

Heat and air pollution – a joint threat for health

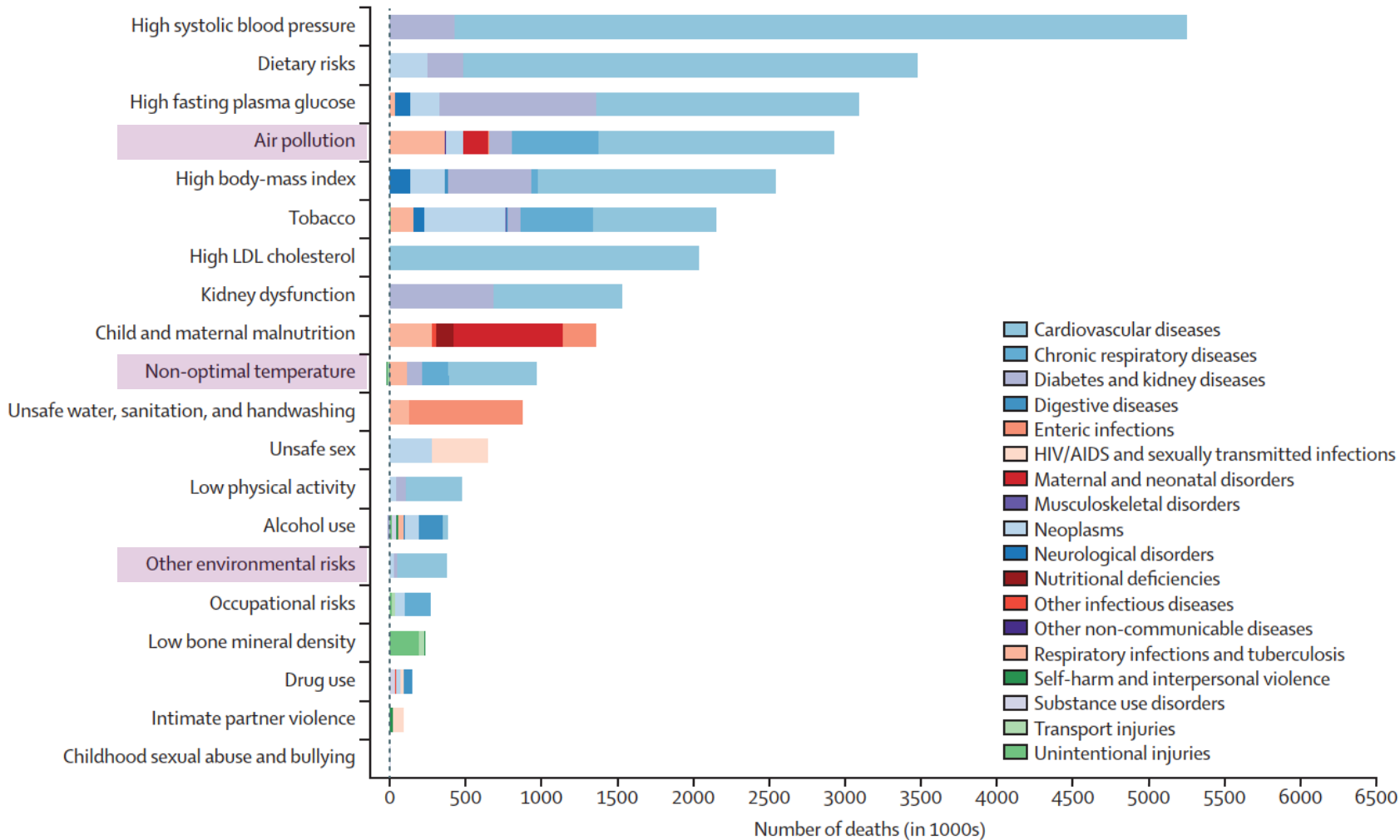
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Helmholtz Munich - Institute of Epidemiology

Brussels, 19.09.2023

Global attributable deaths by risk factors

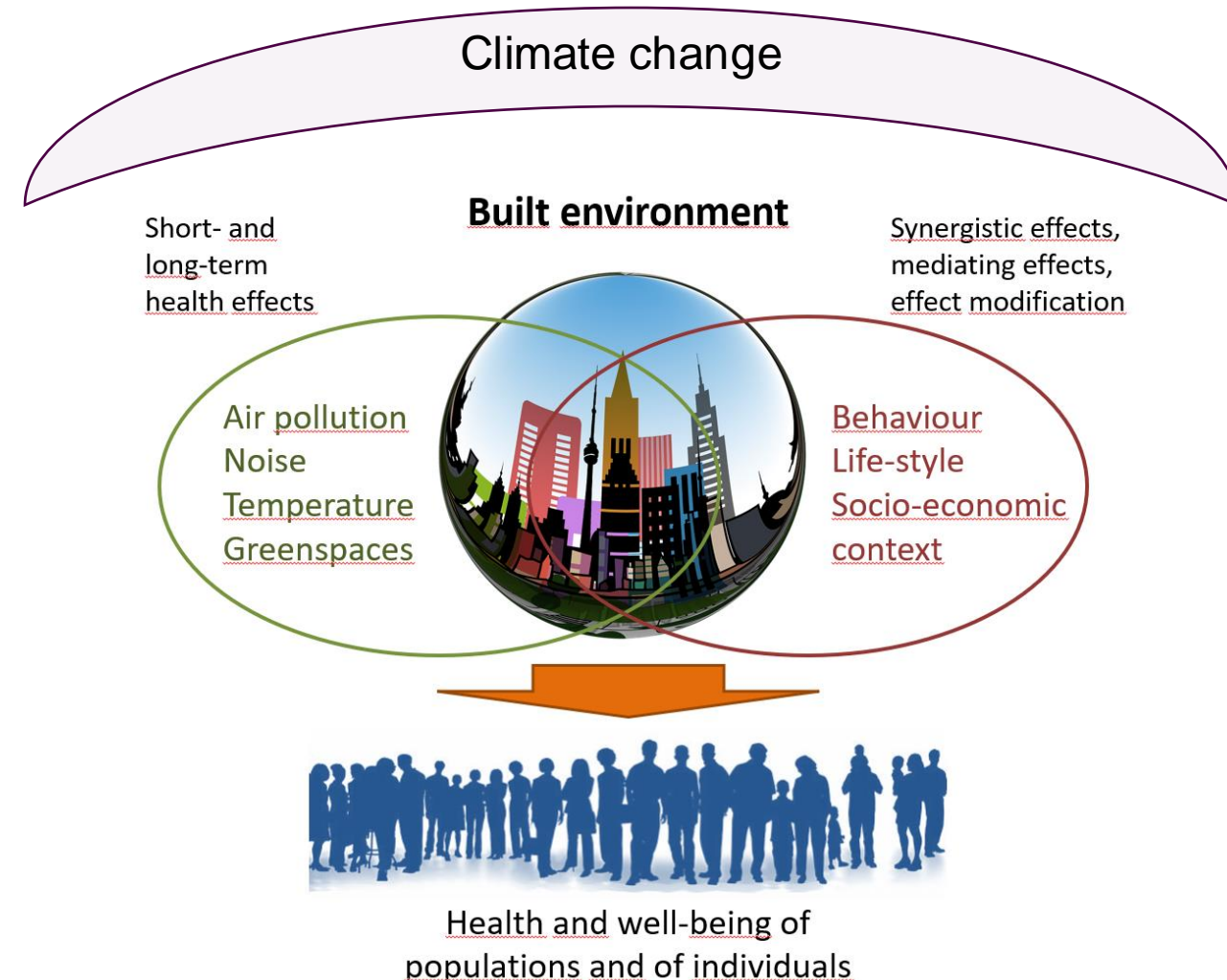
A Global attributable deaths from Level 2 risk factors for females in 2019



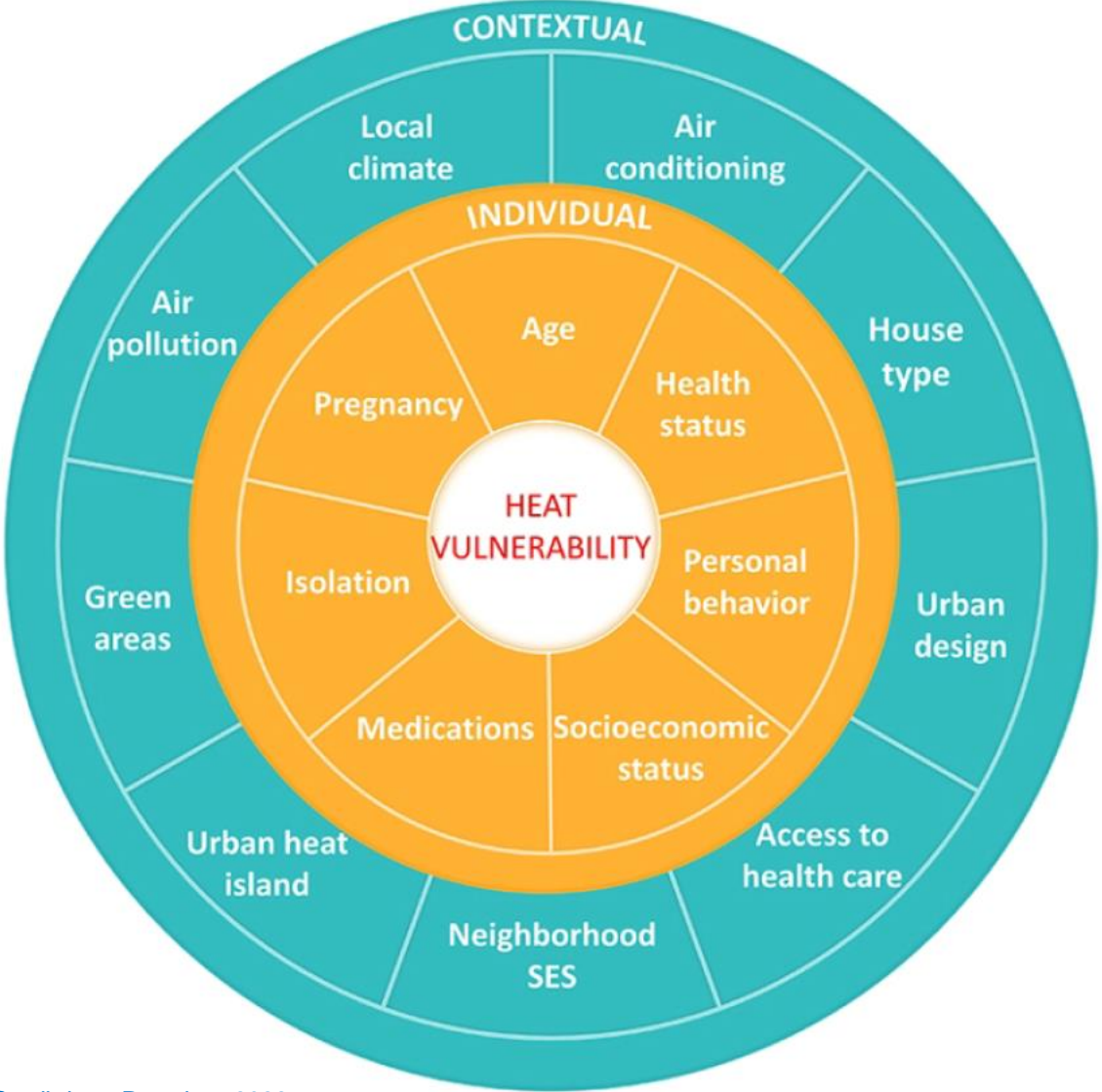
Air pollution and non-optimal temperature among top ten

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



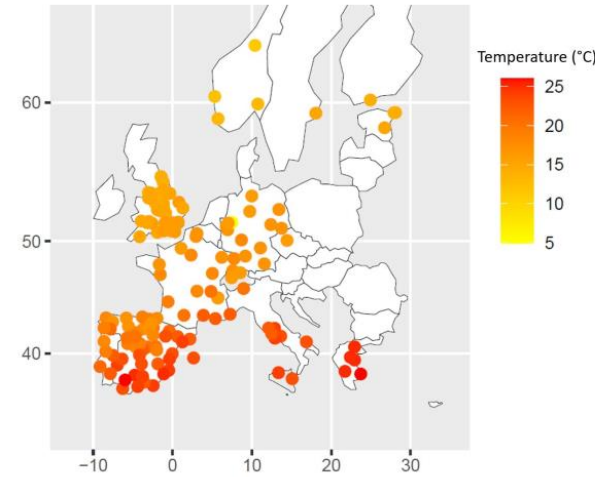
So far, mostly isolated analysis of heat effects, but:



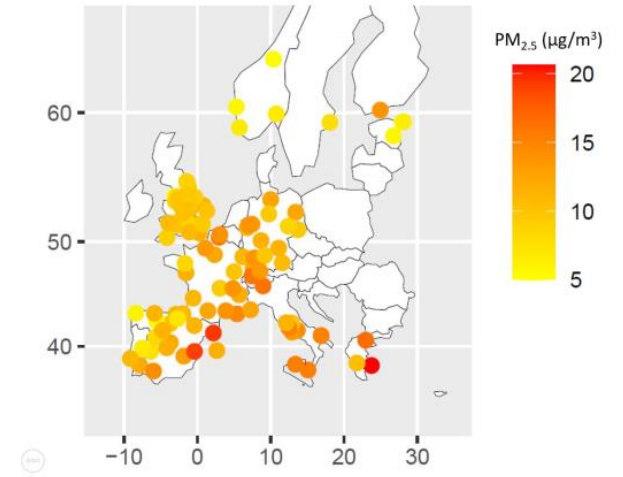
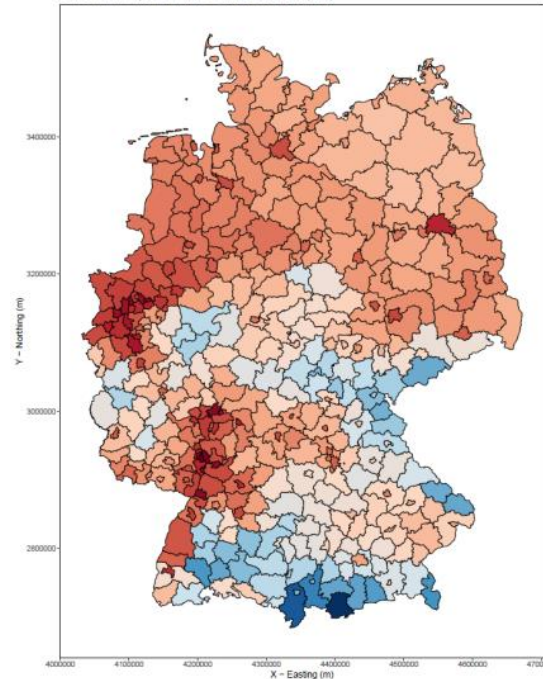


EXHAUSTION: Exposure to heat and air pollution in Europe

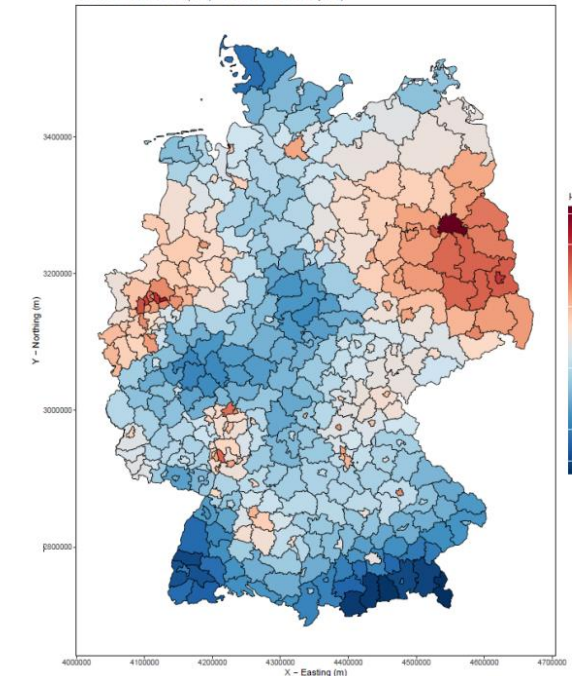
- **Level 1: Mortality data for cities** in 15 European countries, 1990-2018
 - Exposure from monitors
 - Based on MCC database
- **Level 2: Small-area health data**
 - Norway, England/Wales, Germany, Italy, Greece
 - Exposure from models
 - Average per area assigned
- **Level 3: prospective cohorts (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 results – temperature and mortality



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Figure 3 Exposure-response functions (ERF) for Europe. Association between mean air temperature (lag 0-10) and the 4 study outcomes: main approach.

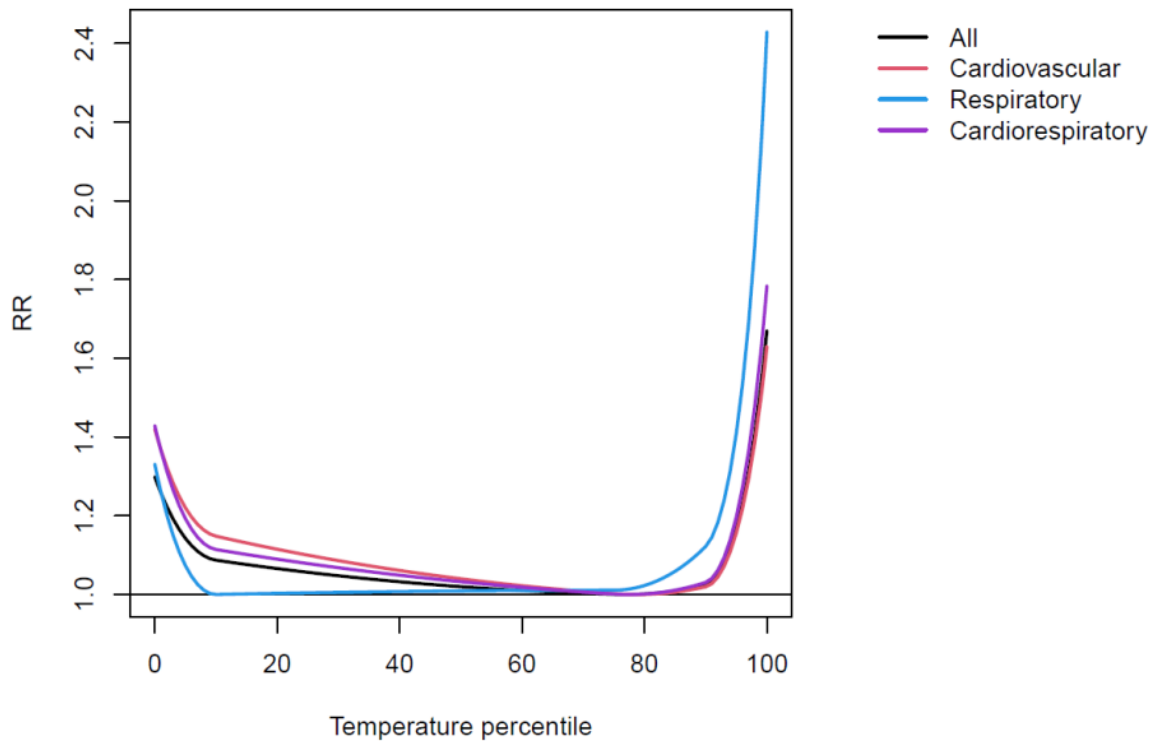
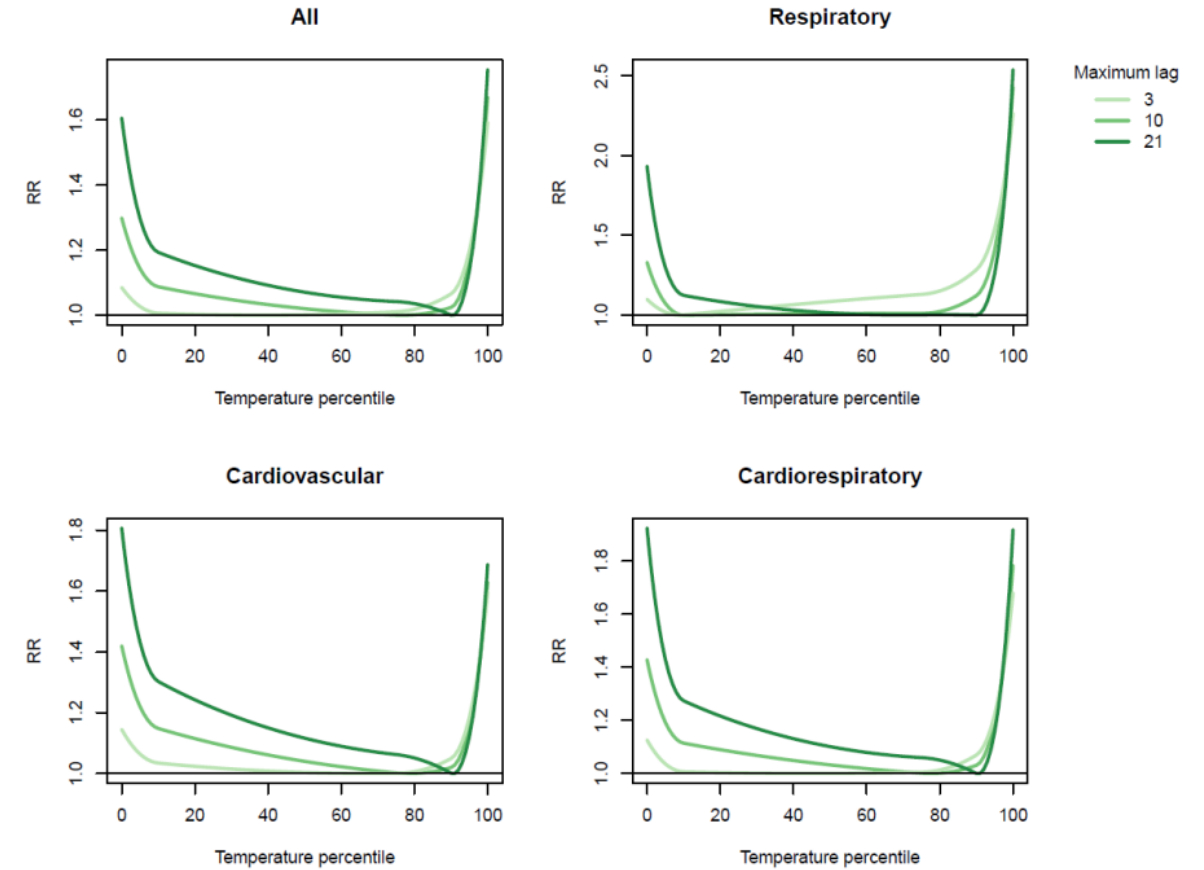


Figure 4 Exposure-response functions (ERF) for Europe at different lags. Association between mean air temperature and the 4 study outcomes by lags (0-3, 0-10, 0-21)



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EXHAUSTION: Interaction of heat and PM_{2.5}



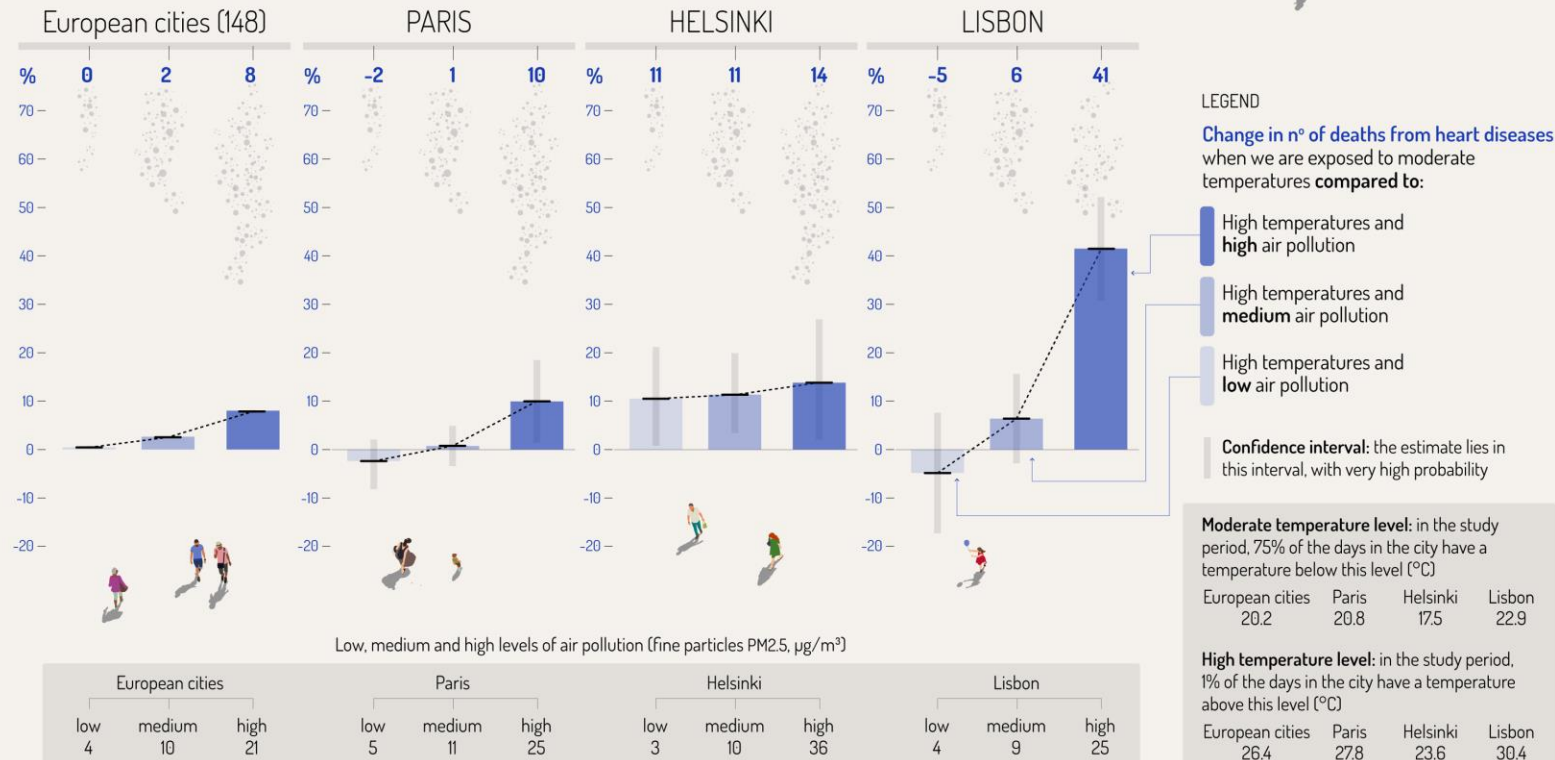
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WE BREATHE CLIMATE CHANGE

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
makes heat
effects on
mortality worse**

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EXHAUSTION: Interaction of heat and PM_{2.5}




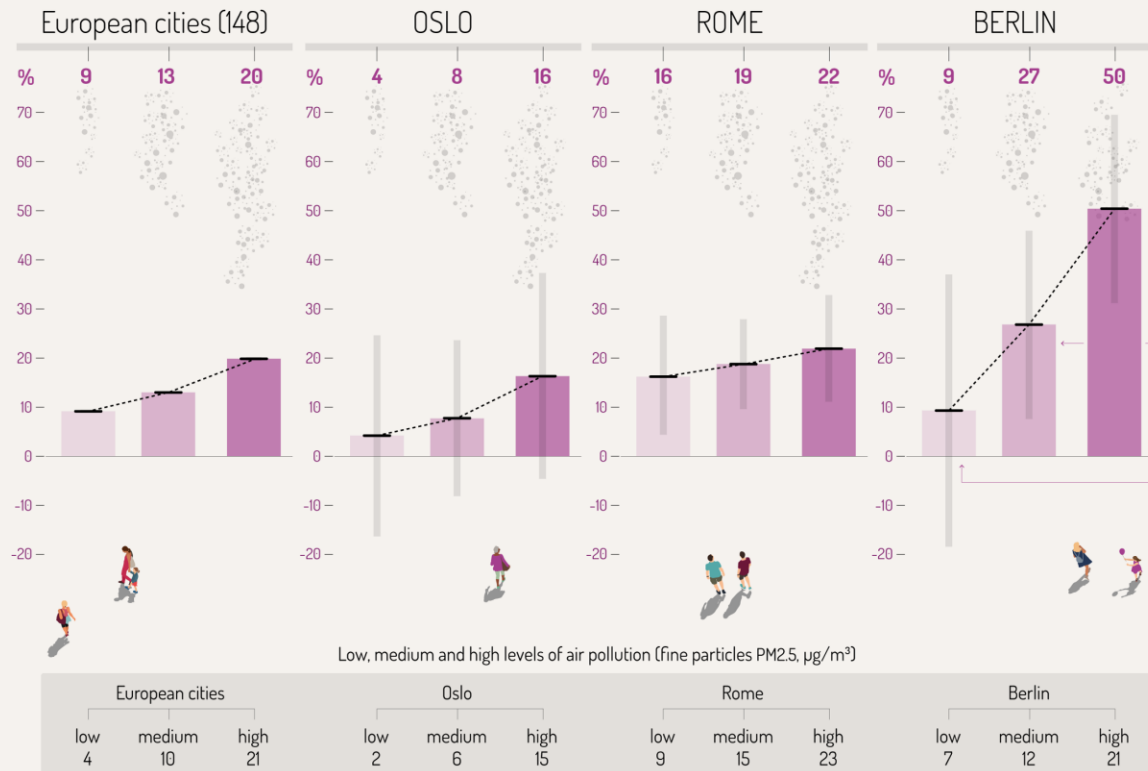
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WE BREATHE CLIMATE CHANGE

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 (PM_{2.5})**



 **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
makes heat
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mortality worse**

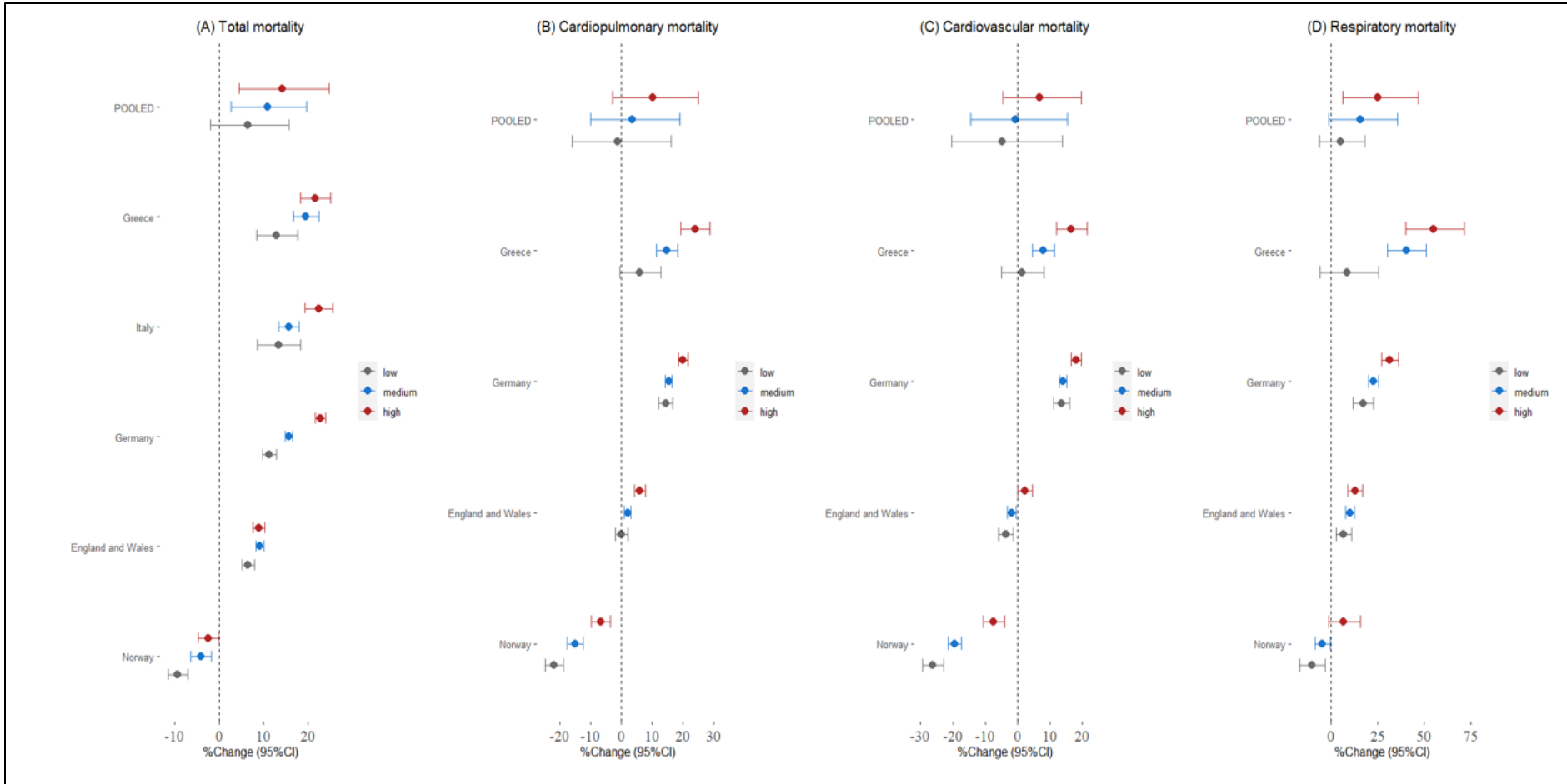
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EXHAUSTION: Level 2 – effect modification by air pollution

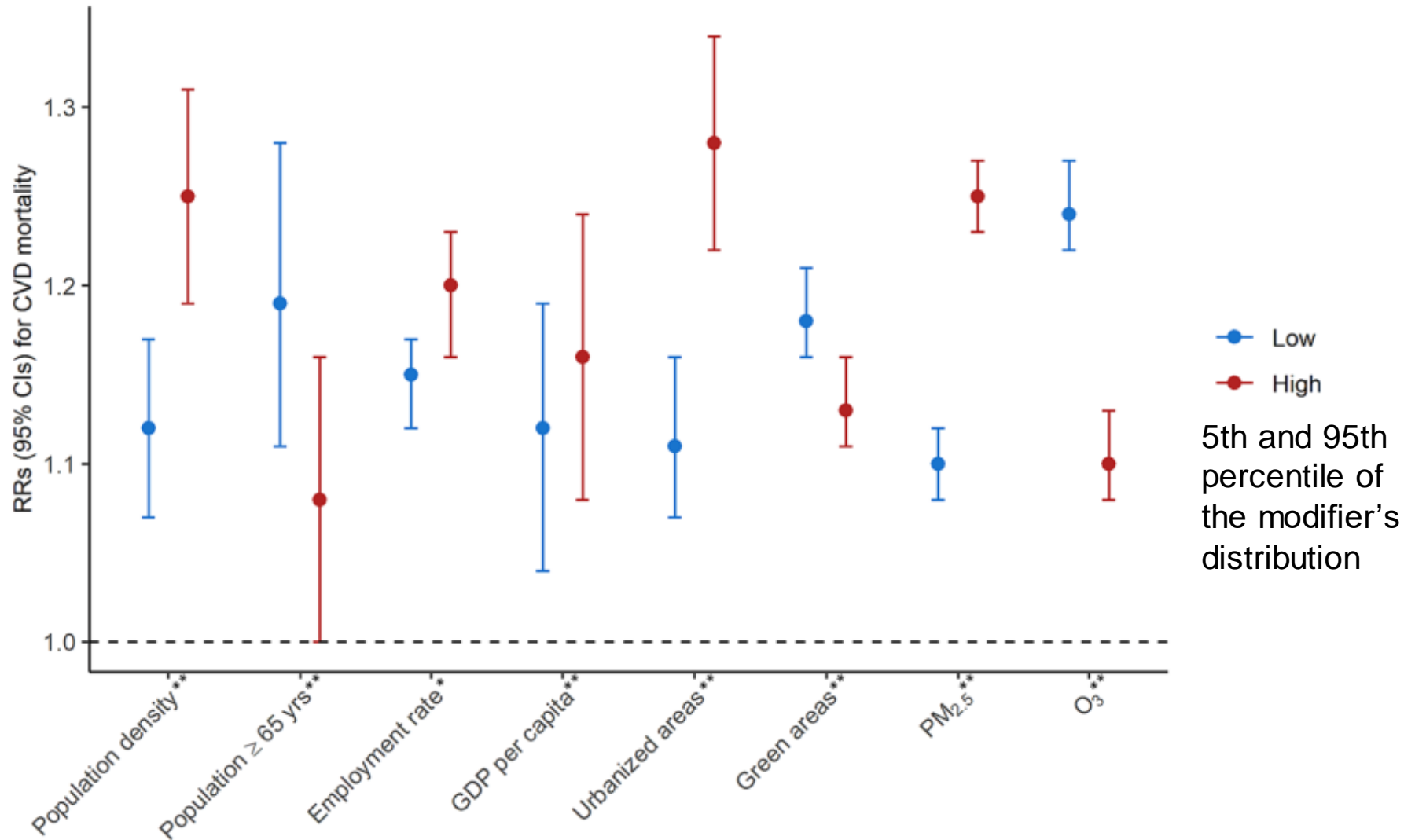


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- Meta-analysis and country-specific estimates
- Association between 2-day mean temperature and mortality
- Effect modification by low, medium, and high levels of PM_{2.5} (PM₁₀ for Greece)
- Temperature effects more pronounced for higher PM

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



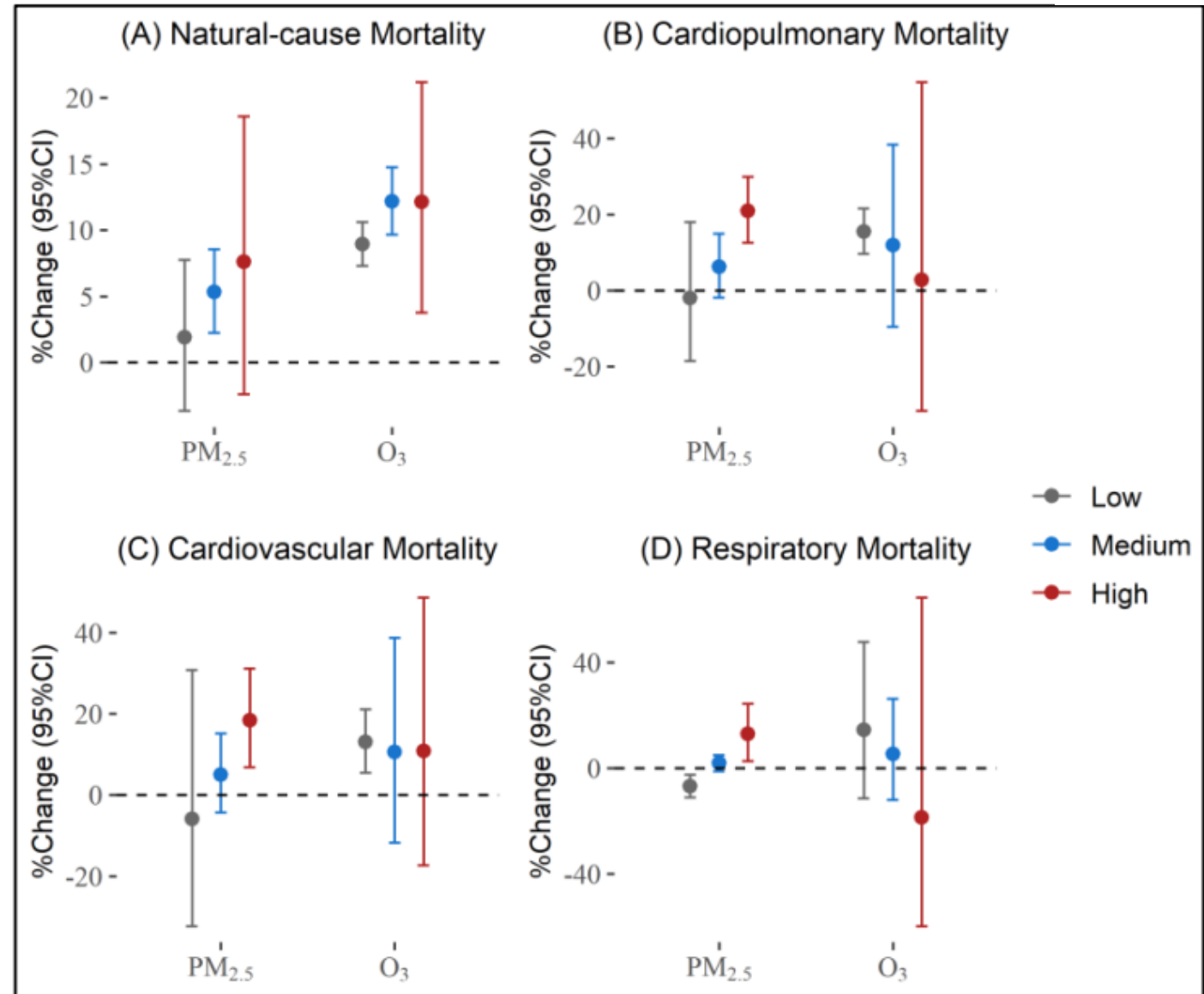
- Meta-analysis estimates
- Association between 2-day mean temperature and CVD mortality
- Greater heat vulnerability was observed in areas with high population density, high degree of urbanization, low green coverage, and high levels of fine particulate matter.

EXHAUSTION: Level 3 results – meta-analysis



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- 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 messages

- Atmospheric environmental exposures do not affect humans in isolation, instead, they are exposed to a mix of environmental factors → a comprehensive view on multi-exposures, such as air pollutants and thermal exposure, is essential
- Interplay of environmental factors is complex – among each other, but also with individual factors
- 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
- An integrated environmental, climate and health policy will have synergistic effects and generate health co-benefits of climate protection and climate adaptation measures



THANKS!



Any Questions ???

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