The Health Impacts of Air Pollution from a Changing Climate

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Japanese Society of Public Health COI Declaration

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The presenter has no conflict of interest with any corporate organizations relating to this presentation.
Air pollution – Then and now

London 1952

London 1950s

Pittsburgh 1946

USA

China

France

India

Air pollution still a problem
Death and Disability Risk Factors: Japan

### Air pollution is a major health risk factor

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>2005 Ranking</th>
<th>2016 Ranking</th>
<th>% Change 2005-2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dietary risks</td>
<td>1</td>
<td>1</td>
<td>-8.3%</td>
</tr>
<tr>
<td>High blood pressure</td>
<td>2</td>
<td>2</td>
<td>-2.8%</td>
</tr>
<tr>
<td>Tobacco</td>
<td>3</td>
<td>3</td>
<td>-12.8%</td>
</tr>
<tr>
<td>High fasting plasma glucose</td>
<td>4</td>
<td>4</td>
<td>-2.5%</td>
</tr>
<tr>
<td>High body-mass index</td>
<td>5</td>
<td>5</td>
<td>2.5%</td>
</tr>
<tr>
<td>Occupational risks</td>
<td>6</td>
<td>6</td>
<td>-2.2%</td>
</tr>
<tr>
<td>High total cholesterol</td>
<td>7</td>
<td>7</td>
<td>5.8%</td>
</tr>
<tr>
<td>Impaired kidney function</td>
<td>8</td>
<td>8</td>
<td>-9.3%</td>
</tr>
<tr>
<td>Alcohol &amp; drug use</td>
<td>9</td>
<td>9</td>
<td>-1.9%</td>
</tr>
<tr>
<td>Air pollution</td>
<td>10</td>
<td>10</td>
<td>-6.1%</td>
</tr>
</tbody>
</table>

Air pollution is a major health risk factor in Japan.
Potential Climate Change Impacts

Agriculture
- Crop yields
- Irrigation demands

Forests
- Composition, health
- Geographic range
- Productivity

Species and Ecosystems
- Shift in ecological zones
- Loss of habitat and species

Water Resources
- Water supply
- Water quality

Coastal Areas
- Erosion of beaches
- Salt water intrusion

Human Health
- Weather-related illness
- Infectious disease
- Air quality effects

Climate Change and Health Scientific Publications

Growing scientific evidence and interest in climate change and health
Tropospheric ozone chemistry (simplified)

1. \[ \text{VOCs} + \text{NO}_x + \text{heat/sunlight} \rightarrow \text{O}_3 \]

Precursors to ozone

Secondary pollutant

Temperature and Ozone Formation

Higher temperature means higher ozone levels

Source: EPA 1996
Tropospheric ozone chemistry (simplified)

VOCs + NO\textsubscript{x} + heat / sunlight \rightarrow \text{O}_3

Precursors to ozone

Climate Change Impacts on Biogenic Emissions

– Increased VOC emissions from trees with higher temperature
– Biogenic emissions can be on the same order of magnitude as anthropogenic emissions
Increase in Ozone (1990s to the 2050s)

Climate change means higher ozone levels

Wildfires under a Changing Climate
Forest Fire Pollution and Health

- Forest fire smoke hazardous to human health (USFS)
  - Almost $7 billion in property damage and $58 million in crop damage (NOAA)

Damages underestimated. Little known about health impacts. (Liu et al. Environ Res 2015)

7.2% increase in respiratory hospital admissions (95% CI 0.25, 14.6%) during smoke waves compare to non-smoke waves
- ”Smoke wave” = >2 days with wildfire-specific PM$_{2.5}$ >37µg/m$^3$

Wildfire smoke associated with risk of respiratory hospitalizations. (Liu et al. Epidemiology 2017)

Estimate PM$_{2.5}$ Specifically from Forest Fires

- GEOS-Chem model (Dr. Loretta Mickley, Harvard)
  - May-Oct 2004-2009 (present day) and 2046-2051 (future under climate change)
  - Generates daily estimated PM$_{2.5}$

- “Smoke Wave” (SW)
  - Defined as >2 days with daily wildfire-PM$_{2.5}$ >20µg/m$^3$ (98$^{th}$ percentile of all daily wildfire-PM$_{2.5}$ in 561 US Western counties)
  - Each county-day defined as a SW or non-SW day
Concluding Thoughts

- Growing evidence that climate change will impact human health
- Ambient air pollution: still an important health concern worldwide
- Tropospheric ozone and wildfire pollution: Two examples of air pollution concerns anticipated to increase under climate change
- Overlaps between air quality and climate change policy – a step towards solutions
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