Climate Change Projected to Reduce European Life Expectancy

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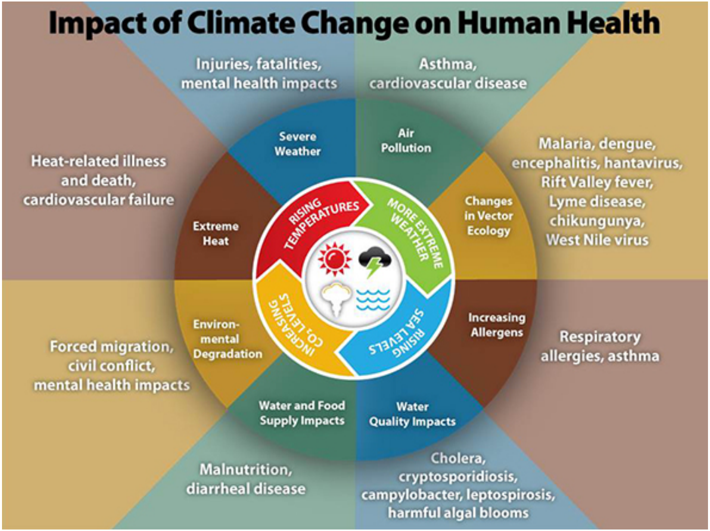
Climate Change and Human Health



morbidity $\neq$ mortality

Climate Change and Mortality

Typically described as excess or "extra" mortality. Most studies quantify exposure rather than mortality.
Some studies do publish projected mortality:

- Forzieri et al (Europe), six-climate hazards: 150k deaths by 2080s
- Silva et al (Global), ozone-related mortality: 375k by 2100

These estimates are useful but sterile – *one death is a tragedy, a million deaths a statistic*.

Climate Change and Life Expectancy

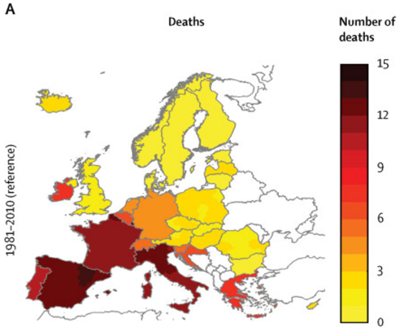
Life expectancy at birth (e_0) is the preferred mortality metric.
To our knowledge, *no studies quantify the possible impact of climate change on human longevity*.
Without properly situating the potential loss of life within metrics like life expectancy, we risk miscommunicating the impact of climate change on human mortality.
We ask and answer the following questions:

- What is the cost of inaction on climate change on human longevity?
- How does climate change related mortality compare to other mortality vectors?

Data 1

We use data from three primary sources:

1. Forzieri et al projected excess mortality due to six climate vectors (heatwaves, coldwaves, wildfires, droughts, river and coastal floods, and windstorms) under conventional greenhouse gas emission scenario (SRES A1B). (150k deaths per year by 2080s)



via: Forzieri et al (2017)

Data 2

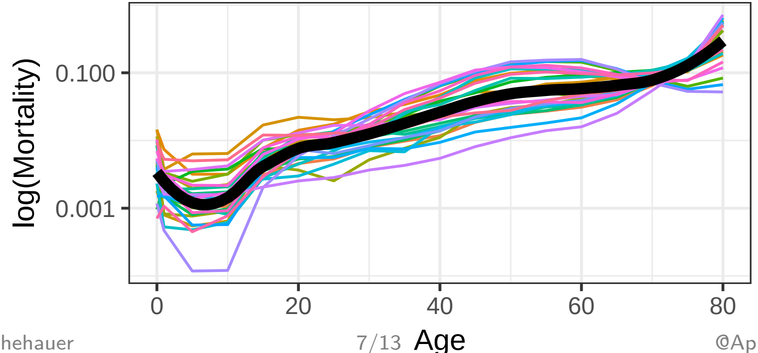
2. To convert Forzieri et al's excess mortality to life expectancy, we use the Human Mortality Database (HMD) for underlying life tables.

- HMD for the correspoding 28 European countries in 5x1 (by age and year) life tables for the most recent life table.
    - Abridge the life table to $[0, 1, 5, ..., 80+]$
- ${}_nP_x$, population aged x to $x + n$
- ${}_na_x$, average length of survival between ages x and $x + n$
- ${}_nd_x$, number of deaths between ages x and $x + n$

Data 3

3. The Global Burden of Disease (GBD) provides cause-specific mortality by age/sex/geography/year for 249 causes of death.

- We gathered ata on age-specific deaths and mortality rates for environmental heat and cold exposure (cause C.2.9) for 2006-2015 for each country in the study.



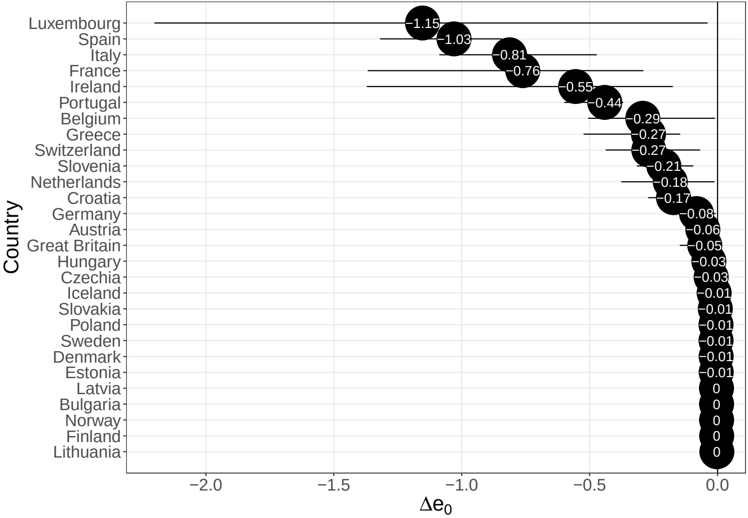
Methods

- From the GBD data, we derived variable $t_{x,i}$ as the proportion of deaths, D, from each age group x in each country i (${}_n t_{x,i} = D^{GBD}_{x,i} / \sum_{\alpha=0}^{80} {}_n D^{GBD}_i$).
- We then derived additional m_x rates for each age group x in each country i for each scenario s ($BASE$, LOW, MID, $HIGH$) from Forzieri et al.

$$ {}_n\hat{m}_{x,i,s} = \left({}_n D^{HMD}_{x,i} + \left(\widehat{\mathbf{D_i}} \cdot {}_{\mathbf{n}}\mathbf{t_{x,i}}\right)\right) / {}_n P^{HMD}_{x,i} \tag{1} $$

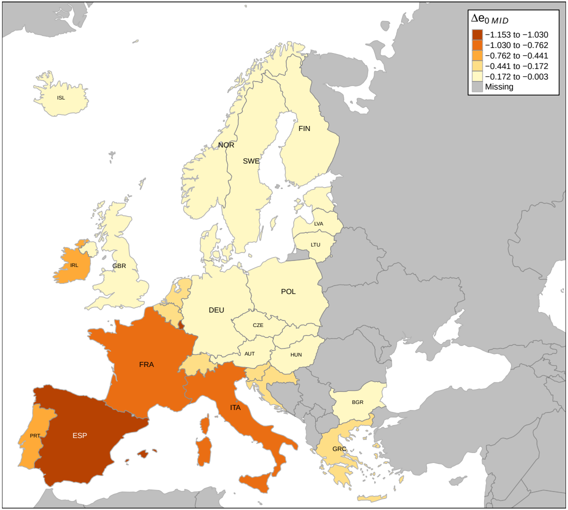
- Calculate the remaining life table using standard life table techniques and simply subtract $e_{x,i,s}$ from $e_{x,i,BASE}$ to arrive a Δe_x.

Results



Luxembourg
Spain
Italy
France
Ireland
Portugal
Belgium
Greece
Switzerland
Slovenia
Netherlands
Croatia
Germany
Austria
Great Britain
Hungary
Czechia
Iceland
Slovakia
Poland
Sweden
Denmark
Estonia
Latvia
Bulgaria
Norway
Finland
Lithuania
Country
−1.15
−1.03
−0.81
−0.76
−0.55
−0.44
−0.29
−0.27
−0.27
−0.21
−0.18
−0.17
−0.08
−0.06
−0.05
−0.03
−0.03
−0.01
−0.01
−0.01
−0.01
−0.01
−0.01
0
0
0
0
0
−2.0
−1.5
−1.0
−0.5
0.0
Δe_0

Results



$\Delta e_{0\ MID}$
−1.153 to −1.030
−1.030 to −0.762
−0.762 to −0.441
−0.441 to −0.172
−0.172 to −0.003
Missing
ISL
NOR
SWE
FIN
LVA
LTU
IRL
GBR
POL
DEU
CZE
AUT
HUN
FRA
ITA
BGR
ESP
PRT
GRC

Results

Country	1	2	3	4	5	6	7	8
Spain	Respiratory Diseases 91.7	Climate Change 78.05 (63.26 - 101.6)	Heart Disease 68.2	Dis. of the Nervous Sys 48.5	Lung Cancer 47.8	Colorectal Cancer 33.6	Suicide 8.2	Transport Accidents 4.3
Luxembourg	Heart Disease 80.3	Climate Change 76.93 (2.36 - 160.9)	Respiratory Diseases 63.8	Lung Cancer 59.6	Dis. of the Nervous Sys 38	Colorectal Cancer 25.5	Suicide 13.4	Transport Accidents 6
Italy	Heart Disease 98.3	Respiratory Diseases 58.3	Climate Change 49.87 (28.15 - 68.2)	Lung Cancer 49.4	Dis. of the Nervous Sys 34.3	Colorectal Cancer 27	Suicide 6.3	Transport Accidents 5.6
France	Respiratory Diseases 52	Dis. of the Nervous Sys 50.2	Lung Cancer 50.1	Climate Change 49.61 (18.24 - 93.5)	Heart Disease 49.3	Colorectal Cancer 26.1	Suicide 14.1	Transport Accidents 5.1
Portugal	Respiratory Diseases 116.7	Heart Disease 69.6	Lung Cancer 36.4	Climate Change 35.95 (29.93 - 49.4)	Colorectal Cancer 35	Dis. of the Nervous Sys 32.8	Suicide 11.3	Transport Accidents 7.8
Ireland	Heart Disease 147.5	Respiratory Diseases 125.9	Lung Cancer 61.5	Dis. of the Nervous Sys 48.7	Climate Change 44.65 (13.57 - 119.6)	Colorectal Cancer 32.4	Suicide 11	Transport Accidents 4

Conclusion

- Two European countries could see reductions of more than one-year (*MID*) but five countries could see more than one-year reduction under higher scenarios (*high*).
- Thus, **the cost of inaction on climate change could approach *one year of life* in some countries**.
- Life expectancy connects mortality estimates into more intuitively understandable metrics, translating global estimates of mortality into individual outcomes.
- Without adaptation measures, our results suggest climate change could emerge as a significant new mortality vector for some European countries by the end of the century.

Thank you!

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