Air pollution as a major risk factor for cancer

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Volume 109 (2016)
Outdoor air pollution classified as human carcinogen
- Sufficient evidence for lung cancer
- Positive associations with urinary bladder cancer
Data includes general population studies/environmental levels of exposures.

Volume 105 (2014)
Diesel engine exhaust classified as human carcinogen
- Sufficient evidence for lung cancer
- Positive associations with urinary bladder cancer
Data mostly from occupational exposure settings. Uncertainty of effect at low dose environmental exposure levels. Less data for other cancers.

Volume 100e (2012)
Indoor emissions from household combustion of coal classified as human carcinogen (lung cancer)

Volume 95 (2010)
Household use of solid fuels (biomass) classified as probable human carcinogen
Global Lung Cancer Burden

Estimated age-standardized incidence rates (World) in 2018, lung, both sexes, all ages

~2.1 million incident cases, ~1.8 million lung cancer deaths
Lung Cancer Burden

- In most countries, lung cancer burden is closely linked to smoking and tobacco control
- In many countries, smoking is the by far major contributor in men and substantial and increasing contributor in women
- Other relevant risk factors:
  - domestic radon
  - occupational (mainly asbestos)
- Air pollution to be seen in the context of other lung cancer risk factors and their interplay
- Air pollution related lung cancer reflects exposure situation of up to several decades ago

Forman et al., J Cancer Policy 2018
Leon et al., Cancer Epidemiol 2015
Dose response relationship with PM

Relative Risk of Lung Cancer by Increase of 10-µg/m³ change in PM$_{2.5}$ and in PM$_{10}$

Overall: 9% / 10-µg/m³

Overall: 8% / 10-µg/m³
Dose response relationship with PM

Relative Risk by Increase of 10-µg/m³ change in PM$_{2.5}$ by Smoking Status

Uncertainties:

- Majority of studies on ambient air pollution (AAP) are from North America and Europe
- Even less data on dose response trends for household air pollution (HAP)
- Risk higher in non-smokers while adjustment for smoking does not alter the overall dose-response function for AAP; less clear for HAP
- AAP dose-response data allows robust estimation up to, at most, 30-µg/m³
- Effect at very high doses (>1000 µg/m³) extrapolated from studies of smoking
- HAP exposures as major contributor in absolute numbers falls mainly in the gap as around 100-300 µg/m³, hence effect estimated from modeling not actual data

Meta-Analysis by:
Hamra et al., Environ Health Perspect 2014
Example: Ambient air pollution related lung cancer in France

Estimated yearly average PM$_{2.5}$ in 2005 in France in ~50,000 neighbourhoods

About 87% of French population exposed to >10 µg/m$^3$ average

Estimated yearly average PM$_{2.5}$ (2005 yearly average, µg/m$^3$)

WHO air quality guideline

Median: 13.6 (9.2-21.8)
Mean: 14.4

Estimated for France (2015):

1500 cases of lung cancer due to AAP
= 3.6% of all lung cancers diagnosed
= 0.4% of all cancers diagnosed

Uncertainties:
Statistical uncertainty of estimate
Attributable Fraction (AF):
3.6% (CI: 1.7 – 5.4%)

Use of different reference level
Higher AF with 7.6%

Using different risk functions
Could be as high as 26%

Kulhanova et al., Environ Int 2018 (in press)
Lung Cancer in China and India

<table>
<thead>
<tr>
<th>ASR / 100,000 (Globocan 2018)</th>
<th>China</th>
<th>India</th>
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</thead>
<tbody>
<tr>
<td>Males</td>
<td>47.8</td>
<td>7.8</td>
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<tr>
<td>Females</td>
<td>22.8</td>
<td>3.0</td>
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</tbody>
</table>

China is the country with combination of high lung cancer rate and low smoking prevalence among women but high exposure to indoor air pollution.

Of annually about 260 000 incident lung cancer cases in Chinese women, vast majority attributable to indoor air pollution. Main driver of air pollution related cancer burden on global scale.
Research questions on cancer

- Other cancers than lung cancer

- More reliable studies in under-researched parts of the world:
  - dose-response with indoor air pollution where common
  - other compositions of air pollution
  - interplay with smoking

- Better understanding of contributions from different components of air pollution
Conclusions

Air pollution and various particles / chemicals in air pollution are known to be carcinogenic to humans.

Air pollution known to be relevant contributor to lung cancer burden.

Indoor air pollution is directly modifiable risk factor.

Air pollution to be integrated in cancer prevention recommendations.
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THANK YOU FOR YOUR ATTENTION!

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