The health impacts of PM$_{2.5}$ in the NSW GMR

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Overview

Why the focus on PM$_{2.5}$?

The evidence of health effects

Health impacts in NSW

Harm related to current levels of anthropogenic PM$_{2.5}$

Harm related to emissions from specific sources

The benefit of reducing PM$_{2.5}$

Conclusions
Why the focus on PM$_{2.5}$?
Why the focus on PM$_{2.5}$?

- There are very well established links between PM$_{2.5}$ and health effects
- Based on current knowledge, it is the air pollutant that does most harm
- The new national PM$_{2.5}$ standard means PM$_{2.5}$ is a major focus of governments.
The evidence of health effects
Health effects

• There’s very strong evidence that PM$_{2.5}$:
  • Shortens lives
  • Hastens the development of cardiovascular and respiratory disease

• There are also associations with a range of other outcomes. For example:
  • Neurological conditions
  • Low birth weight
  • Diabetes

• Around 85% of the social cost of PM$_{2.5}$ is attributable to loss of life
Different types of study have been used to investigate the effects of PM$_{2.5}$:

- Toxicological studies that look at effects on animals
- Clinical studies that look at effects in individual humans
- Observational studies that look at effects on populations:
  - Time series studies
  - Cohort studies
Health impacts in NSW
• HIA is a process for translating evidence into information about the local effects of PM$_{2.5}$

• Why is it necessary?
  • Generally speaking, local studies that directly assess the impacts of PM$_{2.5}$ aren’t feasible
  • Without impact assessment, the effects of PM$_{2.5}$ are largely invisible (and hence unlikely to be managed efficiently).

• HIA can answer questions like:
  • How much harm is caused by current levels of PM$_{2.5}$?
  • What would be the benefit of doing something to reduce PM$_{2.5}$ concentrations?
How much harm occurred in 2011 as a result of long-term exposure to PM$_{2.5}$?
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Results

Population-weighted concentration 2 μg/m³
Loss of life expectancy 53 days
Years of life lost 5,800
Attributable number of deaths 420
Interpretation

• If everyone is exposed to the same level of PM$_{2.5}$ for a lifetime we would lose, on average, 2 months of life
  • But PM$_{2.5}$ does not affect everyone equally
  • If only half the population were susceptible, this half would lose 4 months
• Each year, around 5,800 years are lost by those whose lives were shortened by PM$_{2.5}$
• If PM$_{2.5}$ was the ’sole’ cause of certain deaths then it would cause 420 deaths at typical ages (ie predominantly among the elderly).
  • But PM$_{2.5}$ is one of many risk factors that affect the timing of people’s deaths
  • PM$_{2.5}$ likely affects the timing of death of a much larger number than 420
Exposure related to specific sources

Power stations
Ships
Wood heaters

0.005−0.04
0.037−0.07
0.069−0.10
0.100−0.13
0.131−0.17
0.171−0.22
0.216−0.29
0.292−0.44
0.439−0.63
0.634−0.84
PM$_{2.5}$ concentrations in 2011
How much harm was caused by PM$_{2.5}$ in 2011?

<table>
<thead>
<tr>
<th>Source</th>
<th>Loss of life expectancy (days)</th>
<th>Years of Life Lost</th>
<th>Attributable number of deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthropogenic</td>
<td>53</td>
<td>5,800</td>
<td>420</td>
</tr>
<tr>
<td>Wood heaters</td>
<td>13</td>
<td>1,400</td>
<td>100</td>
</tr>
<tr>
<td>Power stations</td>
<td>5</td>
<td>550</td>
<td>40</td>
</tr>
<tr>
<td>Ships</td>
<td>–</td>
<td>220*</td>
<td>17*</td>
</tr>
</tbody>
</table>
What would be the benefit of reducing PM$_{2.5}$?

The effect of reducing exposure to PM$_{2.5}$

- People live longer
- The population increases in size
- But ultimately you get the same number of deaths
- We model the life-extending effects to estimate the number of life-years produced

Specifically, we have looked at:

- Ships use low-sulphur fuel at berth
- Implementation of more stringent wood heater standards
- Elimination of precursors to PM$_{2.5}$ from power station emissions
<table>
<thead>
<tr>
<th>Action</th>
<th>Life-years produced†</th>
<th>Present monetary value (milions AUD)‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-sulphur fuel in ships</td>
<td>6,240*</td>
<td>251*</td>
</tr>
<tr>
<td>2.5g/kg emissions standard for wood heaters</td>
<td>58,600</td>
<td>2,600</td>
</tr>
<tr>
<td>1.5g/kg emissions standard for wood heaters</td>
<td>88,400</td>
<td>3,900</td>
</tr>
<tr>
<td>Elimination of NO\textsubscript{X} emissions from power stations</td>
<td>37,600</td>
<td>1,700</td>
</tr>
<tr>
<td>Elimination of SO\textsubscript{X} emissions from power stations</td>
<td>13,600</td>
<td>630</td>
</tr>
</tbody>
</table>

† These are the life-years produced among people who were alive in 2011. There would also be benefits to people born in the future

‡ Assuming VSLY of $187,000 and 3% discount rate
Conclusions
Conclusions

• PM$_{2.5}$ related to human activity is reducing life expectancy by about 2 months and causing 5,800 YLL each year.
• Actions that reduce in PM$_{2.5}$ emissions are likely to produce a substantial social benefit.
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