Air Pollution and Health

What is needed for more health impact studies in India

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Human Health

Clean Air
Safe Food
Safe Water
Adequate Housing
Safe Working Places
Safe Streets
Environmental Health

Air, Water and Places

Hippocrates
(460 - 370 BC)
Adverse Effects of Air Pollution
London Smog

• Acute Respiratory Infections
• Chronic Respiratory Diseases
• Cardiovascular Diseases
• Low Birth Weight
• Cataract
Are Health Effects of Air Pollution Similar in Developing World?

- Socio-economic conditions – poor nutrition
- Demographics - younger
- Climates - tropical
- Air pollutants - level/ mixtures/ fuels
Air Pollution and Morbidity
Mandi Gobindgarh Study
Study Design

• Cross Sectional Survey: 1999-2001
  – Mandi Gobindgarh & Morinda

• Air Quality Monitoring: Twice a Week
  – High Volume Sampler: SPM, NOx, SO2

• Sample Household Survey: 4000 Adults
  – Socio-demographics, Symptoms, Height, Weight, BP, Spirometry, ECG
## Ambient Air Quality

<table>
<thead>
<tr>
<th>Microgram/cubic meter</th>
<th>Mandi Gobindgarh</th>
<th>Morinda</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPM</td>
<td>890.3</td>
<td>291.3</td>
</tr>
<tr>
<td>NOx</td>
<td>27.4</td>
<td>7.4</td>
</tr>
<tr>
<td>SO2</td>
<td>29.6</td>
<td>8.9</td>
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</tbody>
</table>
Air Pollution Risk
Mandi Gobindgarh

Logistic Regression- Adjusted for age, sex, social economic status, smoking, kitchen fuel
Air Pollution and Mortality

Ludhiana Study
Study Design

- Air Quality - RSPM, NOx, SO2
- Meteorological - Temp. Humidity, Visibility
- Mortality - Age, Sex, Address, Cause
- Relationship of RSPM/Visibility with mortality with after taking into account the effect of temperature & humidity
# Air Quality Monitoring Days

<table>
<thead>
<tr>
<th>Site</th>
<th>Site Name</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1</td>
<td>Vishawkarma Chowk</td>
<td>114</td>
<td>88</td>
<td>138</td>
<td>448</td>
</tr>
<tr>
<td>Site 2</td>
<td>Jolly Hosiery</td>
<td>103</td>
<td>73*</td>
<td>0*</td>
<td>176</td>
</tr>
<tr>
<td>Site 3</td>
<td>Verka Milk Plant</td>
<td>126</td>
<td>86</td>
<td>119</td>
<td>331</td>
</tr>
<tr>
<td>Site 4</td>
<td>Rita Sewing Machine</td>
<td>128</td>
<td>104</td>
<td>100</td>
<td>332</td>
</tr>
</tbody>
</table>

* Monitoring stopped in middle of 2003
**Air Quality Monitoring**

<table>
<thead>
<tr>
<th>Site</th>
<th>Type</th>
<th>Days of monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mon</td>
</tr>
<tr>
<td>Site 1</td>
<td>Commercial</td>
<td>X</td>
</tr>
<tr>
<td>Site 2</td>
<td>Commercial</td>
<td>X</td>
</tr>
<tr>
<td>Site 3</td>
<td>Residential</td>
<td>✓</td>
</tr>
<tr>
<td>Site 4</td>
<td>Industrial</td>
<td>✓</td>
</tr>
</tbody>
</table>
Sitewise Plot of RSPM(2002-04), df=20

Vishavkarma-1
Milk plant-3
Rita-4
Daily number of deaths (2002-04), df = 20
Association of RSPM/Visibility with Mortality

- Time Series:
  - RSPM, Visibility, Temperature, Humidity, Deaths

- Generalized Additive Model (GAM) with Natural Spline Smoother (3-6 degree of freedom)

- Quasi Possion Function- Daily Mortality and RSPM/Visibility adjusted for the effect of temperature & humidity
Air Quality & Mortality

Loess Plot of Visibility (mid-day) and Mortality

Number of Deaths

Visibility (meters)
Association of Air Quality with Mortality

- Visibility (proxy for air pollution)
  - 2.4% rise in mortality for every 1000 meter decrease in visibility (p < 0.001)
Conclusion

Air pollution adversely affects human health in subtropical climatic conditions of northern India.
Limitations

• Air Quality of City
  – RSPM rather than PM2.5
  – large number of missing days
  – Lack of log books for quality assessment
  – Semi quantitative visibility measurement

• Death Registration
  – lack of computerization of data
  – incomplete death recording
  – cause of death data not available
The Way Forward

- Better exposure monitoring techniques
- Regular monitoring for all criteria pollutants
- Health effects of persistent pollutants and emerging pollutants
- Effects of vulnerable populations
- Long term epidemiological & toxicological studies
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