

Heat and air pollution – a joint threat for health

Dr. Alexandra Schneider

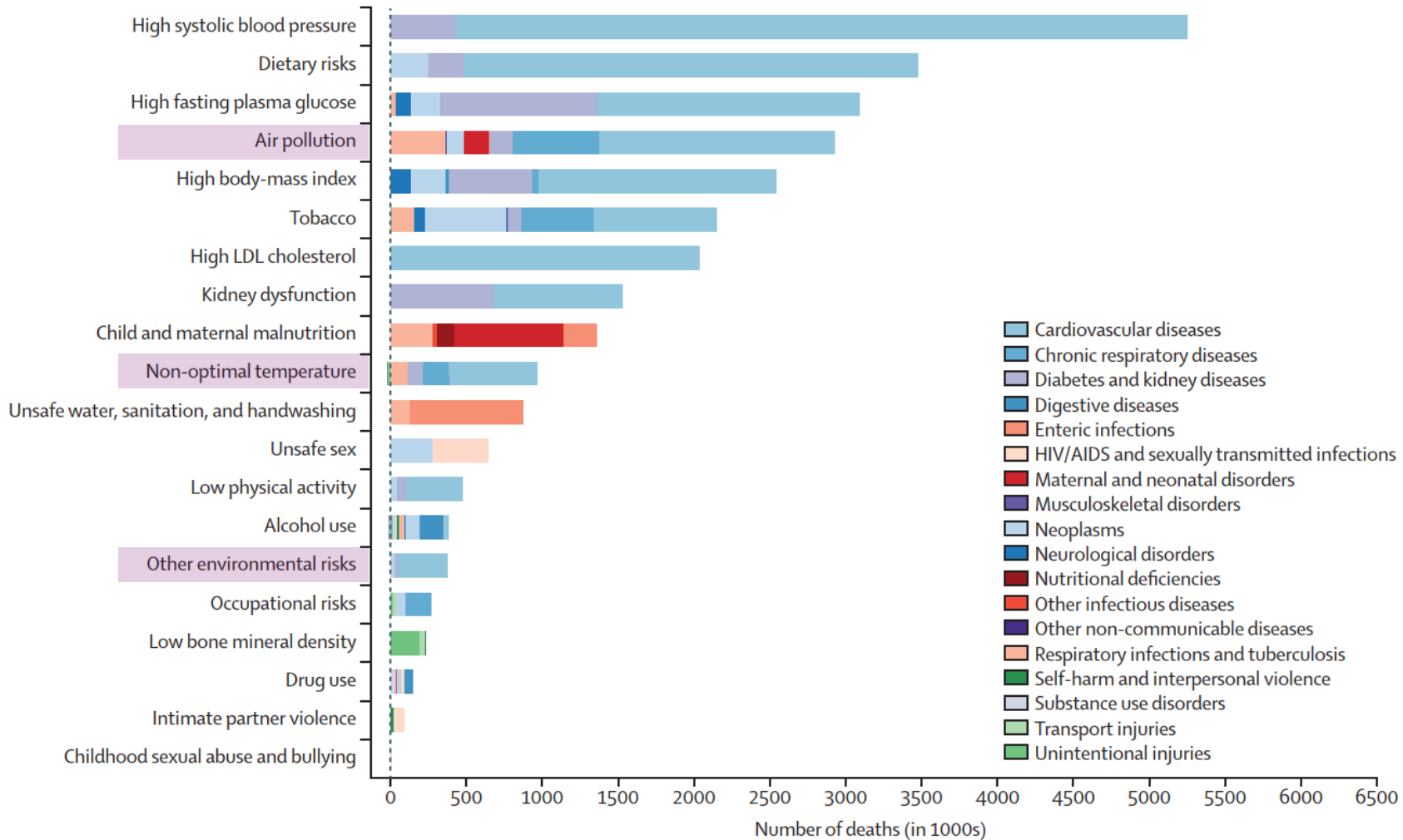
Helmholtz Munich - Institute of Epidemiology

Brussels, 15.11.2023



Global attributable deaths by risk factors

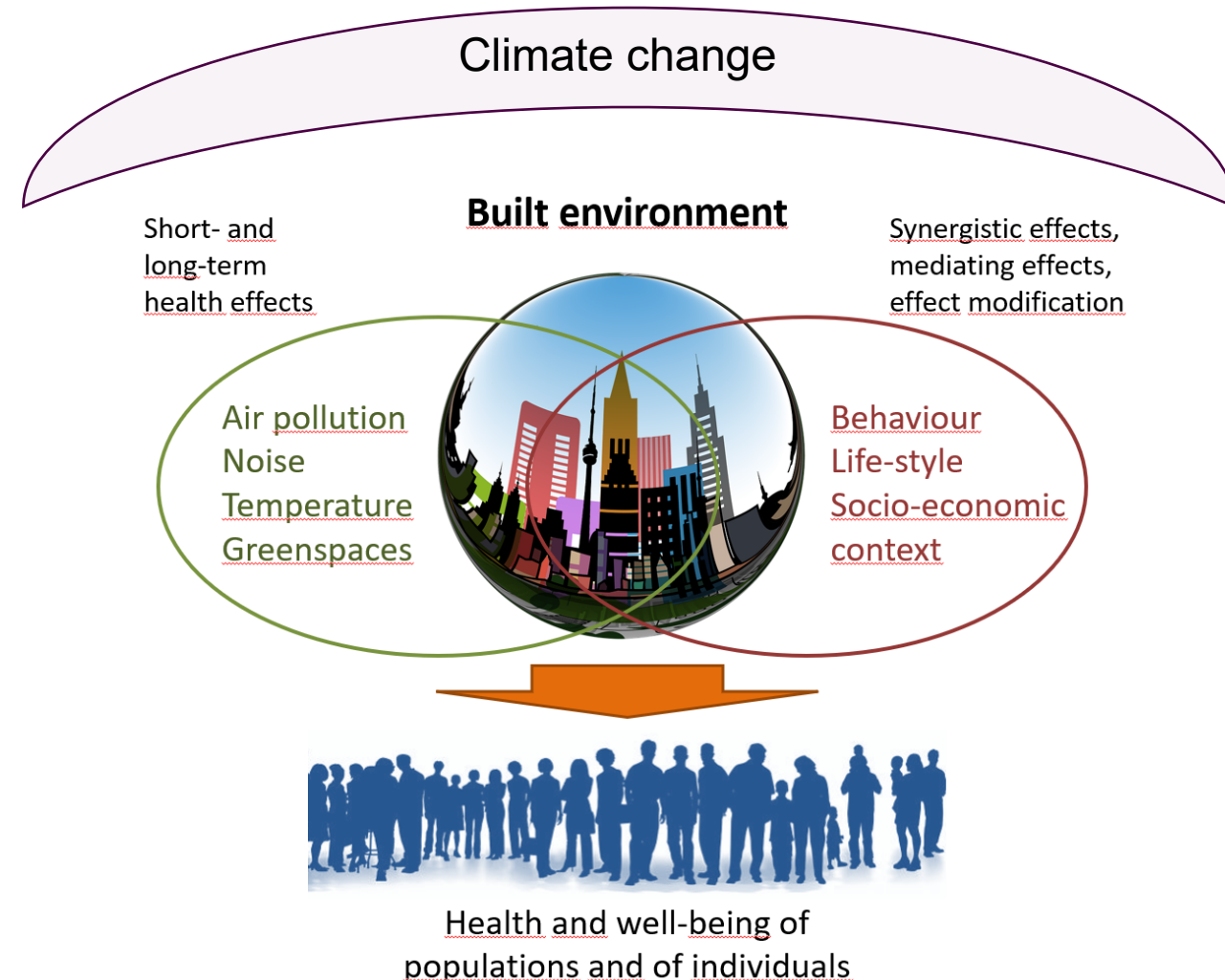
A Global attributable deaths from Level 2 risk factors for females in 2019



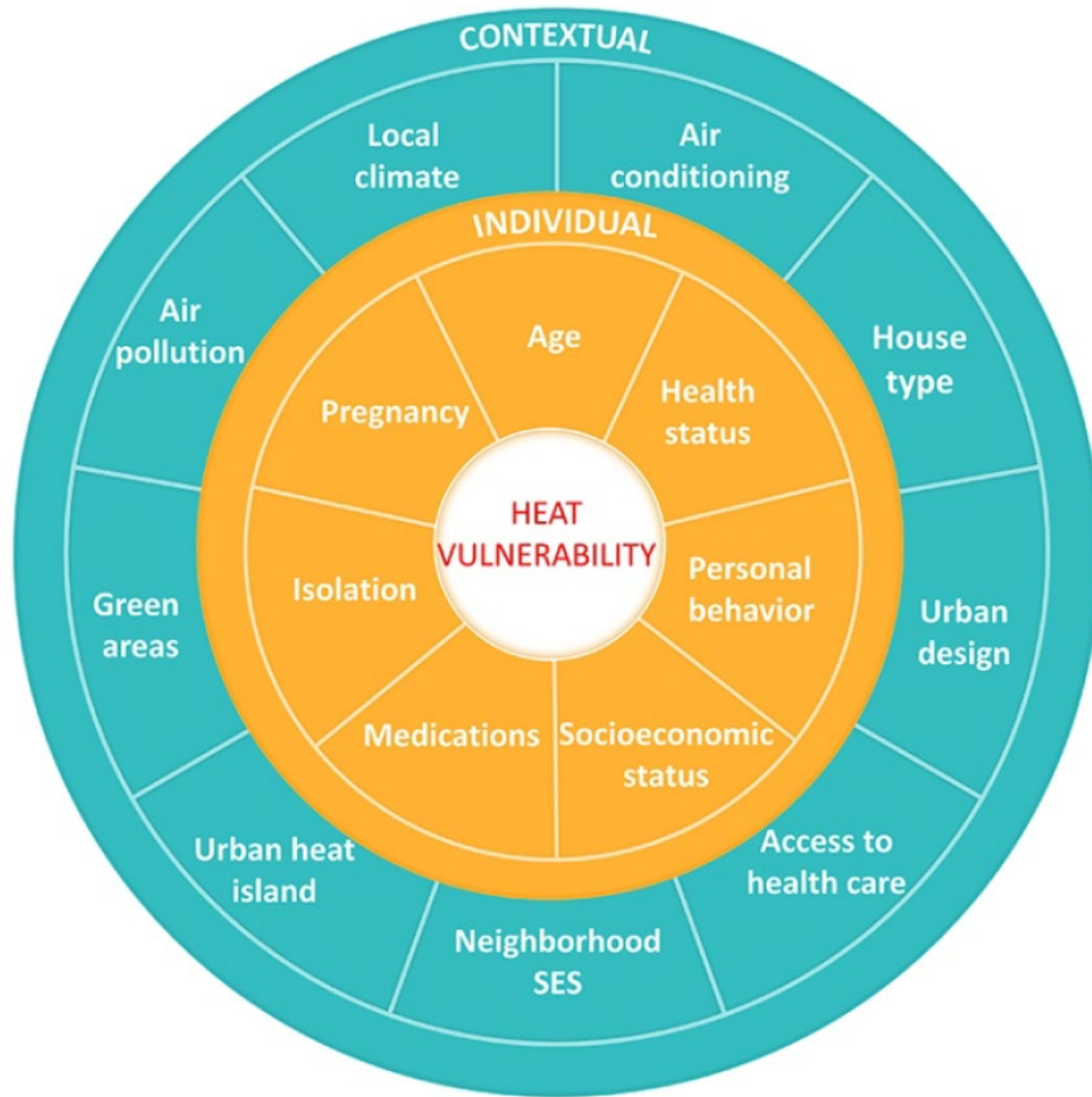
Air pollution and non-optimal temperature among top ten

The environment impacts our health and well-being

- The **environment** is a major factor determining **health and quality of life**
- Several factors identified which affect health negatively or beneficially
- **BUT: comprehensive assessment is missing as exposures do not affect humans in isolation**
- 75% of European population live in urban areas, trend is increasing
- Effects will be further enhanced with climate change

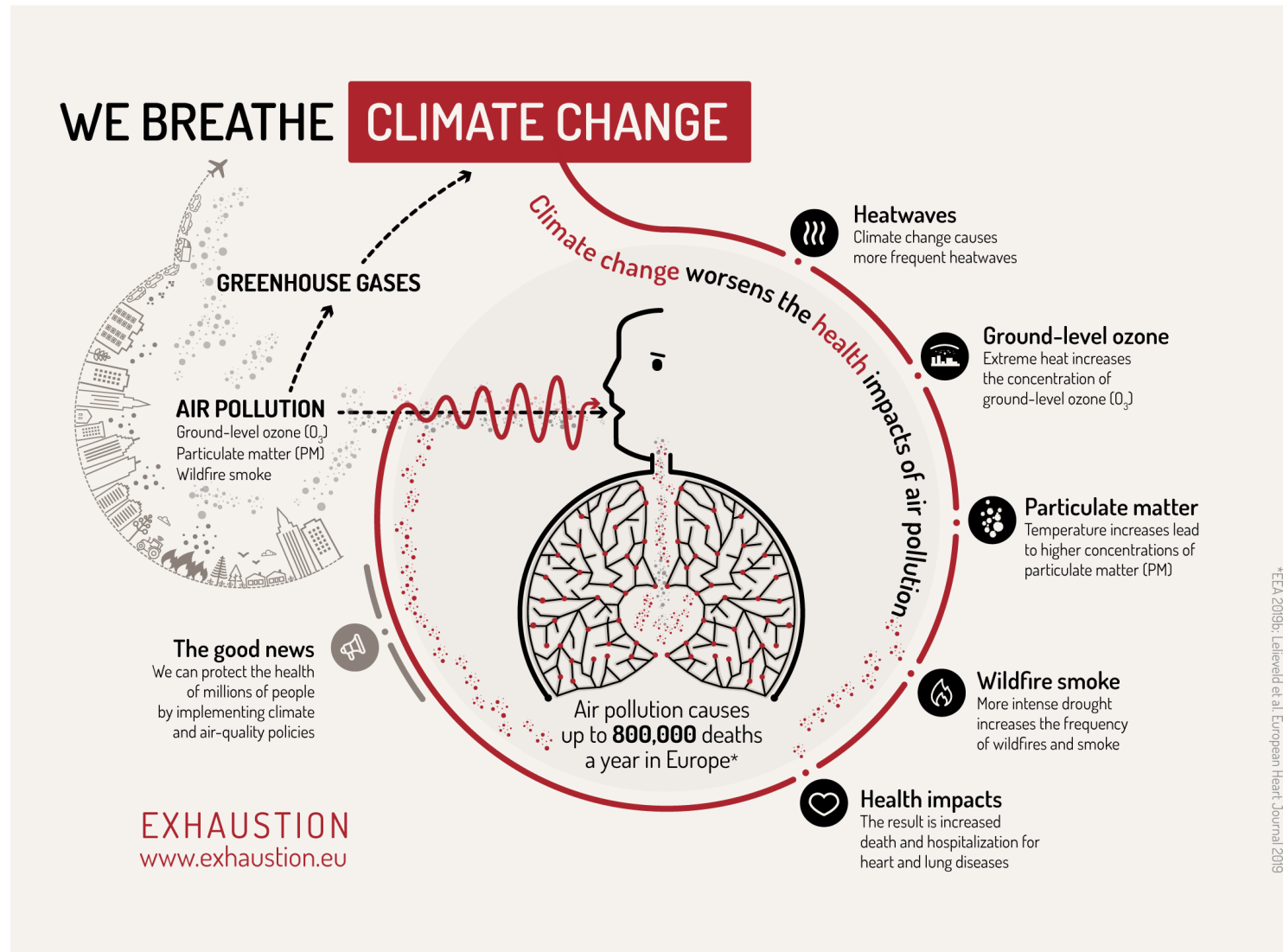


So far, mostly isolated analysis of heat effects, but:



Interplay of environmental factors is complex – among each other, but also with individual factors

EXHAUSTION: Interaction of heat and air pollution in Europe



Entire population affected:
public health action
→ high potential for beneficial effects and prevention



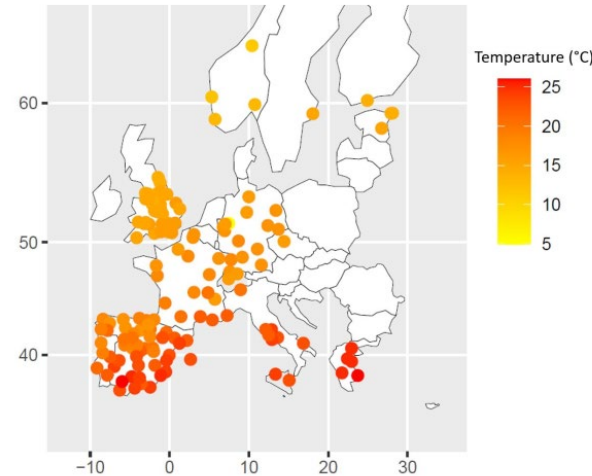
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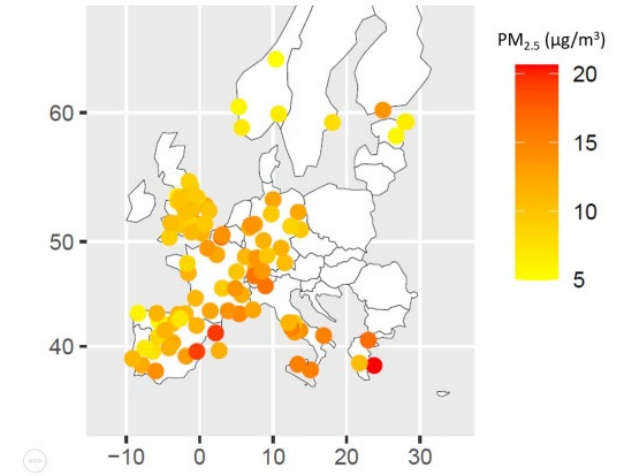
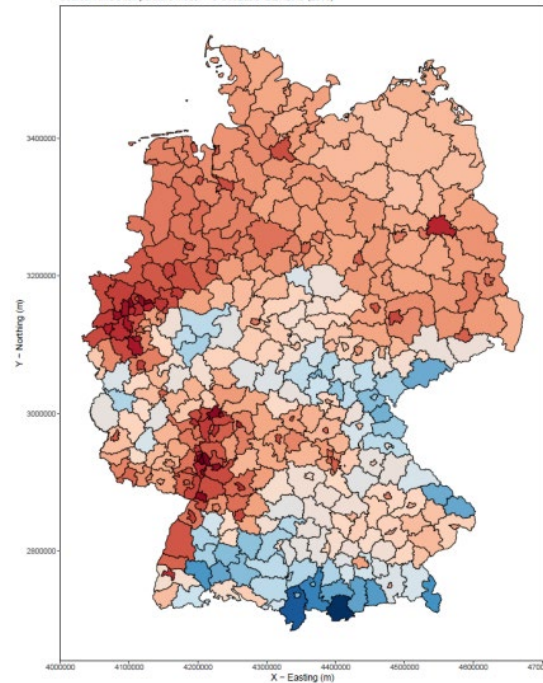


EXHAUSTION: Exposure to heat and air pollution in Europe

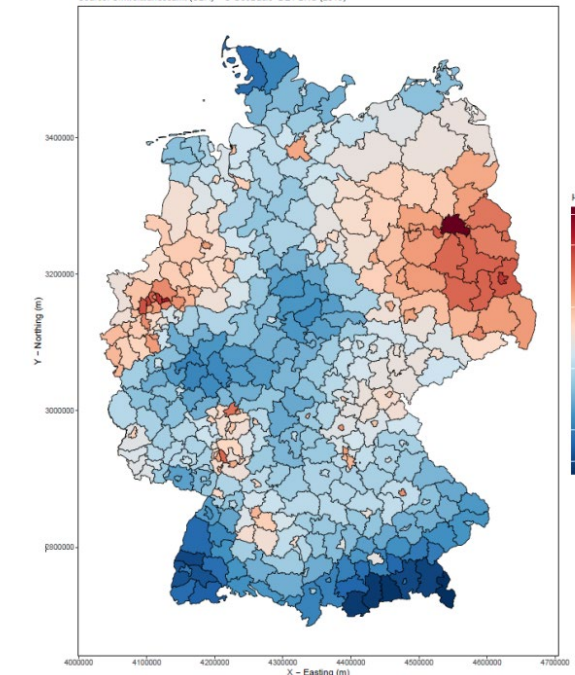
- **Level 1:** Mortality data for **cities** in 15 European countries, 1990-2018
 - Exposure from monitors
 - Based on MCC database
- **Level 2:** Small-area health data
 - Norway, England/Wales, Germany, Italy, Greece
 - Exposure from models
 - Average per area assigned
- **Level 3:** Prospective cohorts (N=5)
 - Exposure from models
 - Individual assignment



Annual average temperature for Germany, 2015
Source: HMGU temperature model - © GeoBasis-DE / BKG (2019)



Annual average PM_{2.5} for Germany, 2015
Source: Umweltbundesamt (UBA) - © GeoBasis-DE / BKG (2019)



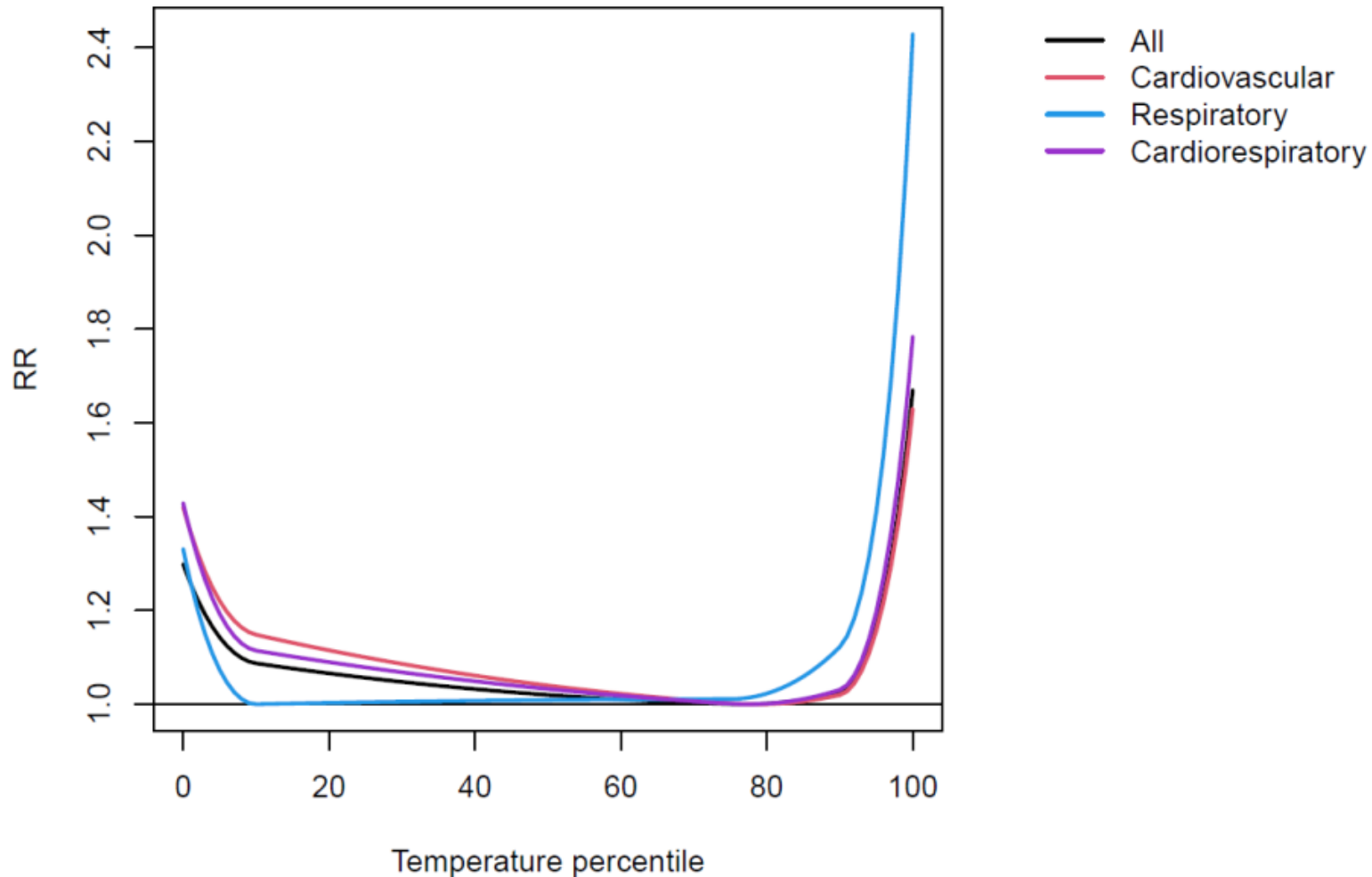
EXHAUSTION: Level 1 – temperature and mortality



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Exposure-response functions for European cities:

Association between mean daily air temperature (averaged over 11 days: lag 0 to lag 10) and total mortality, cardiovascular mortality, respiratory mortality and cardiorespiratory mortality



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Project EXHAUSTION: Interaction of heat and PM_{2.5}

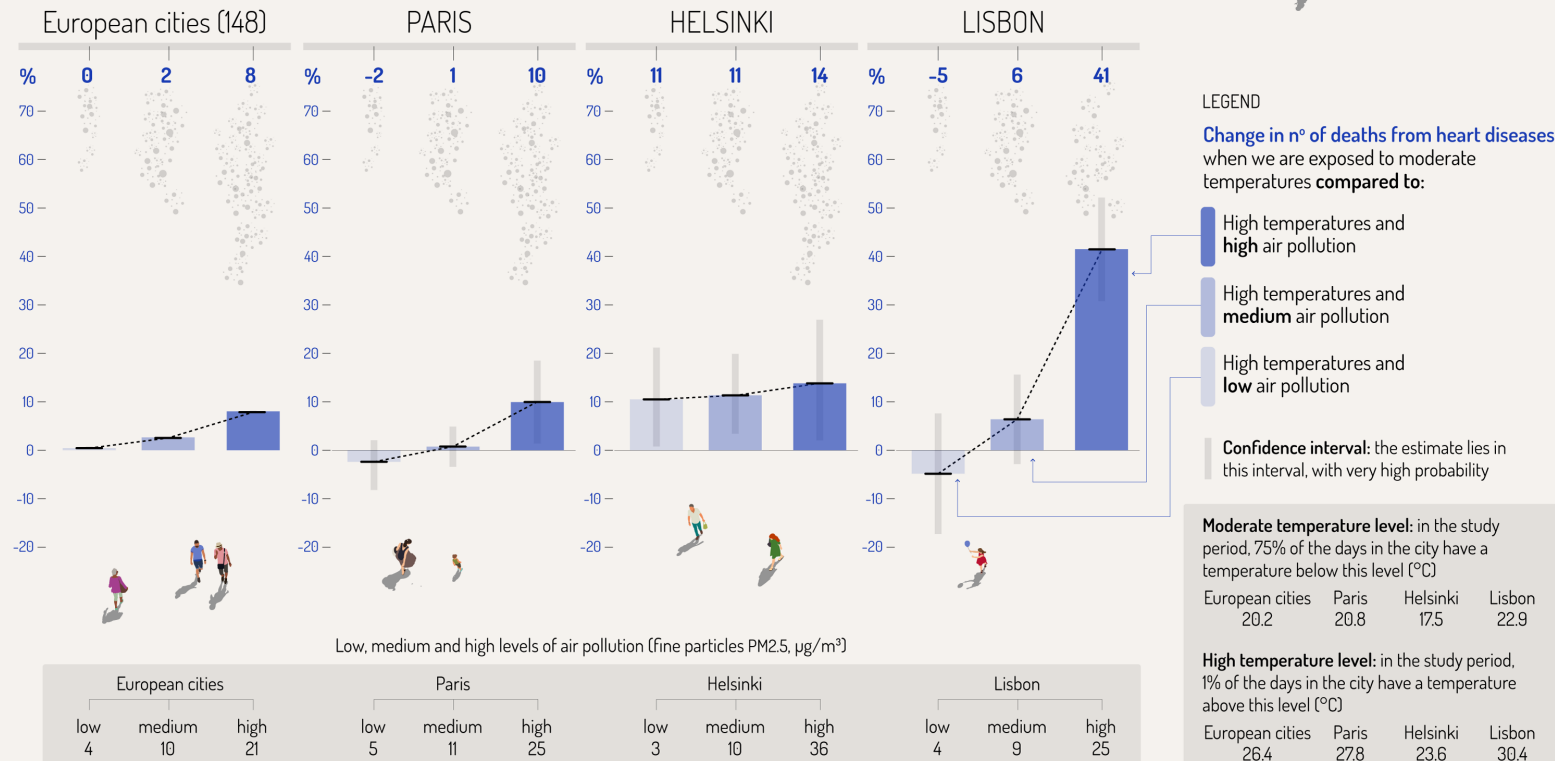


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WE BREATHE CLIMATE CHANGE

More people will die of **heart** 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 n° of deaths from heart 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.




**Heart disease:
Air pollution
worsens heat
effects on
mortality**

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Project EXHAUSTION: Interaction of heat and PM_{2.5}




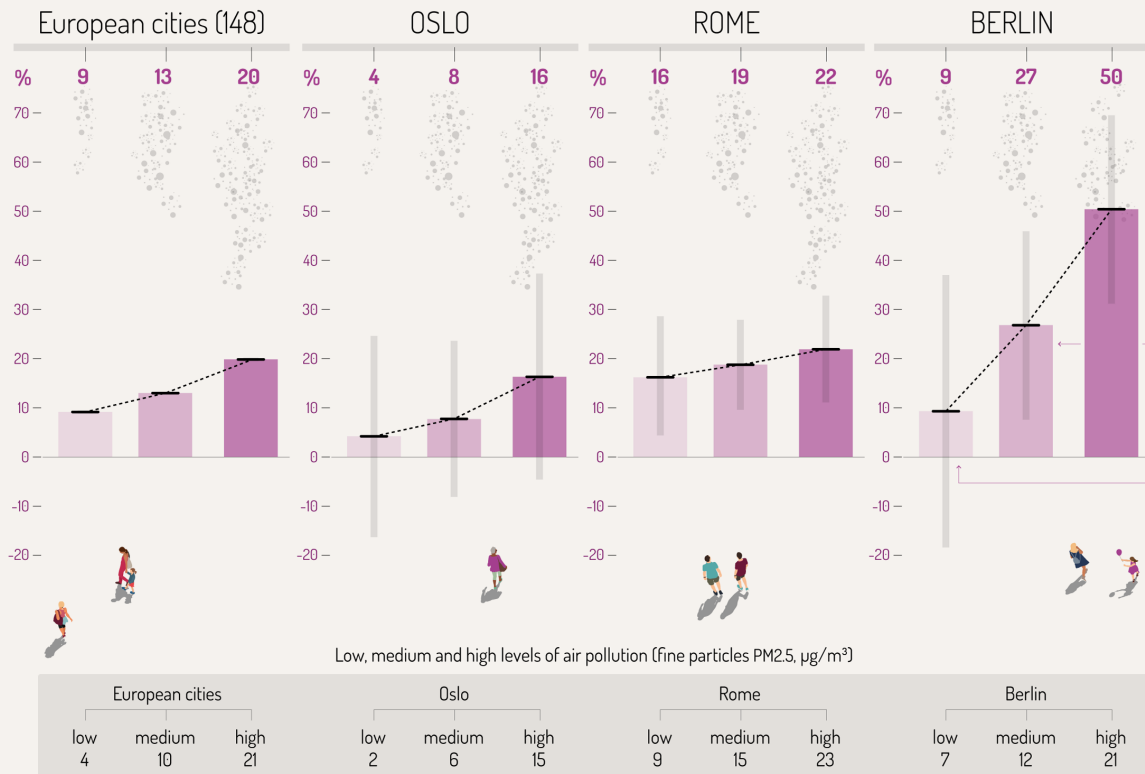
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WE BREATHE CLIMATE CHANGE

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 n° 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 n° 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)

European cities	Oslo	Rome	Berlin
20.2	15.3	25.7	20.2

High temperature level: in the study period, 1% of the days in the city have a temperature above this level (°C)

European cities	Oslo	Rome	Berlin
26.4	21.7	29.6	27.1



**Lung disease:
Air pollution
worsens heat
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mortality**

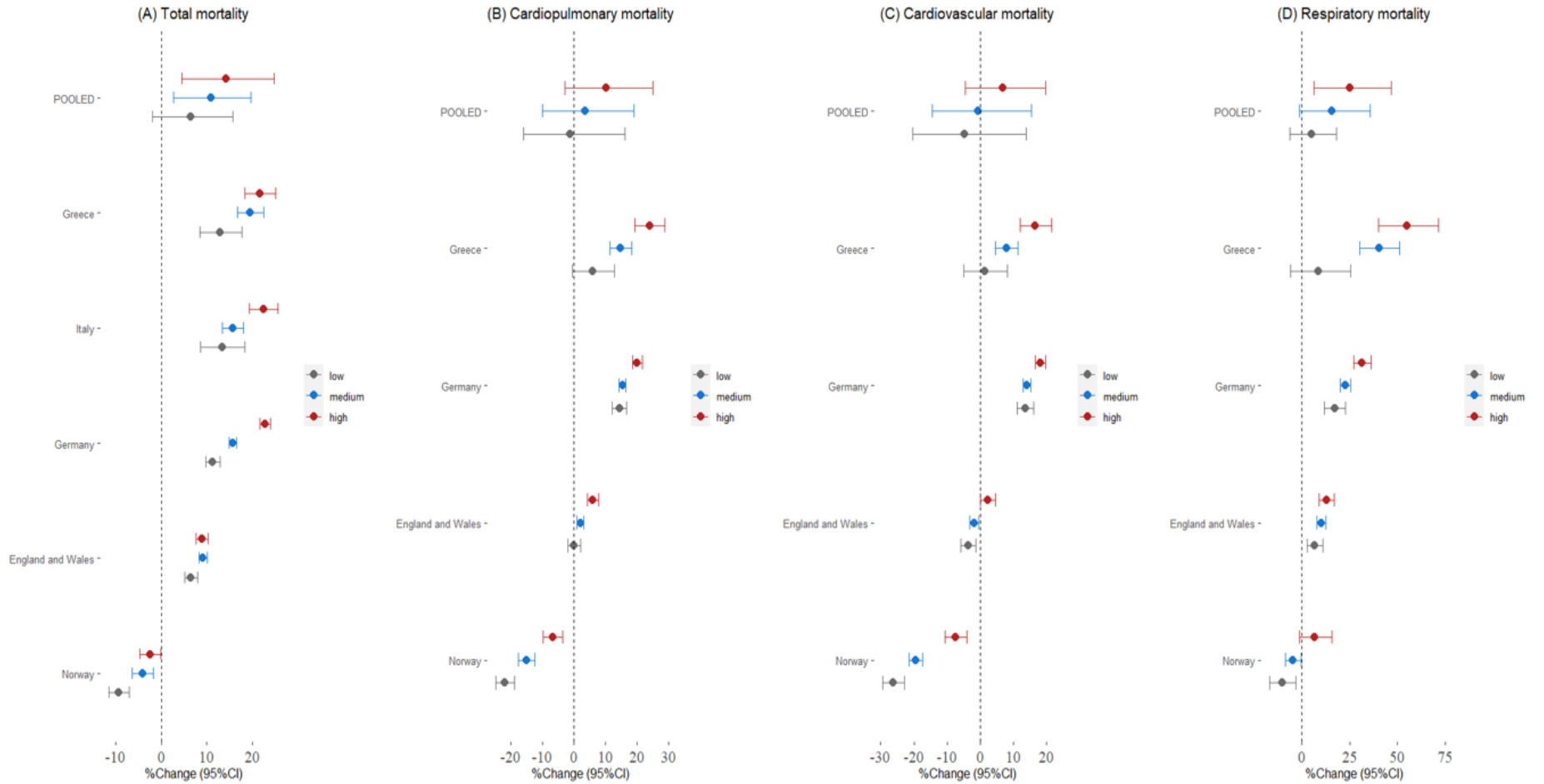
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EXHAUSTION: Level 2 – effect modification by air pollution



EXHAUSTION

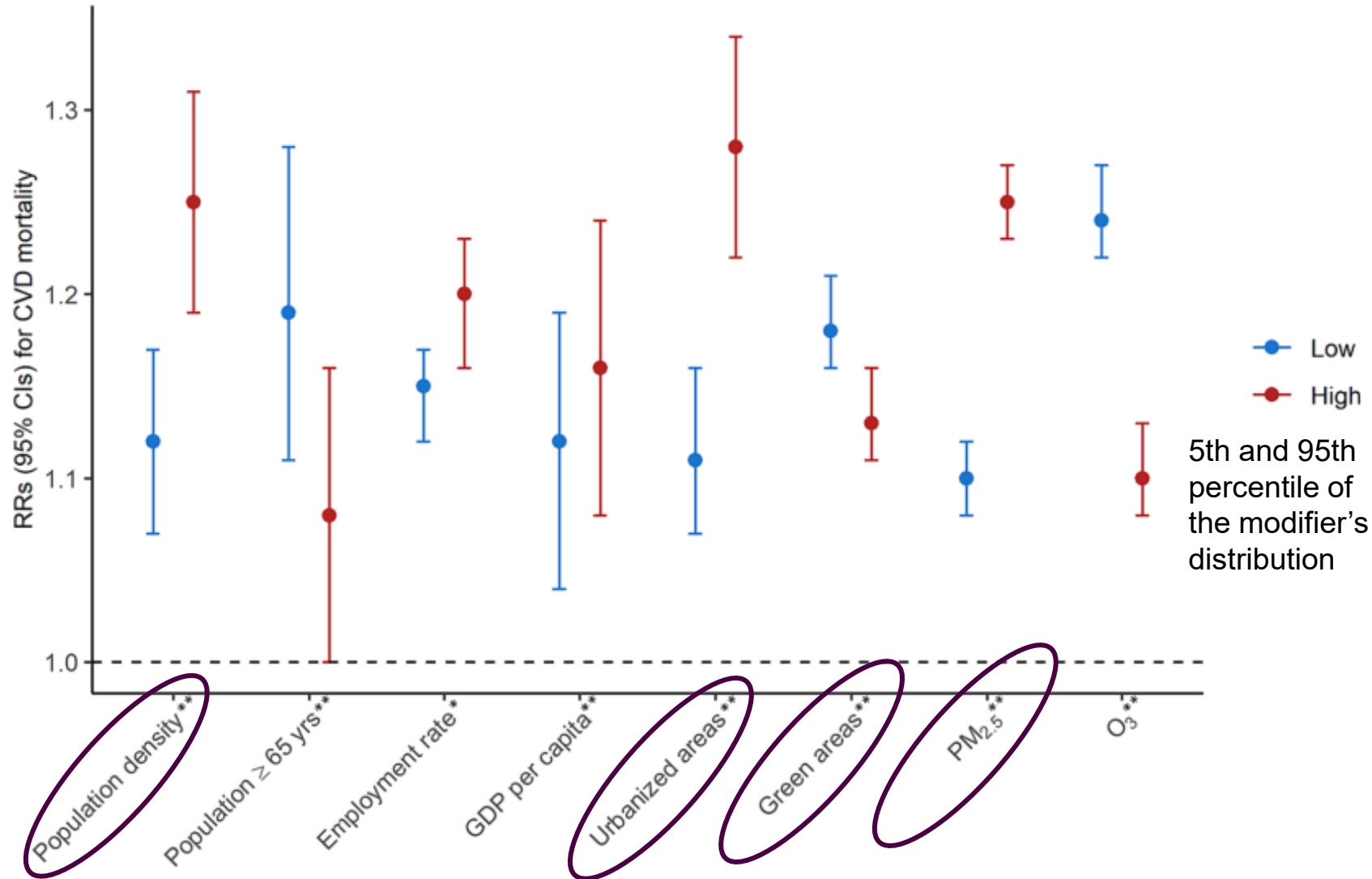


- Meta-analysis and country-specific estimates
- Association between 2-day mean temperature and mortality
- Effect modification by low, medium, and high levels of $PM_{2.5}$ (PM_{10} for Greece)
- Temperature effects more pronounced for higher PM

EXHAUSTION: Level 2 – Heat effects on cardiovascular mortality at low and high levels of effect modifiers



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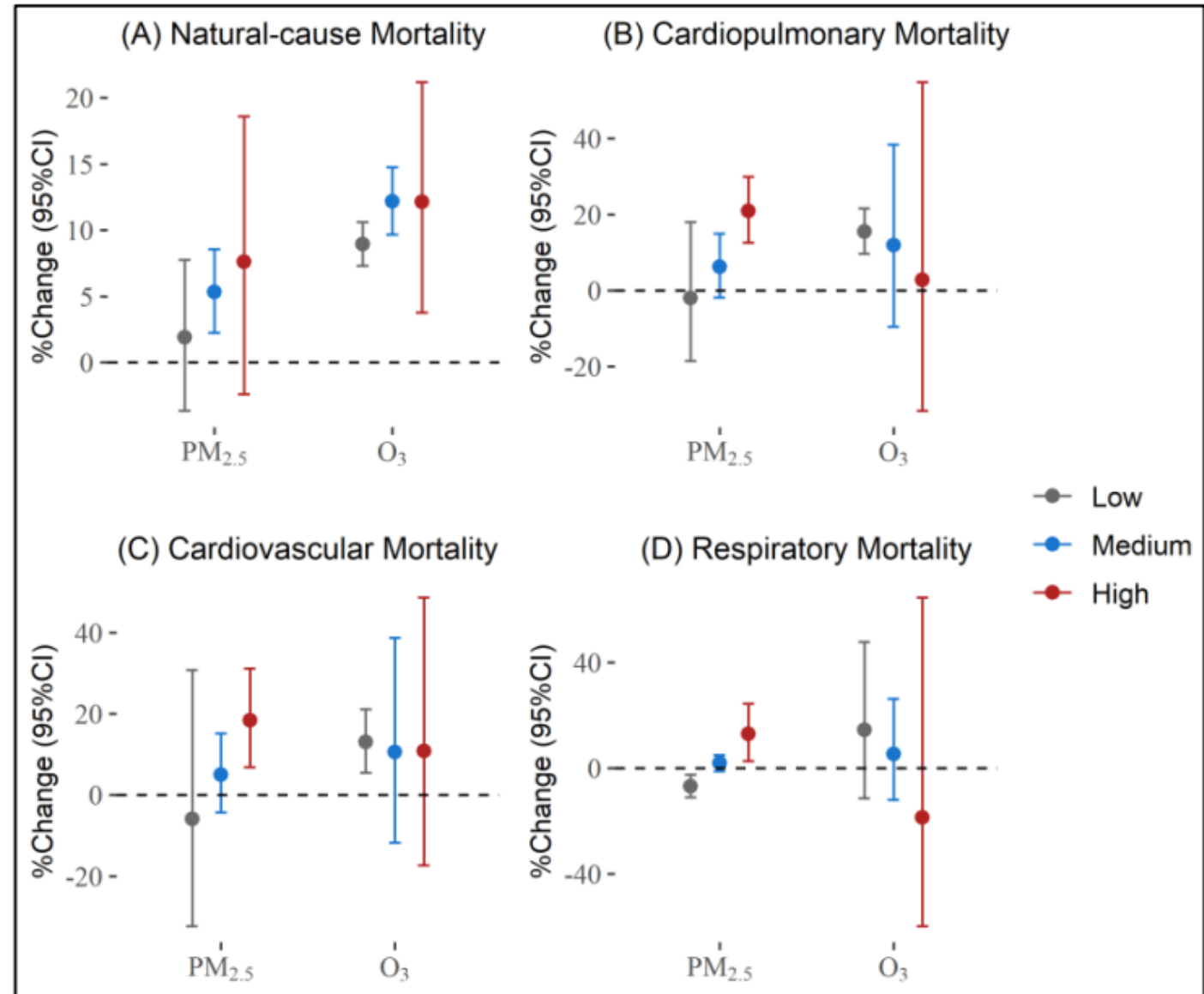


- Meta-analysis estimates (Norway, England/Wales, Germany)
- Association between 2-day mean temperature and CVD mortality
- **Greater heat vulnerability was observed in:**
 - areas with high population density
 - high degree of urbanization
 - low green coverage
 - high levels of fine particulate matter



EXHAUSTION: Level 3 – meta-analysis across cohorts

- **5 prospective cohorts:**
KORA (Germany),
RoLS (Italy),
CONOR (Norway),
SWEDEHEART (Sweden),
UK Biobank
- Meta-analysis of heat-mortality effect modification by $PM_{2.5}$ and O_3 in all cohorts
- **Temperature effects more pronounced for higher $PM_{2.5}$**



Take home message

- Atmospheric environmental exposures do not affect humans in isolation, but humans are instead exposed to a **mix of environmental factors**
→ a more comprehensive view on multi-exposures is essential
- Alignment of new air pollution limit values with the latest **WHO Air Quality Guidelines**:
 - leads to immediate improvements in health and prevention
 - helps significantly in mitigating and adapting to climate change
- Integrated environmental, climate and health policies can have synergistic effects and generate **health co-benefits** of climate protection and climate adaptation measures



THANKS!



Any Questions ???

alexandra.schneider@helmholtz-munich.de

+49 89 3187-3512

@SchneiderAlex71