Why is air pollution bad for human health?

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Who died?

| Deaths Registered in London Administrative County Classified by Age (Bates, 1995) |
|--------------------------------------|---|---|---|---|---|---|
|                              | < 1 Month of Age | 1-12 Mo. Old | 1-14 Years of Age | 15-44 Years of Age | 45-64 Years of Age | 65-74 Years of Age |
| Week Before the Episode          | 16 | 12 | 10 | 61 | 237 | 254 | 335 |
| Week After the Episode           | 28 | 26 | 13 | 99 | 652 | 717 | 949 |
| Before/After Episode Ratio       | 1.75 | 2.17 | 1.3 | 1.62 | 2.75 | 2.82 | 2.83 |

The greatest relative increase in mortality was from bronchitis, which rose nine-fold.
Health Effects of Ambient Pollution

1952 London Fog
- Hospital admissions rose by 50%
- Respiratory admissions by 160%

- Proportion of effected population
- Lung function changes, immune cell responses, heart rate or heart rate variability responses
- Asthma attacks, medication use, symptoms
- Doctor visits
- Hospital Admissions
- Death

Severity

Proportion of effected population
Health impact of fine particulate pollution

<table>
<thead>
<tr>
<th>City</th>
<th>Total particles (μg/m³)</th>
<th>Fine particles (μg/m³)</th>
<th>Sulfate particles (μg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steubenville</td>
<td>89.9</td>
<td>29.6</td>
<td>12.8</td>
</tr>
<tr>
<td>St. Louis</td>
<td>72.5</td>
<td>19.0</td>
<td>8.1</td>
</tr>
<tr>
<td>Harrimen</td>
<td>49.4</td>
<td>20.8</td>
<td>8.1</td>
</tr>
<tr>
<td>Watertown</td>
<td>49.2</td>
<td>14.9</td>
<td>6.5</td>
</tr>
<tr>
<td>Topeka</td>
<td>56.6</td>
<td>12.5</td>
<td>4.8</td>
</tr>
<tr>
<td>Portage</td>
<td>34.1</td>
<td>11.0</td>
<td>5.3</td>
</tr>
</tbody>
</table>

The Six Cities study


COPD - Chronic Obstructive Pulmonary Disease
CVD - Cardiovascular Disease
**Controlled Diesel Exposures**

**Exposure to DE:** $\text{PM}_{10} \ 300\mu g/m^3$ and filtered air for 1 hour & $100\mu g/m^3$ and filtered air for 2 hours
Diesel induces inflammation

Neutrophils after air

Neutrophils after DE

Epithelium

Submucosa

p = 0.01

p = 0.003

p = 0.04

p = 0.02

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Responses to PM in the Real World

Does short term exposure to real world atmospheres (diesel traffic and background) cause respiratory effects in asthmatics?

Responses to PM in the Real World

Impaired lung function

Inflammation

PM Concentration Near a Major Road

Children’s respiratory health

Postcodes in the Tower Hamlets area within 100 m of major road
Examine effect of LEZ on:

- **Respiratory health** -
  - Spirometry, exhaled NO, respiratory symptoms
- **Biomarkers of exposure**
  - Urinary metals, carbon content of airway macrophages
- **Susceptibility**
  - Gene polymorphisms
- **Response**
  - Urinary 8-isoprostanes
  - Urinary 8-oxydG

Linkage at residential address level to estimated modelled exposures (NOx, NO₂, PM₁₀, PM₂.5)
Estimated current PM10 air pollution index levels, based on measurements taken up to 15:00 on Wednesday 9th November.

Low (1-3)  Moderate (4-6)  High (7-9)  Very High (10)
How does the choice of route impact on an individual's exposure?
Summary

• Prolonged exposure to elevated PM is associated with significant life-shortening and poor respiratory health. Acute episodes can precipitate death in sensitive subjects.

• Subjects with pre-existing cardiopulmonary conditions are particularly sensitive.

• Reductions in ambient PM provide measurable health benefits

• Human chamber and field exposures have provided a mechanistic evidence to underpin the validity of the epi-observations

• Individual exposures can be limited by informed use of the urban environment