Geographical and Sex Heterogeneity in Temperature Related Deaths in Europe

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BACKGROUND

- **European countries widely differ in their exposure, vulnerability and preparedness to extreme cold and heat events that generate excess human mortality.** Climate change is expected to exacerbate excess deaths in the future**,** threatening public health.
- Europe is characterized by a **high population magnitude** and an **aging demographic structure**.
- Although it is unequivocal that changing surface temperature affects human health, it remains challenging to accurately estimate the scale, the impact, and the geographical disparities of many temperature-sensitive health risks. Here, we explore heterogeneity in the relationship by **sex and geography**.

RQ: *How does geographical and sex heterogeneity in Europe affect the extreme-temperatures related-mortality in individuals aged above 65?*

OUR CONTRIBUTION

- Period: **2014 to 2022;**
- **28 European Countries** clustered at **NUTS3** level;
- Analysis of temperature-related mortality on **people aged above 65** categorized **by geographical area and sex;**
- **Climate Risk Typology Classification:** climate risk diverges across Europe not only spatially, but also in terms of hazards, exposure, vulnerability, and capability to adaptation.

DATA SOURCES AND VARIABLES

1. Population data: Eurostat

- *Deaths counts by week, sex, 5-year age group and NUTS 3 region grouped by month* (DEMO_R_ MWEEK3);
- *Population estimates on 1 January by age group, sex and NUTS 3 region* (DEMO_R_PJANGRP3);

2. Meteorological data: E-OBS provided by Copernicus Data Store

- *solar radiation, wind speed, relative humidity;*
- *daily average temperature in percentile ranges: ≤1st, 1st-5th, 5th-10th,10th-25th, 25th-75th, 75th-90th, 90th-95th, 95th-99th, ≥99th;*

3. European Climate Risk Typology Map: provided by European Environment Agency

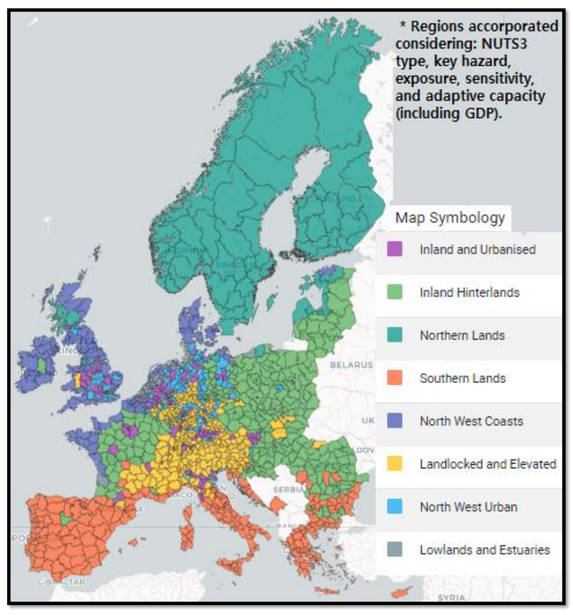

Figure 1: Climate risk typology Maps of NUTS 3 regions in Europe

METHOD

Poisson fixed effects approach

$$\log(Y_{nt}) = \log(E_{nt}) + \sum_j \theta_j TEMP_{nt}^j + X_{nt}\beta_{nt} + \alpha_{nw} + \delta_{yw} + e_{tn}$$

Y_{nt}: deaths in in month-year *t* and Nuts region *n*;
E_{nt} : population exposure in each month-year *t* and Nuts region *n*;
$TEMP_{nt}^j$: Number of days in each temperature *j-bin* in month-year *t* and NUTS3 region *n*;
X_{nt} : vector of control (solar radiation, relative humidity, wind speed, sex, age groups);
Fixed effects:δ_{yw}(year by month), α_{nw} (NUTS3 by month);
SE: NUTS3.

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SCAN ME

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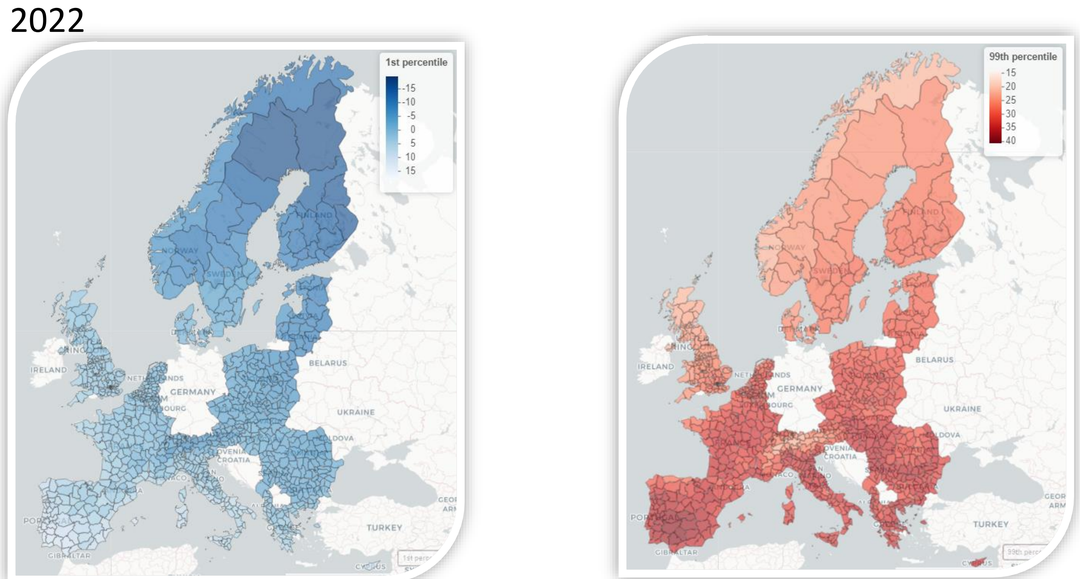
Percentile temperatures in Europe

Figure 2: 1st and 99th percentile in NUTS3 temperature distribution in 2014-2022



Extreme temperature and mortality in Europe

Figure 3: Extreme temperature and mortality in Europe (65+)

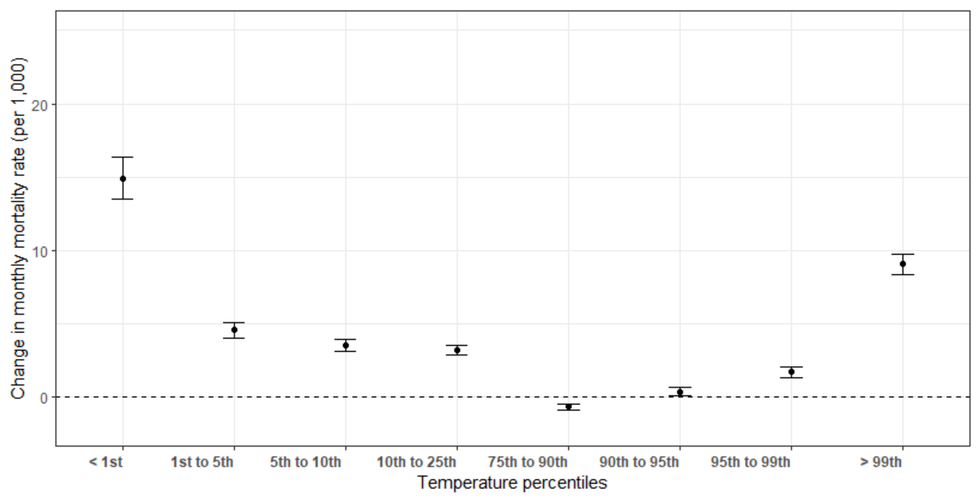
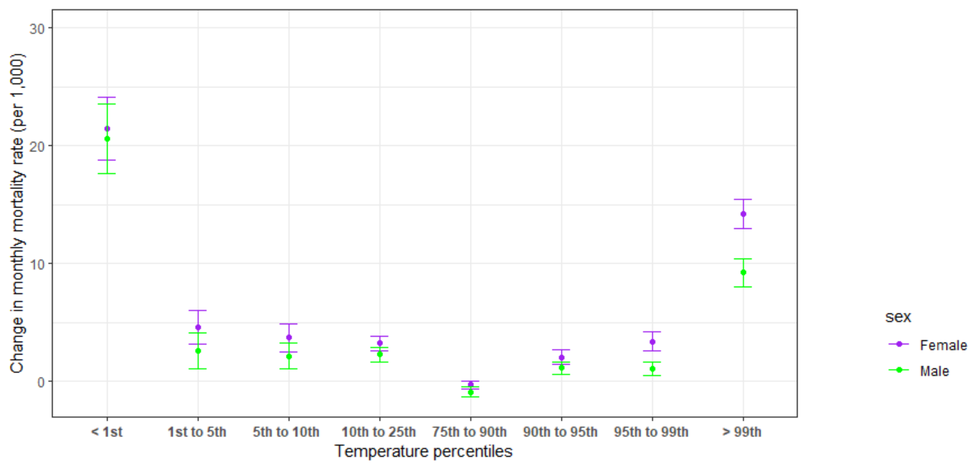
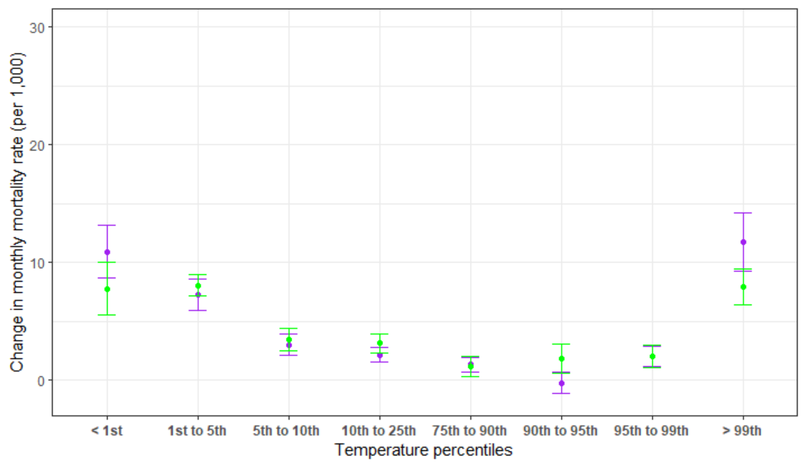


Figure 4: Extreme temperature-related mortality (65+ by sex) in Southern [(a)], Urbanized [(b)] and Northern [(c)] Europe

(a)



(b)



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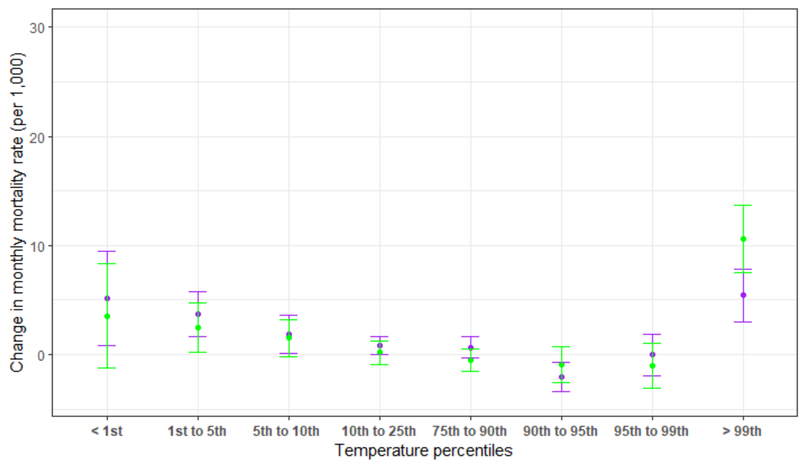

CONCLUSION

- Effect of hot temperatures seem to exacerbate sex differences more than cold temperatures;
- Geography determines differences in heat and cold-related deaths in over 65s.
- It is necessary to better understand which mechanism and factors determine geographical differences.