

# Comments on the Integrated Science Assessment for Sulfur Oxides – Health Criteria

Presented by  
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appearing on behalf of the  
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# The ISA Concludes:

- Causal relationship between short-term ambient SO<sub>2</sub> exposure and respiratory morbidity
- “Clear and convincing evidence of consistency, specificity, temporal and biologic gradients, biological plausibility, and coherence.”
- “In the epidemiological studies, the SO<sub>2</sub>-related respiratory effects were consistently observed in areas where the maximum ambient 24-h avg SO<sub>2</sub> concentrations was below the current 24-h avg NAAQS level of 0.14 ppm.”
- “The evidence is suggestive but not sufficient to infer a causal relationship between short-term exposure to SO<sub>2</sub> and mortality.”

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# Exposure Misclassification

- Data quality
  - Method precision
  - Method accuracy
  - Percent of samples > LOD
  - Sample size
  - Completeness of data collection
  - QA/QC procedures

# Exposure Misclassification

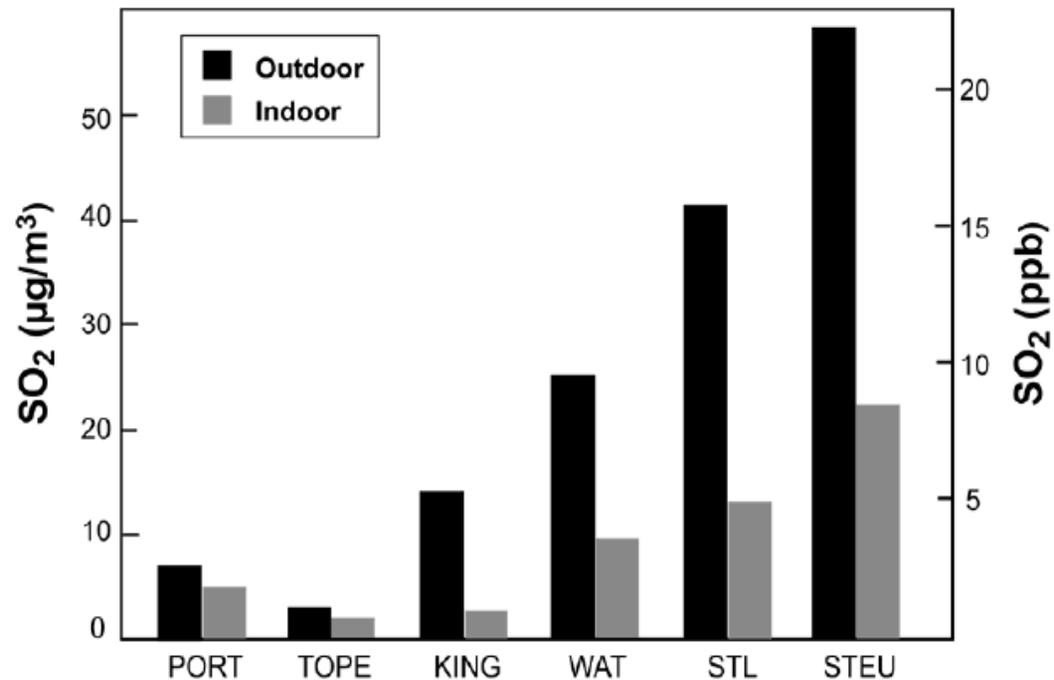
- Measurements from central monitors are not representative of human exposure
  - Local sources cause SO<sub>2</sub> to be unevenly distributed
  - Monitoring site actually represents a nearby source
  - Terrain features and weather lead to different pollution patterns
  - Errors in measurements of low concentrations
  - Daily variations in [SO<sub>2</sub>] at a central monitoring site differ from those variations experienced by people in the geographic area from which health measurements are drawn
  - Ratio of indoor and outdoor measures varies by region

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# Exposure Misclassification



**Figure 2-22. Average annual indoor and outdoor SO<sub>2</sub> concentrations for each of the six cities included in the analysis.**

PORT = Portage, WI

TOPE = Topeka, KS

KING = Kingston, TN

WAT = Watertown, MA

STL = St. Louis, MO

STEU = Steubenville, OH.

Source: Adapted from Spengler et al. (1979).

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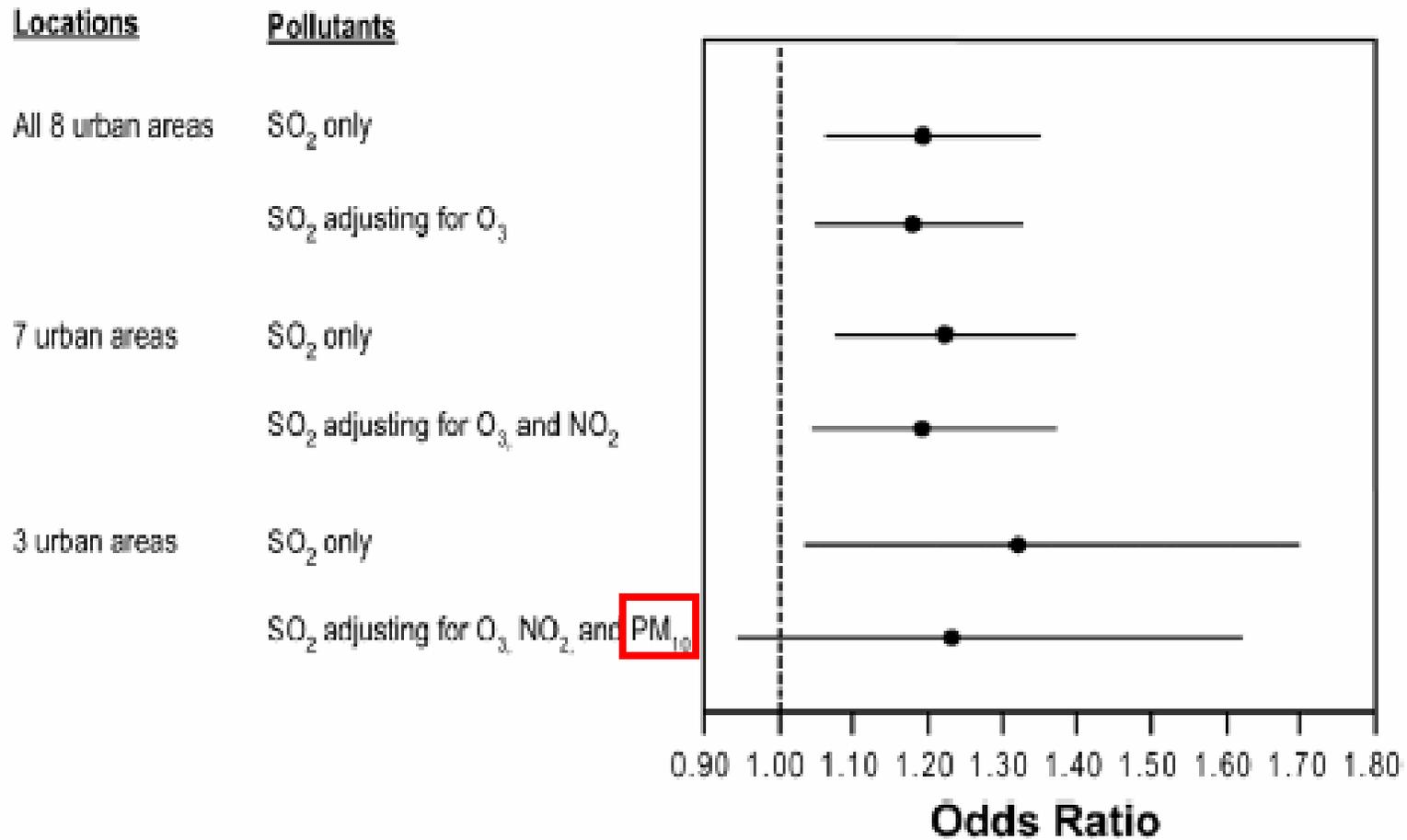
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# Exposure Misclassification

- Non-differential misclassification can bias results towards or away from null

# Confounders/Co-Pollutants



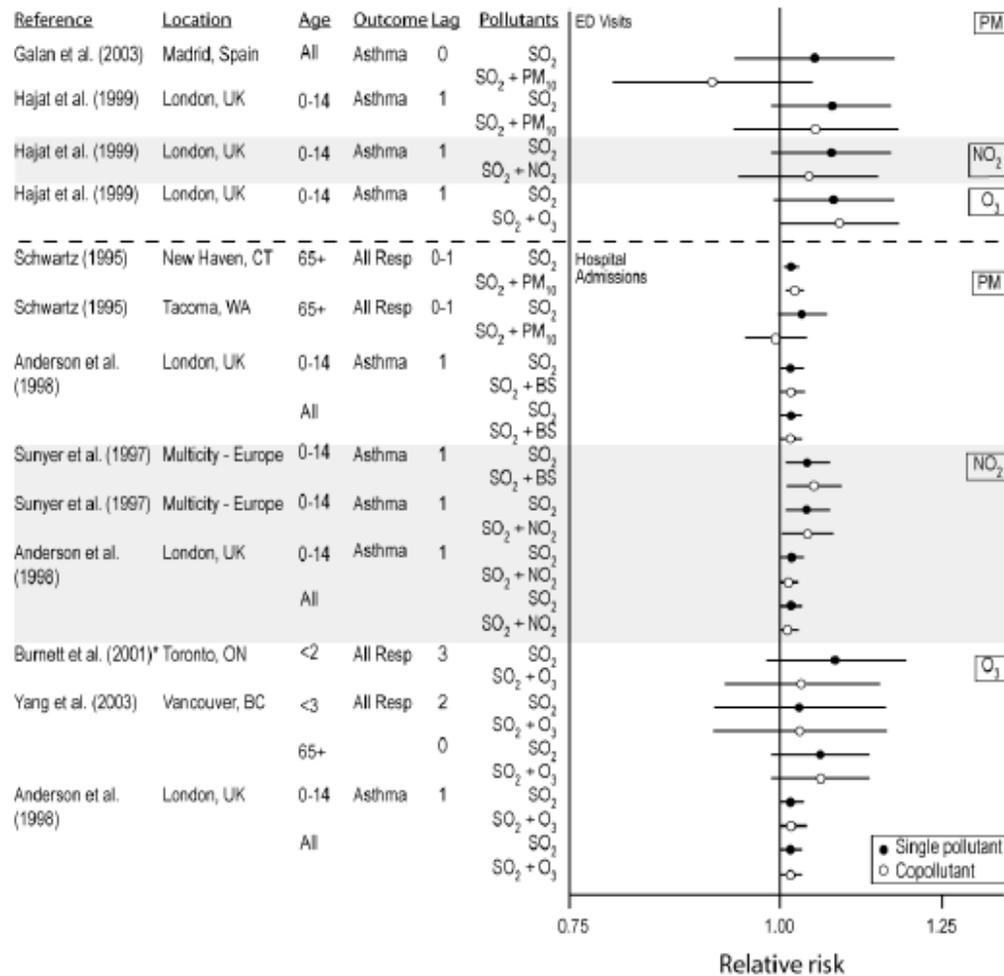
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**Figure 3-2. Morning Asthma Symptoms -- NCICAS**

# Bias Away From Null

- Exposure misclassification
- Known confounders
- Residual confounding
- Unmeasured confounders
- Unknown confounders

# Bias Away From Null



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Figure 3-8. ED Visits and Hospitalizations for All Respiratory Causes and Asthma

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# Inconsistent Use of Criteria for Determining Causation

- Evidence for causation
  - Morbidity: sufficient
  - Mortality: suggestive but NOT sufficient
- Risk coefficients for both morbidity and mortality
  - Not robust to inclusion of confounders
  - Same order of magnitude
- Results consistent, ISA conclusions are not

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# Risk Estimates Calculated from Several Statistical Models are Not Consistent or Biologically Plausible

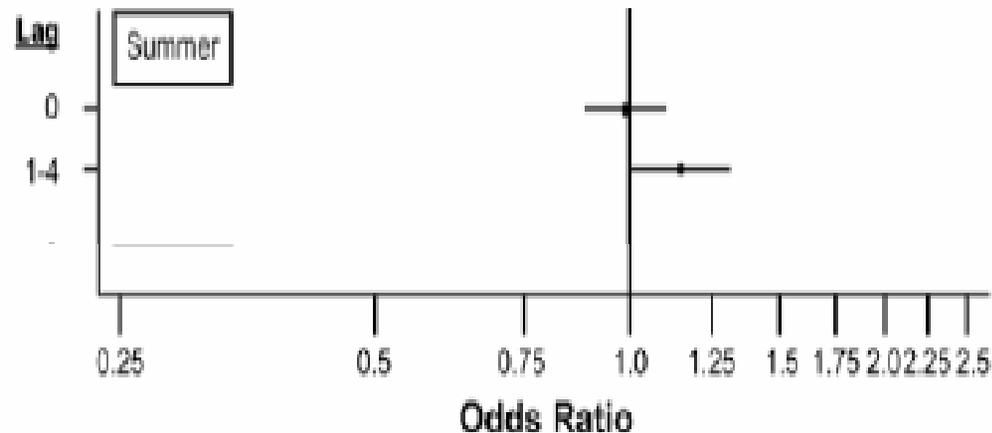
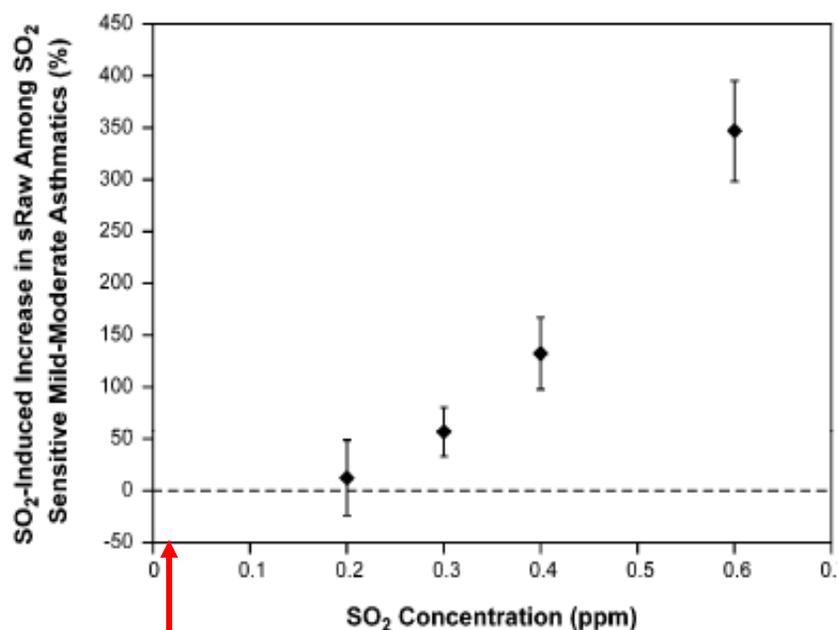


Figure 3-4 (adapted). Cough Among Children (Schwartz et al., 1994)

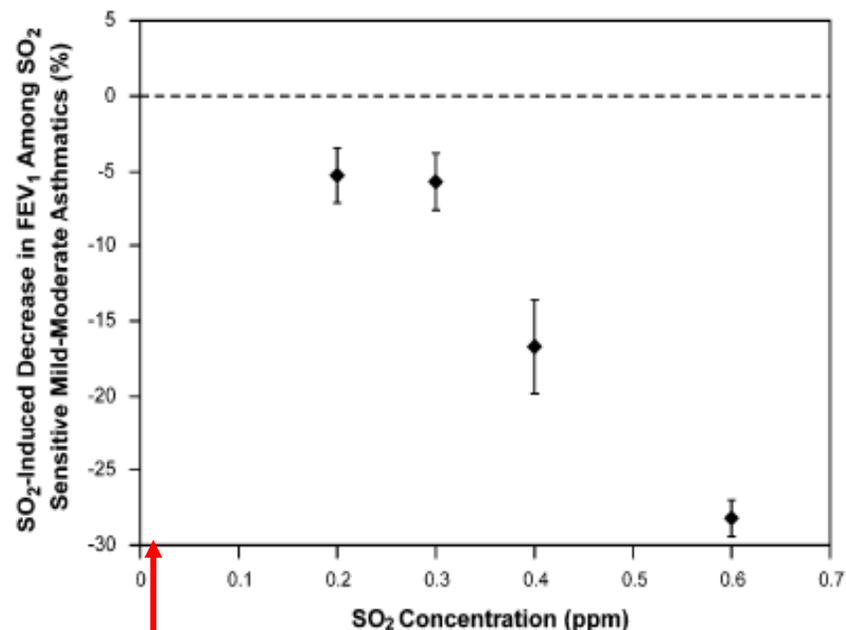
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# No Statistically Significant Effects in Asthmatics in Clinical Studies at $[SO_2] < 0.4$ ppm



Morbidity/  
Mortality  
Reported in  
Epi Studies

**Figure 4-2. sRaw**



Morbidity/  
Mortality  
Reported in  
Epi Studies

**Figure 4-3. FEV<sub>1</sub>**

# EPA Should Revise the ISA to Account For These Issues:

- Quality of measurements varies
- Measurements from central monitors poorly reflect human exposure
- Co-pollutants and other confounders bias risk estimates away from null
- Inconsistent use of criteria for determining causation
- Risk estimates calculated from several statistical models are not consistent or biologically plausible
- Associations reported in epidemiology studies not found at much higher exposures in clinical studies
- No compelling new scientific evidence for a causal association between short-term SO<sub>2</sub> exposure and respiratory morbidity and mortality

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