Air pollution and health

• Ambient air pollution (individual) risk is small…but large exposed population = large population risk

• Diseases impacted by air pollution have other causes...

• ...Air pollution as a contributing risk factor
Air pollution and health

• On **days** with worse air quality, more people die*

• In **more polluted cities**, people die earlier than in less polluted cities...

• ...and, in the **most polluted areas** of cities, there is an increased risk of dying

*out-of-hospital, >65 yrs

health impacts of air pollution:

- shorter life
- cognitive development
- cognitive decline
- mental health
- stroke
- heart disease
- asthma
- lung cancer
- reduced lung function
- obesity
- birth defects
- low birth weight
- diabetes

- established effects
- possible effects
Particulate Matter

HUMAN HAIR
50-70 μm (microns) in diameter

PM2.5
Combustion particles, organic compounds, metals, etc.
< 2.5 μm (microns) in diameter

PM10
Dust, pollen, mold, etc.
< 10 μm (microns) in diameter

90 μm (microns) in diameter
FINE BEACH SAND

Image courtesy of the U.S. EPA
300,000 Adult Canadians (CCHS)
8 – 11 year follow-up

No evidence of threshold above 1 µg/m³ minimum level

92% global population in areas exceeding WHO Air Quality Guideline (10 μg/m³ PM$_{2.5}$ annual average)

Brauer et al., 2016
BC Crude Estimate (population proportion):
930 PM$_{2.5}$ + 90 Ozone

Among top risk factors (#10 deaths, #12 DALYs)

7,100 deaths/yr PM$_{2.5}$  690 deaths/yr ozone


https://vizhub.healthdata.org/gbd-compare/
Woodsmoke and heart attack hospitalization in BC

Monthly mean biomass contributions (% levoglucosan/PM$_{2.5}$) to 3-day mean ambient PM$_{2.5}$

For each 5 µg/m$^3$ increase in 3-day mean PM$_{2.5}$, 6.0% increased risk of MI among elderly subjects (≥ 65 years)

Restricting to cold days and days with highest biomass contribution: 19% increased risk

Weichenthal et al. 2016. Epidemiology
Woodsmoke & multiple health measures

- 15% increase in SGA birth
- 32% increase in otitis media
- 8% increase in bronchiolitis
- 15% increase in COPD hospitalization
- No associations with:
  - pre-term birth
  - asthma incidence
  - cardiovascular, COPD mortality

• ~39% reduction in winter PM$_{10}$
• ↓ winter cardiovascular (-19.6%) and respiratory (-27.9%) mortality
• Similar decreases not observed in control community

Combustion conditions, composition & toxicity

More Toxic: Conventional burning

Less Toxic: “Advanced”

M. F. Heringa; P. F. DeCarlo; R. Chirico; A. Lauber; A. Doberer; J. Good; T. Nussbaumer; A. Keller; H. Burtscher; A. Richard; B. Miljevic; A. S. H. Prevot; U. Baltensperger; Environ. Sci. Technol. 2012, 46, 11418-11425. DOI: 10.1021/es301654w Copyright © 2012 American Chemical Society
California Rule 4901

New sales/property transfer - Certified stoves/Pellet stoves.

No fireplaces

No burn days

No sale of used heaters

PM2.5 Reductions
12% (11% rural, 15% urban)

Adults > 65 yrs
Prevent 7% of CVD and 16% of IHD admissions)

New regulations

- 2016-17: Only wood and pellet stoves, boilers, furnaces certified to meet new US EPA or CSA emission standards legal to sell in B.C.
- 30 m setback for new Outdoor Wood Boilers (OWBs); Phase-out of older OWBs
- Prohibit burning of undesirable fuels, such as garbage, plastics and treated wood
The number of smoky days within the most recent two years of available data for each community as classified by the algorithm using the most informative parameter values.

<table>
<thead>
<tr>
<th>Location</th>
<th># Smoky Days</th>
<th># Days with Data (730 max)</th>
<th>% Smoky Days</th>
</tr>
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<tbody>
<tr>
<td>Houston</td>
<td>277</td>
<td>623(^a)</td>
<td>0.445</td>
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<tr>
<td>Courtenay</td>
<td>211</td>
<td>716</td>
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<td>Port Alberni</td>
<td>143</td>
<td>729</td>
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<td>Vanderhoof</td>
<td>136</td>
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<td>Whistler</td>
<td>125</td>
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<td>Castlegar</td>
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<td>116</td>
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<td>Duncan</td>
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<td>727</td>
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<td>Burns Lake</td>
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<td>514(^a)</td>
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<td>0.007</td>
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</tbody>
</table>

\(^a\) Data were missing during summer months, so the percentage of smoky days will be higher than if data were missing at random.
Thank you!

Questions?

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