Synthesizing the Science of Cumulative Impacts: Implications for Policy

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Assessing and Addressing Cumulative Impacts in California Communities
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Outline

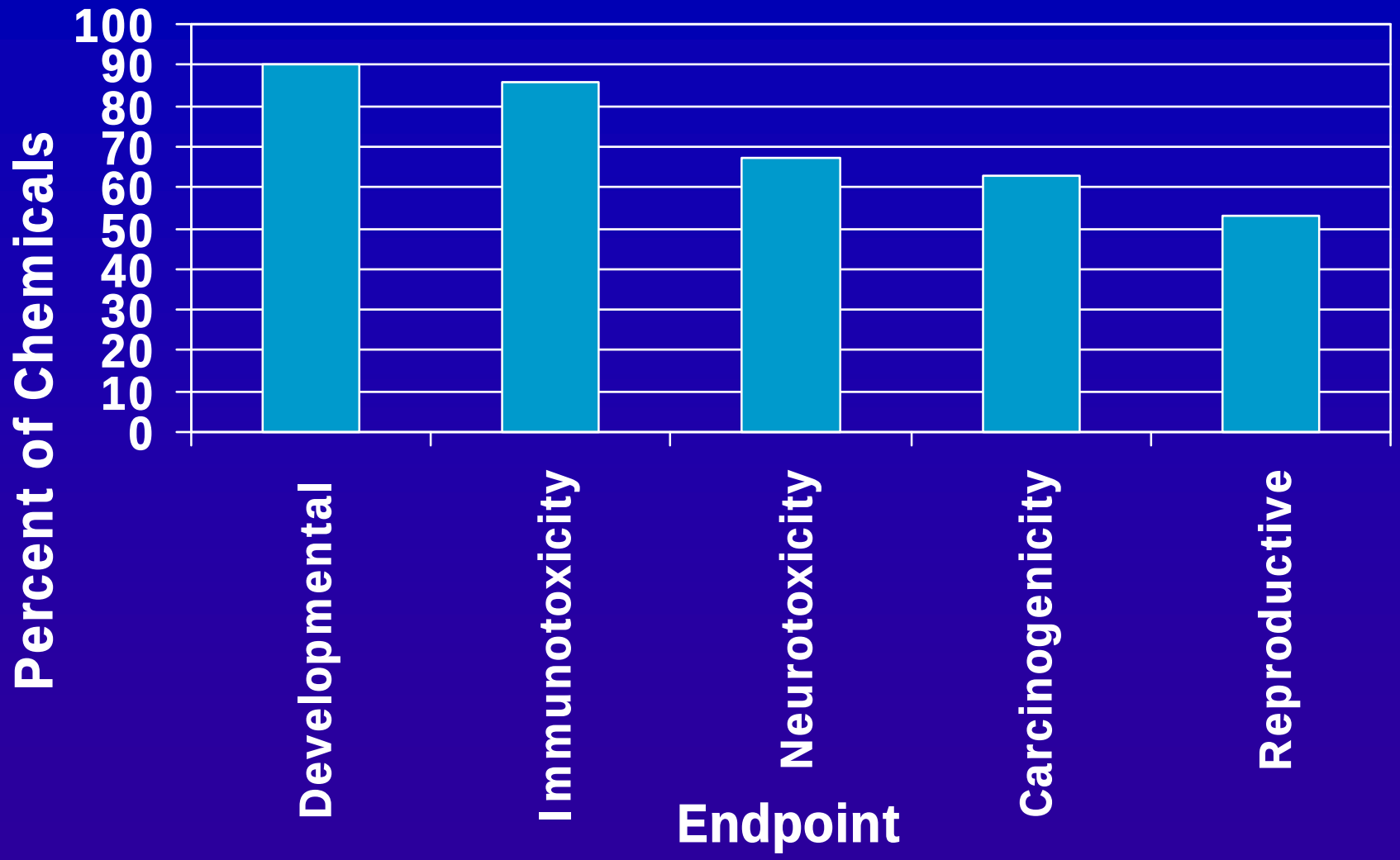
- Environmental Justice and Cumulative Impacts
- Scientific Assertions
- Future research
- Implications for action

EJ advocacy improves regulatory science : Cumulative Impact

Encouraging researchers and regulators to address:

- ***Multiple*** hazards where communities live, work, and play
- ***Vulnerability*** due to social stressors
  - poverty, malnutrition, chronic health problems
- ***Toxic Ignorance*** -- data gaps
  - "no data, no problem???"

Toxic Ignorance: Percent of High-Production-Volume Chemicals Lacking Toxicity Studies by Endpoint



EDF 2000

Cumulative Impacts in Richmond, CA

Exposure data are sparse on acute events

Chevron Refinery Fire – January 2007

Photos: KCBS News

Cumulative Impacts

- **Multiple exposures**

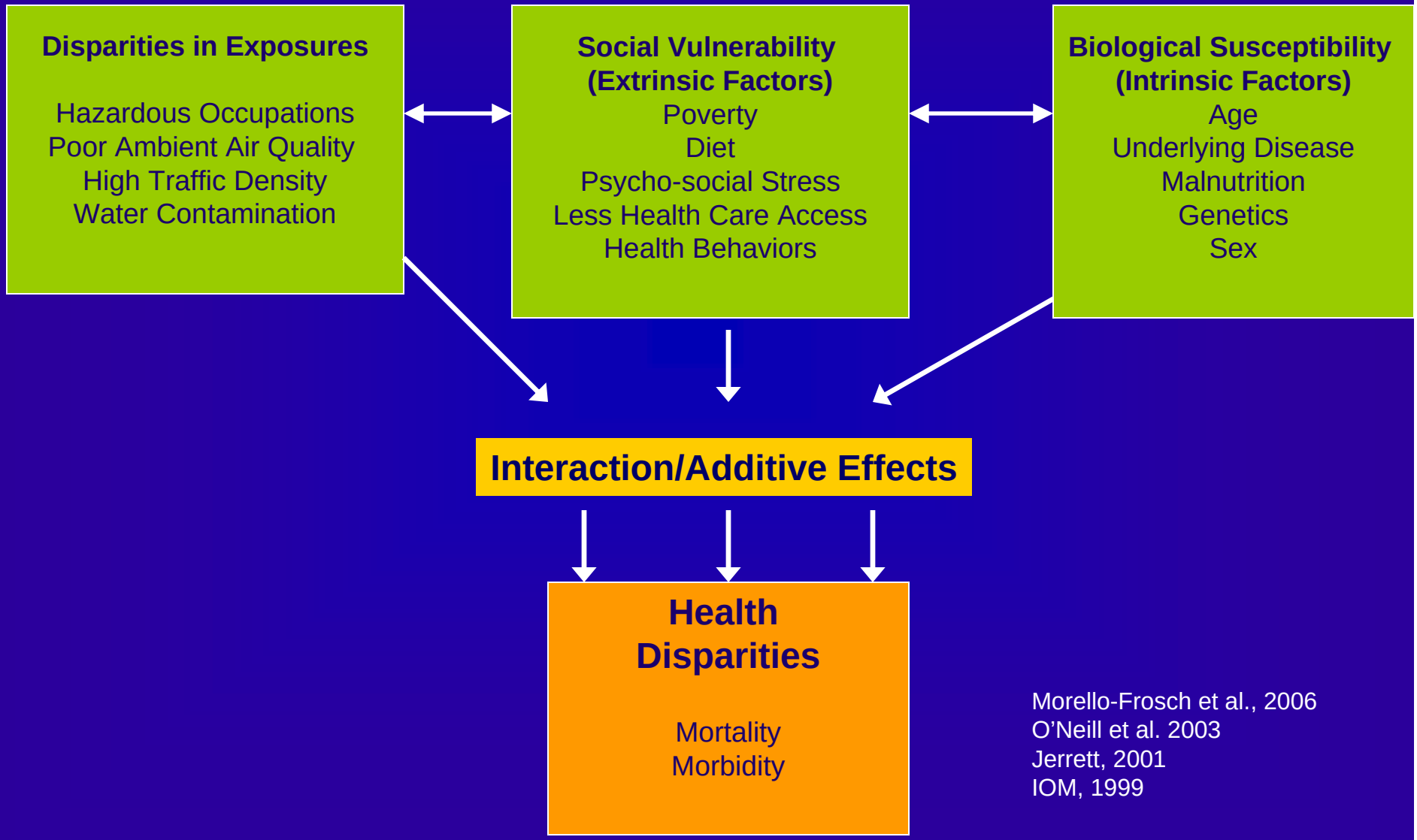
  in a geographic area from combined emissions and discharges, from all sources, whether single or multi-media, routinely, accidentally, or otherwise released

- **Susceptibility**

  to take into account sensitive populations and socio-economic factors

Adapted from CEJAC working definition of CI

Social Inequality and Triple Jeopardy



Morello-Frosch et al., 2006
O'Neill et al. 2003
Jerrett, 2001
IOM, 1999

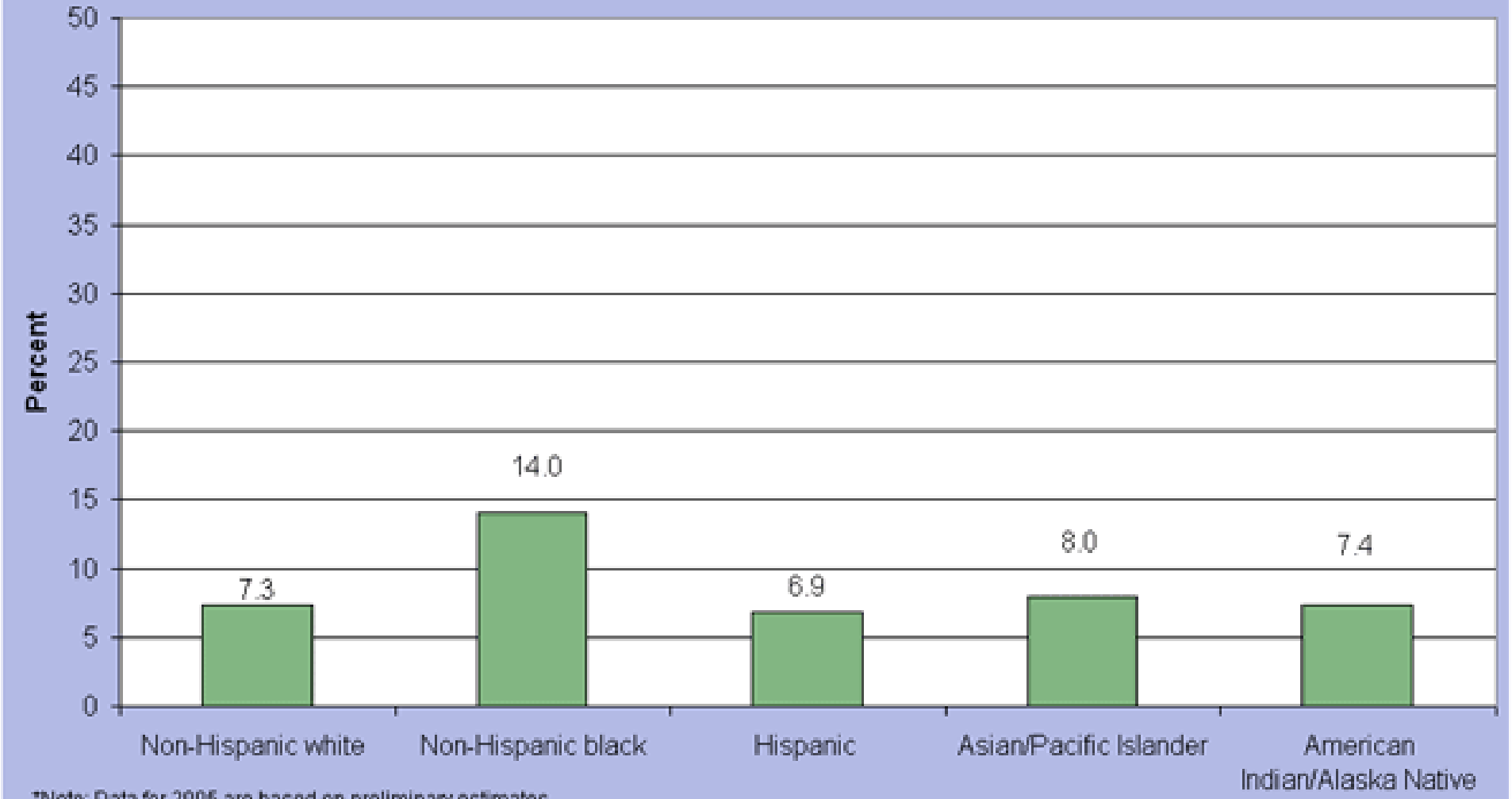
What does the science tell us (so far)?

Assertion 1

- Health disparities are significant and exist for diseases that are both socially and environmentally mediated

Figure 2

Percentage of Infants Born at a Low Birthweight, by Race and Hispanic Origin, 2005*

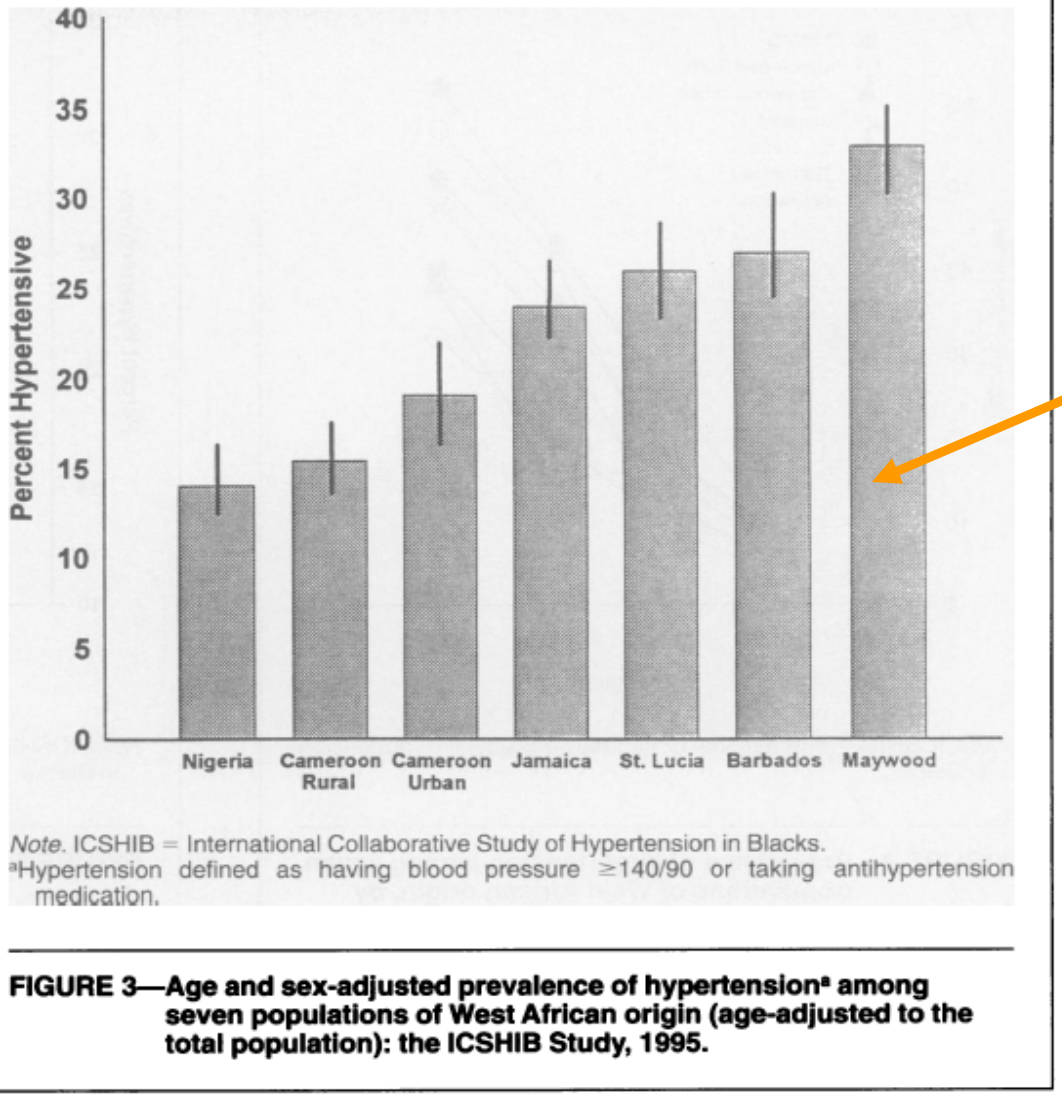


*Note: Data for 2005 are based on preliminary estimates.

Source: Hamilton BE, Martin JA, and Ventura SJ. (2006). "Births: Preliminary data for 2005." *National vital statistics reports*; vol 55. Hyattsville, MD: National Center for Health Statistics. Table 4. http://www.cdc.gov/nchs/products/pubs/pubd/hestats/prelimbirths05/prelimbirths05.htm#ref02.

Child TRENDS DATABANK

High blood pressure among blacks of West African origin—US and other locations



Note. ICSHIB = International Collaborative Study of Hypertension in Blacks.
[a]Hypertension defined as having blood pressure ≥140/90 or taking antihypertension medication.

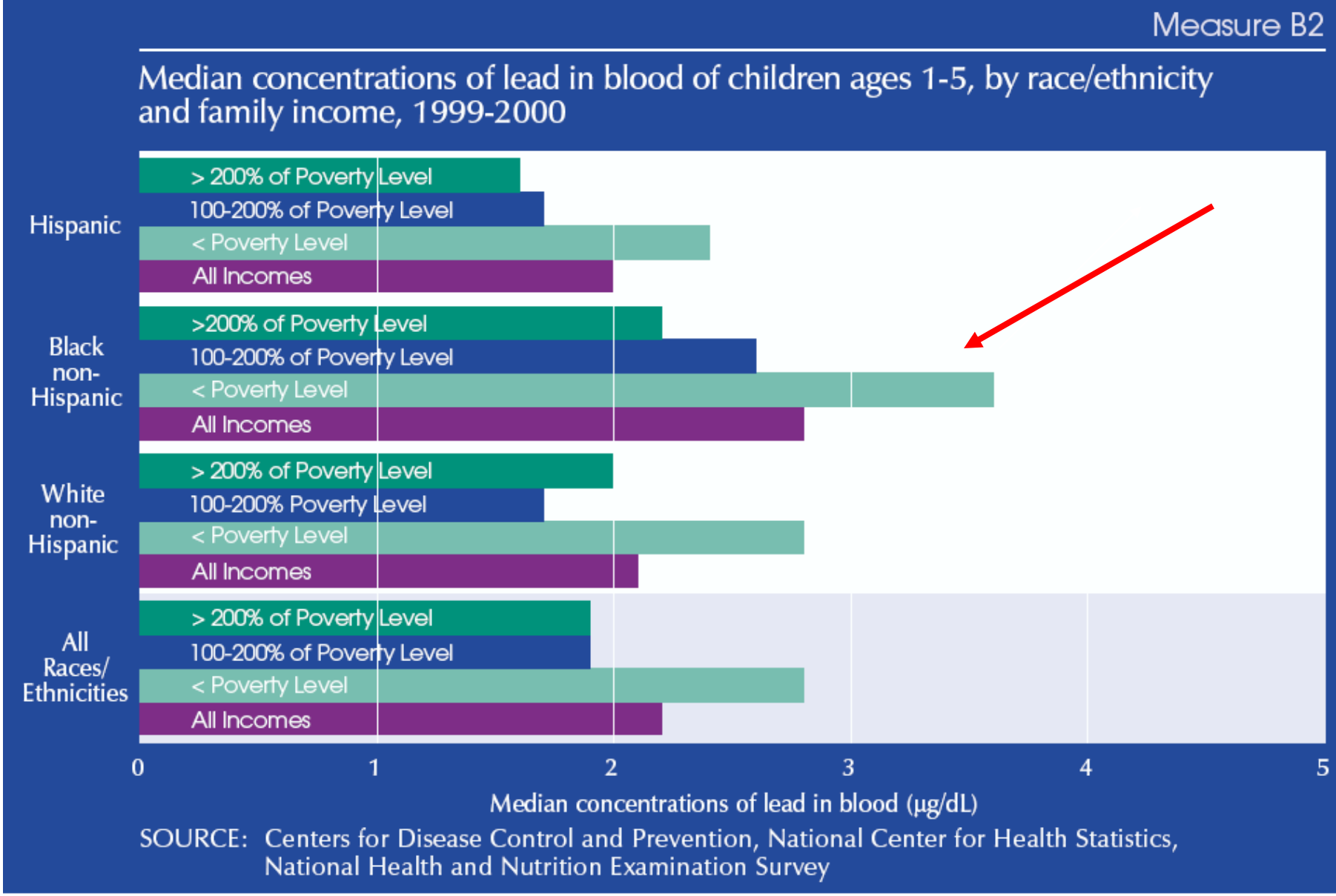
FIGURE 3—Age and sex-adjusted prevalence of hypertension[a] among seven populations of West African origin (age-adjusted to the total population): the ICSHIB Study, 1995.

Cooper et al. AJPH 1997

Assertion 2

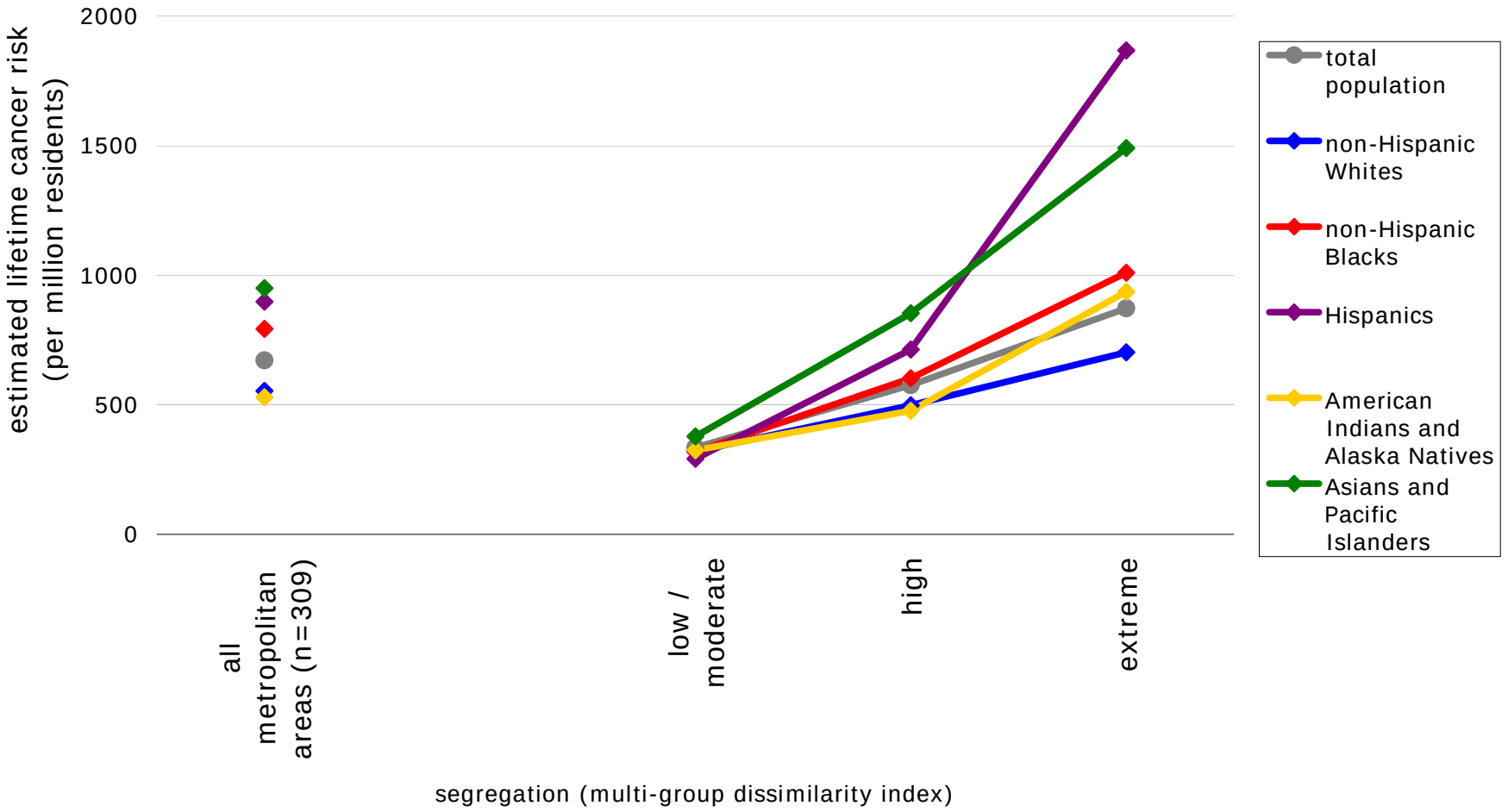
- Disparities in exposures to environmental hazards between racial and socioeconomic groups are significant and are linked to adverse health risks and outcomes

Surveillance – Lead
Who Bears the Burden?



Cumulative Impact

Estimated cancer risk associated with ambient air toxics by race/ethnicity and racial/ethnic residential segregation, continental United States metropolitan areas

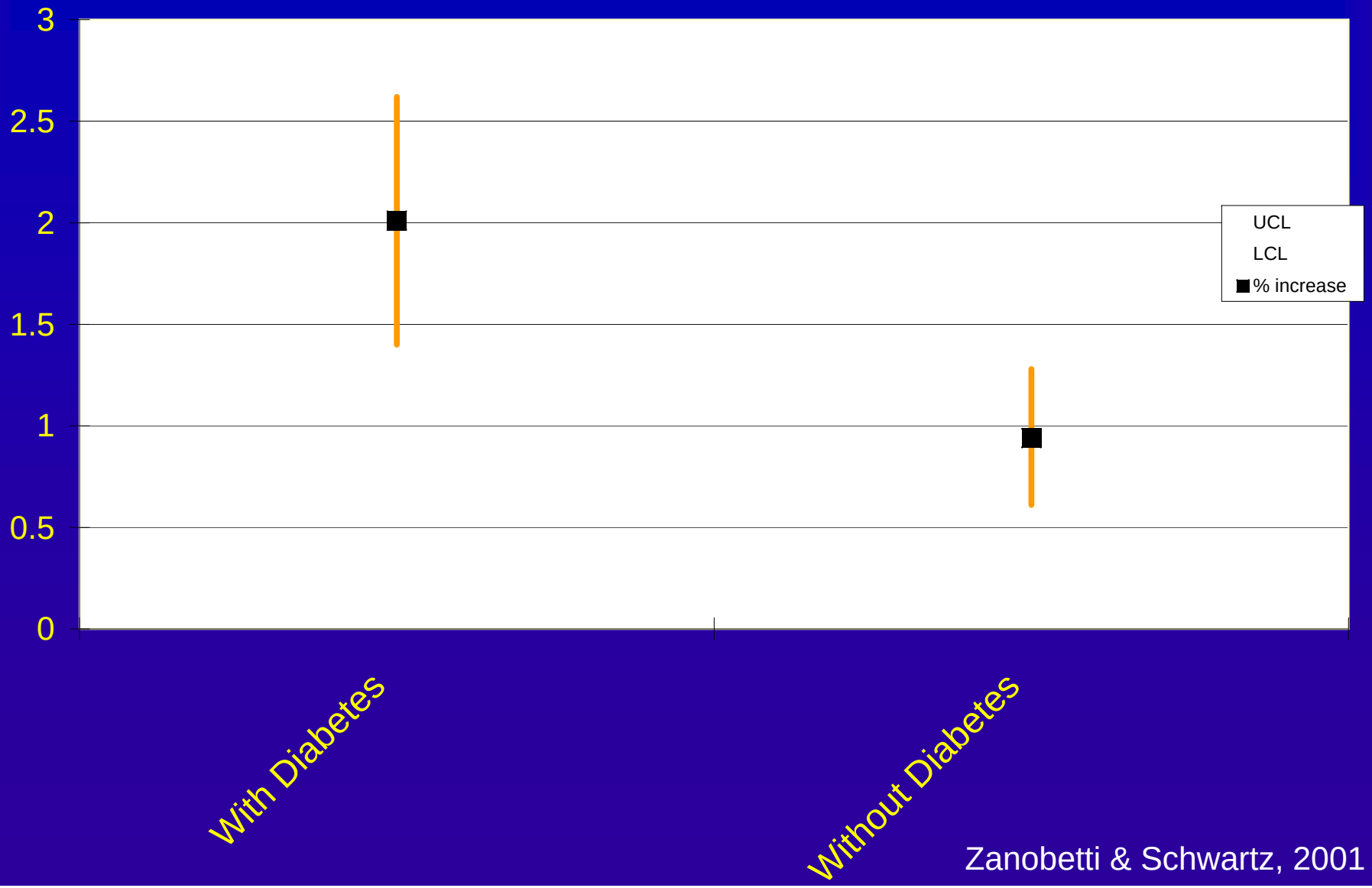


Morello-Frosch & Jesdale, EHP 2006

Assertion 3

- Intrinsic (biological and physiological) susceptibility contributes to differences in the frequency and severity of environmentally-mediated disease

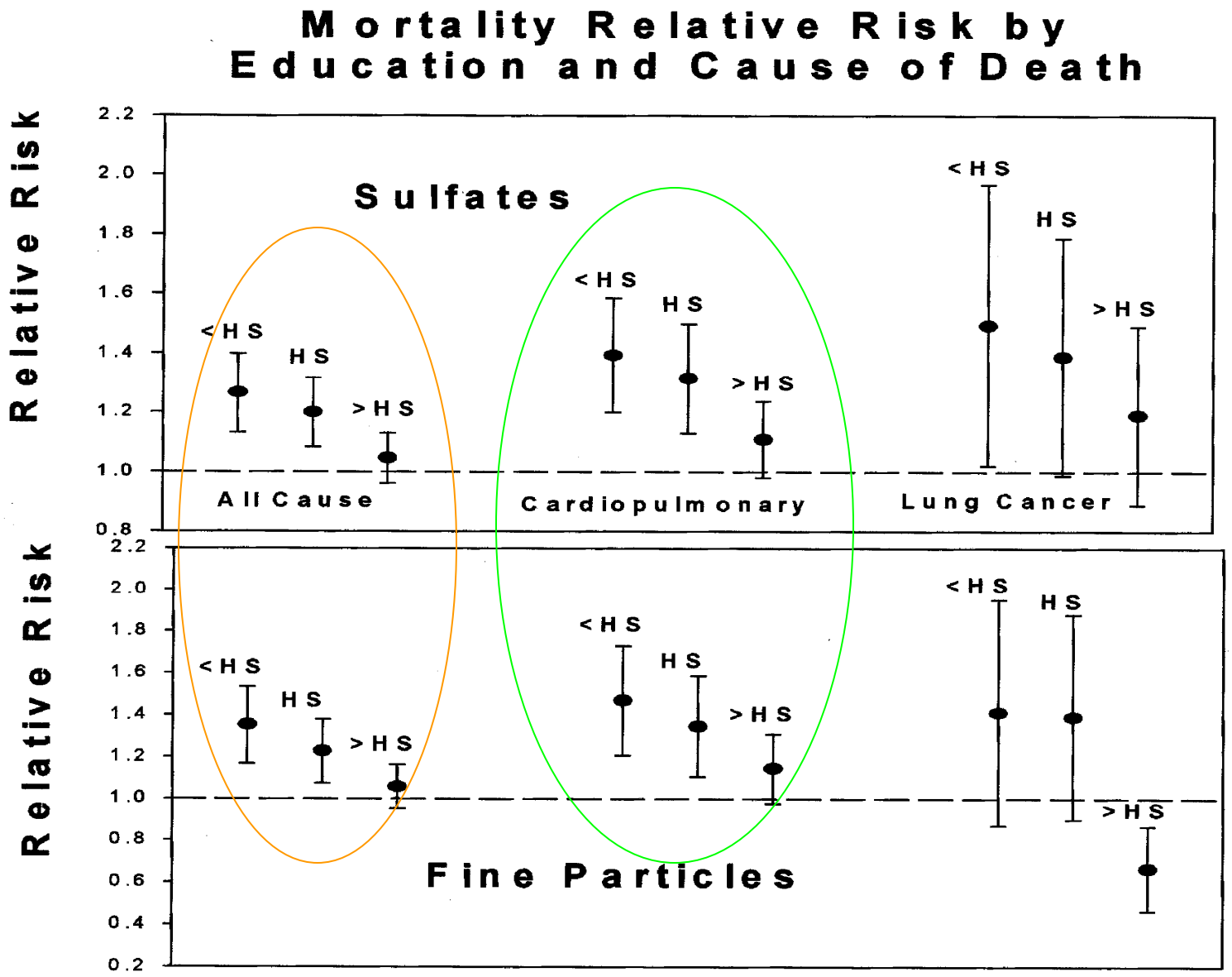
% Increase in Daily Hospital Admissions for Cardiovascular Disease Associated with PM10 (per 10 ug/m3 increase)



Zanobetti & Schwartz, 2001

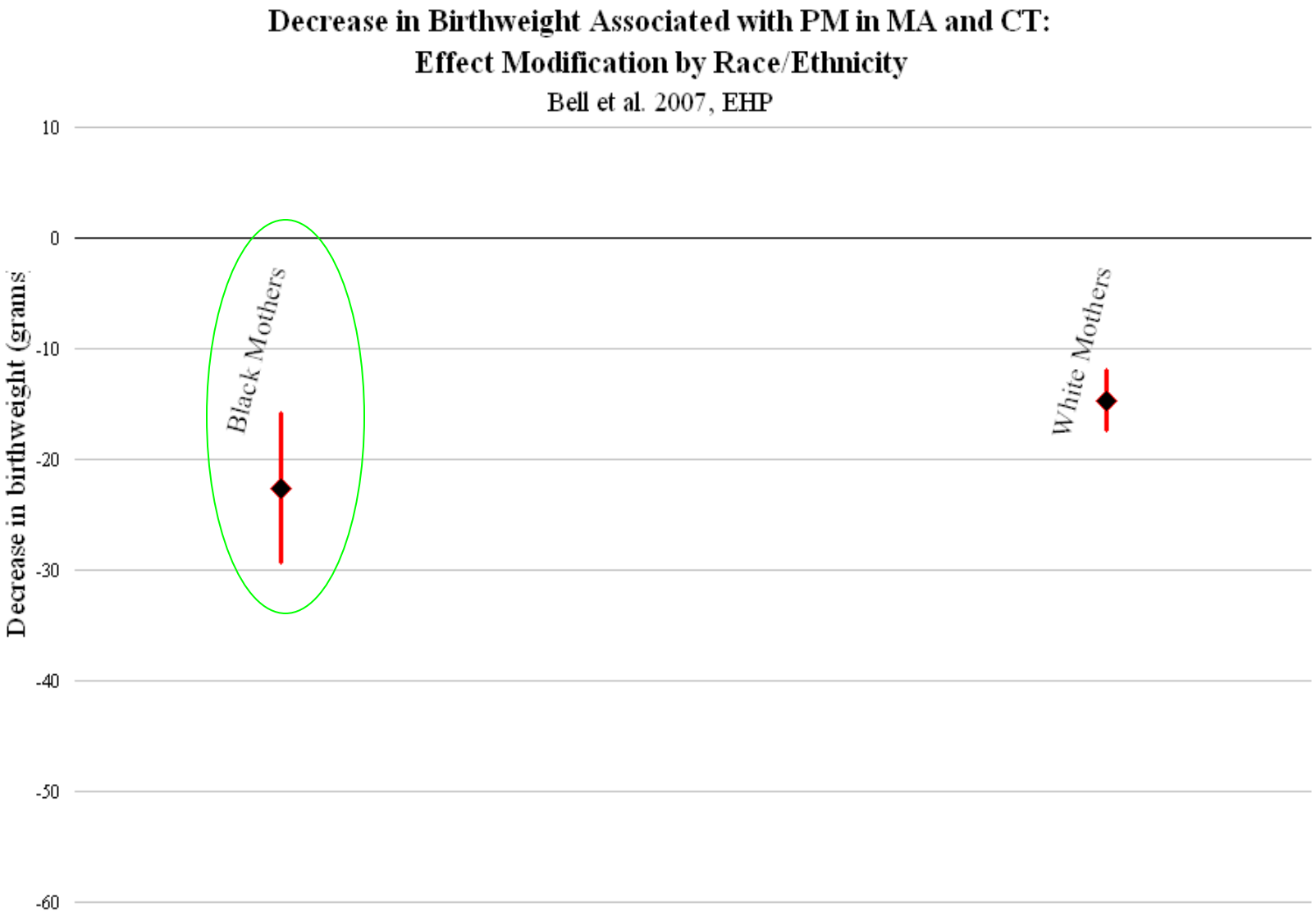
Assertion 4

- Vulnerability from social factors amplify the effect of environmental agents on health and can contribute to health disparities
  - Includes community and individual-level factors



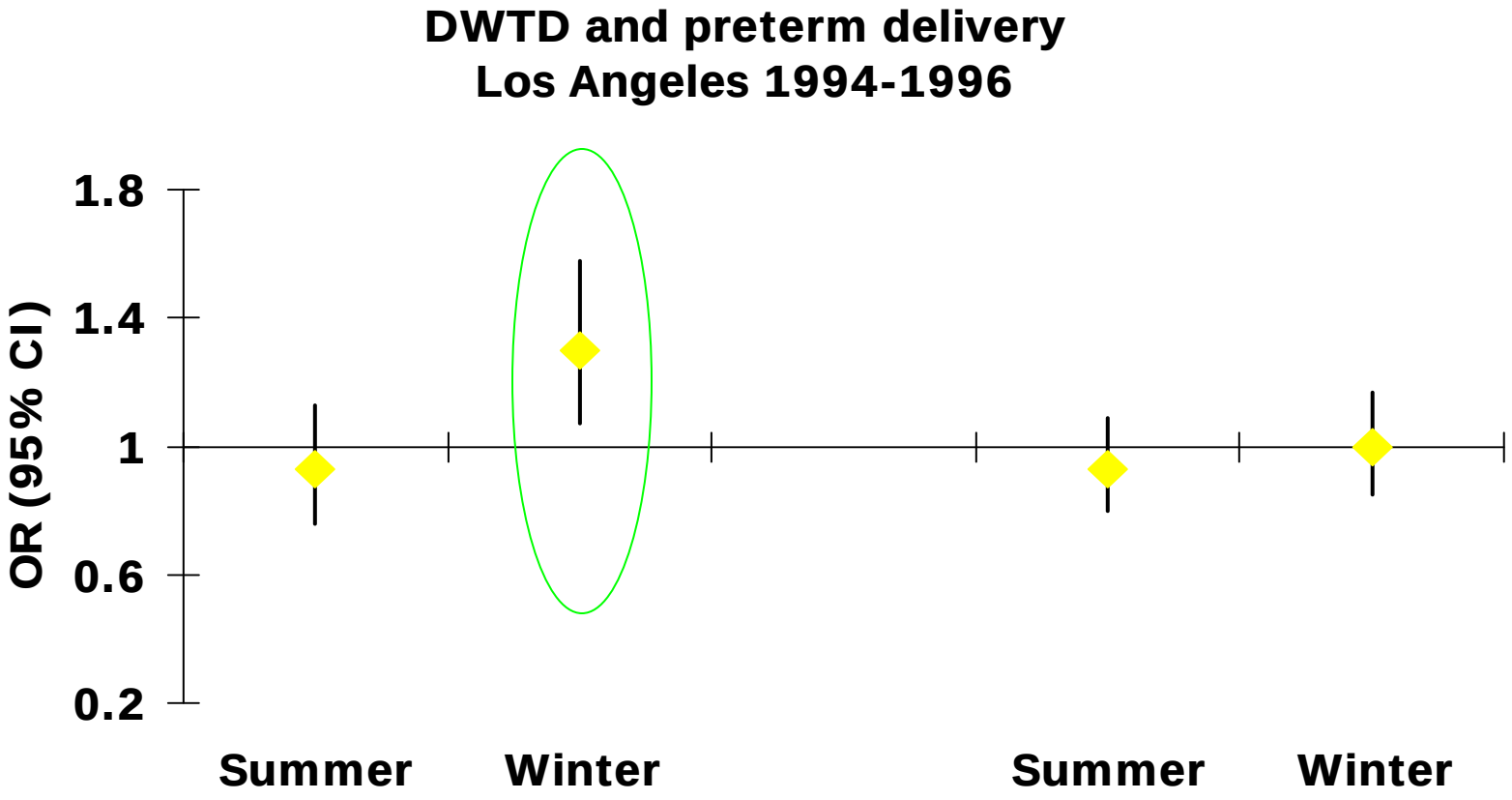
Kwreski et al. *Journal of Toxicology and Environmental Health, Part A*, 68:1093–1109, 2005

Vulnerability

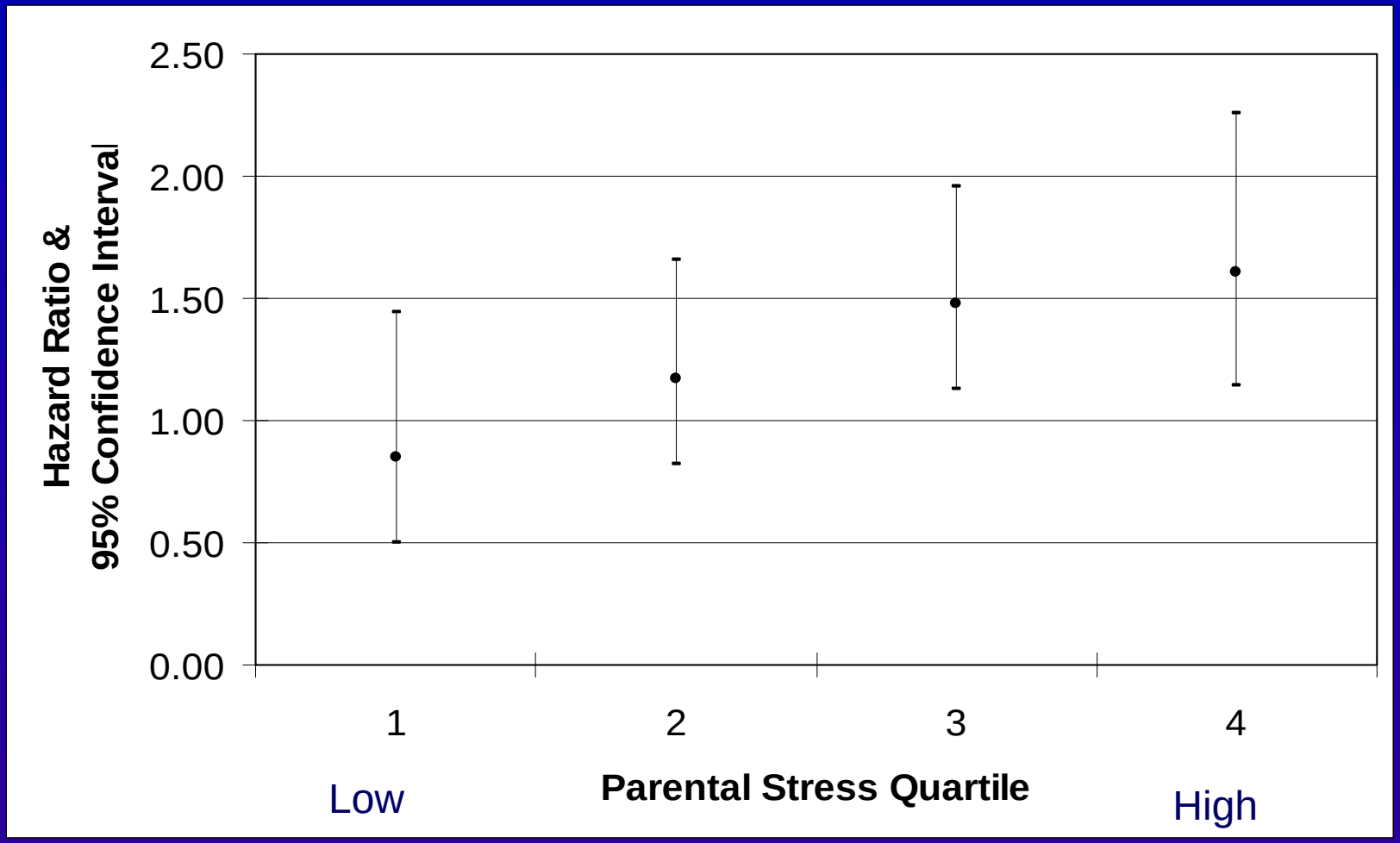


Vulnerability - Place:

Traffic Density and Risk of Preterm Delivery
is Amplified in Low Income Neighborhoods
(Ponce et al EHP 2005)



The Role of Stress: Effect of NOx on Incident Asthma

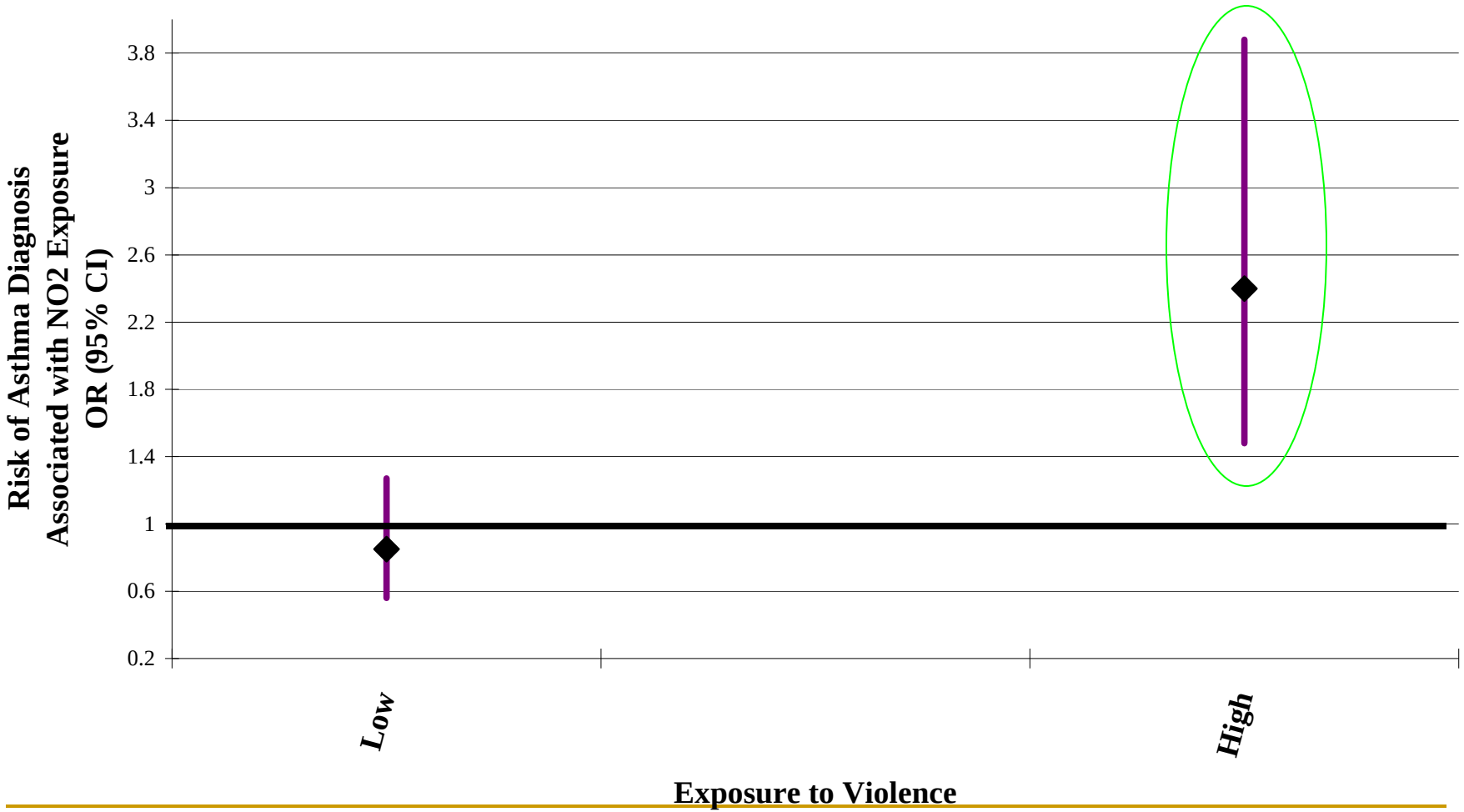


Shankardassa et al. PNAS, 2009

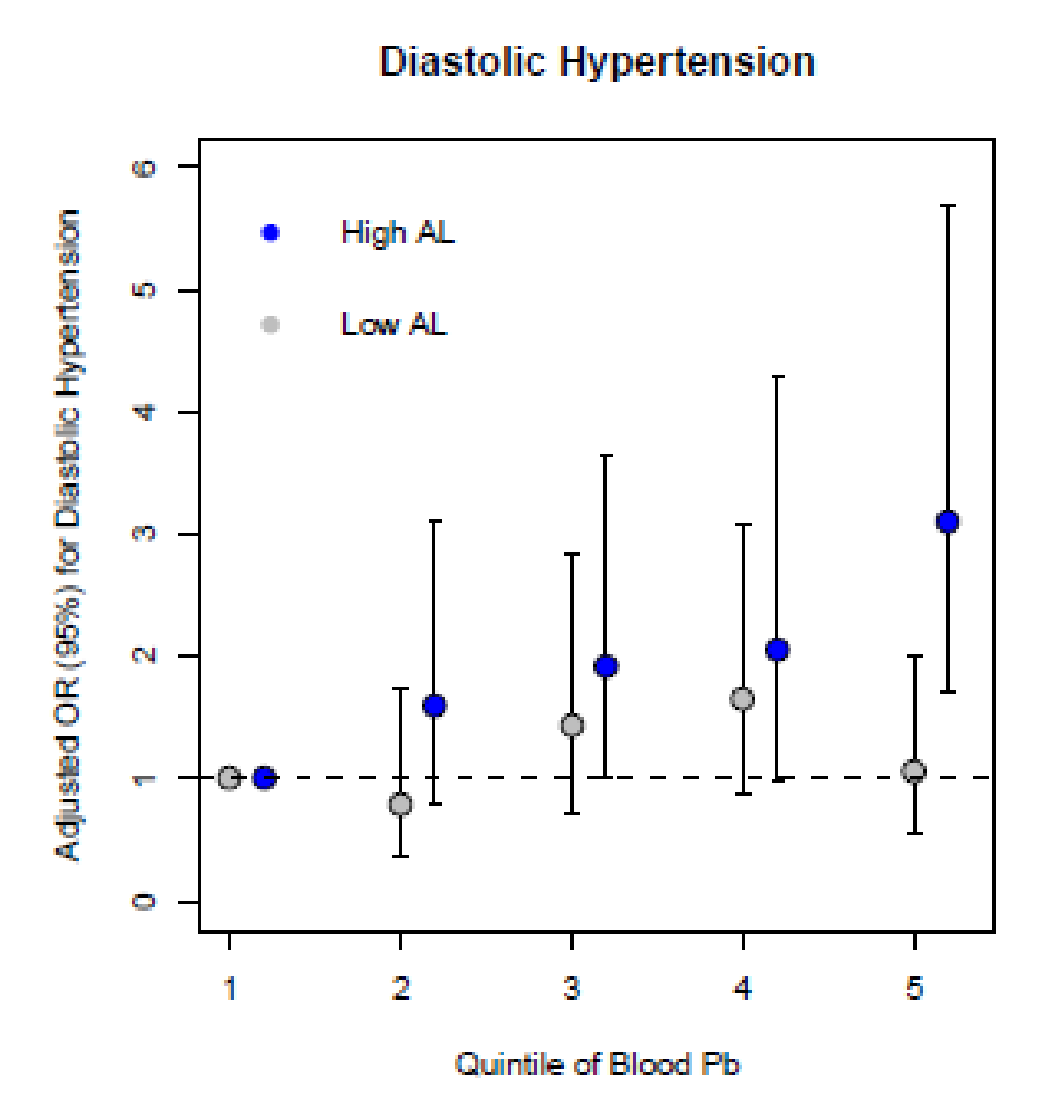
Vulnerability Due to Psycho-social Stress

Effect Modification: Exposure to Violence and Risk of Asthma Diagnosis Associated with Traffic-Related Air Pollution (NO2)

(Clougherty et al., EHP 2007)



Biomarkers of Stress (Allostatic Load):
Hypertension Risk from Lead Exposure Among Adults



Zota, Morello-Frosch, Shenassa, in preparation

Improving Science & Policy

- **Exposure:** Move away from chemical-by-chemical, facility-by-facility analysis toward a cumulative exposure approach
  - Assess population exposures for multiple “emerging pollutants”
- **Data Gaps:** regulatory challenge for many pollutants
  - Precautionary Approaches: Enhance opportunities for exposure reduction when effect mechanisms remain unclear
    - Important for highly impacted and vulnerable communities

Future work

- Community and individual-level stressors amplify pollution/health outcome relationships

Methodological questions to consider:

- Integrating individual and area – level measures of SES, discrimination, poverty, etc.
  - Indicators for institutional processes
  - Surrogates for individual measures for which we do not have data

Future work

Macro-level Questions :

- More policy-relevant exposure measures needed
  - E.g. traffic data as a surrogate for pollution exposure
- Geographic scales of CI are important
- Regional and neighborhood differences are both important
  - Zoning and facility siting decisions affect pollution streams among diverse communities and tend to operate regionally
  - Intervention points would focus on -- land use planning, industrial and transportation development

What Is To Be Done?

Four Policy/Regulatory Principles

- Move regulation toward holistic approaches that consider neighborhoods and regions as basic units of analysis for CI
- Consider existing disparities in pollution exposures/risk and use proxy measures when needed
  - Screen for EJ concerns using transparent and valid methods
- Engage communities – Community knowledge is key to groundtruthing CI approaches and highlighting data gaps
- Incorporate CI into policy objectives and implementation
- Address/Acknowledge Data Gaps

Thank you

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National Academy of Sciences

Combination of risks posed by:

- aggregate exposure to multiple agents or stressors;
- by all routes and pathways;
- from all sources of each given agent or stressor;
- chemical, biologic, radiologic, physical, and psychologic stressors are all acknowledged as affecting human health (Callahan and Sexton 2007).

[Cited from p. 197 NAS Report, 2008]