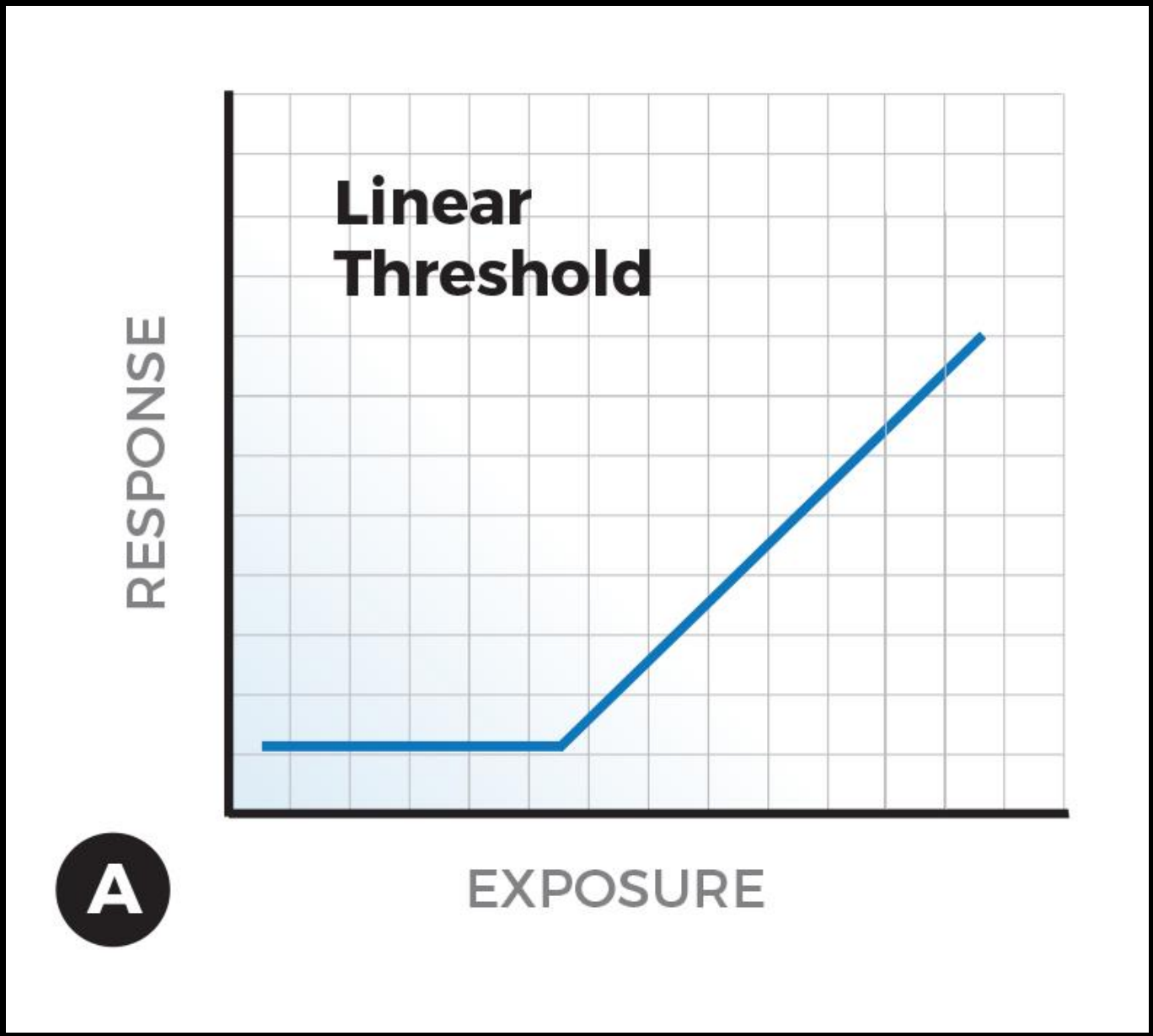
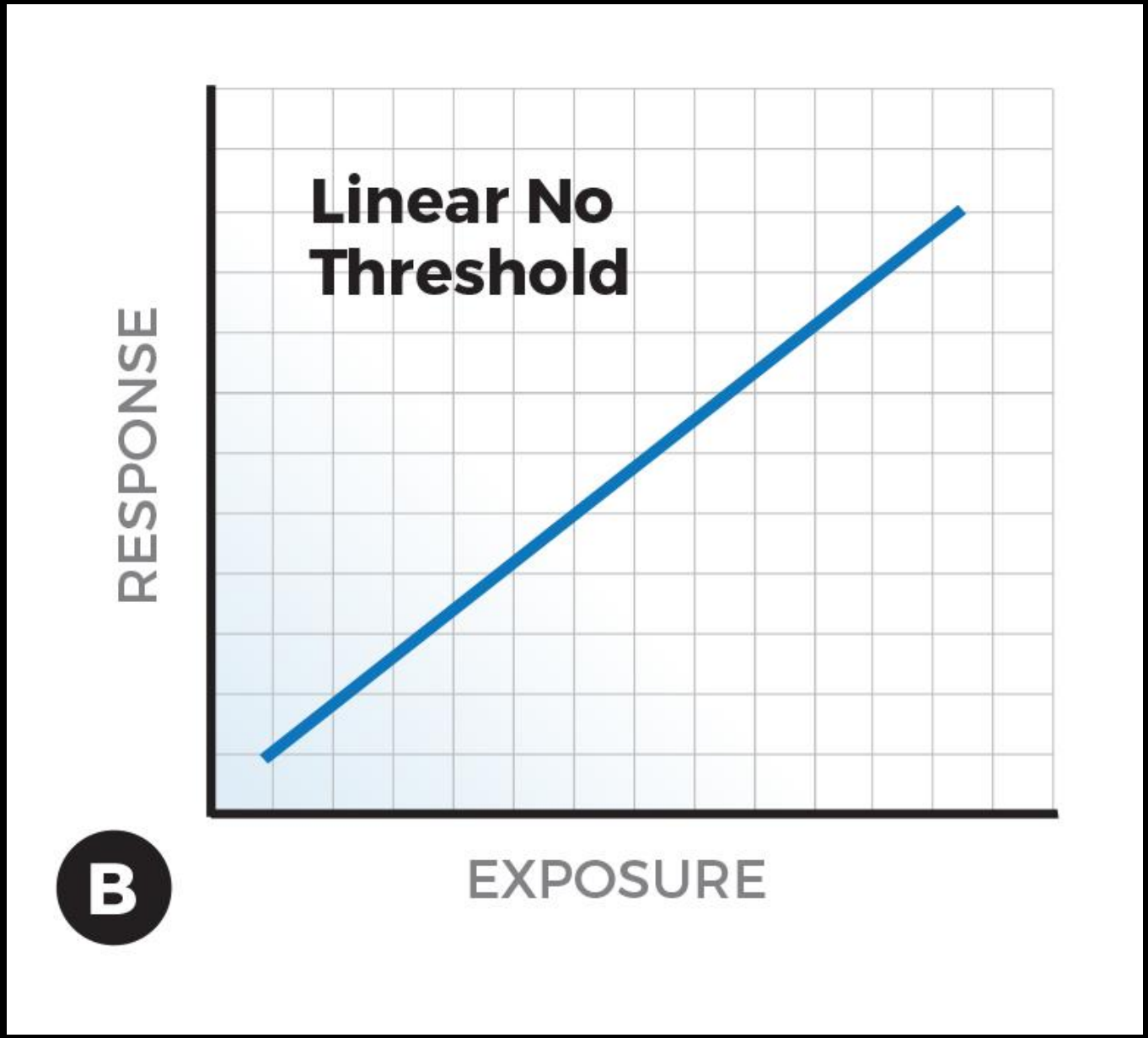
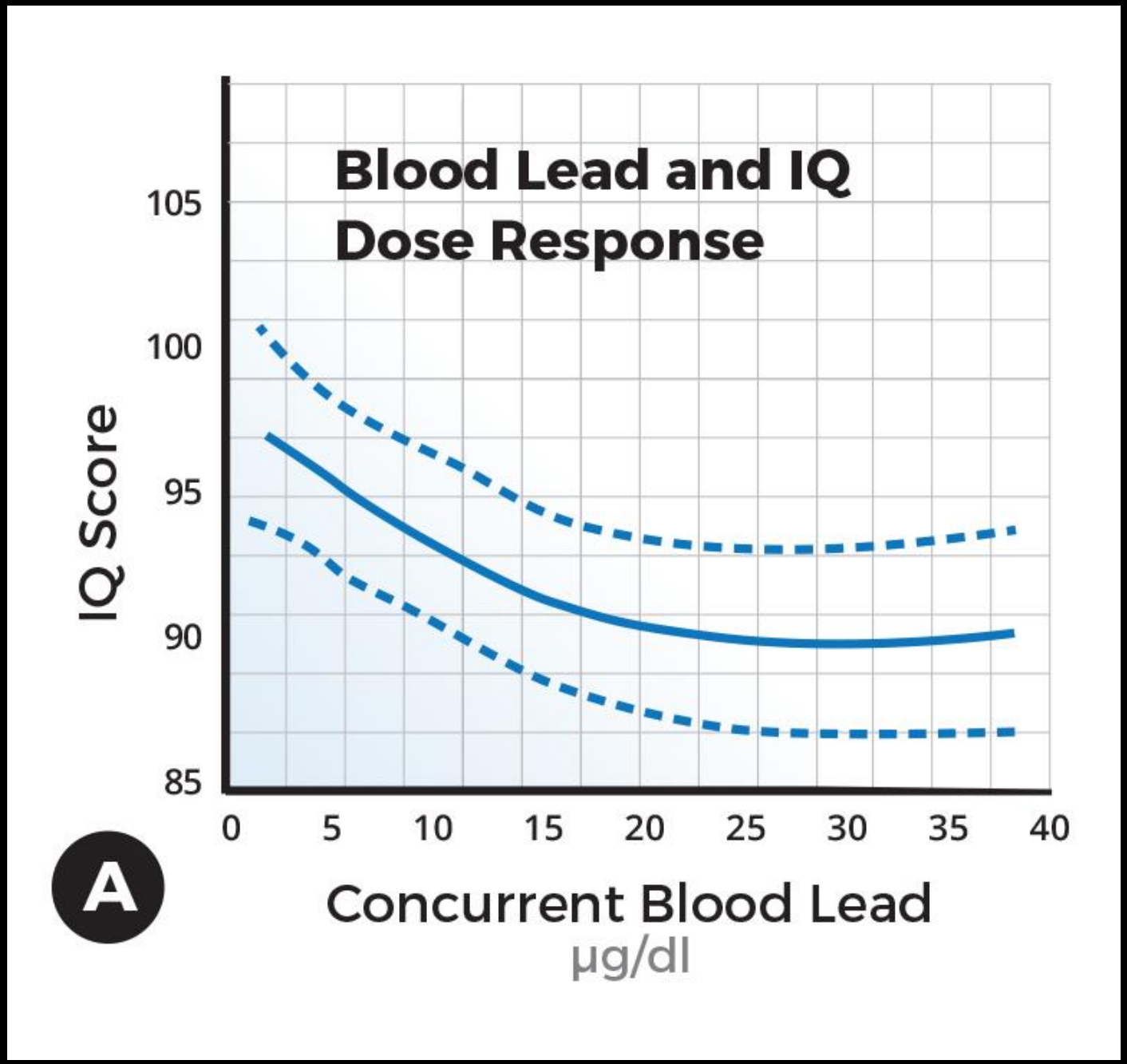
The Impact of Pollutants on Human Health: No Safe Levels?

8th International Conference on Global Health
Florida International University, Miami FL

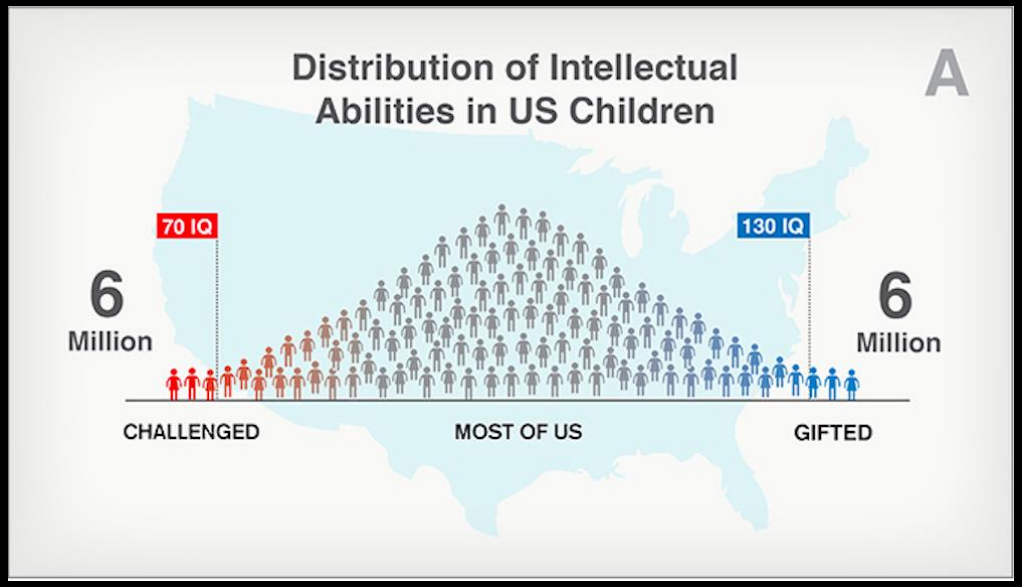

Linear
Threshold
RESPONSE
EXPOSURE
A

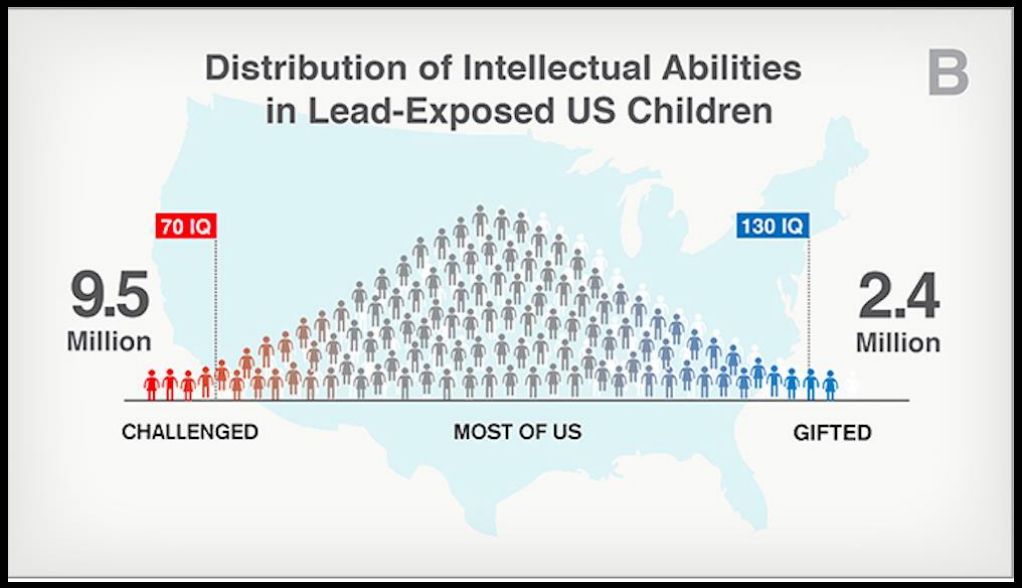

Linear No Threshold
RESPONSE
EXPOSURE
B

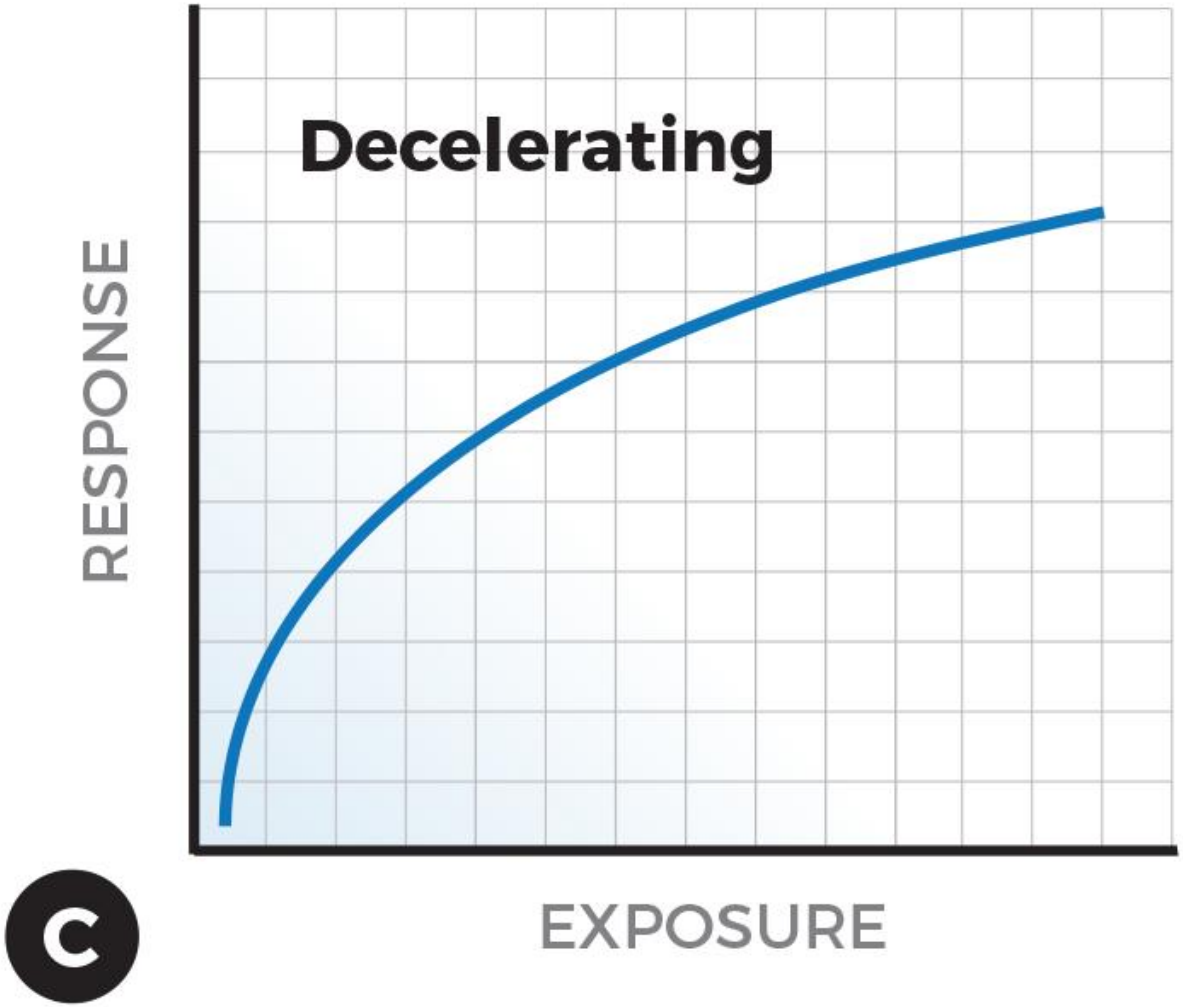


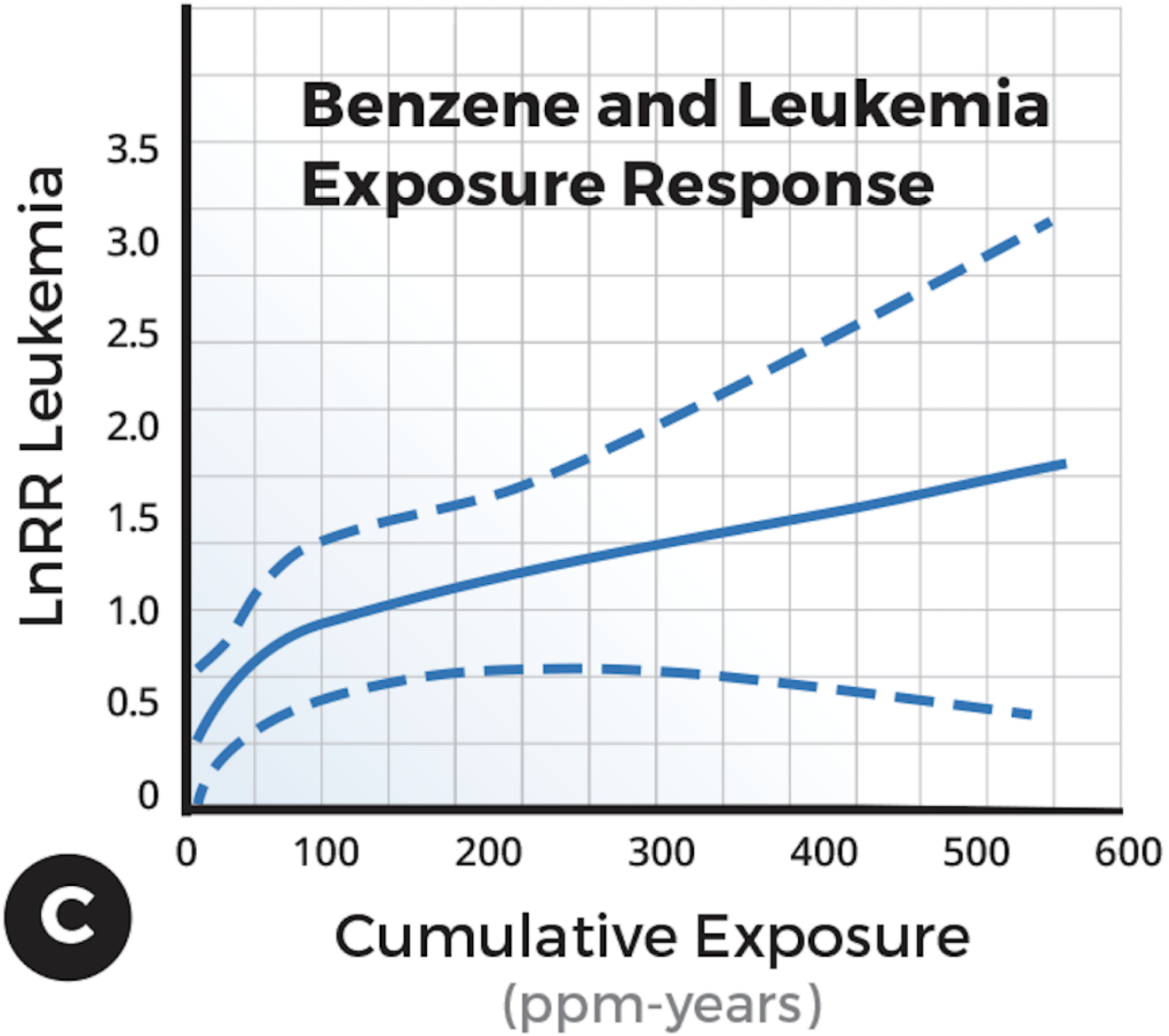
Lanphear BP, et al. Environ Health Perspect 2005;113:894-899.

Little Shifts Matter

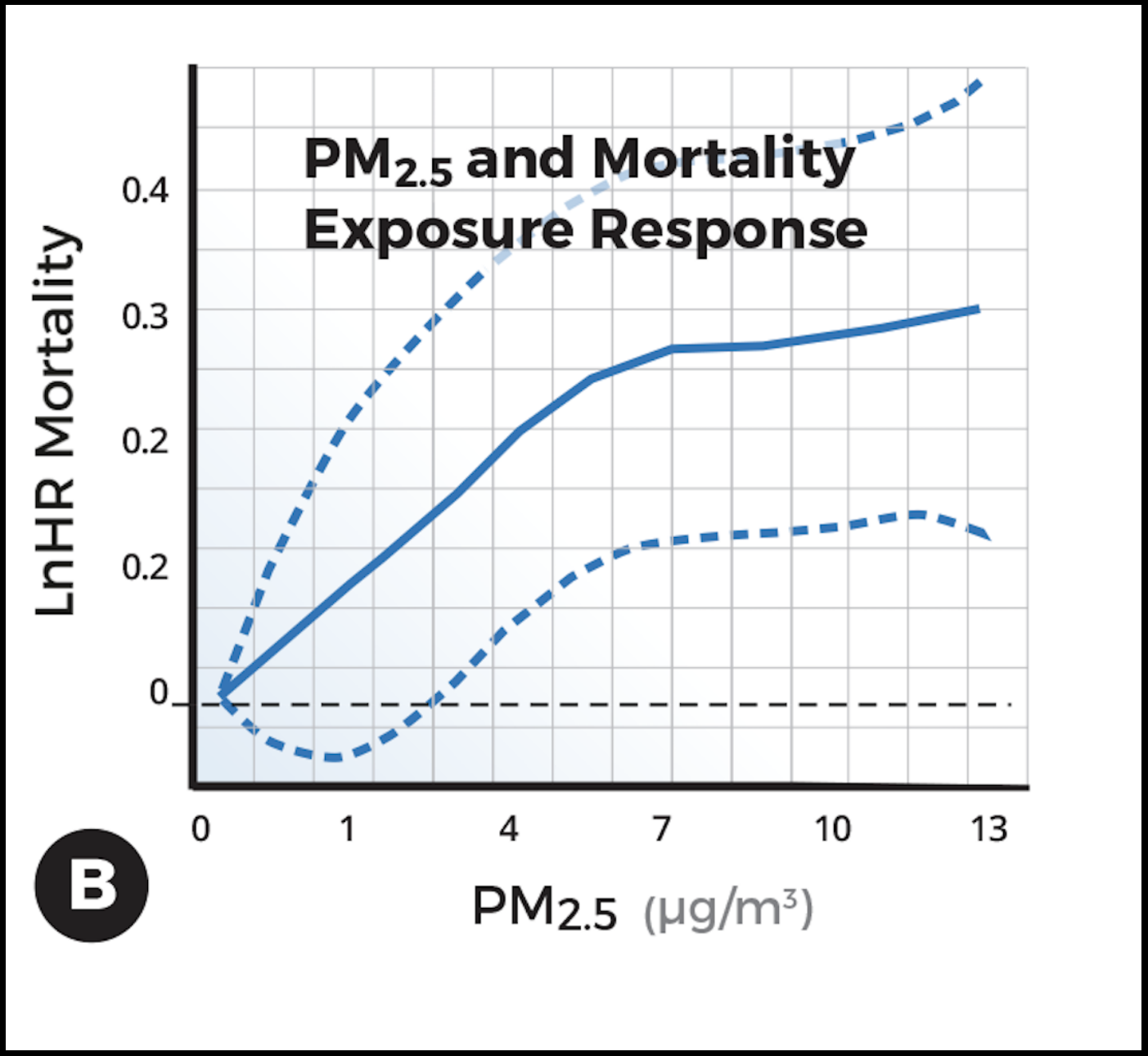





Decelerating
RESPONSE
EXPOSURE



Vlaanderen J, et al. Environ Health Perspect 2010;118:526-532.

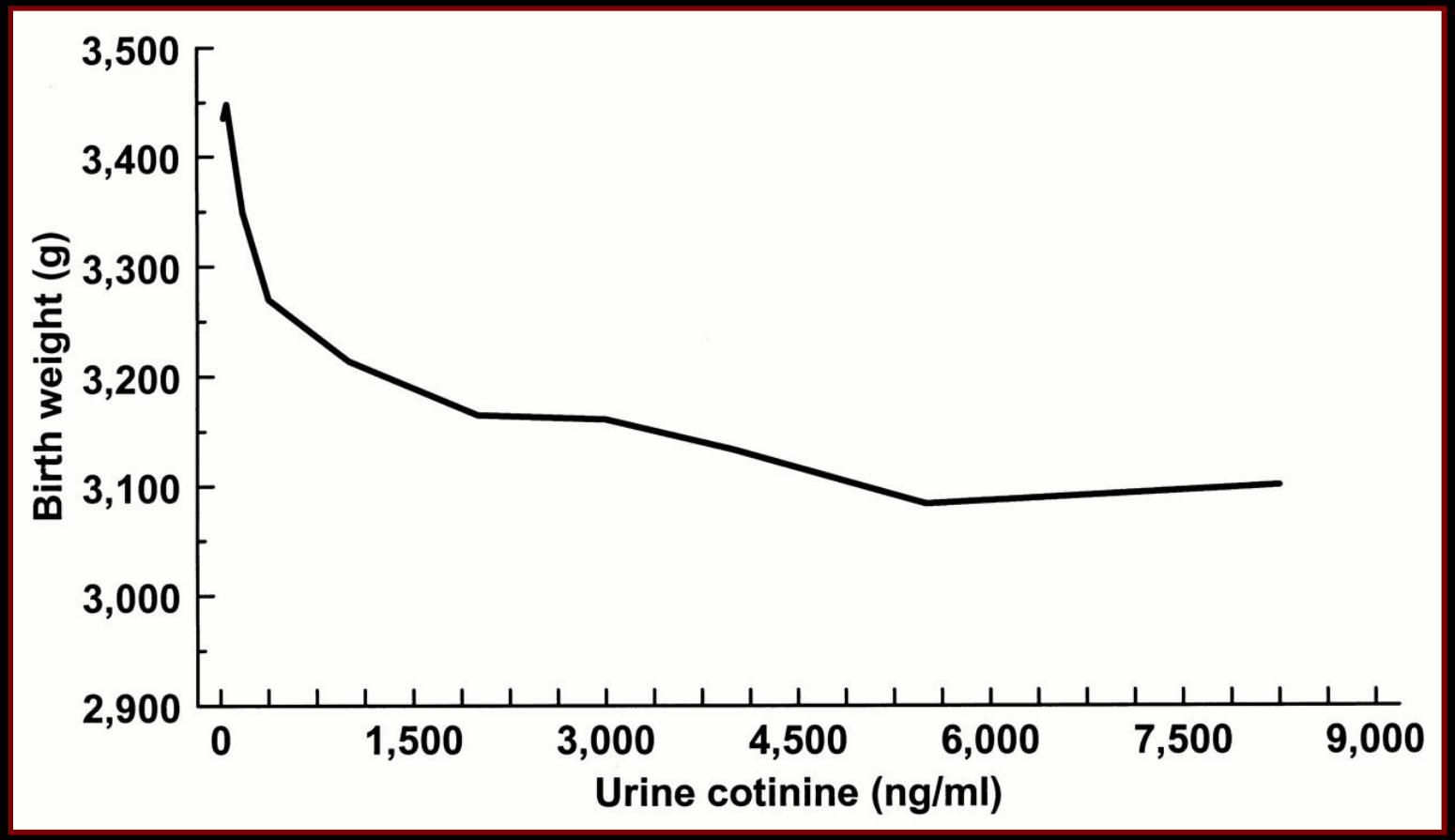


Pinault L, et al. Environ Health 2016 DOI: 10.1186/s12940-016-0111-6

THE DEADLY IMPACT OF AIRBORNE PARTICLES

No Safe Level?

Tobacco Exposure and Birthweight



England LJ, et al. AJE 2001;153:954-960.

Smoking Ban

Smoking Ban

15% Reduction PTB

Mackay DF, et al. PLoSMedicine 2012: e1001175. doi:10.1371/journal.pmed.1001175

Smoking Ban

21% Reduction AMI

Pell J, et al. NEJM 2008;359:482-491.

Lead and CVD

- Lead is an established risk factor for HTN and a risk factor for EKG abnormalities, peripheral arterial disease and CVD mortality (Navas-Acien, 2006; NTP, 2012)
- Five of six prospective studies found a significant association of lead and CVD mortality
- In laboratory studies, lead enhances atherosclerosis by inactivating NO, inhibiting endothelial repair, impairing angiogenesis and promoting thrombosis (Vaziri, 2008)
- No studies have calculated the number of premature CVD deaths in the US attributable to lead exposure using a prospective, longitudinal cohort

Results

- 14,289 adults were followed for a median of 19.5 years; 4,422 participants died; 1,801 (38%) were due to CVD, 988 (22%) were due to IHD (CHD)
- The geometric mean blood lead of the participants was 2.71 μg/dL; 3,632 (20%) had a blood lead >5 μg/dL
- Participants who had higher blood lead levels were older, less educated and more likely to be male. They were more likely to smoke cigarettes, consume larger amounts of alcohol, have less healthy diets, elevated serum cholesterol, higher rates of HTN and diabetes

Adjusted Hazard Ratios for All-Cause and CVD Mortality

Cause of Death	Hazard Ratio	95% CI
All-Cause Mortality	1.43	1.21-1.68
CVD Mortality	1.70	1.29-2.24
IHD Mortality	2.05	1.49-2.83

Hazard ratios for continuous blood lead represent risk for a 10th-90th percentile increase in log transformed blood lead. Adjusted for age (continuous and age-squared); sex; household income (< or > $20,000 per annum); race and ethnicity (White, Black, Mexican American); body mass index: normal (<25 kg/m^2), overweight (25-29.9 kg/m^2) or obese ($\geq$30 kg/m^2); smoking status (current and former); hypertension; urinary cadmium (tertiles); alcohol consumption (none, 1-4, 5-29 or >30 drinks per month); physical activity in previous month (never, 1-14 time, > 15 times); Healthy Eating Index (tertiles); serum cholesterol (continuous); glycated hemoglobin (continuous).

Adjusted Hazard Ratios for All-Cause and CVD Mortality at BPb < 5 μg/dL

Cause of Death	Hazard Ratio	95% CI
All-Cause Mortality	1.38	1.15-1.66
CVD Mortality	1.95	1.46-2.60
IHD Mortality	2.57	1.56-4.52

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Population Attributable Fraction and Avoidable Deaths from Lead Exposure

Cause of Death	Attributable Fraction	Avoidable Deaths
All-Cause Mortality	18.0% (10.9-26.1)	412,000
CVD Mortality	28.7% (15.5-39.5)	256,000
IHD Mortality	37.4% (23.4-48.6)	185,000

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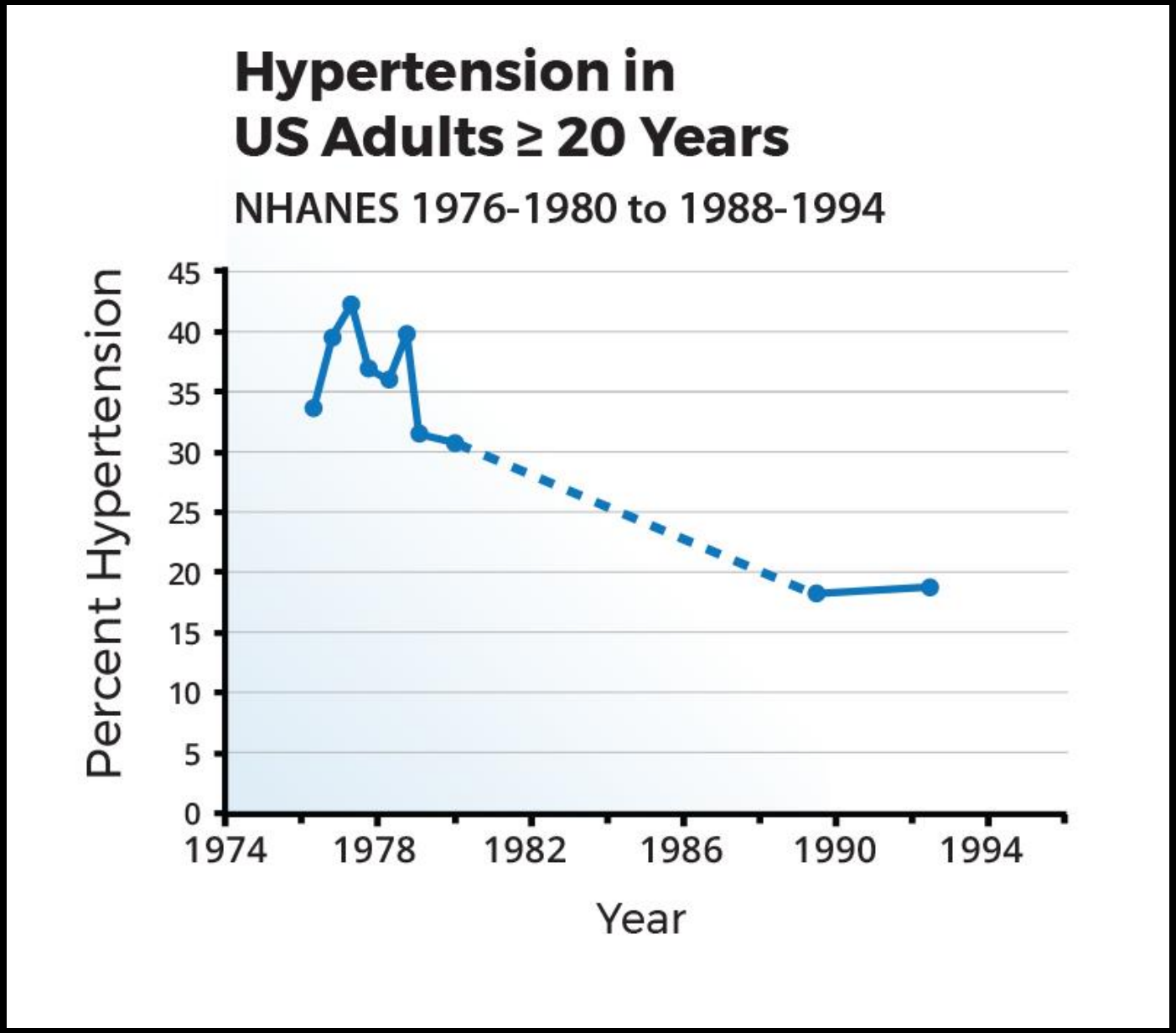
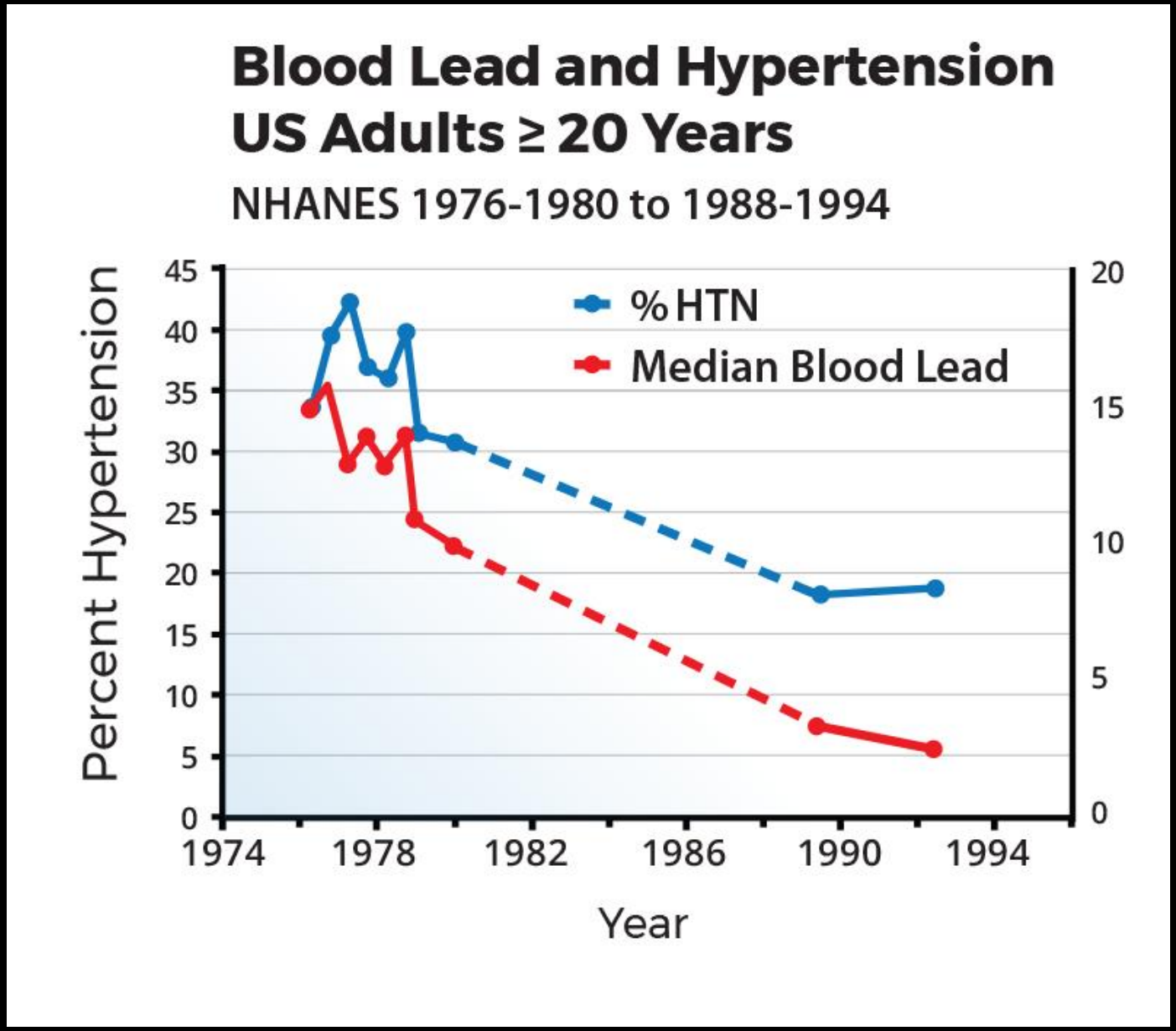


Lanphear B, et al. (unpublished data)



Lanphear B, et al. (unpublished data)

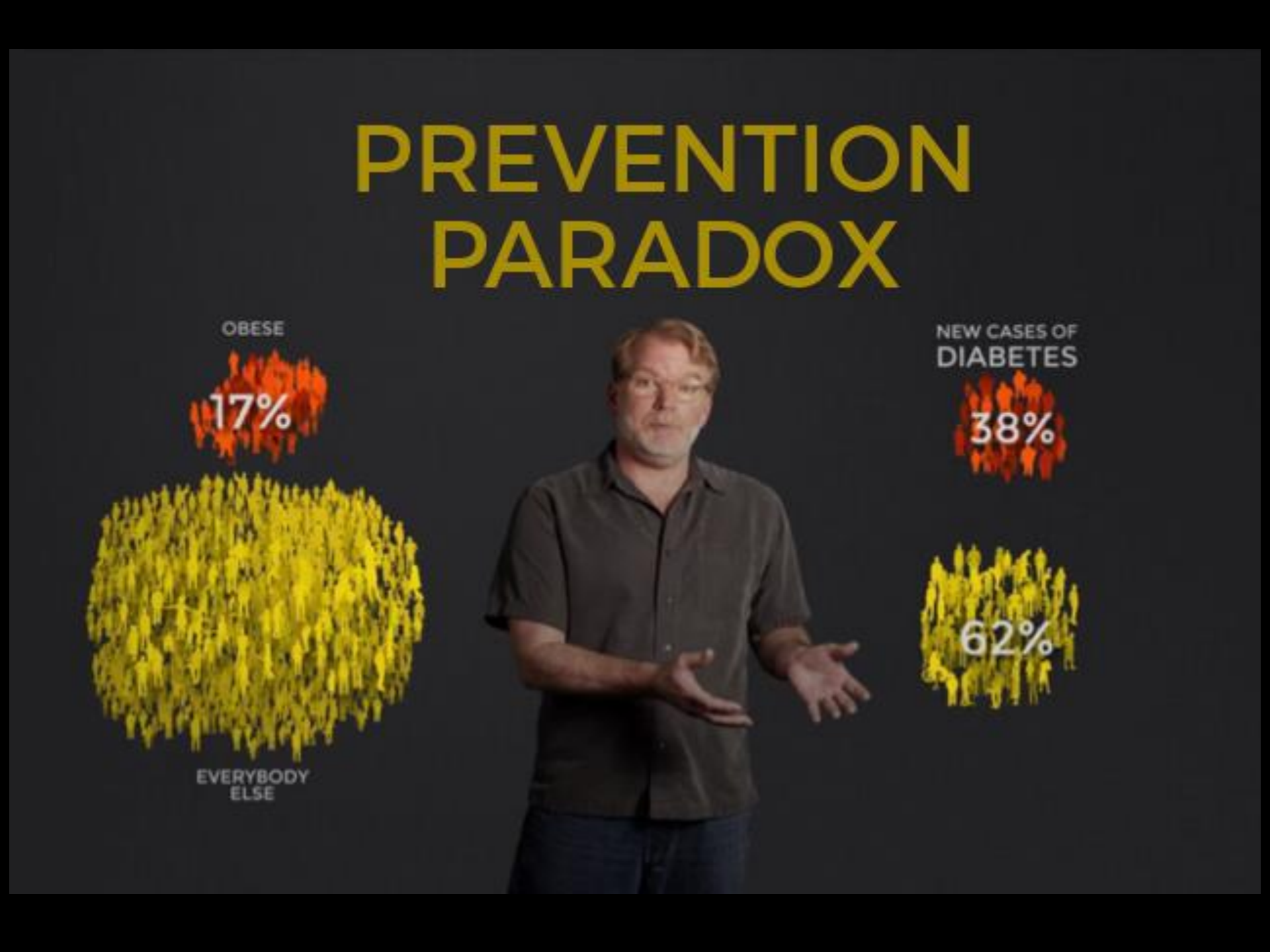
Potential Reasons for Decelerating Exposure-Response Relationship

- Saturation of effect (e.g., enzyme systems or platelet aggregation)
- Depletion of susceptible hosts
- Exposure misclassification
- Confounding or modification

Modified from Steenland, et al. Scand J Work Environ Health 2003;29:317-324.

Lancet Commission on Pollution + Health October, 2017

PREVENTION PARADOX

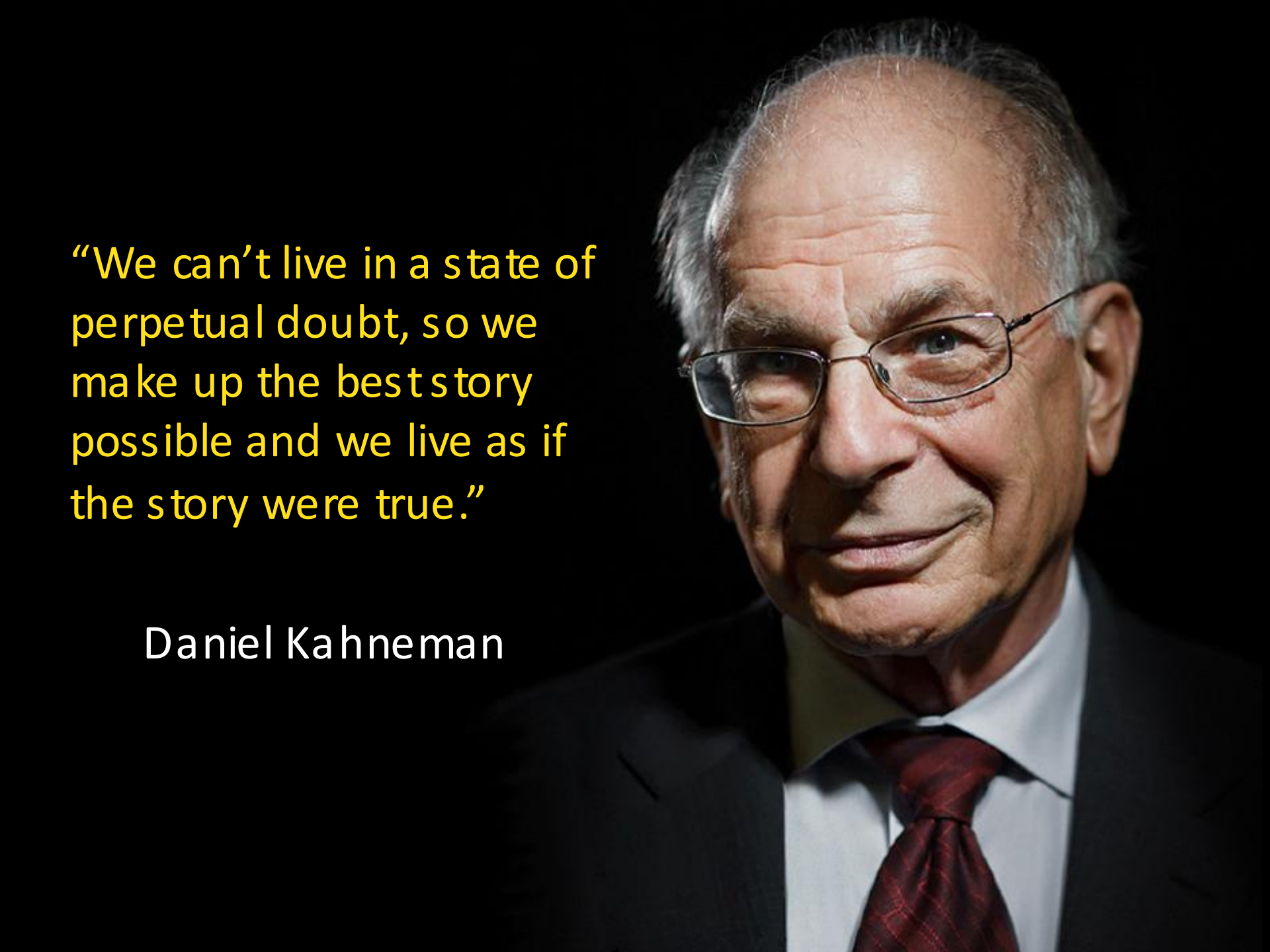


The Prevention Paradox

The majority of disease and disability occurs in those who are at low to moderate risk

Conclusions

- For a given exposure, toxic chemicals and pollutants may be associated with greater effects or steeper increases in risk at lower levels
- Past studies often included "exposed" subjects in reference population, underestimating effect size
- Steeper effects at low levels pose regulatory challenges *and* public health opportunities
- Reinforces the importance of population strategies that focus on low-to-moderate risk groups


“We can’t live in a state of perpetual doubt, so we make up the best story possible and we live as if the story were true.”
Daniel Kahneman