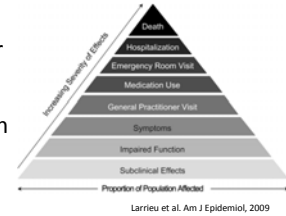


# Air Pollution and Health

Michael Brauer  
School of Population and Public Health

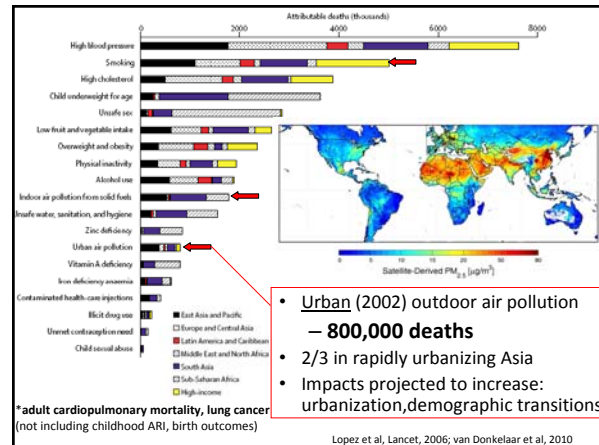
# Air pollution and health

- On **days** with worse air quality, more people die...from cardiovascular disease (CVD)
- In **more polluted cities**, people die earlier than in less polluted cities, from CVD...
- ...and, in the **most polluted areas** of cities, there is an increased risk of dying from CVD



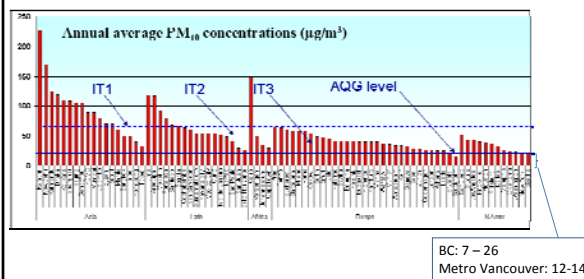
# Why don't we notice this?

- Air pollution **RISK** is small...but large **EXPOSED POPULATION**
  - Smoking: larger risk, smaller exposed population
  - For smoking, **EXPOSURE** is much easier to define
- Major impacts are on chronic (cardiovascular) **disease progression**
- Diseases impacted by air pollution have other causes...air pollution as a contributing risk factor
  - improved baseline health reduces air quality impacts



- **Urban (2002) outdoor air pollution - 800,000 deaths**
- 2/3 in rapidly urbanizing Asia
- Impacts projected to increase: urbanization, demographic transitions

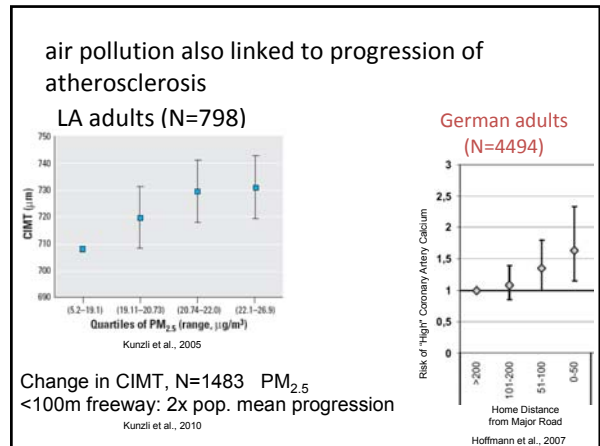
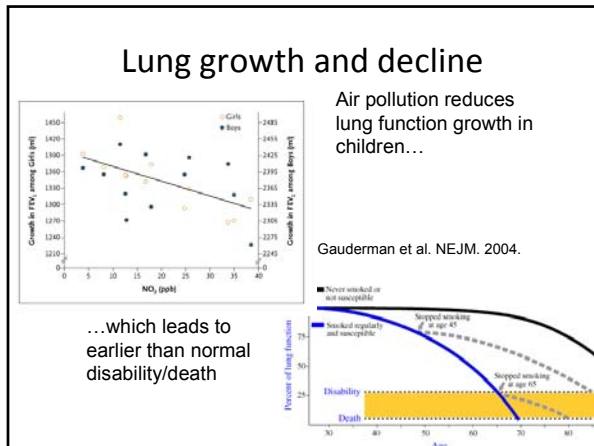
# Global Air Quality and WHO Guidelines



# Air pollution attributable deaths

8 major Canadian cities

City	Deaths/yr	% chronic	% attrib (95% CI)
Quebec	400	80	8 (5-11)
Montreal	1540	74	9 (5-12)
Ottawa	340	68	7 (4-9)
Toronto	1840	68	10 (6-13)
Hamilton	460	72	10 (7-4)
Windsor	260	65	9 (6-12)
Calgary	400	67	8 (5-11)
<b>Metro Van</b>	<b>680</b>	<b>65</b>	<b>5 (3-7)</b>
<b>Total</b>	<b>5900</b>	<b>71</b>	<b>8 (5-11)</b>



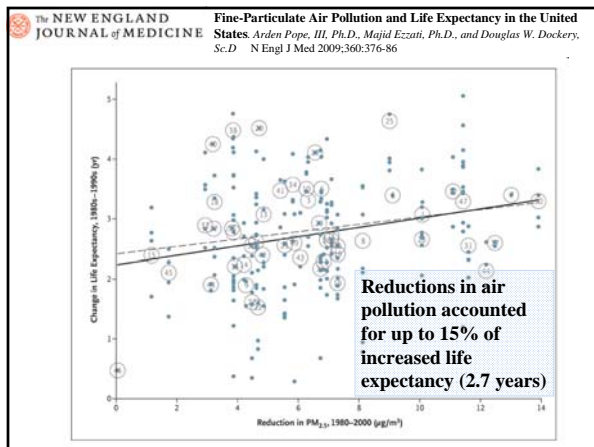
### Don't standards protect us?

- In Canada...guidelines not standards
- Even standards are not protective...
  - air pollution has no safe level for population
    - what is level of acceptable risk?
- Exposure reduction
  - air quality management is VERY GOOD value for money

### Air quality management

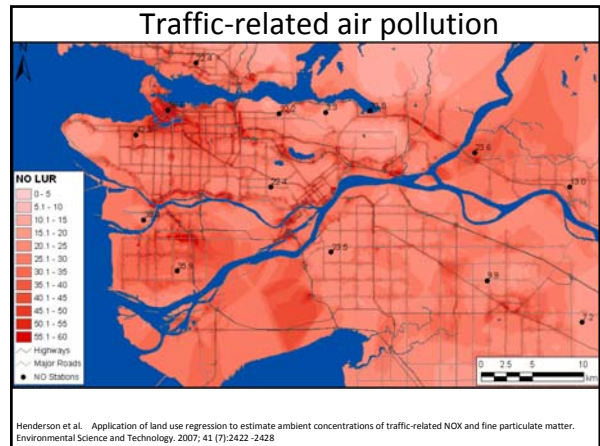
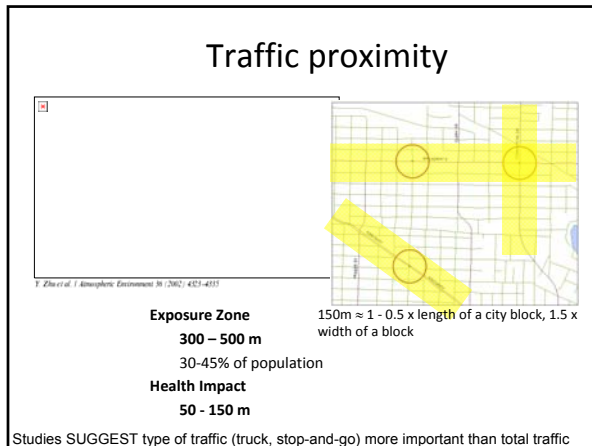
- Early:
  - Emission control
  - Tall stacks
  - Centralized heating
  - Zoning
- Modern airshed management
  - overall emissions reductions
  - regional air quality
  - Ozone, Acid rain
- Motor vehicle emissions control
  - Engine technology
  - Inspection & maintenance
  - Fuel quality
- Point source emissions controls

False Creek, Vancouver, in 1939 (noon)  
2010 annual average PM<sub>2.5</sub> = 6 µg/m<sup>3</sup>



### Some important remaining sources of air pollution exposure in BC:

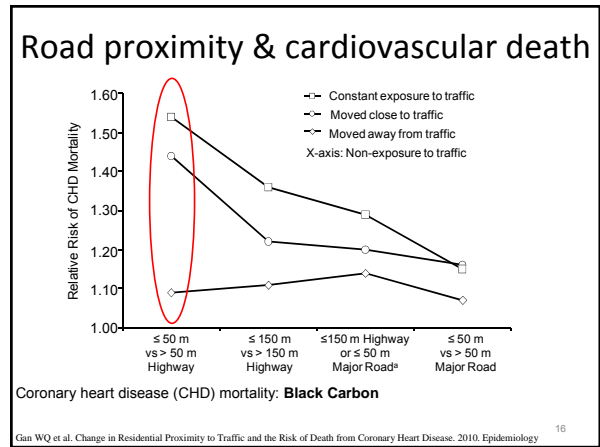
- Vehicles: increasing V km T, longer commutes
  - partially offsets emissions reductions
  - changing patterns of land use and pollutant emissions
- Biomass
  - Woodsmoke
  - Open burning/Wildfires
- Goods movement / ports
- Construction machinery (non-road vehicles)
- Industrial?, oil and gas?



### In Metro Vancouver, children living in areas with higher traffic-related air pollution:

- Increased low birthweight and pre-term birth
  - living <50m from provincial highway: 21% ↑ low birthweight
- Bronchiolitis
  - living <50m from provincial highway: 6% ↑
- Asthma (early life exposure)
  - 13% of new childhood asthma attributable to traffic
- Middle ear infections
  - 7% of cases attributable to traffic

Brauer M, et al. Environ Health Perspect. 2008; Clark NA, et al. Environ Health Perspect 2010; Karr CJ et al. Am J Resp Crit Care Med 2009; MacIntyre et al. Epidemiology, 2010

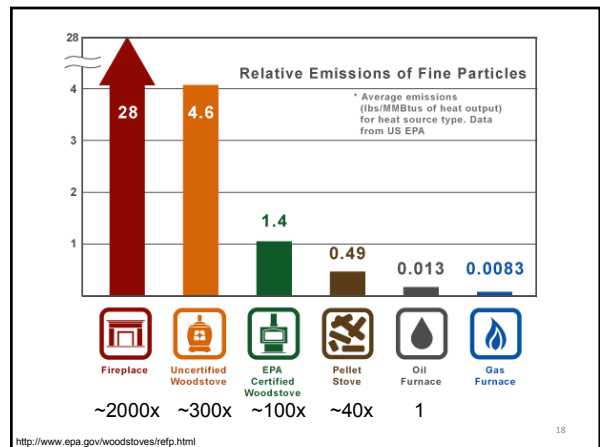


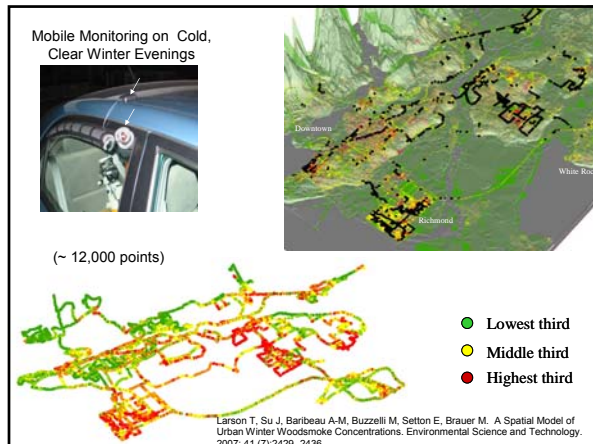
### Woodsmoke...what's the concern?

- Importance in Canada
  - Available, "inexpensive" residential fuel supply
  - Increasing/fluctuating costs & taxes for other fuels
- Promoted as a renewable, GHG neutral fuel
- Relatively unregulated source
- Impact on winter air quality coinciding with stagnation
- Exposure proximity

Residential wood combustion (heaters, fireplaces): 13%

Riet F, Marshall J, Brauer M. Intake fraction of urban wood smoke. Environ Sci Technol. 2009 Jul 14;43(13):4701-6; Brauer M, Miller P, Allen G, Rector L. Modeling Pollution from Residential Wood Combustion. EM Magazine (Air and Waste Management Association). May, 2010, pp 24-28





- ## Residential Woodsmoke
- No association with
    - low birthweight, premature births
    - development of asthma
    - adult cardiovascular disease deaths
  - Children living exposed to higher woodsmoke levels had:
    - 8% greater risk of bronchiolitis
    - 32% greater risk of middle ear infection
      - 10% of ear infection incidence in Metro Vancouver
- Karr et al. AIRCCM 2009; MacIntyre et al. Epidemiology 2011; Clark et al. EHP 2010; E. MacIntyre. PhD Thesis, UBC, 2010

- ## A way forward?
- Health disparities associated with SPATIAL air pollution variability within urban areas
  - Interventions lead to health benefits
  - Opportunities to link with other built environment initiatives (physical activity, climate change) to improve population health
- 
- Giles L et al. Environmental Health Perspectives, 2011 119(1):29-36

- ## Healthy urban design
- **Strategies to separate major roadways from people**
    - Road setbacks
    - Dedicated truck routes / locations of truck distribution centers
    - Low emission zones
    - Congestion charging
    - Locations of bike / walking routes
    - Design of road networks/traffic flows to consider people, not cars only
  - **Emphasis on “sensitive” land use**
    - Schools, long term care facilities
- 



- ## Healthy urban design
- **Reduce barriers to active transport**
    - Understand negative determinants
  - **Infrastructure to promote active transport**
    - Mixed-use, density
    - Mixed-mode transit
    - Public bicycles, sidewalks, etc.
  - **Other approaches to promote physical activity (especially utilitarian activity)**
  - \$\$\$? Consider increasing oil prices
-

# OUTDOOR AIR QUALITY & HEALTH

## & THE AIR QUALITY HEALTH INDEX (AQHI)

### E-course

- common air pollutants & sources
- Air pollution & health effects
- General scheme for clinical advice on reducing adverse health impacts
- AQHI as a risk communication tool
- On demand & online
- Multimedia content
- Discussion forum (asynchronous); Ask an Expert
- CME and other CE credits
- en Français aussi
- **FREE!**

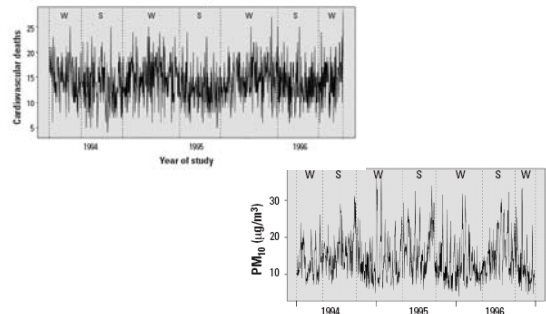
[www.soeh.ubc.ca/Continuing\\_Education](http://www.soeh.ubc.ca/Continuing_Education)

<http://www.spph.ubc.ca> [continuing education]

Funding provided by Health Canada in partnership with UBC

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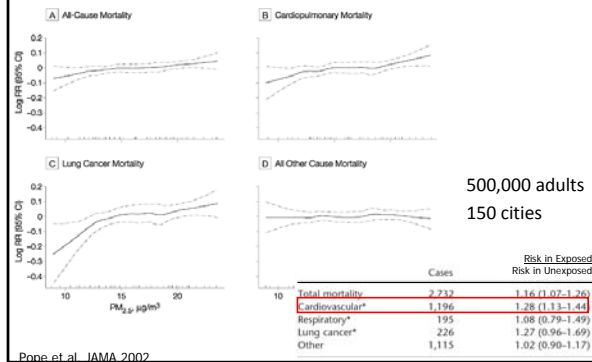
On days with worse air quality, more people die...especially from cardiovascular disease



Vedal et al. EHP. 2003

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In more polluted cities, people die earlier than in less polluted cities...from cardiovascular disease



Pope et al. JAMA 2002

and, in the most polluted areas of cities, there is an increased risk of dying from CVD

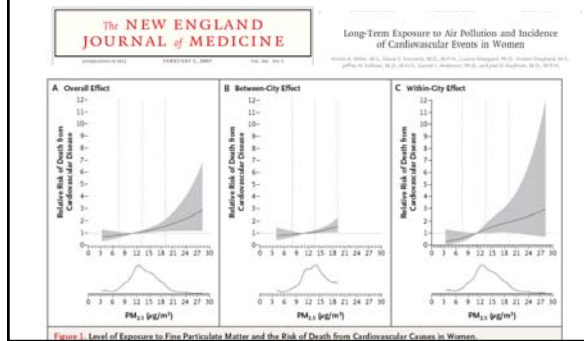
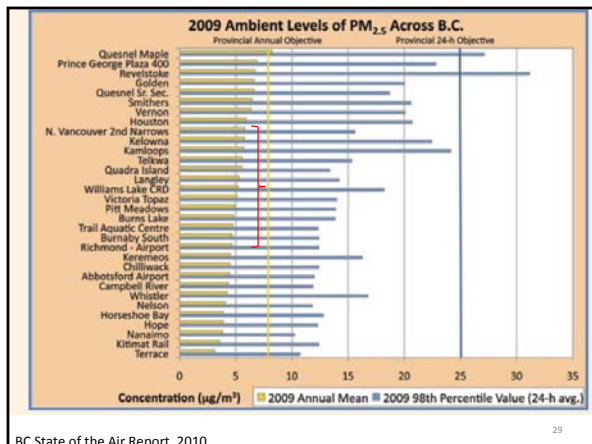
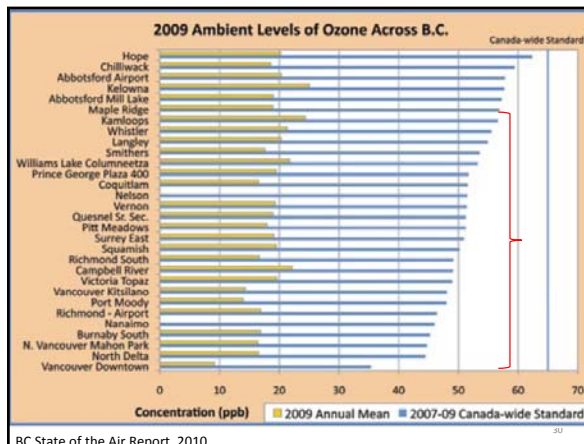


Figure 1. Level of Exposure to Fine Particulate Matter and the Risk of Death from Cardiovascular Causes in Women.



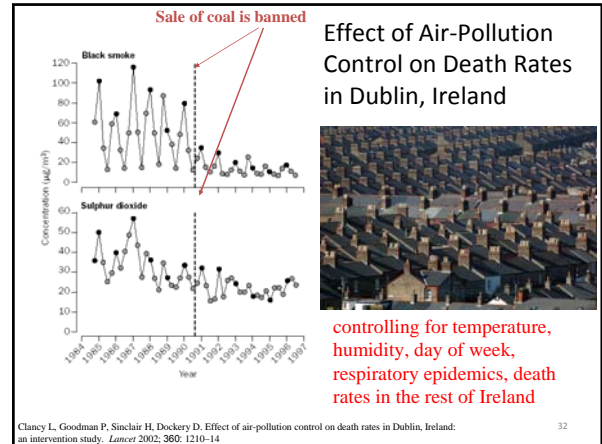
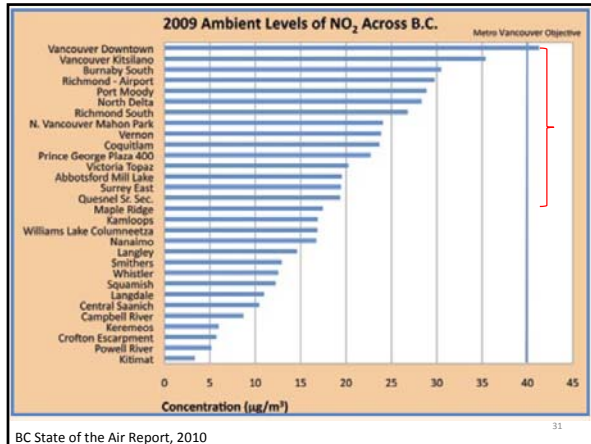
BC State of the Air Report, 2010

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BC State of the Air Report, 2010

30



### E-Z pass and premature birth

Reductions in traffic congestion generated by E-Z Pass reduced incidence of prematurity (10.8%) and low birth (11.8%) among mothers within 2km of a toll plaza

Currie J, Walker R. TRAFFIC CONGESTION AND INFANT HEALTH: EVIDENCE FROM E-ZPASS. Working Paper 15413 <sup>33</sup> <http://www.nber.org/papers/w15413> NATIONAL BUREAU OF ECONOMIC RESEARCH

Outcome	Exposure window	N (n cases)	Design	Mean Days exposed [IQR]	Adjusted* OR (95% CI)
SGA birth	All pregnancy	70,249 (6,939)	Cohort	65 [43]	1.00 (0.91 - 1.09)
				Exposed 30% of pregnancy	1.05 (0.98 - 1.12)
Bronchiolitis <sup>†</sup>	2 - 12 months	86,337 (10,485)	Nested C-C*	54 [45]	<b>1.08 (1.04 - 1.11)</b>
Otitis Media <sup>‡</sup>	1 month pre-diagnosis (1 - 24 mos.)	45,513 (19,115)	Cohort	15 [16]	<b>1.32 (1.27 - 1.36)</b>
Asthma <sup>‡</sup>	All pregnancy	37,401 (3,482)	Nested C-C**	60 [33]	1.00 (0.94 - 1.07)
				89 [17]	1.00 (0.98 - 1.02)

\* per IQR increase, adjusted for covariates: Infant sex (SGA, B, OM) First Nations Status (SGA, B, OM), Parity (SGA, B, A), Maternal age (SGA, B, OM), Maternal smoking during pregnancy (SGA, B, OM), Month-year of birth (SGA), maternal initiation of breastfeeding at birth (B, OM, A), Income (SGA, B, OM, A), Maternal education (SGA, B, OM, A), older siblings (OM), birth season (OM), birthweight (OM, A), gestational duration (OM, A). \*\*incidence-density matching (up to 1:10) on date of birth \*\*matched 1:5 by sex, month-yr of birth

<sup>†</sup>Karr et al., AJRCCM 2009; <sup>‡</sup>Macintyre et al., Epidemiology 2011; <sup>§</sup>Clark et al., EHP 2010

