The Health Effects of Air Pollution in Asia

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Health Effects of Air Pollution in Asia

- Pollutants and Effects
- Source Information
- PAPA Review of Health Effects of Outdoor Air Pollution in Developing Countries of Asia
- Priorities and Gaps

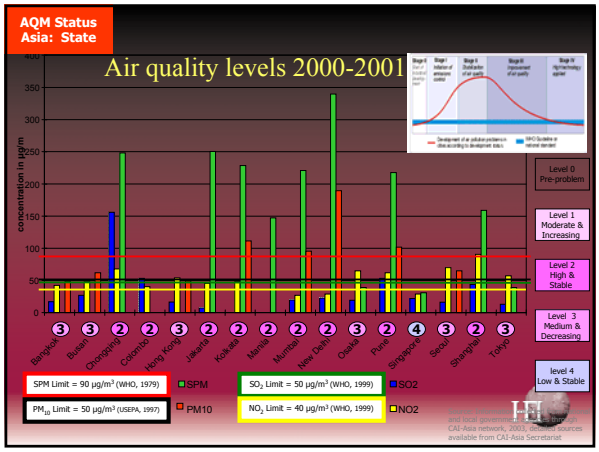
The Major Air Pollutants

Emitted from vehicles, industries, other sources

- Carbon Monoxide
- Diesel Exhaust
- Particulate Matter (PM)
- Lead
- Sulfur Dioxide
- Nitrogen Oxides (NOx) and Hydrocarbons (HC)
  - *Precursors to **Ozone** and PM*
- Nitrogen Dioxide
- Air Toxics
  - Aldehydes
    - formaldehyde
    - acetaldehyde
    - others
  - Benzene
  - 1,3-butadiene
  - Methanol
  - Polycyclic organic matter (e.g. PAHs)
  - Metals (e.g. iron, cadmium, mercury, nickel, manganese)

Health Effects

- **Different Pollutants have Different Effects**
  - Carbon Monoxide - circulatory system, heart
  - Ozone - respiratory system, lung
  - Lead - nervous system, brain
  - PM - premature mortality, lung, potential effects on heart
  - Sulfur Dioxide - respiratory, possibly mortality effects
  - Diesel, Air Toxics - cancer, respiratory, reproductive, neurotoxic effects
- **There are potential effects of the Mixture**



Many Sources of Air Pollution in Asia

- Combustion
  - Agricultural burning
  - Brick Kilns
  - Vehicles
  - Trash burning
  - Factories
  - Power generation
  - Cooking in slums
- Non-Combustion
  - Agricultural cultivation
  - Street sweeping
  - Windblown sand
  - Unpaved roads
  - Paved roads (asbestos, rubber etc)
  - Construction

Significant gaps in documenting sources, pollutants

- Urban & rural sources can vary significantly (Pune study will help)
- Sources and pollutants can also vary across regions due to prevailing fuels, SES, other factors
  - Coal (SO2, PM, metals)
  - High sulfur fuel (SO2, PM)
  - Leaded fuel
  - High vehicle use (PM, Ozone, organic chemicals)
  - Prevailing weather patterns (dust)
  - Agriculture (dust, open burning)
  - Cooking (PM. Organic chemicals)
- Detailed characterization of sources, pollutants needed to inform heath effect analysis, effective regulation
- Although several pollutants are common across categories

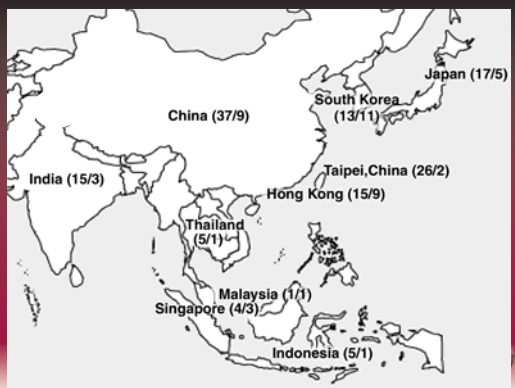
PAPA: *Scientific Review*

- Systematic identification of all peer-reviewed Asian studies on effects of air pollution on health
- Daily time series, cohort and panel studies collected from across Asia
- Focus on key subset: *studies of daily changes in air pollution and health ("time series")*
  - Conduct first regional "meta analysis" to quantify risks
  - Assess what is currently known, identify gaps in understanding
- Report Asian results in context of broader air pollution & health science

Scientific Review of the Asian Literature: *Results*

- **Significant Asian health literature exists**
  - 138 studies of air pollution and health identified across Asia
- **Studies address a wide range of health endpoints**
  - similar to the broader literature
- **Of varying quality**: most use basic epidemiology methods
  - Some (e.g. 28 time series studies) are conducted recently and of higher quality
- **Some countries studied extensively**
  - e.g. China, Korea
- But **research lacking in others**
  - e.g. India, Indonesia, Vietnam

Studies of Air Pollution and Health in Asia 1980–2003

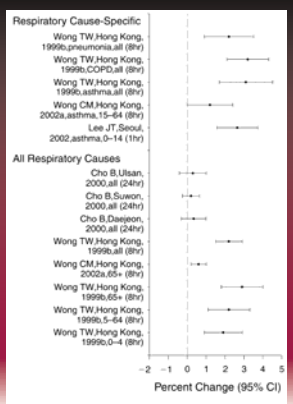


First Ever "Meta analysis" of Asian Studies of Acute Effects: *Results*

- 28 studies of daily changes in air pollution and health ("time series") studied in depth
- Studies more recent, of higher quality
- Studies find effects of air pollution on rate of death, illness
  - ~0.5% increase per 10 μg/m^3 of PM10
  - With high levels of air pollution in Asian cities (>100 μg/m^3), this could mean a substantial public health impact
- *Limitations exist:*
  - Small number of cities studied
  - Not geographically representative (areas with high pollution, high poverty less well studied)
  - Future studies needed to address

Ozone

Figure 35 Ozone and Respiratory Hospital Admissions

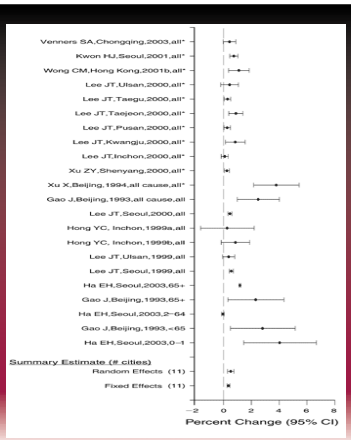


Ozone Health Effects

- Known to cause inflammation in respiratory tract
- reduces ability to breathe (lung function) for some people
- Increases hospitalization for asthma, other lung diseases
- Effects have been demonstrated for short term, long term effects are less certain
  - some people appear to develop “tolerance”

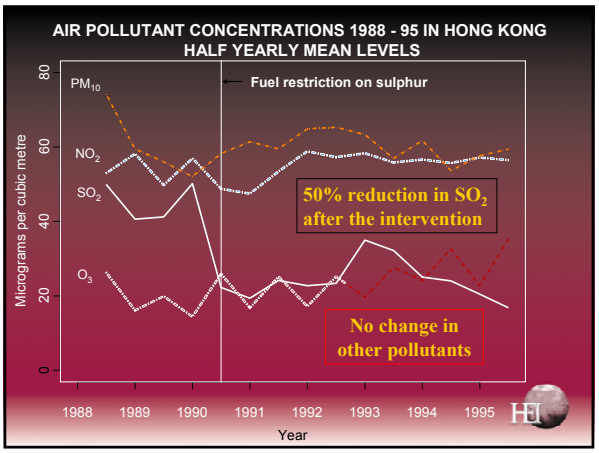
Sulfur Dioxide

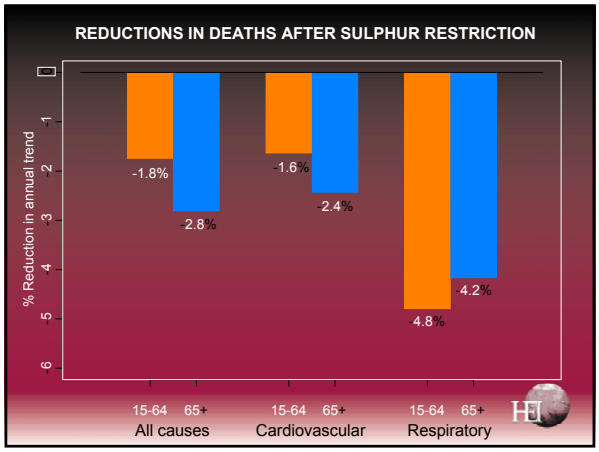
Figure 37 SO2 and All Cause Mortality

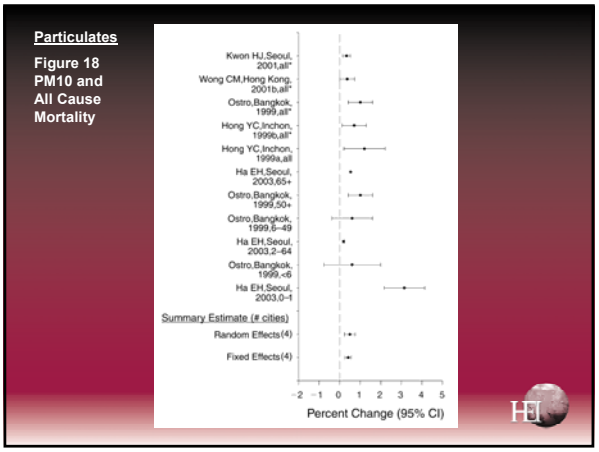


Sulfur Dioxide

- Emitted from fossil fuel combustion
  - especially from coal burning facilities, high sulfur fuels
- Can impair breathing in asthmatic children and adults
- Has been associated, along with PM, with
  - increased aggravation of heart and lung disease
  - premature mortality
- Recent study in Hong Kong (Lancet 2002) has found:
  - substantial reductions in SO2 emissions can result in measurable improvements in mortality and illness



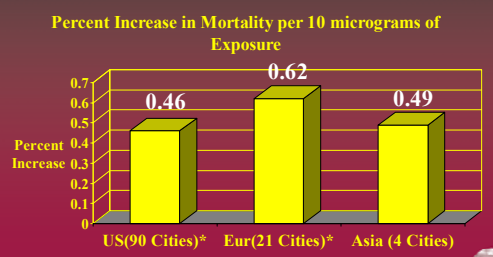




PM Health Effects

- High levels of PM (e.g. 500 μ/m^3) known to cause premature death
  - e.g. London 1952
- Recent studies in US, Europe, Asia, South America have found association of PM with death at much lower levels (<50 μ/m^3)
  - no evidence of a "threshold" (safe level)
- Recent progress toward identifying biological mechanism, though not conclusive

Initial Results:
Asian Risk Estimates Similar to West



* Estimates Using Pre-GAM Results (without revision)

Conclusions

- Exposure to air pollution has been linked with increased death and illness
  - Most studies have been done in Europe and North America
- Asia faces significant air pollution problems today
  - Problem will grow with economic expansion
- The PAPA program is building a better base of Asian health and air pollution science
  - Review of the Asian literature found nearly 140 existing studies – partial basis for policy action
  - For small number of cities studied, effects appear to be similar to those in West

Conclusions

- Many pollutants of concern
  - CO, SO2, PM, NOx. Lead, Air Toxics (including metals), Ozone (VOC\NOx)
  - *Progress made in some areas should be a factor in priorities*
- Many Sources
  - Combustion, Non Combustion
  - Regional differences exist, depending on fuels, weather patterns, industrial profile, SES, *suggesting both general and region-specific priorities*
- Greater monitoring, source characterization needed
  - To inform health impact assessment, target control measures, especially in highly populated areas
- However, several pollutants of concern common across sectors, regions.

Potential Priorities

- Pollutants associated with morbidity, mortality and found in urban, rural areas at high levels
  - Particulates
  - SO2
    - **Also recommend specific monitoring, for PM10, 2.5**
- Of concern but less studied in Asia
  - Ozone
    - **Associated with respiratory problems, asthma exacerbation**
    - **May be a concern with increased vehicles, manufacturing**
    - **Limited monitoring in Asian cities… enhance *both urban and suburban monitoring***
  - Air Toxics
    - **Benzene, metals, diesel, though monitoring difficult, expensive, even in developed regions**
    - **Some (not all) reductions possible with control measures for PM, Ozone**

Thank You!

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