Health Impacts of air pollution & climate change in cities

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Healthy cities, healthy people: Pathways for clean air in the EU’s urban environments

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Talk Outline

- Air pollution and health
- Climate change and health
- How climate change and air pollution show in our cities
- Joint effects of air pollution and heat in cities (EU Exhaustion project results)
- Wildfires, air pollution and health
- Challenges presented for respiratory patients in cities
- Conclusions
Air Pollution and Health
Air pollution got lot worse:

‘Air pollution more harmful, and harmful at even lower levels than previously known - substantial lowering of the guidelines compared to 2005 WHO AGQ’

1. All (97%) Europeans exposed
2. PM$_{2.5}$ caused 432,000 premature deaths in Europe in 2021, of which 253,000 were > 5 μg/m$^3$ (likely underestimated)

**WHO AIR QUALITY GUIDELINES**

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>2005</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO$_2$</td>
<td>40 μg/m$^3$, annual</td>
<td>10 μg/m$^3$, annual</td>
</tr>
<tr>
<td>PM$_{2.5}$</td>
<td>10 μg/m$^3$, annual</td>
<td>5 μg/m$^3$, annual</td>
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Air Pollution and Lung

**16% asthma cases in children**

Ella Adoo-Kissi-Debrah: Air pollution a factor in girl's death, inquest finds

**GBD - Mortality specific-causes, ‘fraction attributable’ to air pollution**
https://www.stateofglobalair.org/

Ella Kissi-Debrah - 9 year old girl suffered fatal asthma attack triggered by air pollution, London, February 2013
Children's lung capacity improved in cleaner air

Even in Sweden: better air – bigger lungs

Cutting air pollution improves children's lung development, study shows

Conclusions from long-term survey in Sweden come days after 10th anniversary of Ella Kissi-Debrah's death in London

Associations of improved air quality with lung function growth from childhood to adulthood: the BAMSE study

Zhebin Yu¹, Simon Kebede Merid², Tom Bellander¹,³, Anna Bergström¹,³, Kristina Eneroth⁴, Antonios Georgelis¹,³, Jenny Hallberg²,³, Inger Kull²,³, Petter Ljungman¹,⁶, Susanna Klevebro⁷,⁵, Massimo Stafoggia⁸,⁷, Gang Wang⁹,², Göran Pershagen¹,³, Olena Gruzieva¹,³ and Erik Melén⁴,⁵
Air Pollution and COVID-19

Ambient air pollution exposure linked to long COVID among young adults: a nested survey in a population-based cohort in Sweden

Zhebin Yu, Sandra Ekström, Tom Bellander, Petter Ljungman, Göran Pershagen, Kristina Eneroth, Inger Kull, Anna Bergström, Antonios Georgiadis, Massimo Stafoggia, Olena Gudieva, and Erik Melin, the BAMSE COVID-19 Study Group

Long-term exposure to air pollution and risk of SARS-CoV-2 infection and COVID-19 hospitalisation or death: Danish nationwide cohort study

How does air pollution affect your heart?

Exposure

Disease processes

Blood vessel narrowing and clots

Electrical disturbances

Clinical outcomes

Heart failure

Myocardial infarction

Stroke

Arrhythmias
Air pollution and heart / cardio-metabolic health

GBD - Mortality specific-causes, ‘fraction attributable’ to air pollution
https://www.stateofglobalair.org/

Type-2-diabetes
Air pollution and cancer

Air pollution and the brain

- Dementia,
- Alzheimer’s
- Depression,
- Anxiety, suicide
- Cognitive development, autism, ADHD
- Parkinson’s disease
Climate change and air pollution inseparable issue - breaking the silos to improve research on health impacts and speed up solutions.
Global warming – world is changing fast

‘eight warmest years on record witness upsurge in climate change impacts’

Global mean temperature difference from 1850-1900 (°C)

© Crown Copyright. Source: Met Office
Figure updated: 04/09/2023
‘Raging’ Climate Change - Unprecedented 2023

A biblical catastrophe: death toll rises to six as Storm Daniel lashes Greece
Torrential rain blocks roads, causes power cuts and severs water supplies
September 6, 2023

Canadian wildfires emissions hit record high as smoke reaches Europe
By Gloria Dickie
June 29, 2023 1:13 AM GMT+2 - Updated 2 months ago
June 12, 2023

Devastating floods in Italy claim lives and leave thousands homeless
Twenty-one rivers burst their banks after heavy storms across country cause landslides and submerge villages
May 17, 2023

Thousands evacuated as wildfires tear through Spanish Island of Tenerife
August 17, 2023

In pictures: Slovenia faces ‘worst-ever natural disaster’ after extreme flooding
June 7, 2023

Wildfire Smoke Blankets Sky Across New York City, Prompting Air-Quality Warnings - WSJ
Global warming – Europe warming faster - prepare for more brutal heatwaves

Global mean temperature between 2013 and 2022 was 1.13-1.17°C warmer than the pre-industrial level: the warmest decade on record. European temperatures have increased faster, by 2.04 to 2.10°C, some cities more affected: southern Europe heating up fastest.

Cities- ‘hot spots’ of air pollution and climate change effects

The urban heat island effect

Refers to the increase in temperature in urban environments compared to surrounding areas.

High temperatures affect health, increasing the risk of cardiovascular disease, heat stroke, sunstroke, dehydration and heat-related deaths.

Building materials such as concrete and asphalt absorb and trap heat, heating up cities.

The consequences are worse for vulnerable groups, such as the elderly, babies or people with chronic illnesses.

Green areas around cities stay cooler.

'Europe saw yet another year of increasing temperatures and intensifying climate extremes — including heat stress with record temperatures, wildfires, heat waves, glacier ice loss and lack of snowfall.'
Heat vulnerability differs across Europe

We investigated the factors explaining these differences. May be addressed in adaptation policies.

Factors increasing heat-health effects:

Area level ambient factors:
➢ High air pollution (PM$_{2.5}$ and O$_3$)
➢ High population density
➢ Urbanized
➢ Lack of green space

- Zafeiratou et al. (2023). Assessing individual and location characteristics as modifiers of heat effects on respiratory mortality at small area scale in Europe. Environmental Epidemiology
An ageing population is a vulnerable population

**SSP3 scenario:**

- 2010: Ten times as many cold-related deaths as heat-related deaths
- 2100: Twice as many heat-related deaths as cold-related deaths
- Today – year 2100: >2 million excess deaths attributable to climate change (SSP370)
- 5-10% of these deaths can be avoided by reaching WHO AQG (5 μg/m³)

Masselot P., Gasparrini A. & EXHAUSTION team (in prep.). Contrasting heat and cold-related mortality attributed to climate change in 854 European cities
Air pollution and climate change - health

WE BREATHE CLIMATE CHANGE

More people will die of lung diseases in our cities when high temperatures are combined with high levels of air pollution. This is especially true for those of us who are 65 and older.

Change in number of deaths from lung diseases in European cities (%) in association with high temperatures, by different levels of air pollution (PM2.5)

The good news
Policies that make us less exposed to heat and air pollution will be beneficial for our health and wellbeing.

Legend
Change in no. of deaths from lung diseases when we are exposed to moderate temperatures compared to:

- High temperatures and high air pollution
- High temperatures and medium air pollution
- High temperatures and low air pollution

Confidence interval: the estimate lies in this interval, with very high probability

Moderate temperature level: in the study period, 75% of the days in the city have a temperature below this level (°C)
Overall estimate Oslo Rome Berlin
Low 4 2 9 7
Medium 10 6 15 12
High 21 15 23 21

High temperature level: in the study period, 1% of the days in the city have a temperature above this level (°C)
Overall estimate Oslo Rome Berlin
Low 26.4 21 20.6 27.1
Medium 27 15.3 25.7 20.2
High 21 9 23 21
Wildfires: 2023 among the worst in the EU in this century

A sharp increase in burnt areas was recorded during the summer months of 2023, mostly affecting the Mediterranean region. By total burnt surface area, 2023 was the fourth worst year since 2000.

Extent of burnt areas in 2023 as reported by EFFIS. Yellow dots refer to areas up to 100 ha, orange up to 500 ha, pink up to 1000 ha, red up to 5000 ha, purple beyond 5000 ha.

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Smoke concentrations from fires may double by the middle of the century.

Population-weighted PM$_{2.5}$ concentration and % contribution from wildfires
US East Coast blanketed in veil of smoke from Canadian fires, New York City, June 8th, 2023
Wildfires in Canada, June 6–9, 2023

Air Pollution Episode in New York City

FIGURE. Daily mean particulate matter with aerodynamic diameter ≤2.5 μm and number of asthma-associated emergency department visits statewide* and selected regions — New York excluding New York City, June 1–14, 2023

Abbreviations: ED = emergency department; PM$_{2.5}$ = particulate matter with aerodynamic diameter ≤2.5 μm.

https://www.cdc.gov/mmwr/volumes/72/wr/mm7234a6.htm
ERS on Climate Change: Position Statement

Canada wildfires: ERS and ISEE call for immediate action to curb the health impact of climate change

ERS on Climate Change: Position Statement

Climate change and respiratory health: a European Respiratory Society position statement

Ana Maria Vicedo-Cabrera1,2, Erik Melén3, Francesco Forastiere4,5, Ulrike Gehring6, Klea Katsouyanni7,8, Arzu Yorgancioğlu9, Charlotte Suppli Ulrik10,11, Kjeld Hansen12,13, Pippa Powell12, Brian Ward14, Barbara Hoffmann15 and Zorana Jovanovic Andersen16

Climate change and respiratory disease: clinical guidance for healthcare professionals

Zorana Jovanovic Andersen1, Ana Maria Vicedo-Cabrera2,3, Barbara Hoffmann4 and Erik Melén5
Summary of Climate Change and Lung Health

Spreading of aeroallergens (new types, longer seasons), mosquitoes and ticks carrying infectious diseases moving North

More frequent and extreme weather events:

• Increasing temperatures and more frequent heat waves: high temperature / humidity / dehydration, increase in ozone

• Wildfires: massive air pollution exposure locally, transported for 1,000s miles

• Droughts: high winds, more frequent (desert) dust and sand storms

• Thunderstorms/showers: high winds, heavy precipitation, bursts of allergen release

• Floods: moisture from rainfall increases dampness and mould indoors

FIGURE 1 Summary scheme of the pathways linking climate change and impacts of respiratory health.
Conclusions:

- ERS calls on the health community and policymakers, European Parliament and governments around the world to urgently reduce emissions of greenhouse gases and mitigate effects of climate change.

- Air pollutants and greenhouse gases must be seen as a combined problem, and action must consider all emissions and health consequences.

- Strict air quality standards (based on science and fully aligned with WHO 2021 Air Quality Guidelines) are major public and planetary health opportunity that would:
  1) mitigate climate change impacts on our health and our planet,
  2) prevent a substantial number of new cases of respiratory (other NCDs) diseases, and improve life of lung (NCD) patients.

- Continued education of clinicians and patients crucially important to mitigate health effects on respiratory patients.
Solid evidence on air pollution and climate change health effects: we know enough to act

- 2018, UN recognized air pollution as risk factor for NCDs
- WHO air pollution - ‘quiet pandemic’
- 2024, COP28 – health on climate action agenda

Reduction of air pollution is a major public and planetary health opportunity, that would:

1. Prevent a substantial number of new NCD & deaths
2. Improve life of lung, heart, and other NCD patients
3. Make citizens more resilient to COVID-19 and other seasonal (influenza) epidemics
4. Help mitigate unprecedented climate change impact on our health and our planet – mitigate heat effects
5. Cities: car traffic reduction, promotion of active travel, greening (parks, shade, green roofs)

Clean air as a basic civil right - no one should get sick or die from breathing
THANK YOU
zorana.andersen@sund.ku.dk

Photos by Branislav Nenin
University of Copenhagen, Challenge - Data for Good Science