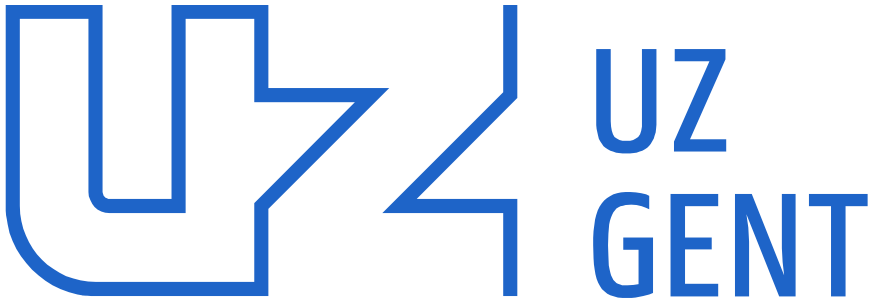


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John Crombez & Rob De Staelen

# On Covid-19 severity and its relation to the pre pandemic health care system: a country comparison

April 6, 2022

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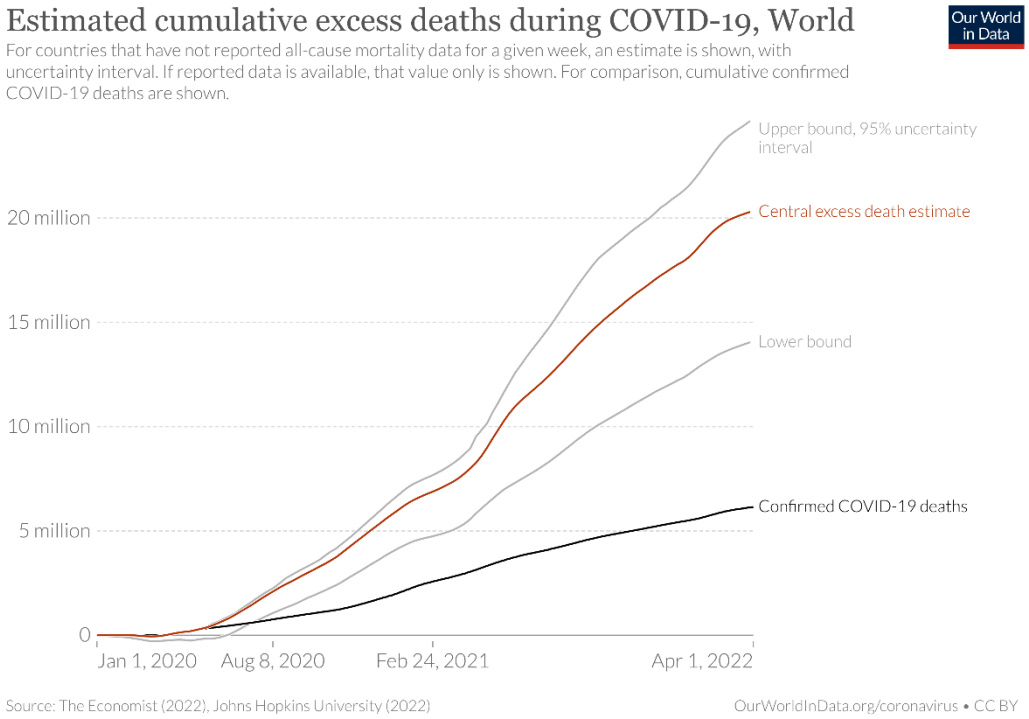
# A pandemic. How to learn from it?

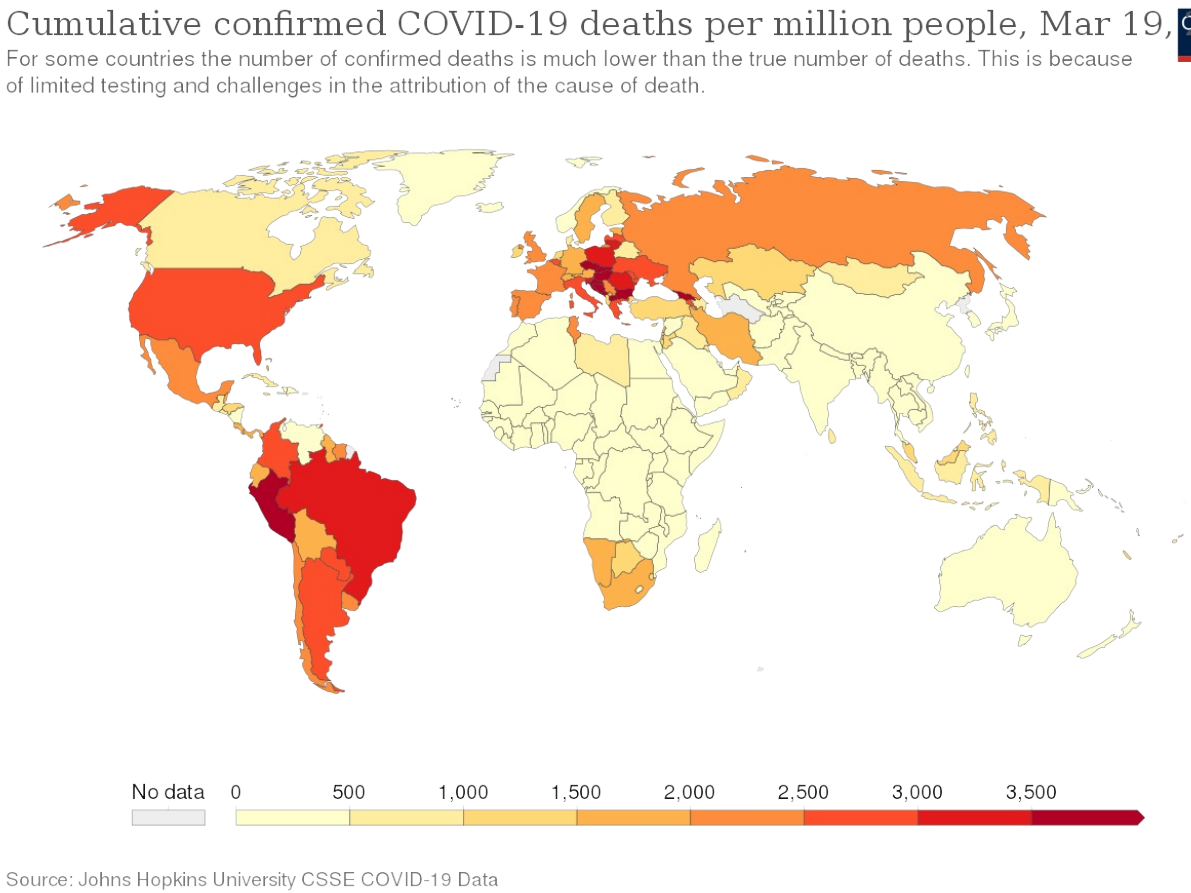



could be higly underestimated (x4)

5 mio reported Covid-19 related deaths

***To answer any questions (e.g. what worked, what didn't) one first needs to objectify/quantify. Because any answer starts with analysing differences.***

# Are countries hit “in the same way” by Covid-19?




A way of comparison

The only one?

The best one?

# Research questions

- How to measure/define Covid-19 severity?

- Can Covid-19 severity be explained by the state of the pre pandemic health care system?

# Limitations

- It is a first attempt at measuring Covid-19 severity
  - Focus on reported deaths and cases
- We didn’t (yet) include
  - Long covid effects
  - Psychological distress
  - Social and economical effects
  - Postponed medical treatment
  - …

# Covid-19 severity

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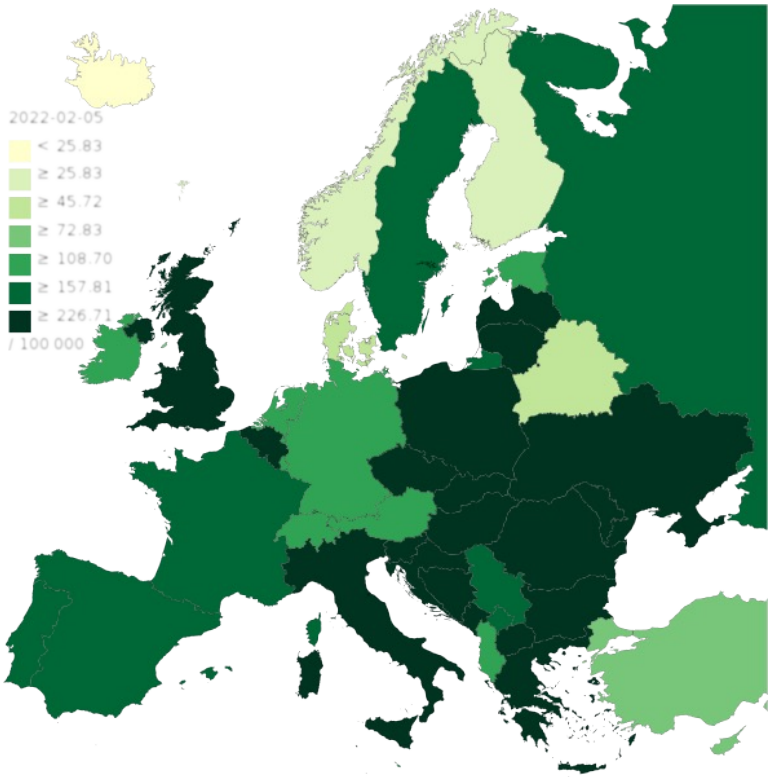
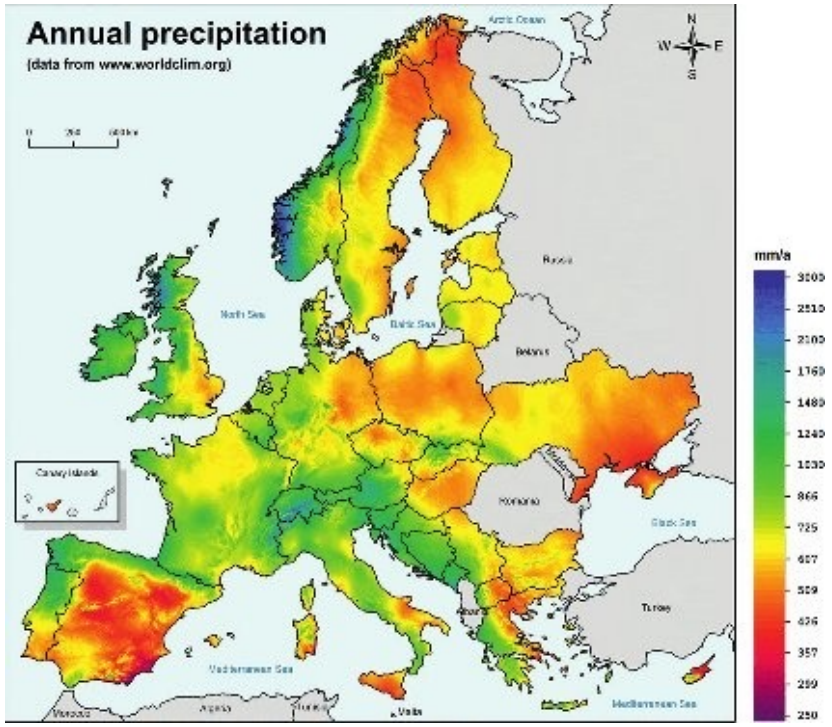
# What do “totals” tell us?

- Totals are just a total… A lot of information is lost

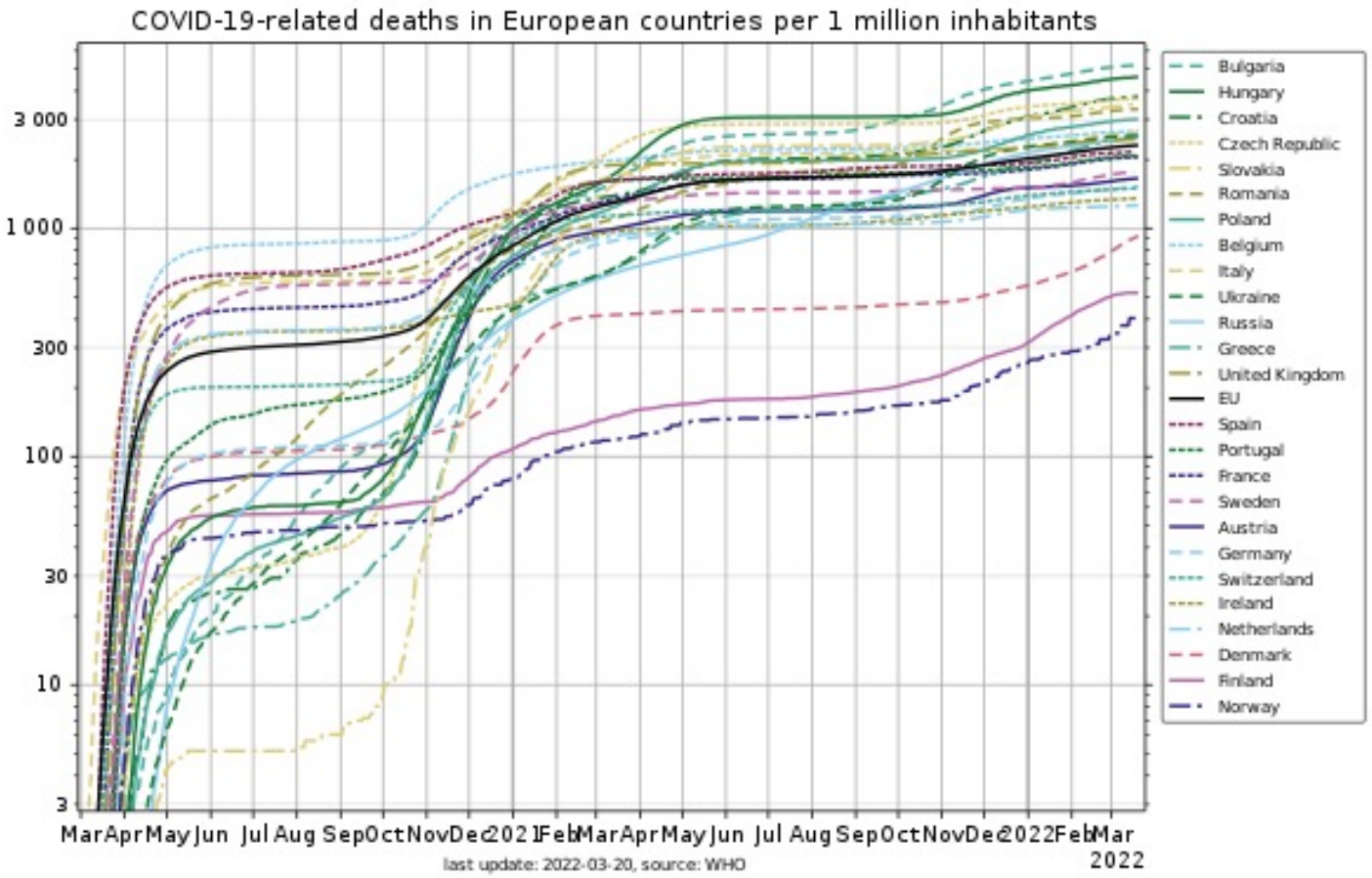


# Same total, completely different outcome

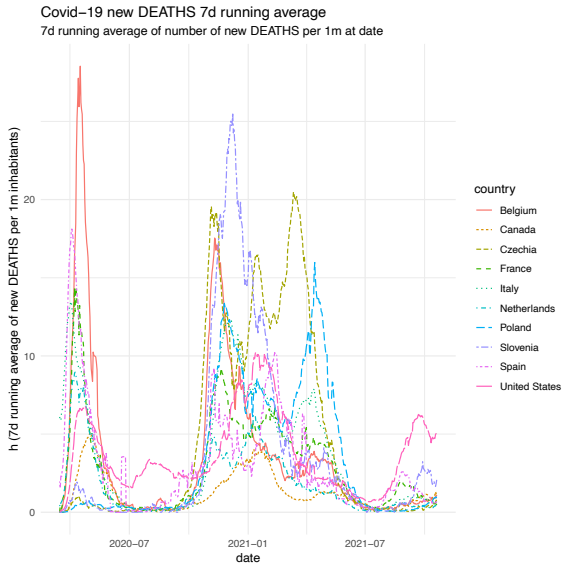
- 20mm rain every day vs. 7300mm on a single day

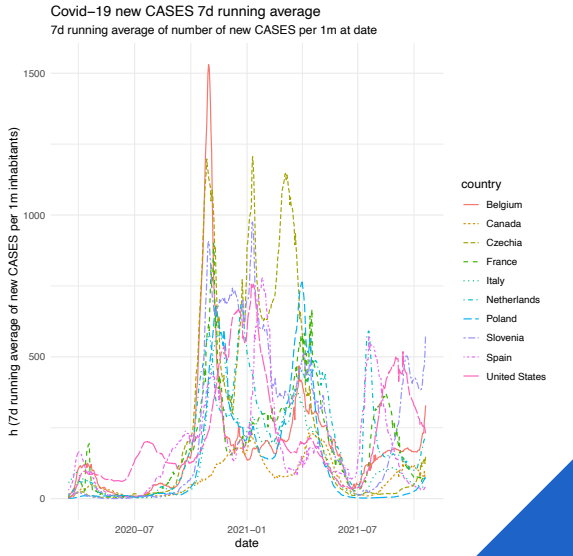
# Is every country hit “in the same way” by Covid-19?



# JHU CSSE COVID-19 Data

- Raw data
  - Center for Systems Science and Engineering
  - Johns Hopkins University
  - https://github.com/CSSEGISandData/COVID-19
- Time frame under investigation
  - 15 March 2020 (start pandemic)
  - 20 October 2021 (decline/end third wave)
- Focus on deaths and cases
- 32 countries



# Severity measure taking into account excess persistence

- Severity measure requirements
  - the higher the indicator gets over a certain period, the higher the severity;
  - the longer the indicator remains at a certain level, the higher the severity.

- Suppose we have a time series $T = \{(t_i, v_i) \mid 1 \leq i \leq d\}$ for a certain indicator with values $v_i$ at time points $t_i$

runs over all the levels of indicator

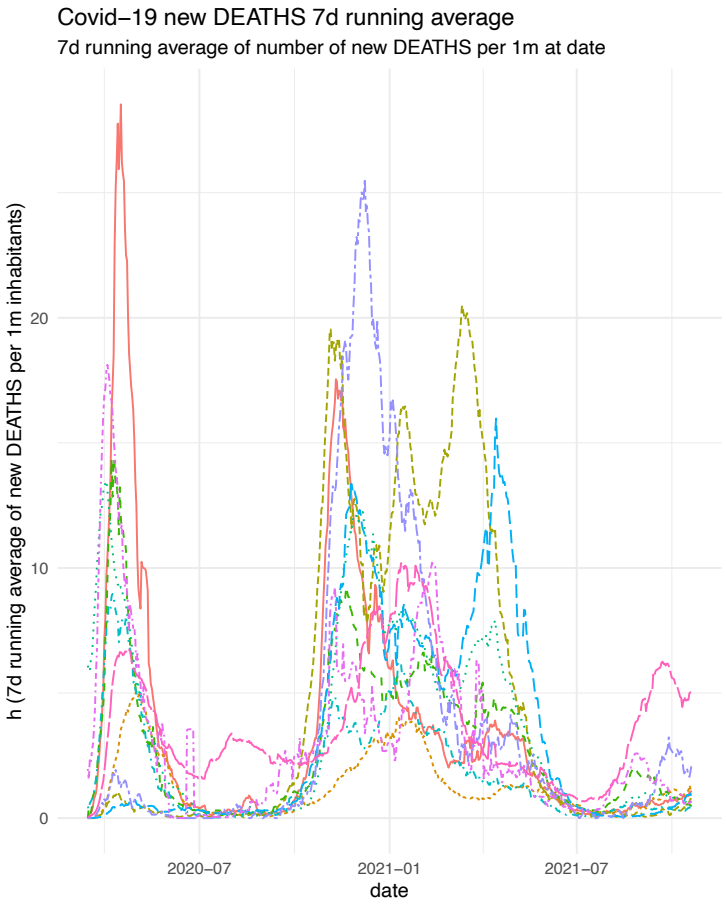
$$\text{SEV} = \int_0^{+\infty} h \cdot p(h)\, dh$$

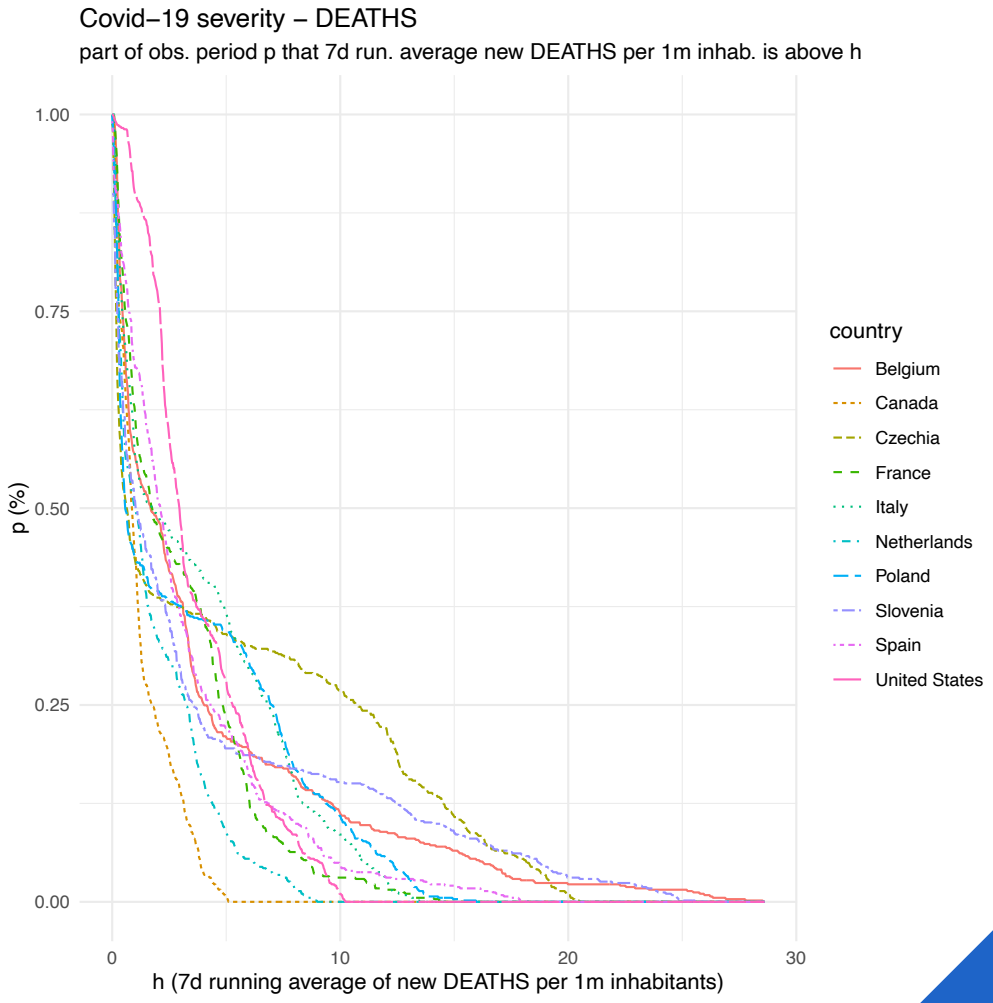
the proportion of the observation period that indicator is above level

$$p(h) = \frac{\#\{t_i \mid v_i \geq h\}}{d}$$

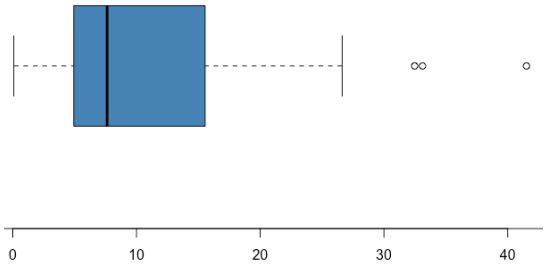
note: $p(0) = 1$ and $p(+\infty) = 0$

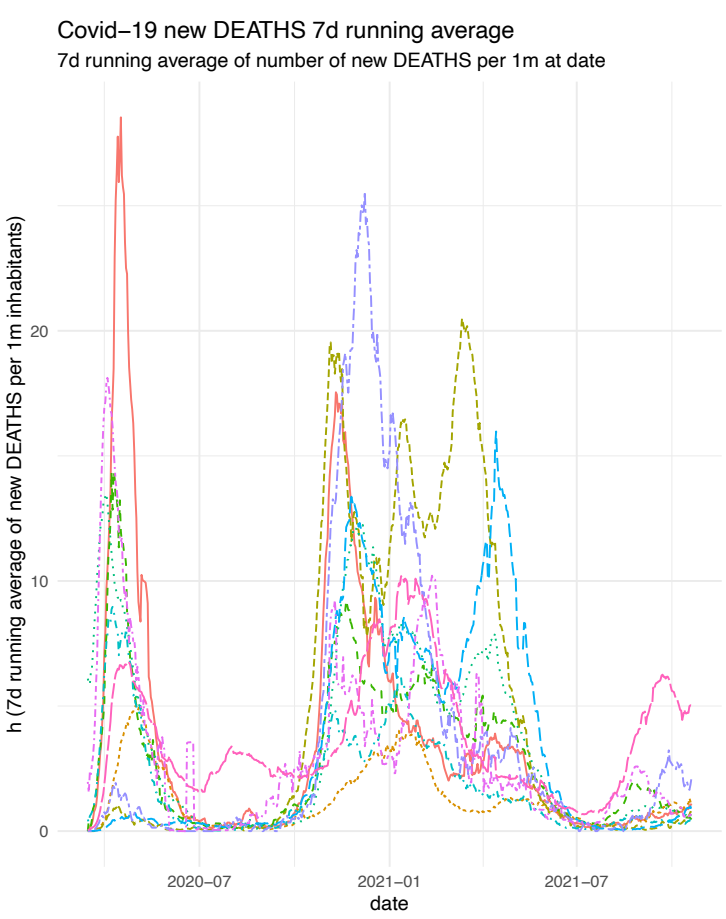
# D-severity


Covid−19 new DEATHS 7d running average
7d running average of number of new DEATHS per 1m at date
h (7d running average of new DEATHS per 1m inhabitants)
0
10
20
2020−07
2021−01
2021−07
date


Covid−19 severity − DEATHS
part of obs. period p that 7d run. average new DEATHS per 1m inhab. is above h
p (%)
0.00
0.25
0.50
0.75
1.00
0
10
20
30
h (7d running average of new DEATHS per 1m inhabitants)
country
Belgium
Canada
Czechia
France
Italy
Netherlands
Poland
Slovenia
Spain
United States

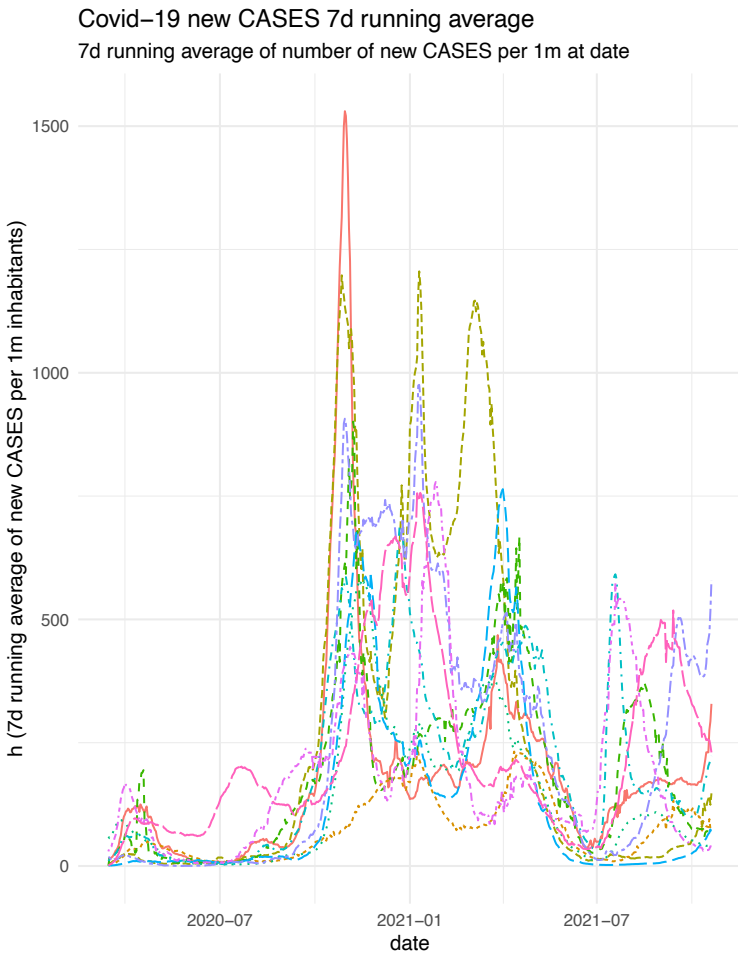
# D-severity

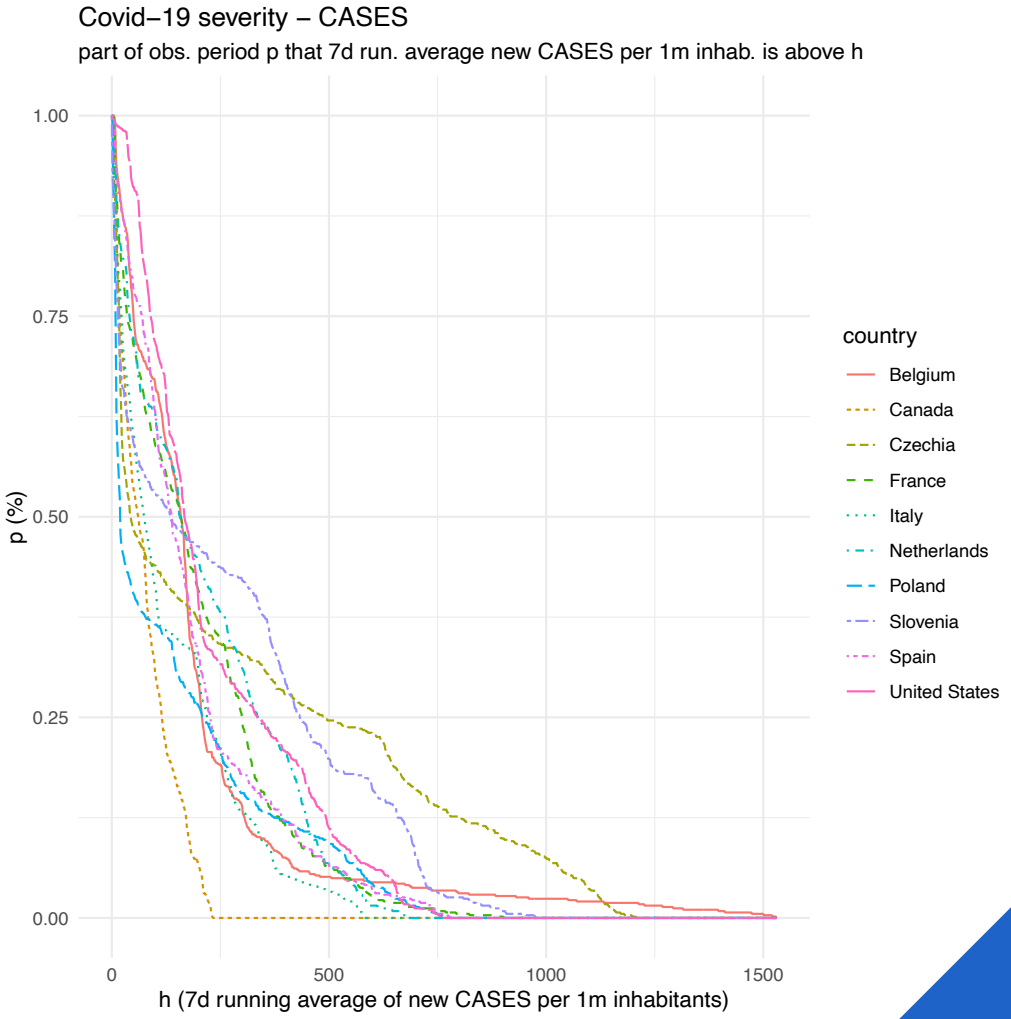

0
10
20
30
40


Covid−19 new DEATHS 7d running average
7d running average of number of new DEATHS per 1m at date
h (7d running average of new DEATHS per 1m inhabitants)
0
10
20
2020−07
2021−01
2021−07
date

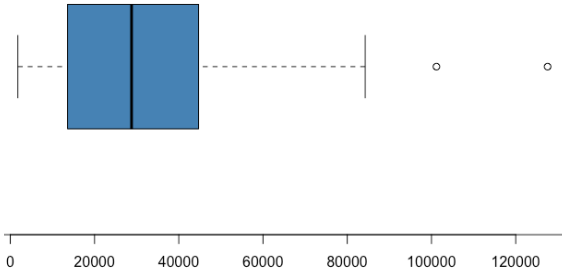

Covid−19 severity − DEATHS
integrand of SEV = $\int_0^\infty h \cdot p(h) dh$
$h \cdot p(h)$
0
1
2
0
10
20
30
h (7d running average of new DEATHS per 1m inhabitants)
country
Belgium, SEV=21.37
Canada, SEV=1.58
Czechia, SEV=32.48
France, SEV=8.75
Italy, SEV=13.95
Netherlands, SEV=3.86
Poland, SEV=14.84
Slovenia, SEV=25.26
Spain, SEV=11.05
United States, SEV=9.89

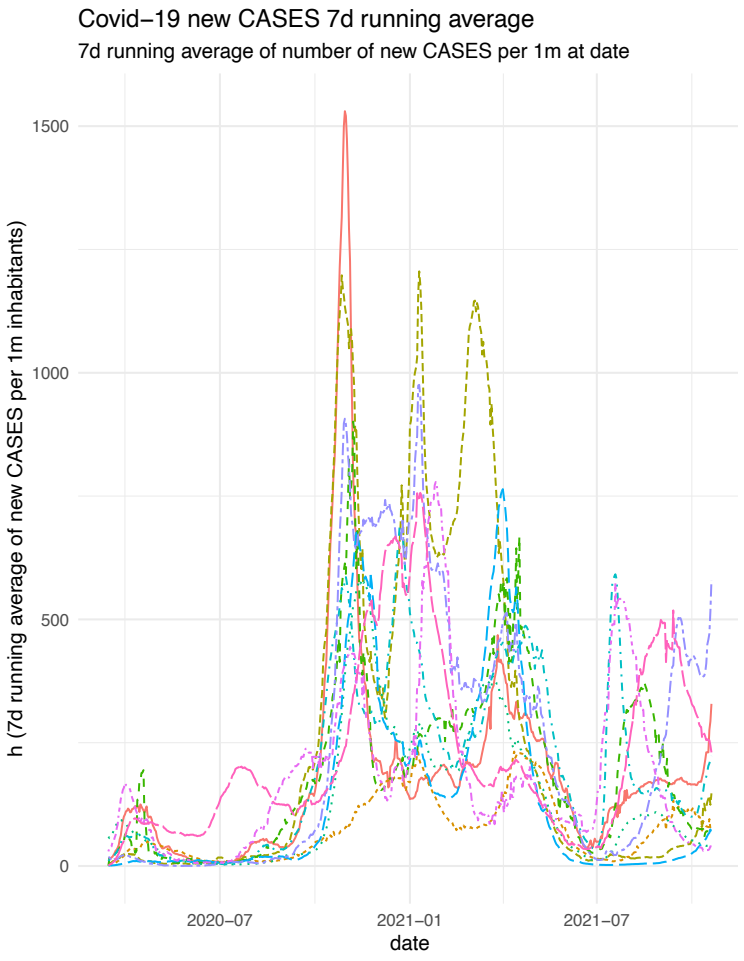
# C-severity


Covid−19 new CASES 7d running average
7d running average of number of new CASES per 1m at date
h (7d running average of new CASES per 1m inhabitants)
1500
1000
500
0
2020−07
2021−01
2021−07
date


Covid−19 severity − CASES
part of obs. period p that 7d run. average new CASES per 1m inhab. is above h
p (%)
1.00
0.75
0.50
0.25
0.00
0
500
1000
1500
h (7d running average of new CASES per 1m inhabitants)
country
Belgium
Canada
Czechia
France
Italy
Netherlands
Poland
Slovenia
Spain
United States

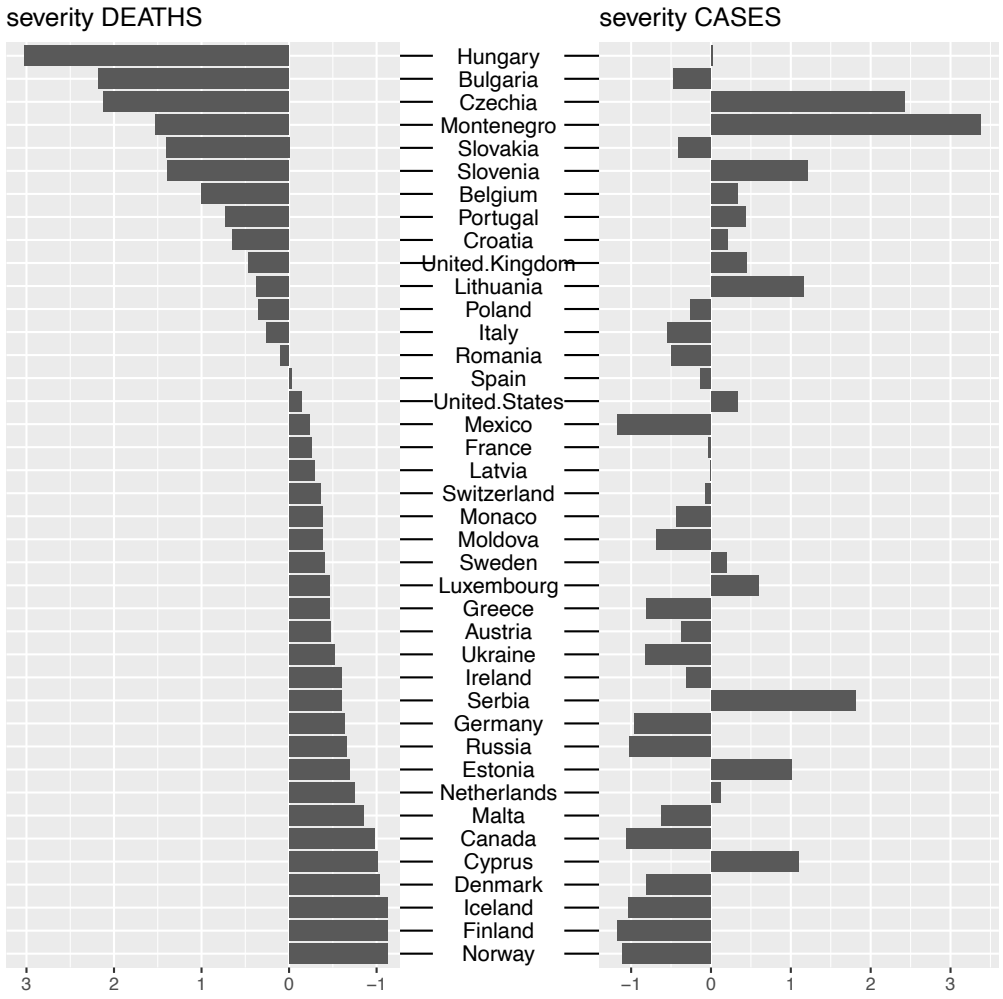
# C-severity


0
20000
40000
60000
80000
100000
120000

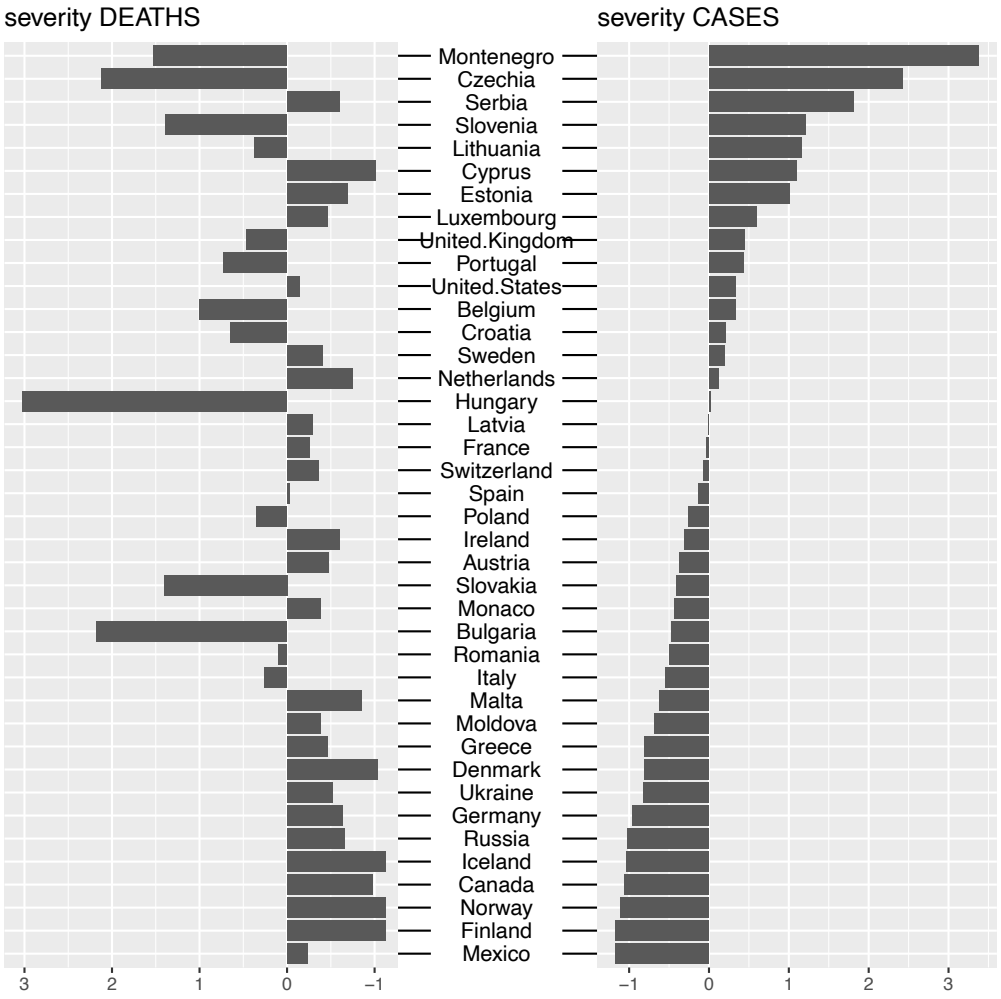

Covid−19 new CASES 7d running average
7d running average of number of new CASES per 1m at date
h (7d running average of new CASES per 1m inhabitants)
1500
1000
500
0
2020−07
2021−01
2021−07
date

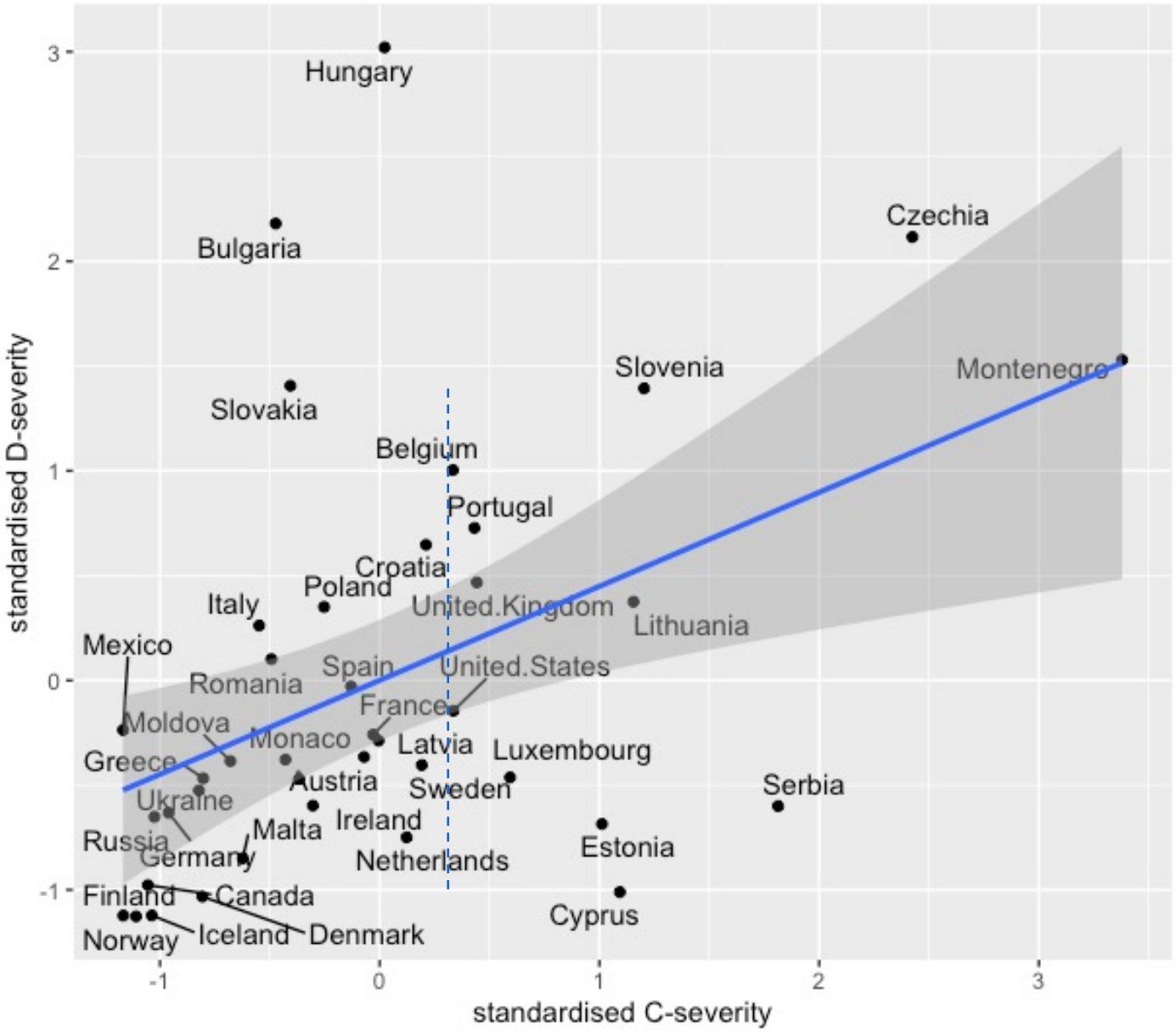

Covid−19 severity − CASES
integrand of SEV = $\int_0^\infty h \cdot p(h) dh$
h · p(h)
100
50
0
0
500
1000
1500
h (7d running average of new CASES per 1m inhabitants)
country
Belgium, SEV=43321
Canada, SEV=4908.86
Czechia, SEV=101172.23
France, SEV=33268.83
Italy, SEV=18916.22
Netherlands, SEV=37487.73
Poland, SEV=27087.69
Slovenia, SEV=67385.29
Spain, SEV=30491.22
United States, SEV=43370.65

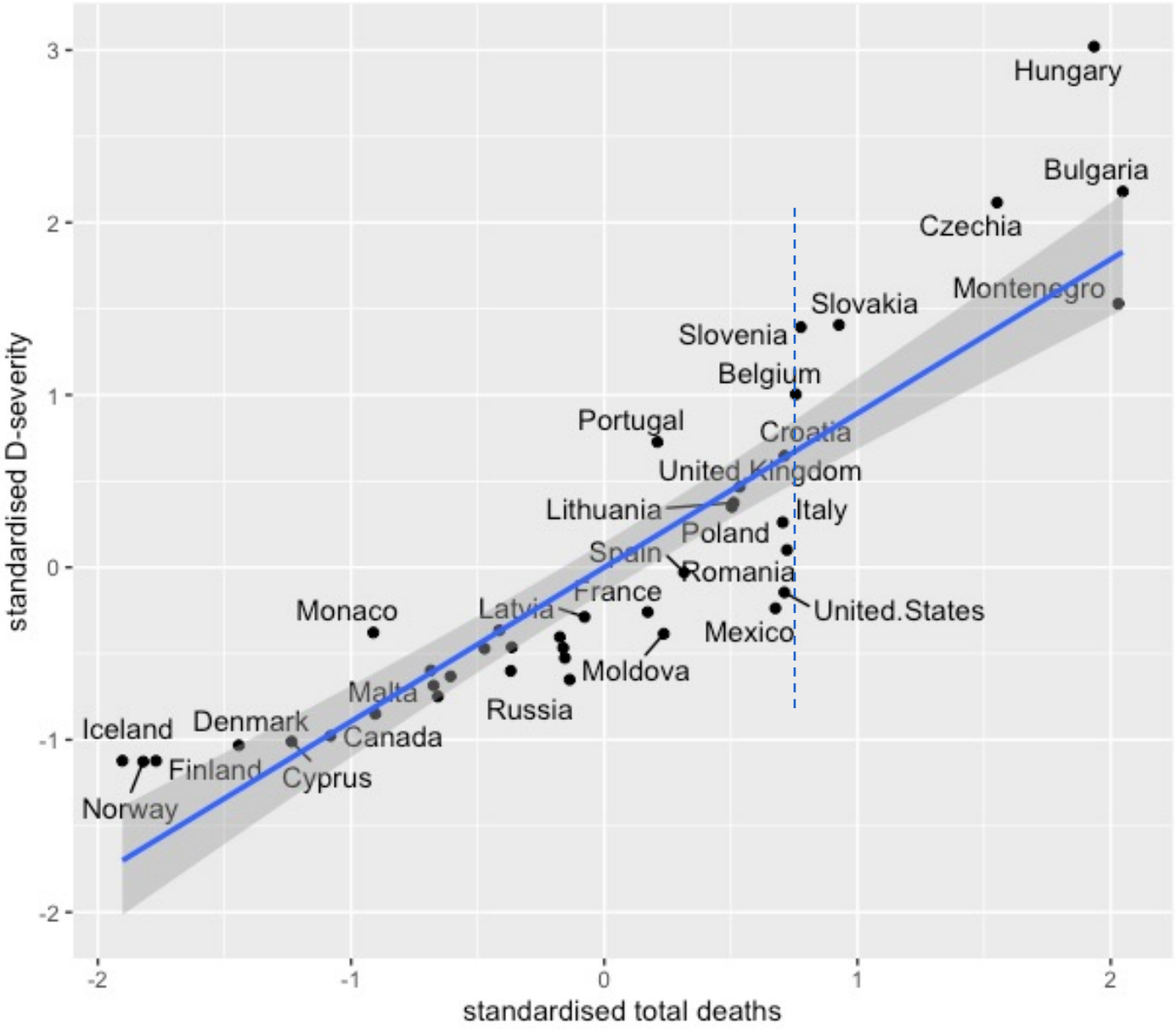
# Standardized severity, D-ranked

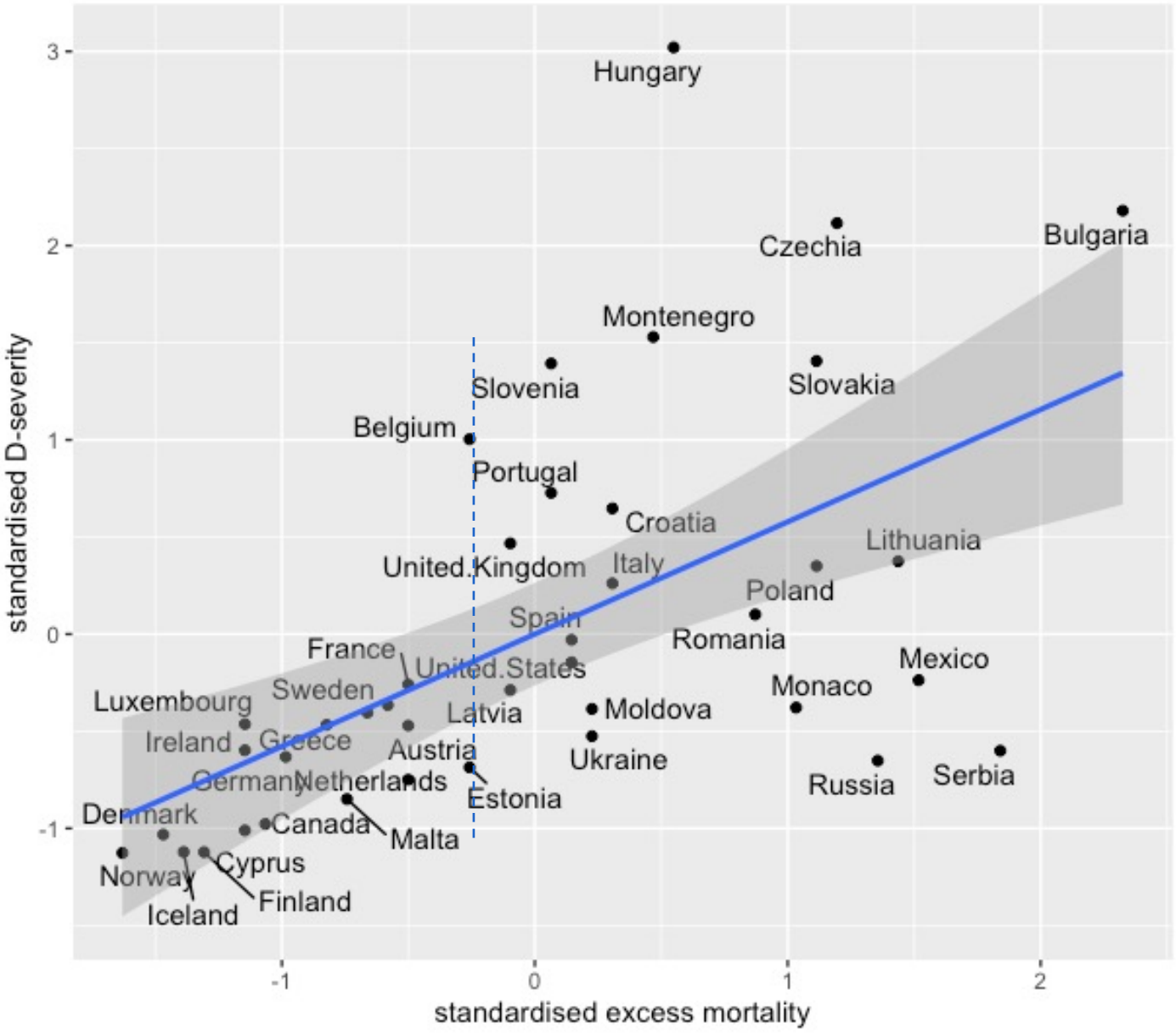


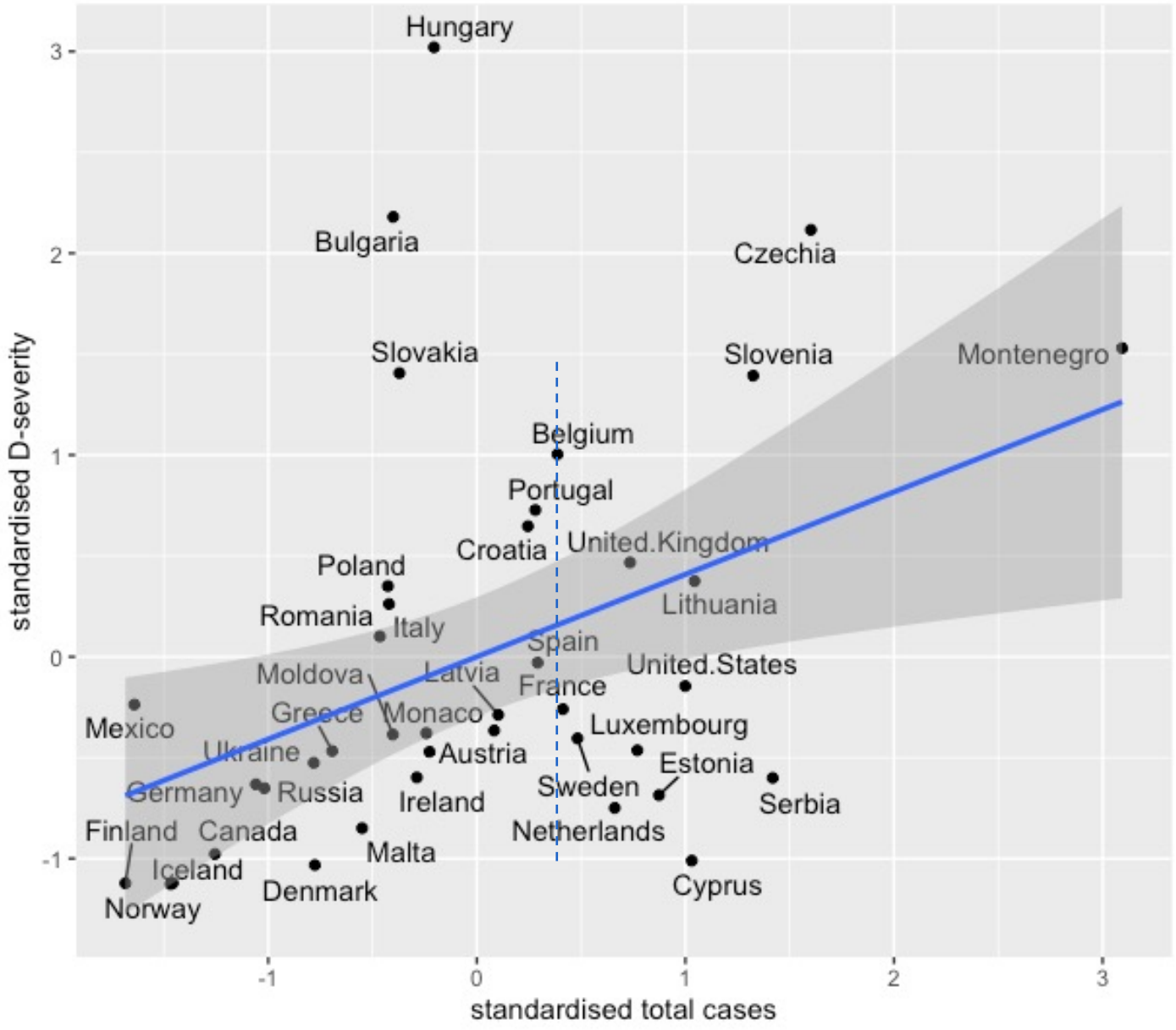
# Standardized severity, C-ranked




Hungary
Bulgaria
Czechia
Slovenia
Montenegro
Slovakia
Belgium
Portugal
Croatia
Poland
Italy
United.Kingdom
Lithuania
Mexico
Spain
United.States
Romania
France
Moldova
Monaco
Latvia
Luxembourg
Greece
Austria
Sweden
Serbia
Ukraine
Ireland
Malta
Russia
Germany
Netherlands
Estonia
Finland
Canada
Cyprus
Norway
Iceland
Denmark
standardised D-severity
standardised C-severity
3
2
1
0
-1
-1
0
1
2
3


standardised D-severity
standardised total deaths
3
2
1
0
-1
-2
-2
-1
0
1
2
Hungary
Bulgaria
Czechia
Montenegro
Slovakia
Slovenia
Belgium
Portugal
Croatia
United Kingdom
Lithuania
Italy
Poland
Spain
Romania
France
United.States
Mexico
Monaco
Latvia
Moldova
Malta
Russia
Iceland
Denmark
Canada
Finland
Cyprus
Norway


Hungary
Czechia
Bulgaria
Montenegro
Slovenia
Slovakia
Belgium
Portugal
Croatia
Lithuania
United.Kingdom
Italy
Poland
Spain
Romania
France
United.States
Mexico
Monaco
Luxembourg
Sweden
Latvia
Moldova
Ireland
Greece
Austria
Ukraine
Germany
Netherlands
Estonia
Russia
Serbia
Denmark
Canada
Malta
Cyprus
Norway
Finland
Iceland
standardised D-severity
standardised excess mortality
3
2
1
0
-1
-1
0
1
2


Hungary
Bulgaria
Czechia
Slovakia
Slovenia
Montenegro
Belgium
Portugal
Croatia
United.Kingdom
Poland
Lithuania
Romania
Italy
Spain
United.States
Moldova
Latvia
France
Mexico
Greece
Monaco
Luxembourg
Ukraine
Austria
Estonia
Germany
Russia
Ireland
Sweden
Serbia
Finland
Canada
Netherlands
Malta
Iceland
Cyprus
Denmark
Norway
standardised D-severity
standardised total cases
3
2
1
0
-1
-1
0
1
2
3

# Conclusions

- There is no standard way to assessing severity
  - We combined *exposure* with *excess persistence*
- Clear evidence that countries were hit differently
- No evidence that the number of cases alone is a/the main driver in assessing D-severity
- COVID-19 casualties (D-severity)
  - Scandinavian countries (except Sweden) least hit
  - Portugal, Belgium, Slovenia, Slovakia, Czechia and Hungary dramatically hit

# Relation to the pre pandemic health care system

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# Health at a Glance: Europe 2020
# State of the health (care) system

- OECD Indicators
  - key indicators for population health and health system performance
  - 19 November 2020 (data relates to pre pandemic state)
  - https://doi.org/10.1787/82129230-en

- Domains – 53 indicators
  - Health status (hsR) – 13 indicators
  - Risk factors (Rf) – 7 indicators
  - Health expenditure and financing (exp) – 10 indicators
  - Effectiveness (effect) – 9 indicators
  - Accessibility (access) – 14 indicators

# Ranking procedure

- 53 indicators (grouped in 5 domains) over 32 countries

- Step 1
  - For each of the 53 indicators
  - Replace indicator value with its rank (1 till 32)

- Step 2
  - Aggregate ranks within each of the 5 domains
    - Unweighted (each indicator in a domain counts the same)
    - Weighted (each indicator in domain gets the weight of its subcategory)

- Step 3
  - Add a 6th domain (total)
    - Average of the unweighted ranks
    - Average of the weighted ranks

- Step 4
  - Grouping countries according to domain quantiles

# Ranking result (step 1-3)

| unweighted | | | | | | |
|---|---|---|---|---|---|---|
| | hsR | Rf | exp | effect | access | tot |
| Austria | 18,23 | 19,43 | 21,80 | 19,11 | 12,36 | 17,66 |
| Belgium | 17,00 | 17,57 | 21,00 | 14,56 | 13,86 | 16,58 |
| Bulgaria | 11,08 | 14,71 | 22,40 | 19,00 | 14,00 | 15,81 |
| Croatia | 9,85 | 18,86 | 8,10 | 12,78 | 17,71 | 13,28 |
| Cyprus | 17,85 | 11,14 | 16,10 | 16,22 | 15,14 | 15,64 |
| Czechia | 11,23 | 15,14 | 12,70 | 15,33 | 16,79 | 14,19 |
| Denmark | 17,00 | 9,71 | 13,70 | 12,89 | 15,64 | 14,36 |
| … | | | | | | |

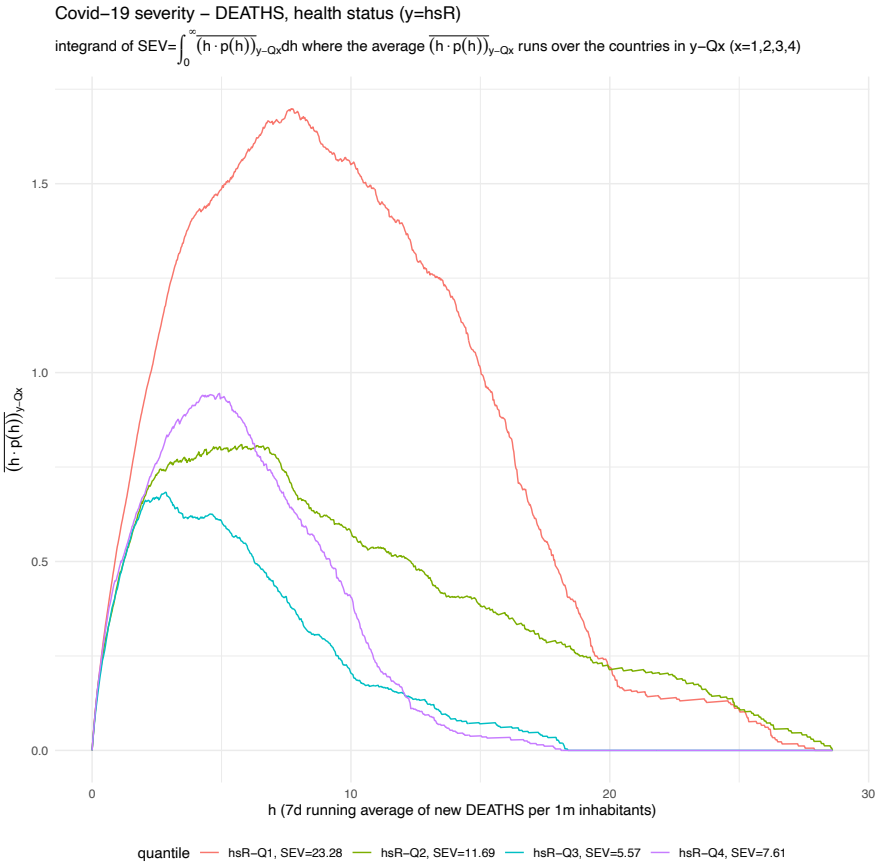
| weighted | | | | | | |
|---|---|---|---|---|---|---|
| | hsR | Rf | exp | effect | access | tot |
| Austria | 17,93 | 18,00 | 23,00 | 18,86 | 15,27 | 18,47 |
| Belgium | 18,67 | 17,75 | 22,07 | 13,71 | 14,16 | 16,99 |
| Bulgaria | 9,90 | 12,92 | 23,48 | 19,14 | 14,16 | 16,26 |
| Croatia | 10,73 | 17,33 | 7,57 | 14,07 | 17,51 | 13,73 |
| Cyprus | 15,00 | 10,50 | 16,45 | 14,21 | 12,13 | 13,58 |
| Czechia | 11,33 | 14,50 | 12,26 | 15,93 | 17,23 | 14,59 |
| Denmark | 15,13 | 10,92 | 12,43 | 13,71 | 13,89 | 13,21 |
| … | | | | | | |

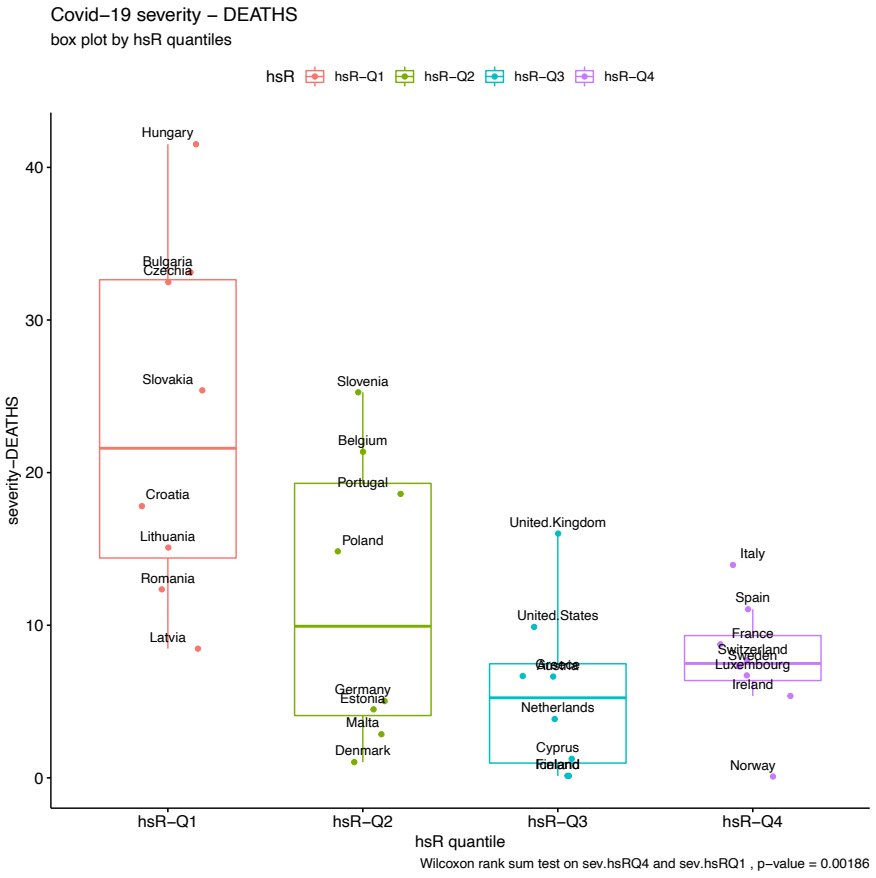
# Ranking result (step 4)

| unweighted | | | | | | |
|---|---|---|---|---|---|---|
| | **hsR** | **Rf** | **exp** | **effect** | **access** | **tot** |
| **Austria** | hsR-Q3 | Rf-Q4 | exp-Q4 | effect-Q4 | access-Q1 | tot-Q3 |
| **Belgium** | hsR-Q2 | Rf-Q3 | exp-Q4 | effect-Q2 | access-Q1 | tot-Q3 |
| **Bulgaria** | hsR-Q1 | Rf-Q2 | exp-Q4 | effect-Q3 | access-Q1 | tot-Q2 |
| **Croatia** | hsR-Q1 | Rf-Q3 | exp-Q1 | effect-Q1 | access-Q3 | tot-Q1 |
| **Cyprus** | hsR-Q3 | Rf-Q1 | exp-Q3 | effect-Q2 | access-Q2 | tot-Q2 |
| **Czechia** | hsR-Q1 | Rf-Q2 | exp-Q1 | effect-Q2 | access-Q3 | tot-Q1 |
| **Denmark** | hsR-Q2 | Rf-Q1 | exp-Q1 | effect-Q1 | access-Q2 | tot-Q1 |
| … | | | | | | |

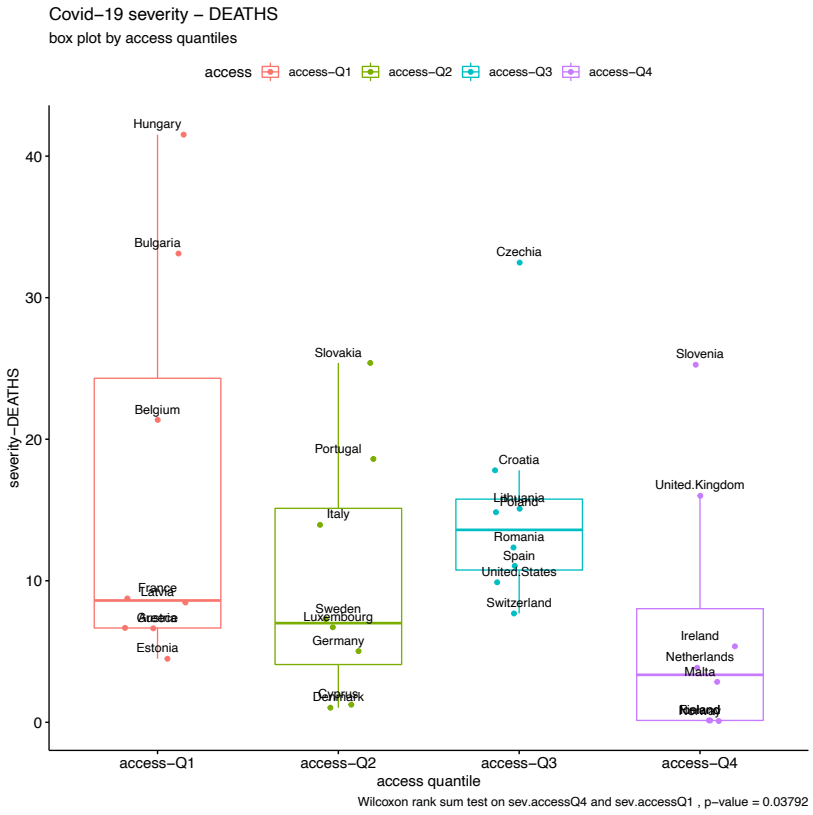
| weighted | | | | | | |
|---|---|---|---|---|---|---|
| | **hsR** | **Rf** | **exp** | **effect** | **access** | **tot** |
| **Austria** | hsR-Q3 | Rf-Q3 | exp-Q4 | effect-Q4 | access-Q2 | tot-Q4 |
| **Belgium** | hsR-Q3 | Rf-Q3 | exp-Q4 | effect-Q1 | access-Q2 | tot-Q3 |
| **Bulgaria** | hsR-Q1 | Rf-Q1 | exp-Q4 | effect-Q4 | access-Q2 | tot-Q3 |
| **Croatia** | hsR-Q1 | Rf-Q3 | exp-Q1 | effect-Q1 | access-Q4 | tot-Q1 |
| **Cyprus** | hsR-Q2 | Rf-Q1 | exp-Q3 | effect-Q1 | access-Q1 | tot-Q1 |
| **Czechia** | hsR-Q1 | Rf-Q2 | exp-Q1 | effect-Q2 | access-Q4 | tot-Q2 |
| **Denmark** | hsR-Q2 | Rf-Q1 | exp-Q1 | effect-Q1 | access-Q1 | tot-Q1 |
| … | | | | | | |

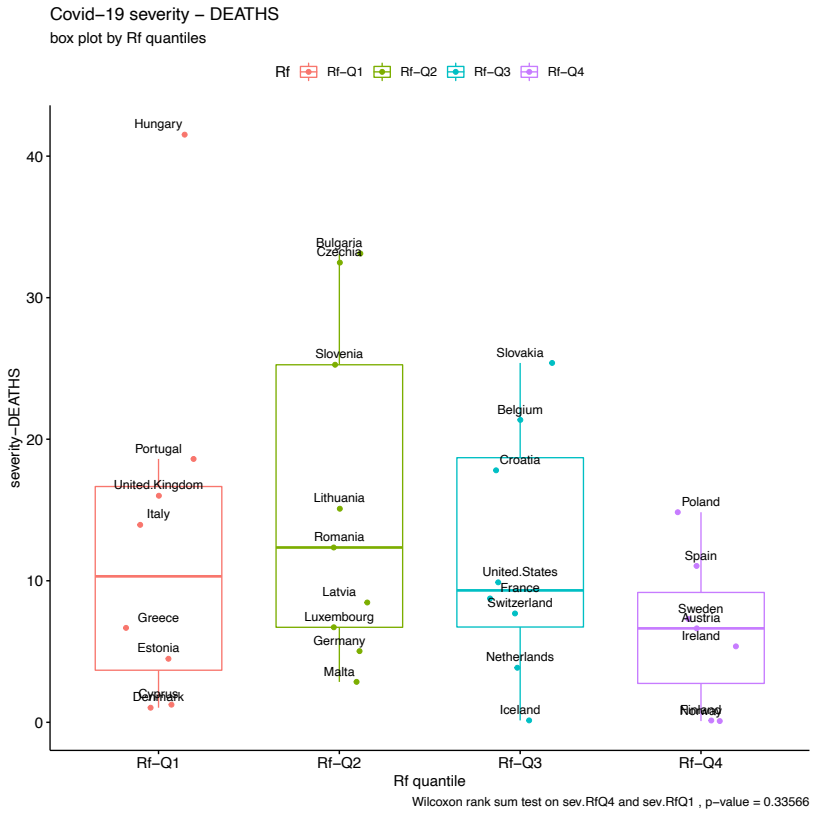
# D-severity, health status domain (hsR), unweighted



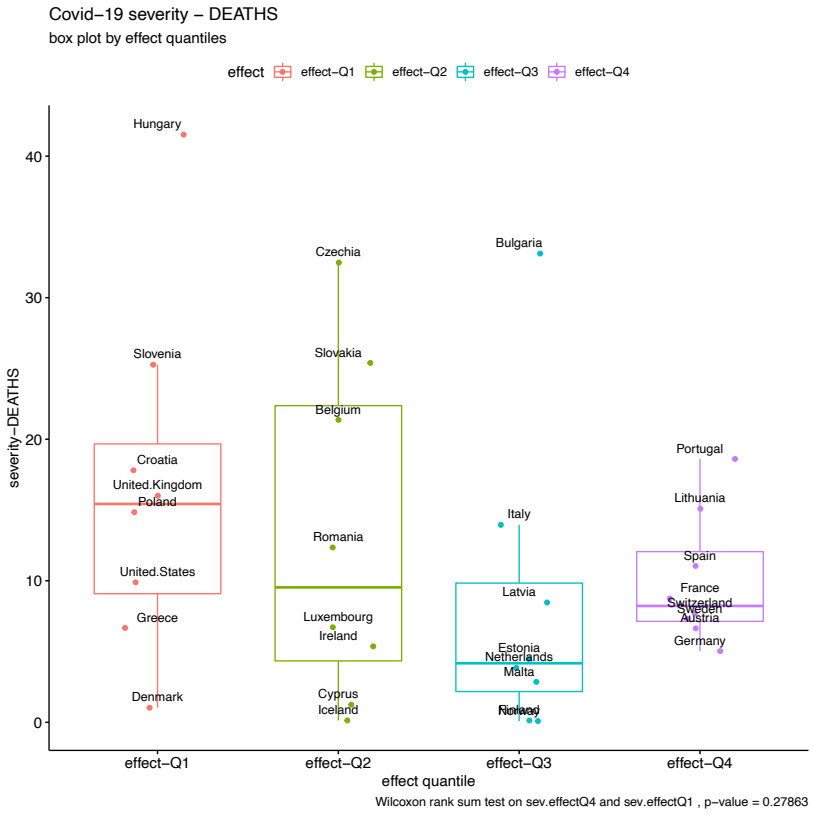



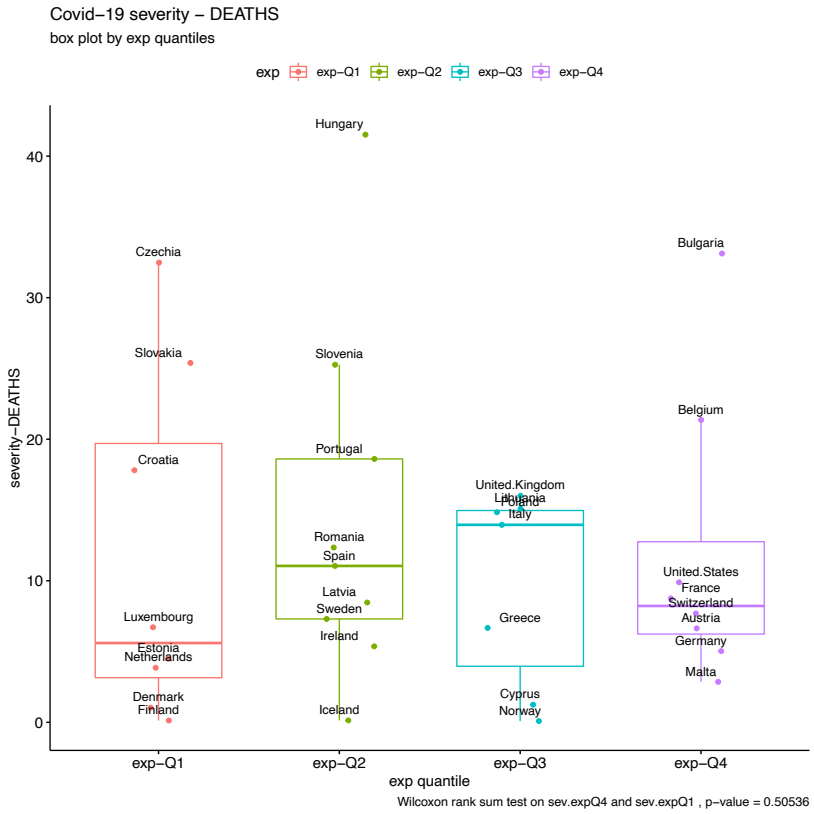
# D-severity, other domains, unweighted



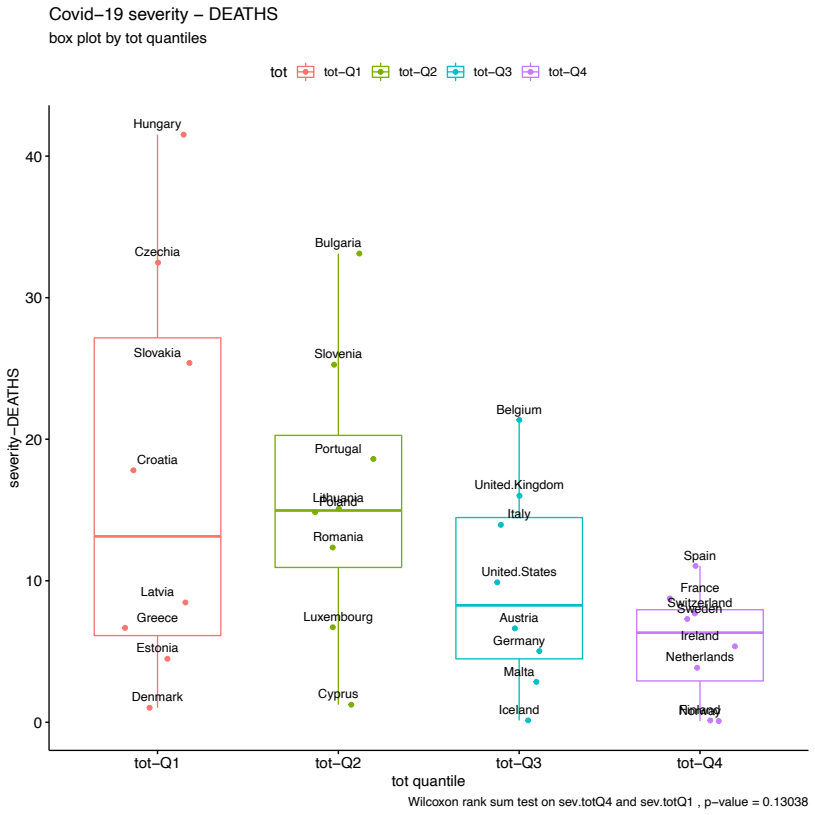



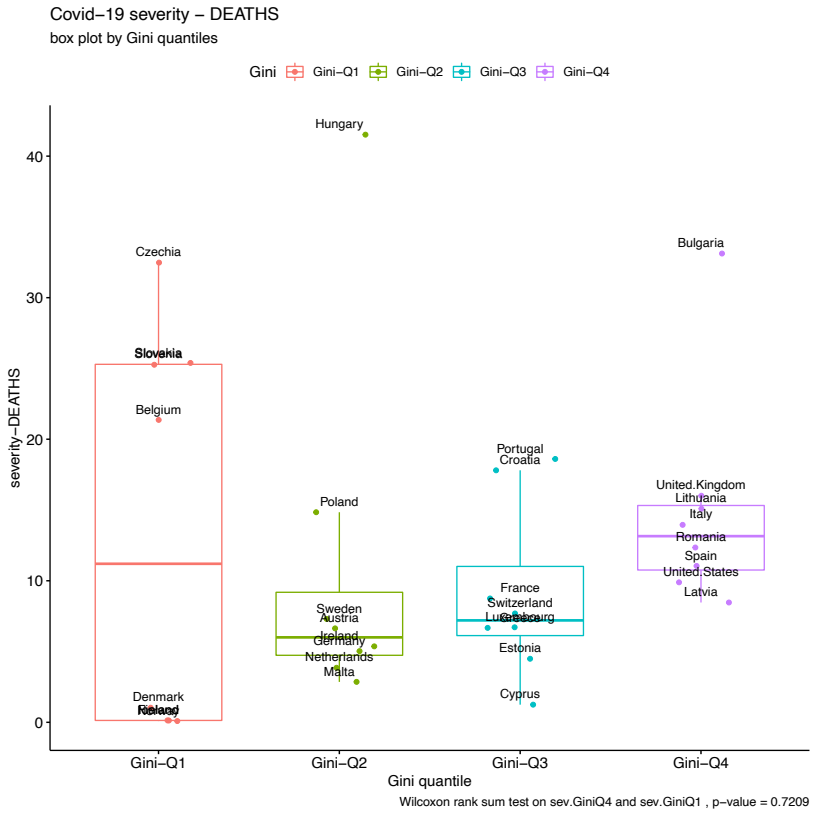
# D-severity, other domains, unweighted



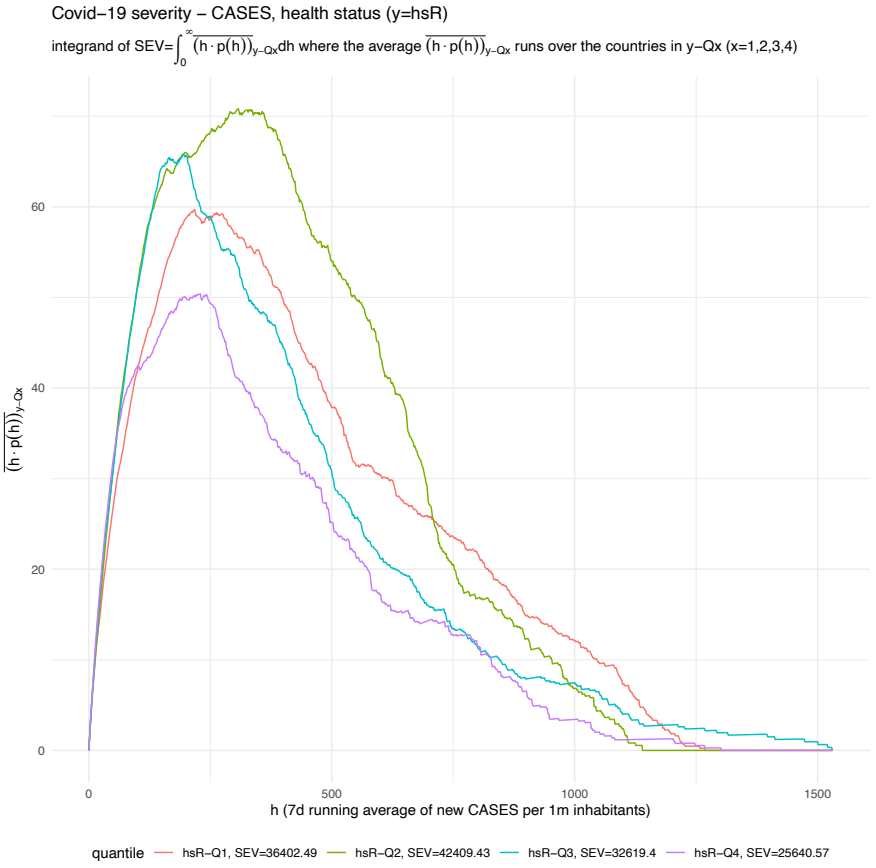



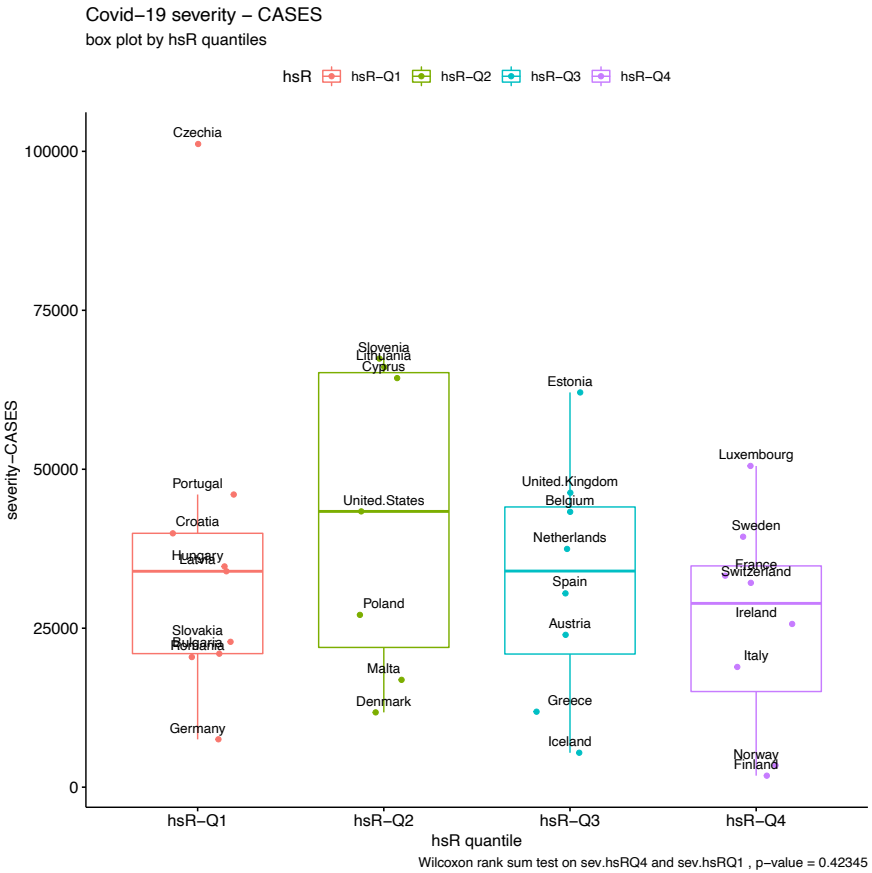
# D-severity, tot domain unweighted & Gini

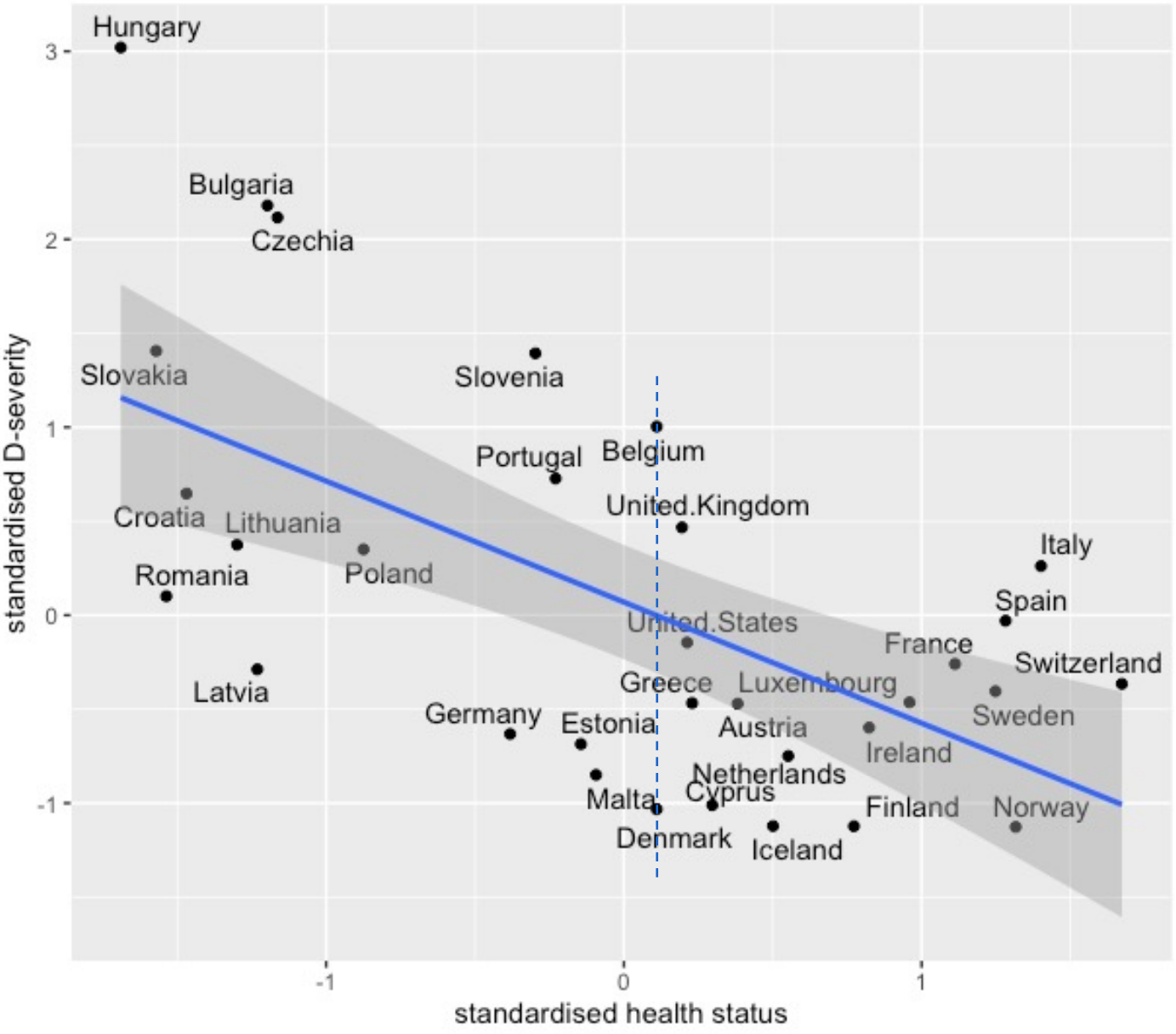


# C-severity, domain hsR, weighted




Hungary
Bulgaria
Czechia
Slovakia
Slovenia
Portugal
Belgium
United.Kingdom
Croatia
Lithuania
Romania
Poland
Italy
Spain
United.States
France
Switzerland
Latvia
Greece
Luxembourg
Germany
Estonia
Austria
Sweden
Ireland
Netherlands
Malta
Cyprus
Finland
Norway
Denmark
Iceland
standardised D-severity
standardised health status
3
2
1
0
-1
-1
0
1

# Conclusions

- There is no standard way to assessing severity
  - We combined *exposure* with *excess persistence*
- Of the pre pandemic HaaG domain rank quantiles:
  - Only health status significantly loads on D-severity
  - None load on C-severity
- Further investigation
  - GLM
    - on indicator values (instead of ranks)
    - use e.g. total deaths as offset or weights
  - Include more countries and other country characteristics
    - given: urbanisation, geography, population density, climate
    - taken: sanitary measures, adherence

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