Москва, Высшая Школа Экономики, 24 октября 2023 г.

Мониторинг и прогноз ожидаемой смертности на основе данных оперативной статистики

Жданов
Дмитрий
Александрович

Современная демография

Forecasting Models

Data

Structure	Rates	Age-at-death distribution	Rates of change	Summary measures
Parametric	Cairn et al. (2006) Alai et al. (2018)	Janseen, DeBeer (2016)	Haberman, Renshaw (2012)	Raftery et al. (2013)
Principal components	Lee & Carter (1992) Li & Lee (2005) Li at al. (2019)	Oeppen (2008) Bergeron-Boucher et al. (2017) Kjærgaard et al.(2019)	Mitchell et al.(2013) Bohk & Rau(2017)	
Relational	De Beer(2012)	Basellini & Camarda(2019)		Torri & Vaupel(2012)
Non-parametric	Currieet al.(2004) Camarda (2019)			

Single population
Coherent forecast for several population
Subnational

Short-tern forecasting and nowcasting

Nowcasting is the prediction of the very recent past, the present, and the very near future state of selected indicators.

Problems:

- Data
- Methods
- Attention to short-term risk factors!

Early estimation of life expectancy using weekly deaths data

Giampaolo Lanzieri

doi: https://doi.org/10.1101/2023.08.11.23293993

Posted August 17, 2023.

Abstract

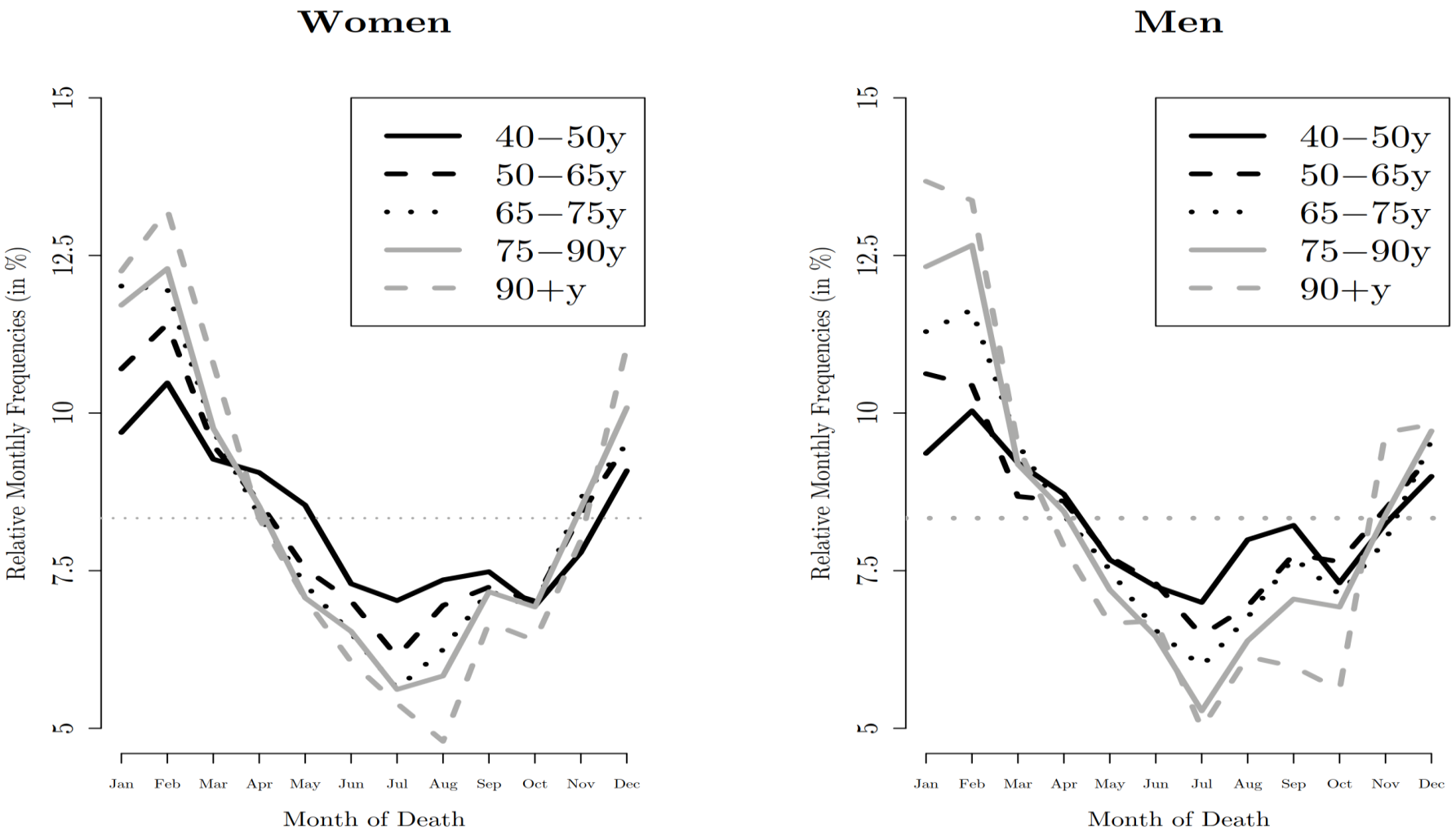
This paper proposes a simple method to obtain early estimates of life expectancy at any age using data on weekly deaths. Although tailored on weekly deaths data from the Statistical

of the method is applicable to any timely data

Seasonality

Seasonality in mortality: first publications

Seasonal distribution of deaths. Belgium, 1830s



Source: Quetelet, 1838; from Rau, R. 2006

Randomized short-term risk factors:
epidemics, heatwaves, economic crises, etc.

Key indicators of epidemics

Spread of the disease:

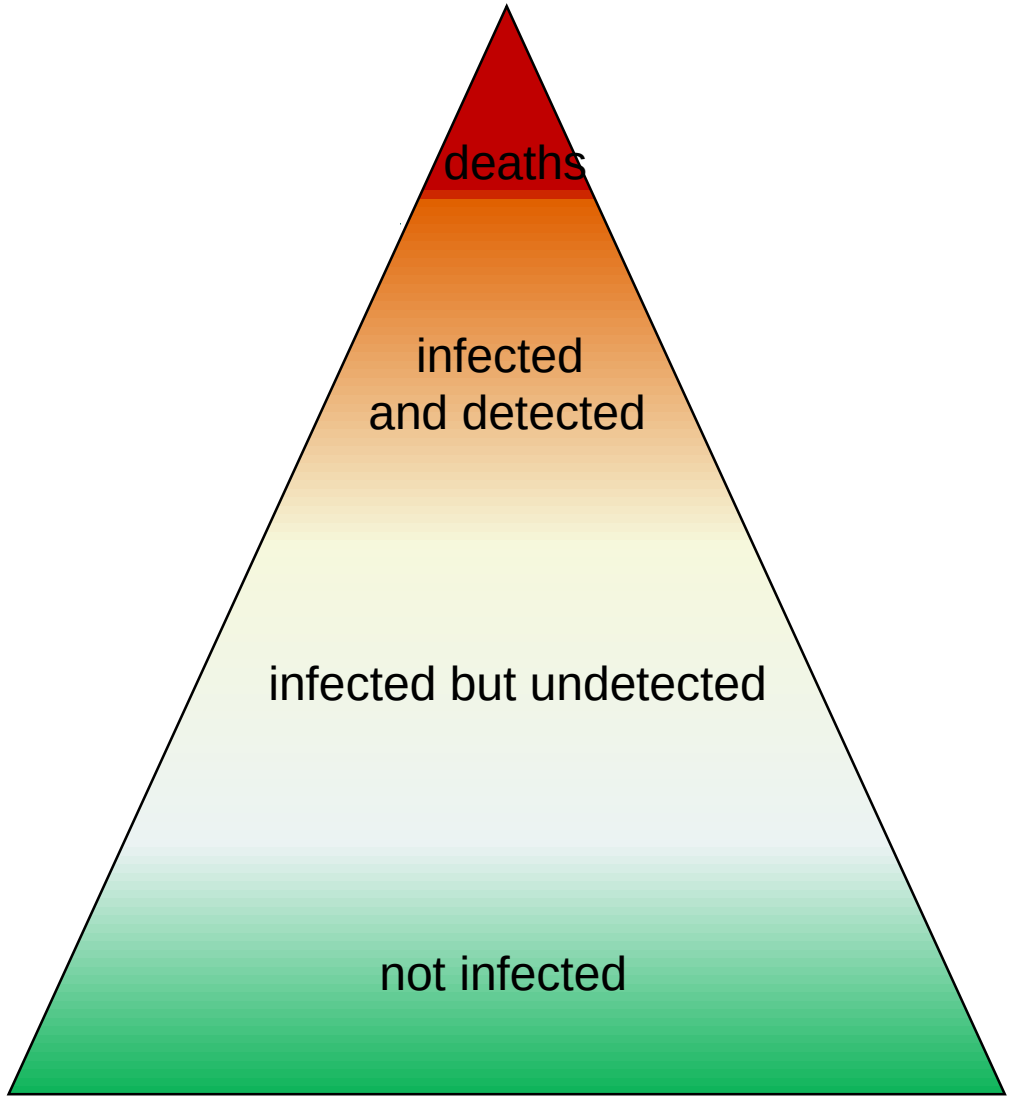
How many are infected in the population? How it evolves in time?

Lethality:

How many of those infected will die? How it depends on age and sex?

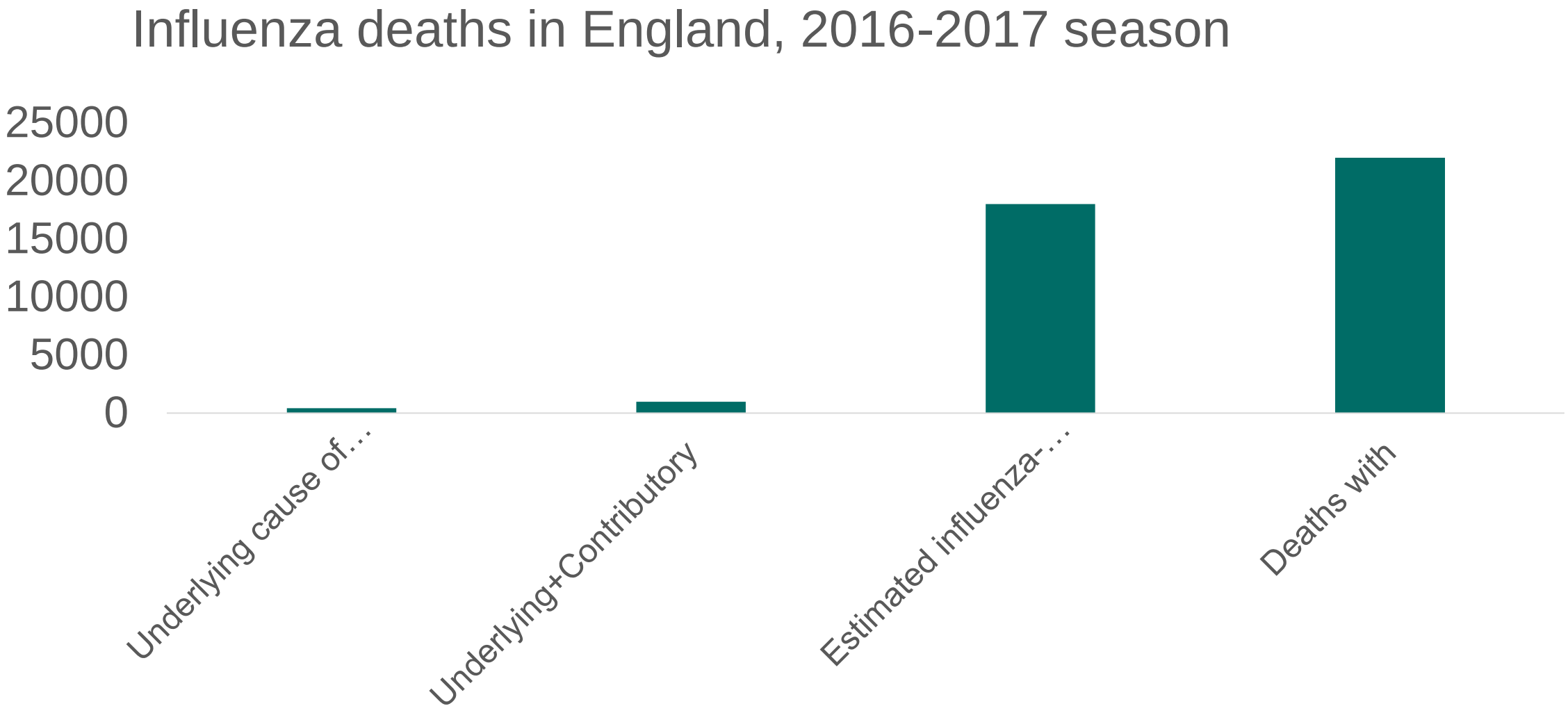
Mortality:

How many deaths will appear in the population due to the disease outbreak? How will it affect mortality and life expectancy trends?



Source: Danilova, Shkolnikov, Jdanov. HSE Webinar: COVID-19: Quantification

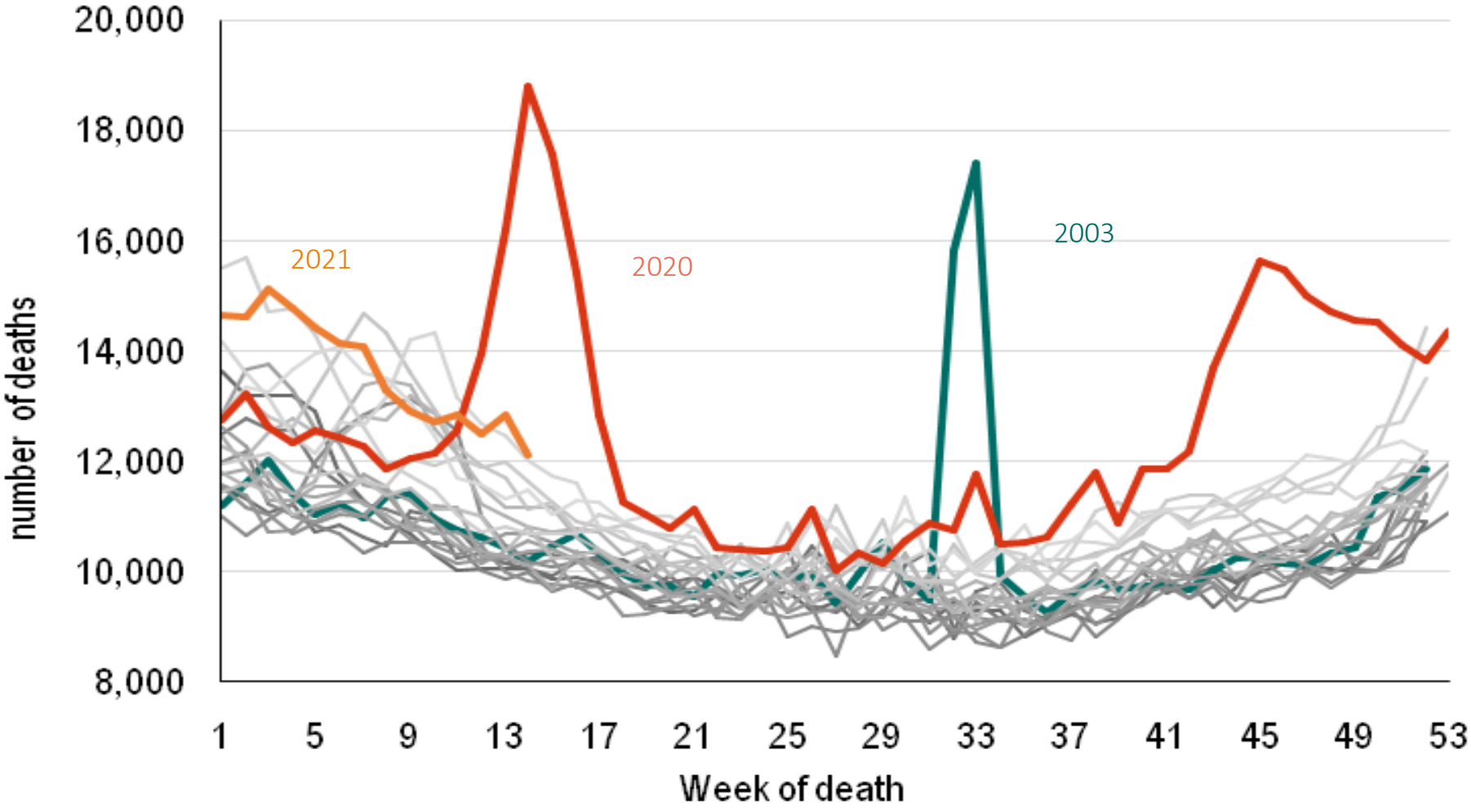
“Deaths With” vs. usual Cause-of-death



Source: Danilova, Shkolnikov, Jdanov. HSE Webinar: COVID-19: Quantification

Excess mortality

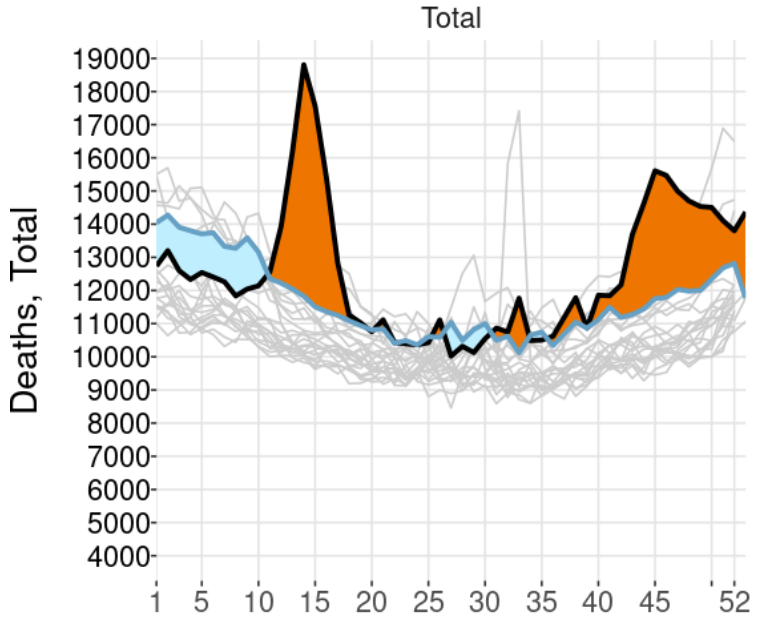
Total number of deaths. France, 2000-2021



Source: STMF series, Human Mortality Database, 2021

Excess mortality

Excess deaths = Observed deaths – Expected deaths



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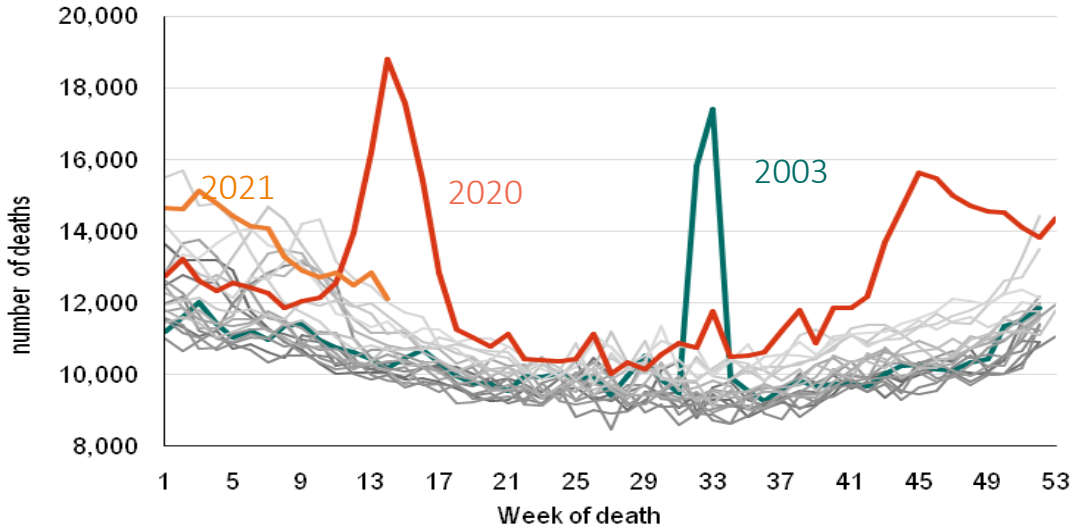
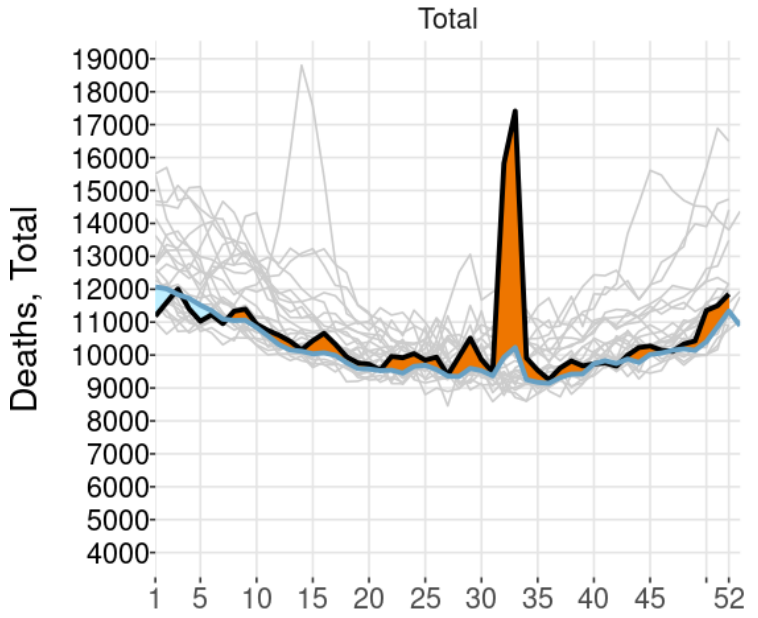
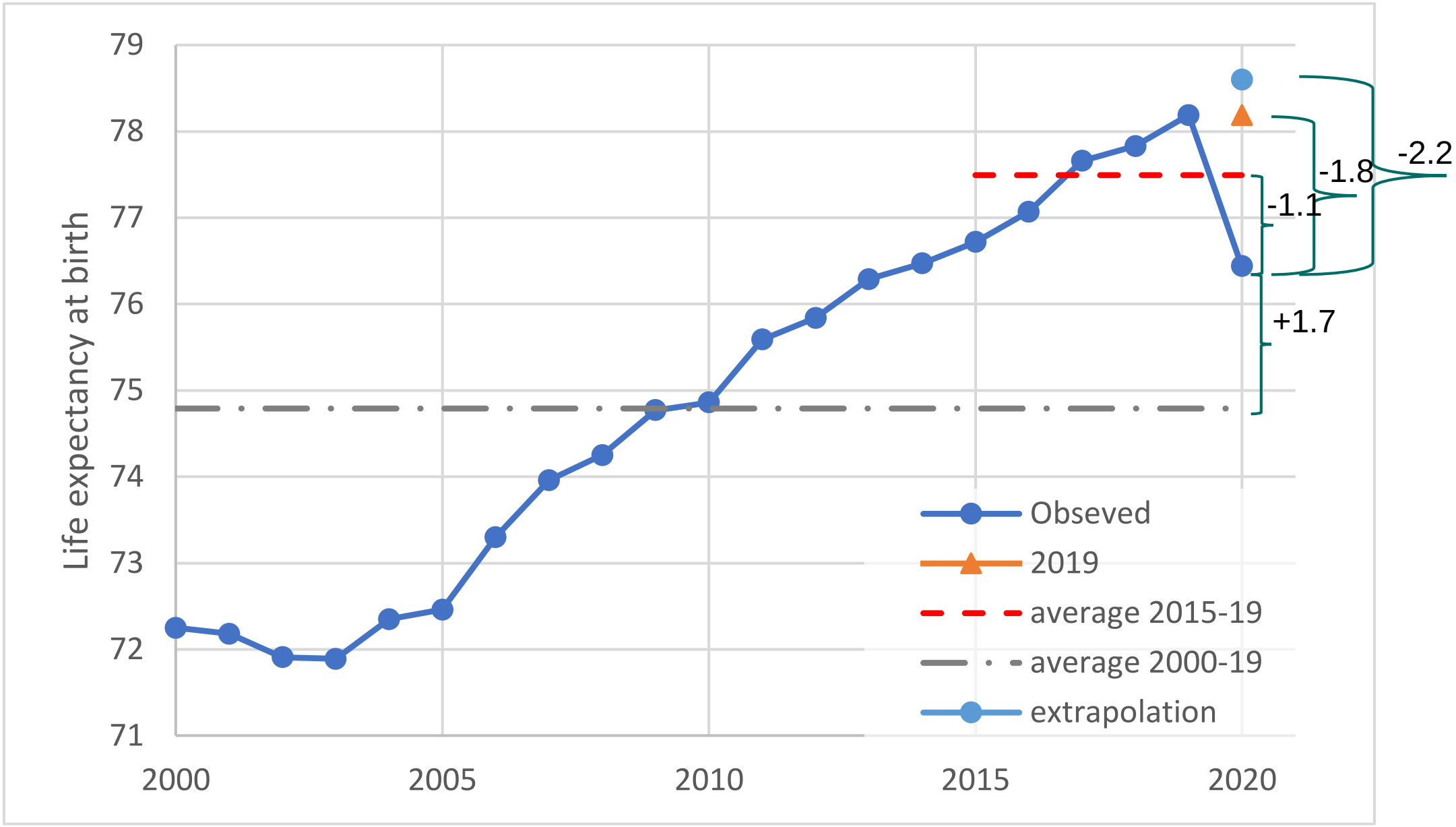


Source: STMF series, Human Mortality Database, 2021

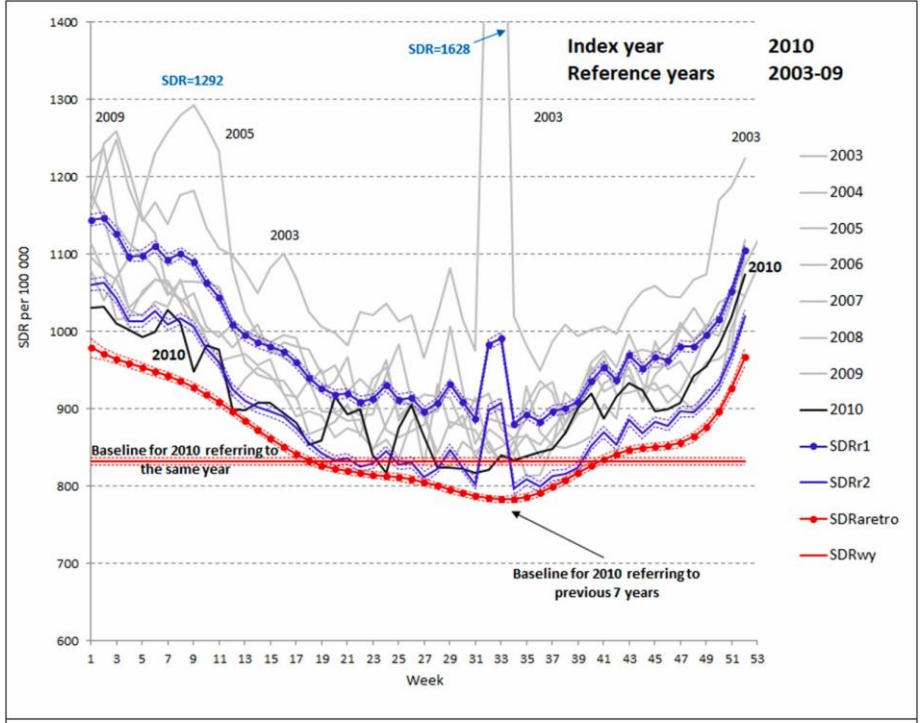


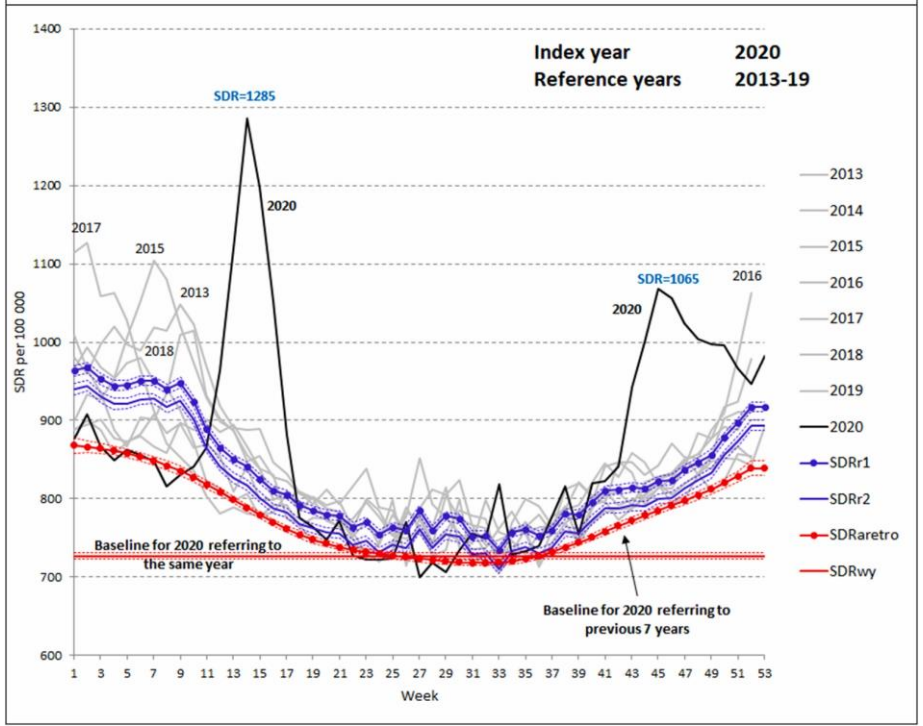
What to compare?



Russia, females

What should be the baseline when calculating excess mortality?

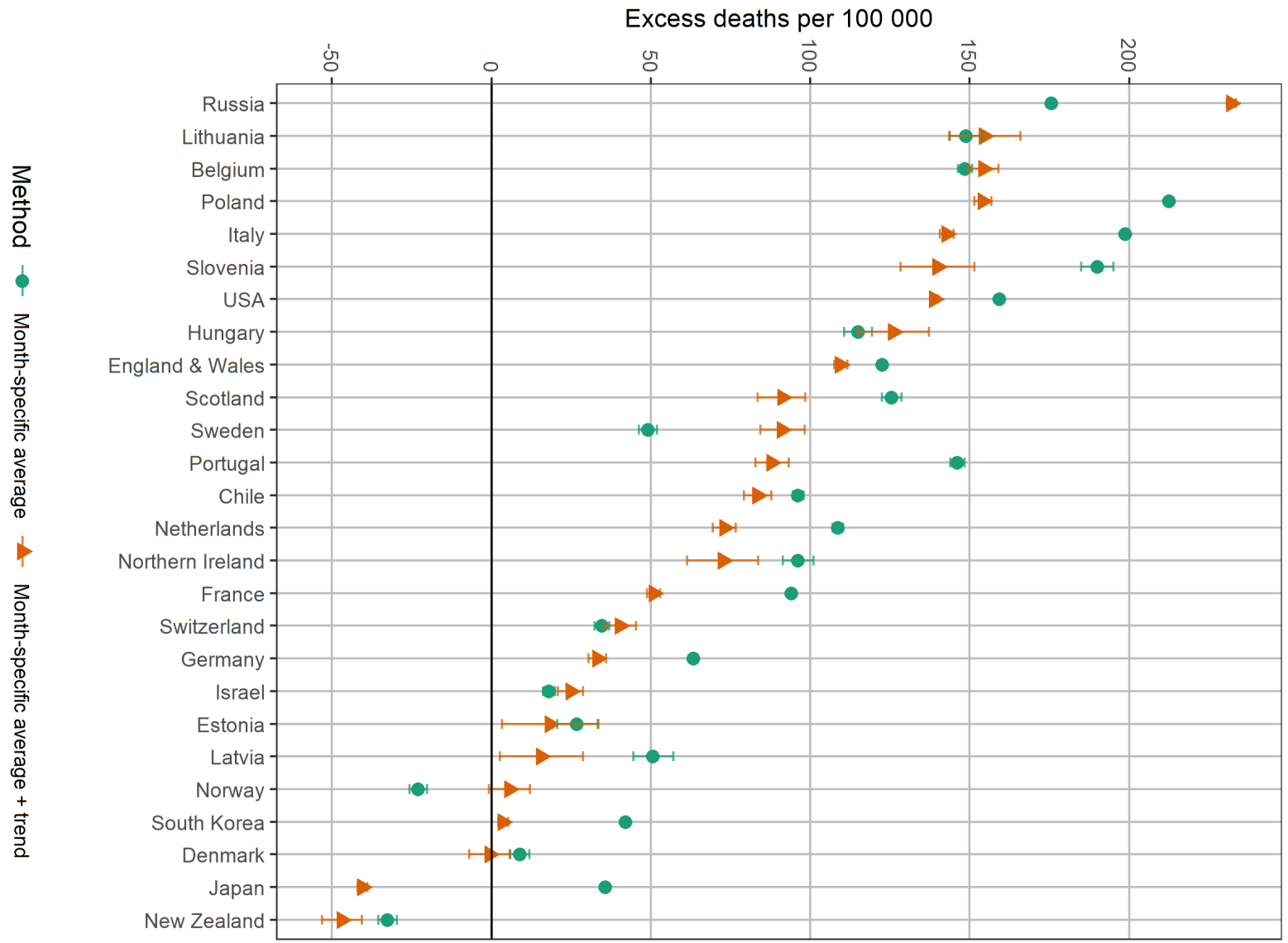




Notes. Baselines: aretro – alternative retrospective baseline; wy - within-year baseline; *r*1 – conventional retrospective baseline (week-specific averages); *r*2 – conventional retrospective baseline (week-specific averages + trend).

Source: Shkolnikov, V. M.; et al.: What should be the baseline when calculating excess mortality? New approaches suggest that we have underestimated the impact of the COVID-19 pandemic and previous winter peaks. *SSM-Population Health* 18:101118, 1–13. (2022)

Age-standardized vs. crude excess death



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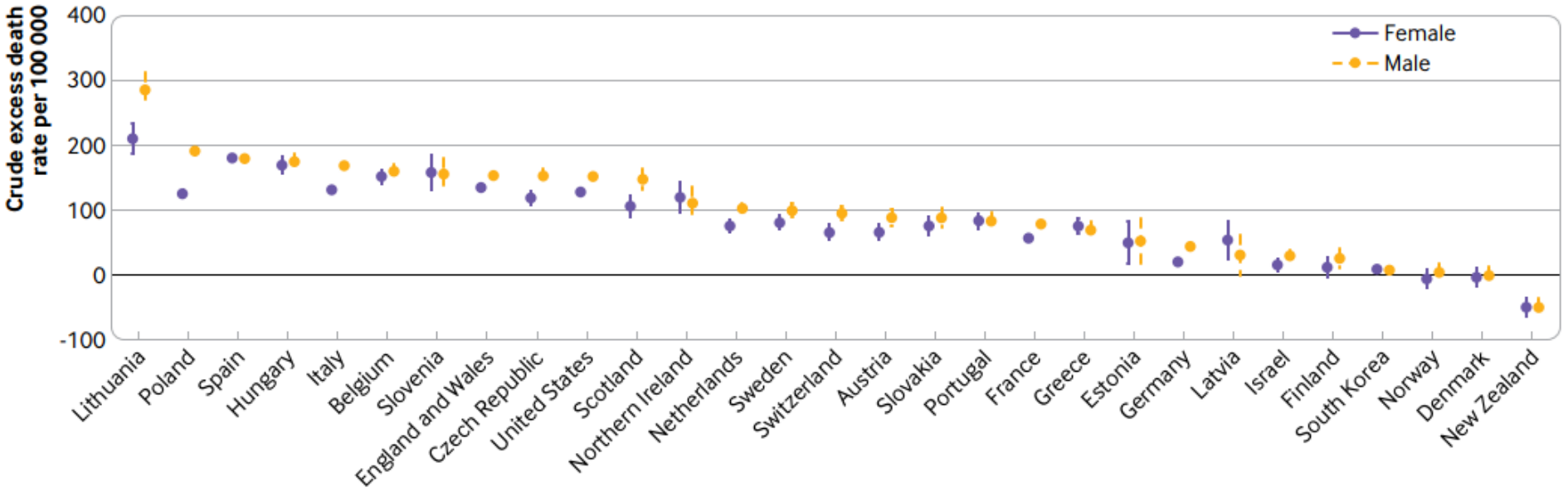
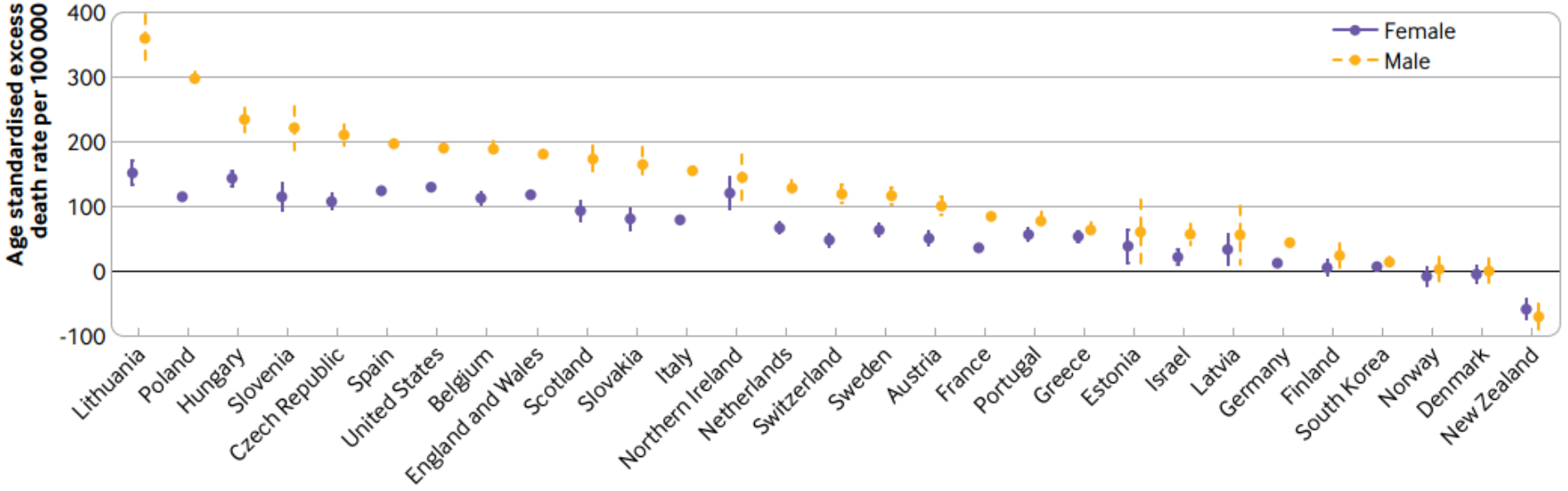




Source:

Islam et al (2021);

http://dx.doi.org/10.1136/bmj.n1137

Annual vs. monthly vs. weekly statistics

Annual

+ Standard tabulation
+ Easy interpretation
- Big delay in publication
- Do not reflect short-term fluctuations (e.g. due to epidemic)

Monthly

+ Standard tabulation
+ Short delay
- Short term-fluctuations are smoothed
- Data privacy issues

Weekly

+ Trace short-term fluctuations (e.g. epidemics)
+ Minimal delay
- Requires well developed statistical system
- Methodological challenges

Expected mortality: methods

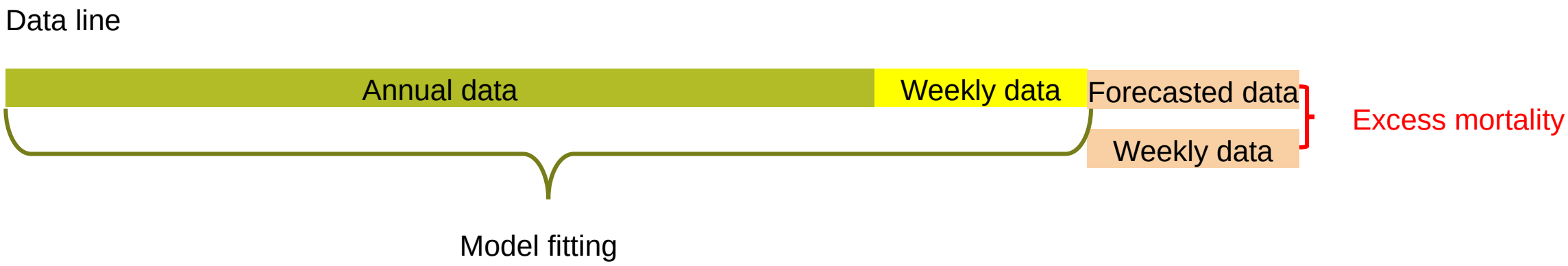
- Extrapolation (e.g. average, weekly-specific trends, annual trend with weekly effects, …) of observed indicator (death counts, CDR, SDR, …). Works with weekly/monthly data

- Bayesian approach. Models total number of deaths or by age group. Works with weekly/monthly data

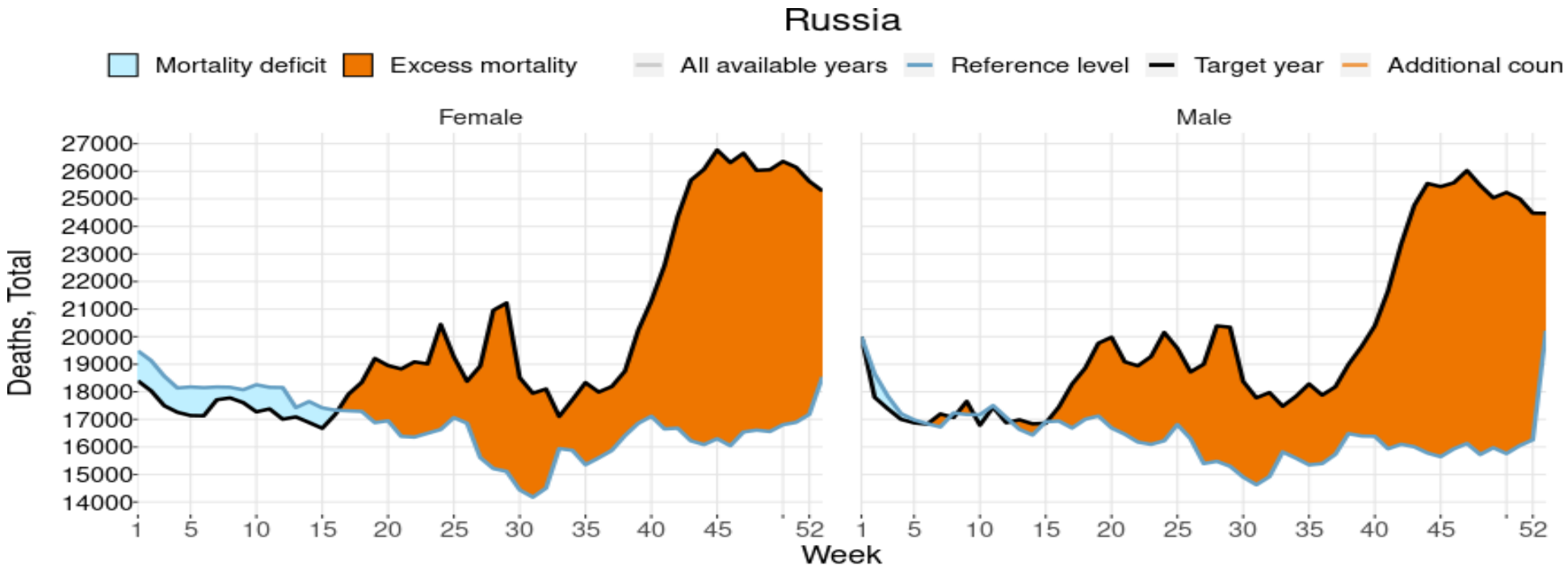
- “Standard” demographic forecast of mortality surface. Works with annual data

Methodology for annual estimates of excess mortality

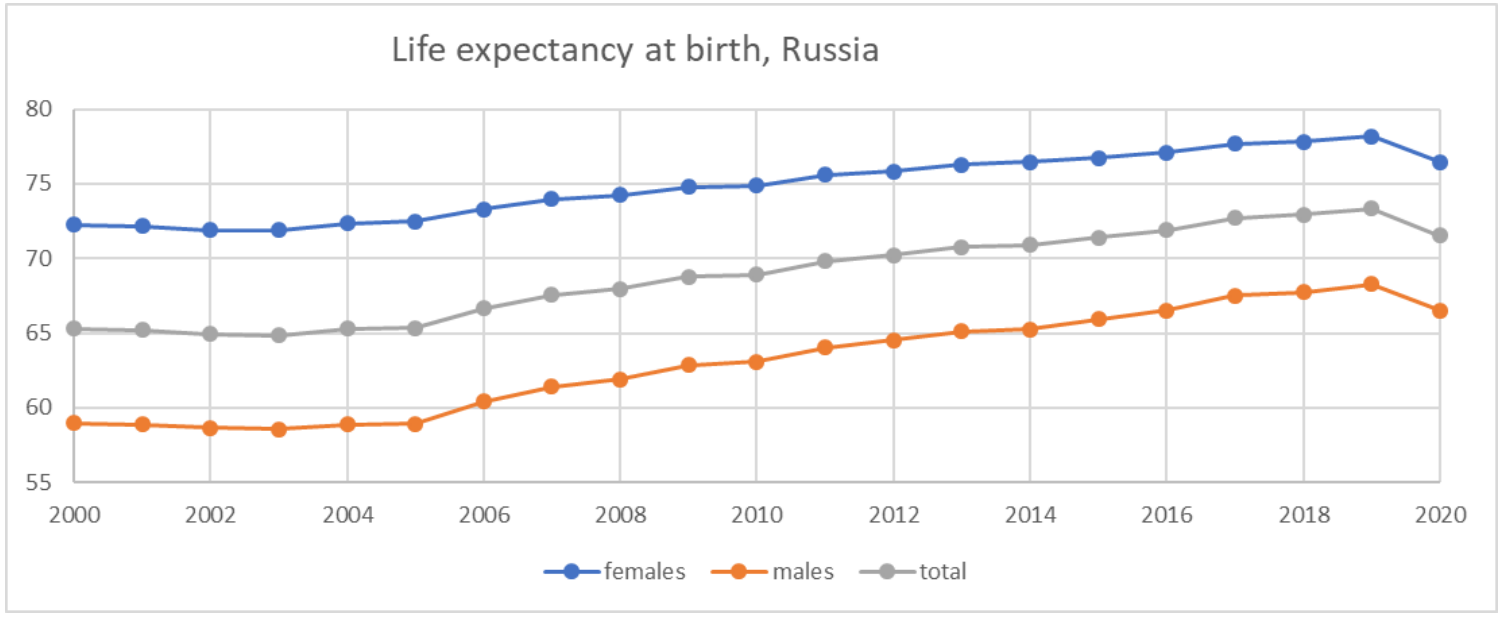
- Whenever possible, we use available annual estimates
- Using the available data series from 2005, we employed the Lee-Carter model to estimate ***expected*** LE and YLL in 2020
- We use the forecasted population exposures and observed ***weekly*** death counts to calculate ***observed*** death rates if annual estimates are not available
- Excess death were calculated as the difference between expected and observed number of deaths



Details in Islam N., Jdanov D., et al. (2021)



Method	Period	Excess deaths, thsd.	%
Week-specific average, total deaths	2015-19	290	15%
	2010-19	218	12%
Week-specific trend, total deaths	2015-19	344	19%
	2010-19	346	19%
Bayesian (age-specific)	2015-19	382	21%
	2010-19	318	17%
Lee-Carter (age-specific)	2005-19	366	20%



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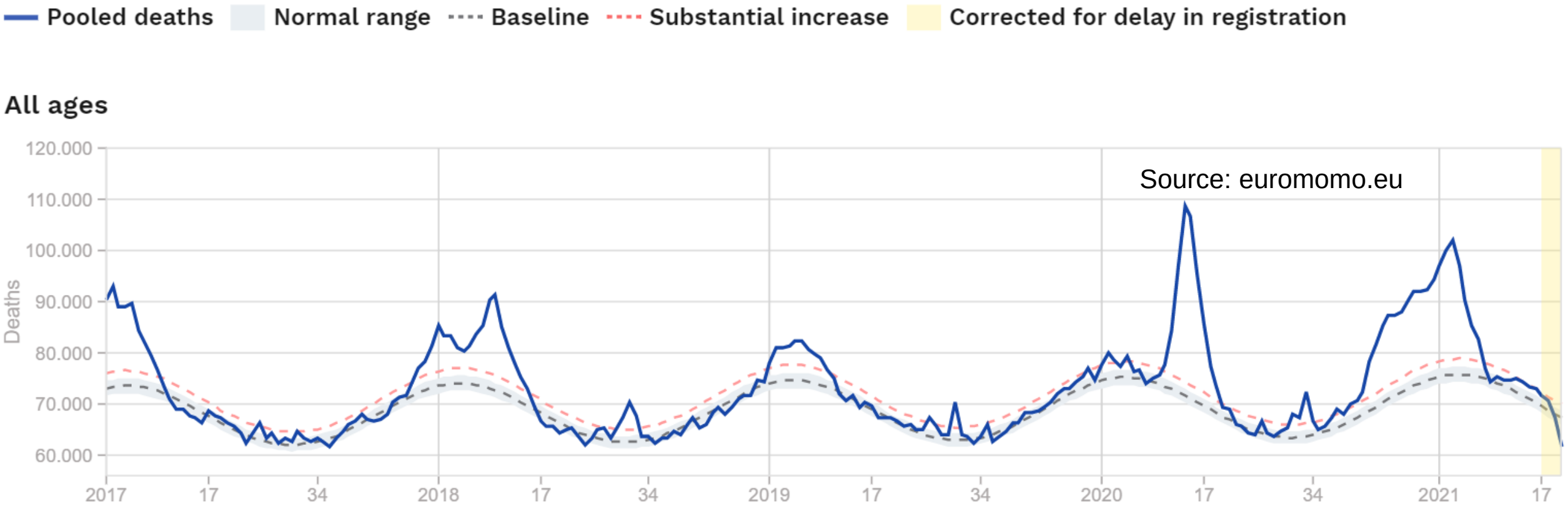
Data

Euromomo

Weekly mortality data for 24 countries; launched in 2011 (work started in 2008)



Before the COVID-19 pandemic, EuroMOMO received no more than a few hundred visitors per month, most of whom were researchers and data enthusiasts. During the first weeks of the pandemic, it gets an increase of 2000%, that is 3 million visitors per month.

STMF@HMD: Short-term Mortality Fluctuations

- The Short-term Mortality Fluctuations STMF database (STMF) is a new part of the Human Mortality Database launched in May 2020.

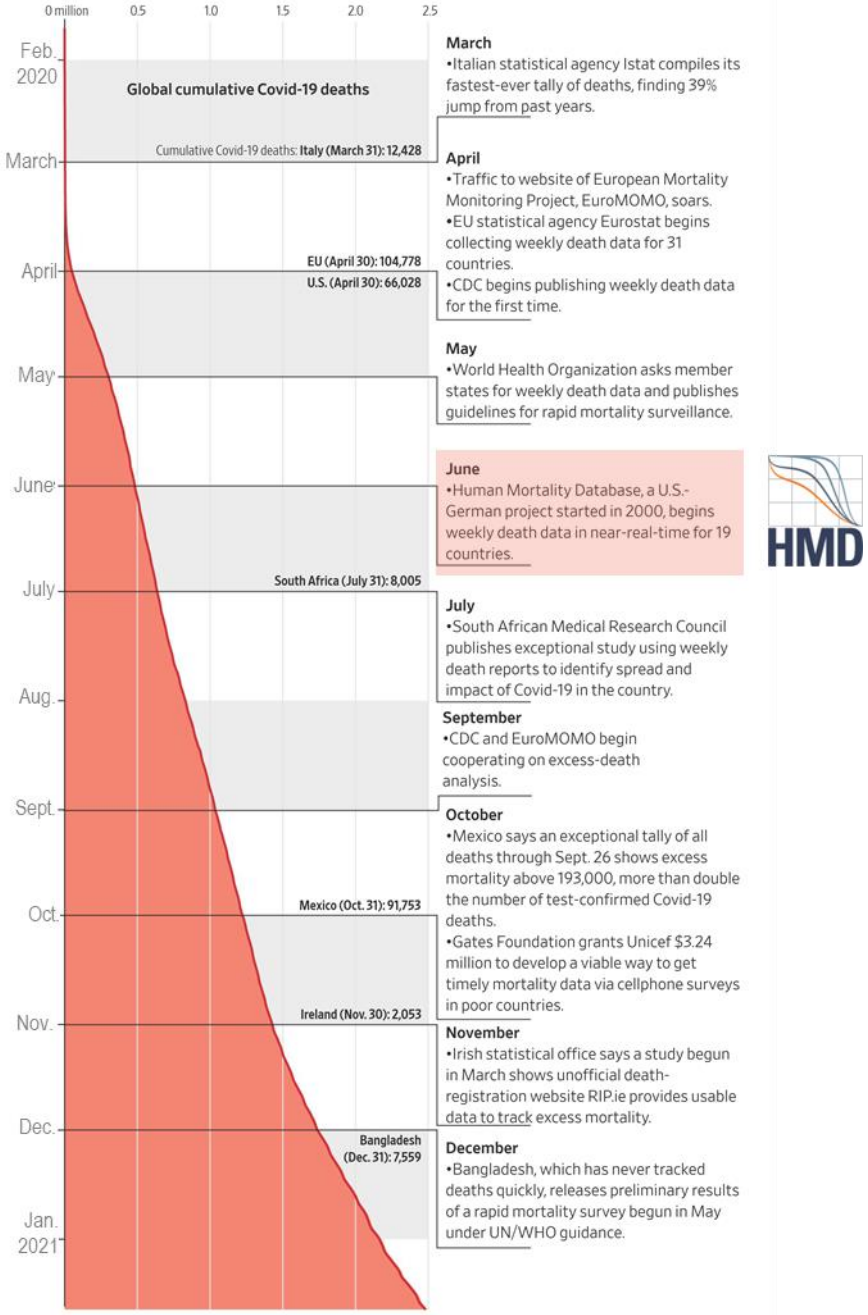
- It provides data for scientific analysis of all- cause mortality fluctuations by weeks within calendar years. Our decision to establish this new data resource was primarily in response to the COVID-19 pandemic of 2019-21.

- However, being able to look at short-term mortality fluctuations is becoming increasingly important because of the growing importance of seasonal/temporary mortality fluctuations that are driven by temperature extremes, seasonal patterns of influenza and other disasters.

Covid-19 Is Speeding Up How Deaths Are Recorded

Daniel Michaels
Jan. 23, 2021 5:30 am ET

THE WALL STREET JOURNAL.

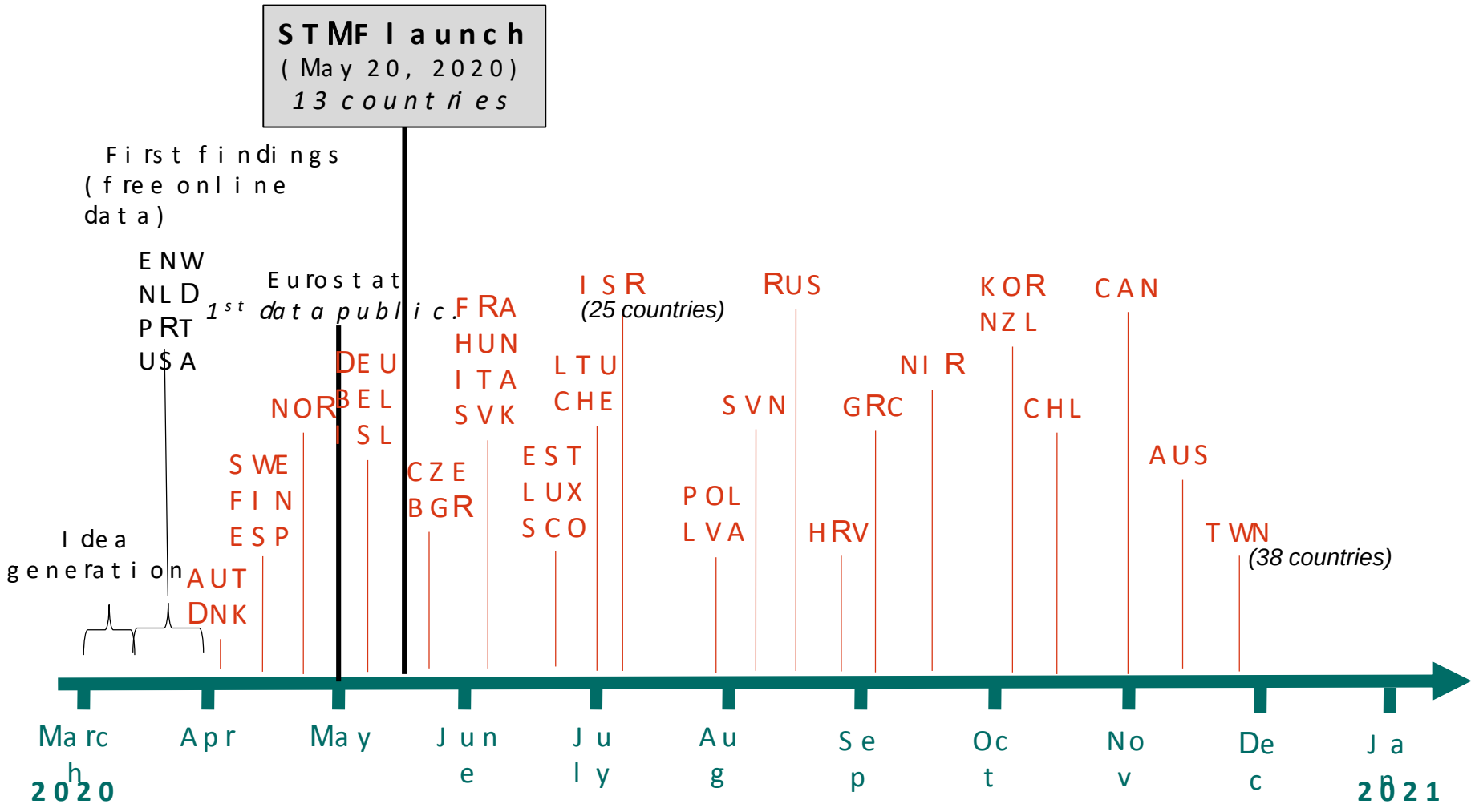


Source: Johns Hopkins CSSE (deaths); the organizations (ways to register deaths)

Human Mortality Database
www.mortality.org

Short-Term Mortality Fluctuation data series

TIMELINE OF DATA AVAILABILITY



Human Mortality Database HMD
www.mortality.org

Short-Term Mortality Fluctuation data series

WHAT DATA PROVIDES THE STMF?

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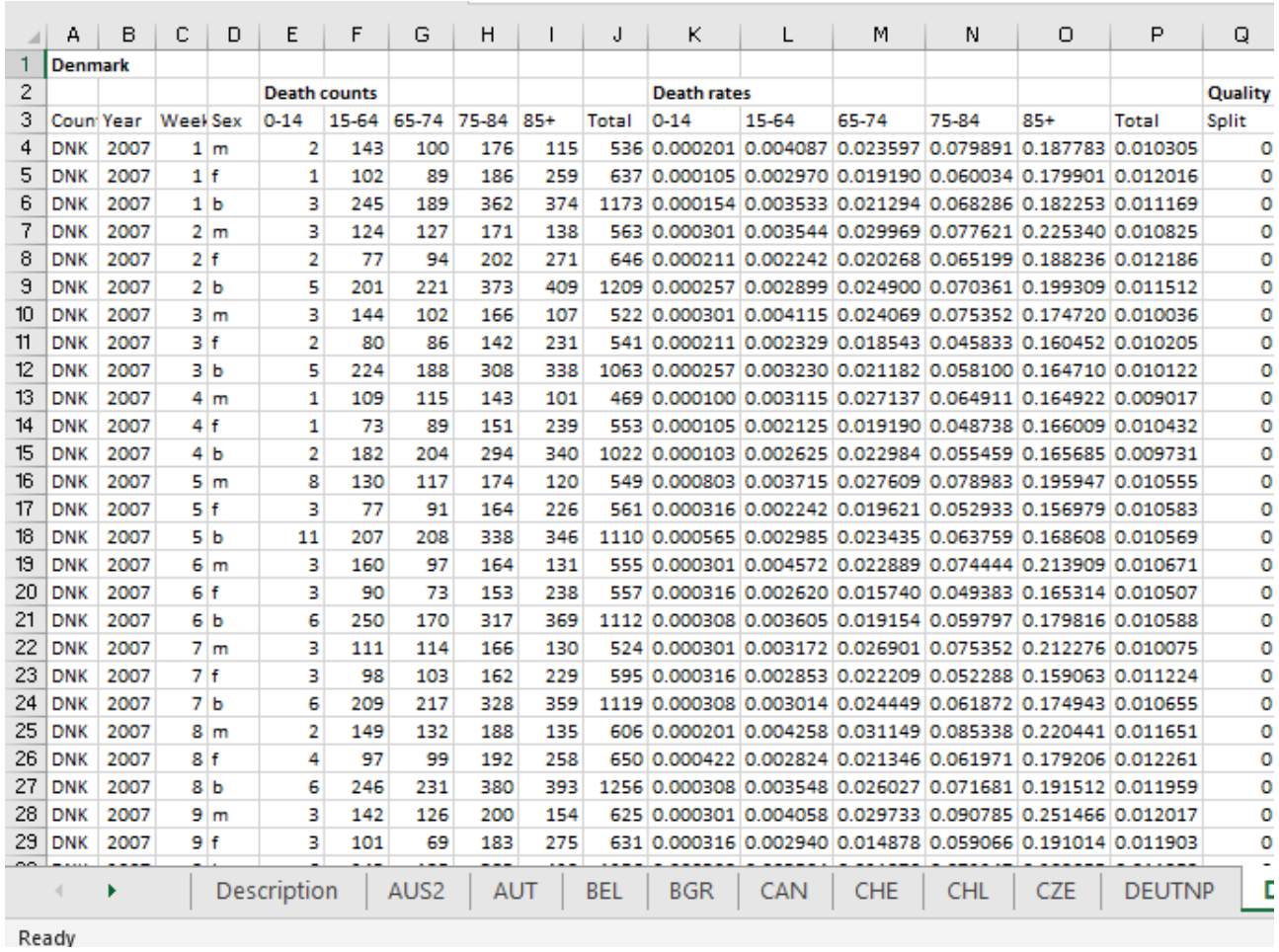
3. **Pooled file with weekly death counts & rates in standard age groups (*csv*)**



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Denmark																
2					Death counts						Death rates						Quality
3	Coun	Year	Week	Sex	0-14	15-64	65-74	75-84	85+	Total	0-14	15-64	65-74	75-84	85+	Total	Split
4	DNK	2007	1	m	2	143	100	176	115	536	0.000201	0.004087	0.023597	0.079891	0.187783	0.010305	0
5	DNK	2007	1	f	1	102	89	186	259	637	0.000105	0.002970	0.019190	0.060034	0.179901	0.012016	0
6	DNK	2007	1	b	3	245	189	362	374	1173	0.000154	0.003533	0.021294	0.068286	0.182253	0.011169	0
7	DNK	2007	2	m	3	124	127	171	138	563	0.000301	0.003544	0.029969	0.077621	0.225340	0.010825	0
8	DNK	2007	2	f	2	77	94	202	271	646	0.000211	0.002242	0.020268	0.065199	0.188236	0.012186	0
9	DNK	2007	2	b	5	201	221	373	409	1209	0.000257	0.002899	0.024900	0.070361	0.199309	0.011512	0
10	DNK	2007	3	m	3	144	102	166	107	522	0.000301	0.004115	0.024069	0.075352	0.174720	0.010036	0
11	DNK	2007	3	f	2	80	86	142	231	541	0.000211	0.002329	0.018543	0.045833	0.160452	0.010205	0
12	DNK	2007	3	b	5	224	188	308	338	1063	0.000257	0.003230	0.021182	0.058100	0.164710	0.010122	0
13	DNK	2007	4	m	1	109	115	143	101	469	0.000100	0.003115	0.027137	0.064911	0.164922	0.009017	0
14	DNK	2007	4	f	1	73	89	151	239	553	0.000105	0.002125	0.019190	0.048738	0.166009	0.010432	0
15	DNK	2007	4	b	2	182	204	294	340	1022	0.000103	0.002625	0.022984	0.055459	0.165685	0.009731	0
16	DNK	2007	5	m	8	130	117	174	120	549	0.000803	0.003715	0.027609	0.078983	0.195947	0.010555	0
17	DNK	2007	5	f	3	77	91	164	226	561	0.000316	0.002242	0.019621	0.052933	0.156979	0.010583	0
18	DNK	2007	5	b	11	207	208	338	346	1110	0.000565	0.002985	0.023435	0.063759	0.168608	0.010569	0
19	DNK	2007	6	m	3	160	97	164	131	555	0.000301	0.004572	0.022889	0.074444	0.213909	0.010671	0
20	DNK	2007	6	f	3	90	73	153	238	557	0.000316	0.002620	0.015740	0.049383	0.165314	0.010507	0
21	DNK	2007	6	b	6	250	170	317	369	1112	0.000308	0.003605	0.019154	0.059797	0.179816	0.010588	0
22	DNK	2007	7	m	3	111	114	166	130	524	0.000301	0.003172	0.026901	0.075352	0.212276	0.010075	0
23	DNK	2007	7	f	3	98	103	162	229	595	0.000316	0.002853	0.022209	0.052288	0.159063	0.011224	0
24	DNK	2007	7	b	6	209	217	328	359	1119	0.000308	0.003014	0.024449	0.061872	0.174943	0.010655	0
25	DNK	2007	8	m	2	149	132	188	135	606	0.000201	0.004258	0.031149	0.085338	0.220441	0.011651	0
26	DNK	2007	8	f	4	97	99	192	258	650	0.000422	0.002824	0.021346	0.061971	0.179206	0.012261	0
27	DNK	2007	8	b	6	246	231	380	393	1256	0.000308	0.003548	0.026027	0.071681	0.191512	0.011959	0
28	DNK	2007	9	m	3	142	126	200	154	625	0.000301	0.004058	0.029733	0.090785	0.251466	0.012017	0
29	DNK	2007	9	f	3	101	69	183	275	631	0.000316	0.002940	0.014878	0.059066	0.191014	0.011903	0

Description | AUS2 | AUT | BEL | BGR | CAN | CHE | CHL | CZE | DEUTNP

Ready

Weekly revision of all preliminary data & additional new data

www.mortality.org

Human Mortality Database
www.mortality.org

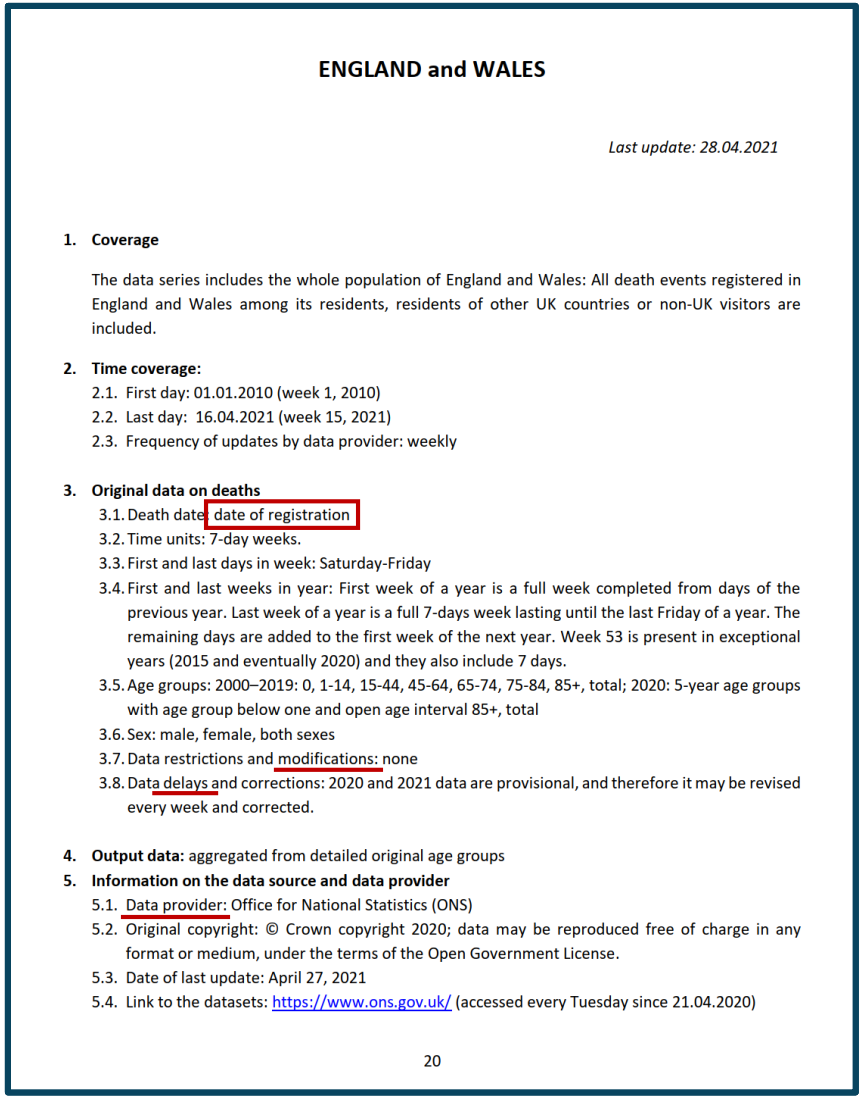
Short-Term Mortality Fluctuation data series

WHAT DATA PROVIDES THE STMF?

1. Weekly original death counts (*csv*)
2. Weekly death counts & rates in standard age groups (*Excel*)
3. Pooled file with weekly death counts & rates in standard age groups (*csv*)
4. Description of data Formats and Methods
5. **Metadata**

Weekly revision of all preliminary data & additional new data

www.mortality.org



ENGLAND and WALES

Last update: 28.04.2021

1. **Coverage**

   The data series includes the whole population of England and Wales: All death events registered in England and Wales among its residents, residents of other UK countries or non-UK visitors are included.

2. **Time coverage:**
   - 2.1. First day: 01.01.2010 (week 1, 2010)
   - 2.2. Last day: 16.04.2021 (week 15, 2021)
   - 2.3. Frequency of updates by data provider: weekly

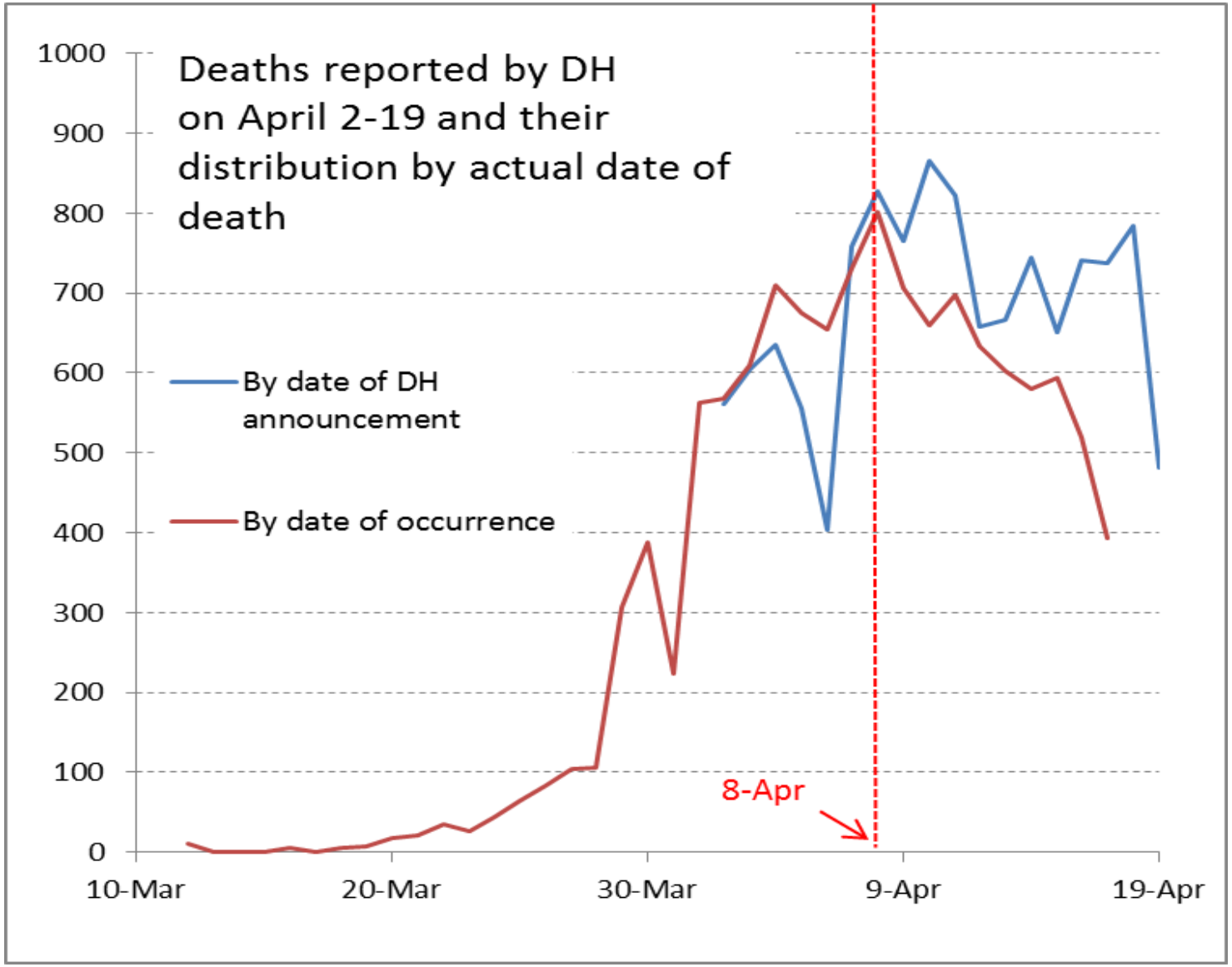
3. **Original data on deaths**
   - 3.1. Death date: date of registration
   - 3.2. Time units: 7-day weeks.
   - 3.3. First and last days in week: Saturday-Friday
   - 3.4. First and last weeks in year: First week of a year is a full week completed from days of the previous year. Last week of a year is a full 7-days week lasting until the last Friday of a year. The remaining days are added to the first week of the next year. Week 53 is present in exceptional years (2015 and eventually 2020) and they also include 7 days.
   - 3.5. Age groups: 2000–2019: 0, 1-14, 15-44, 45-64, 65-74, 75-84, 85+, total; 2020: 5-year age groups with age group below one and open age interval 85+, total
   - 3.6. Sex: male, female, both sexes
   - 3.7. Data restrictions and modifications: none
   - 3.8. Data delays and corrections: 2020 and 2021 data are provisional, and therefore it may be revised every week and corrected.

4. **Output data:** aggregated from detailed original age groups
5. **Information on the data source and data provider**
   - 5.1. Data provider: Office for National Statistics (ONS)
   - 5.2. Original copyright: © Crown copyright 2020; data may be reproduced free of charge in any format or medium, under the terms of the Open Government License.
   - 5.3. Date of last update: April 27, 2021
   - 5.4. Link to the datasets: https://www.ons.gov.uk/ (accessed every Tuesday since 21.04.2020)

20

COVID-19 Death Counts, E&W

Deaths by Date of Reporting vs. Date of Death



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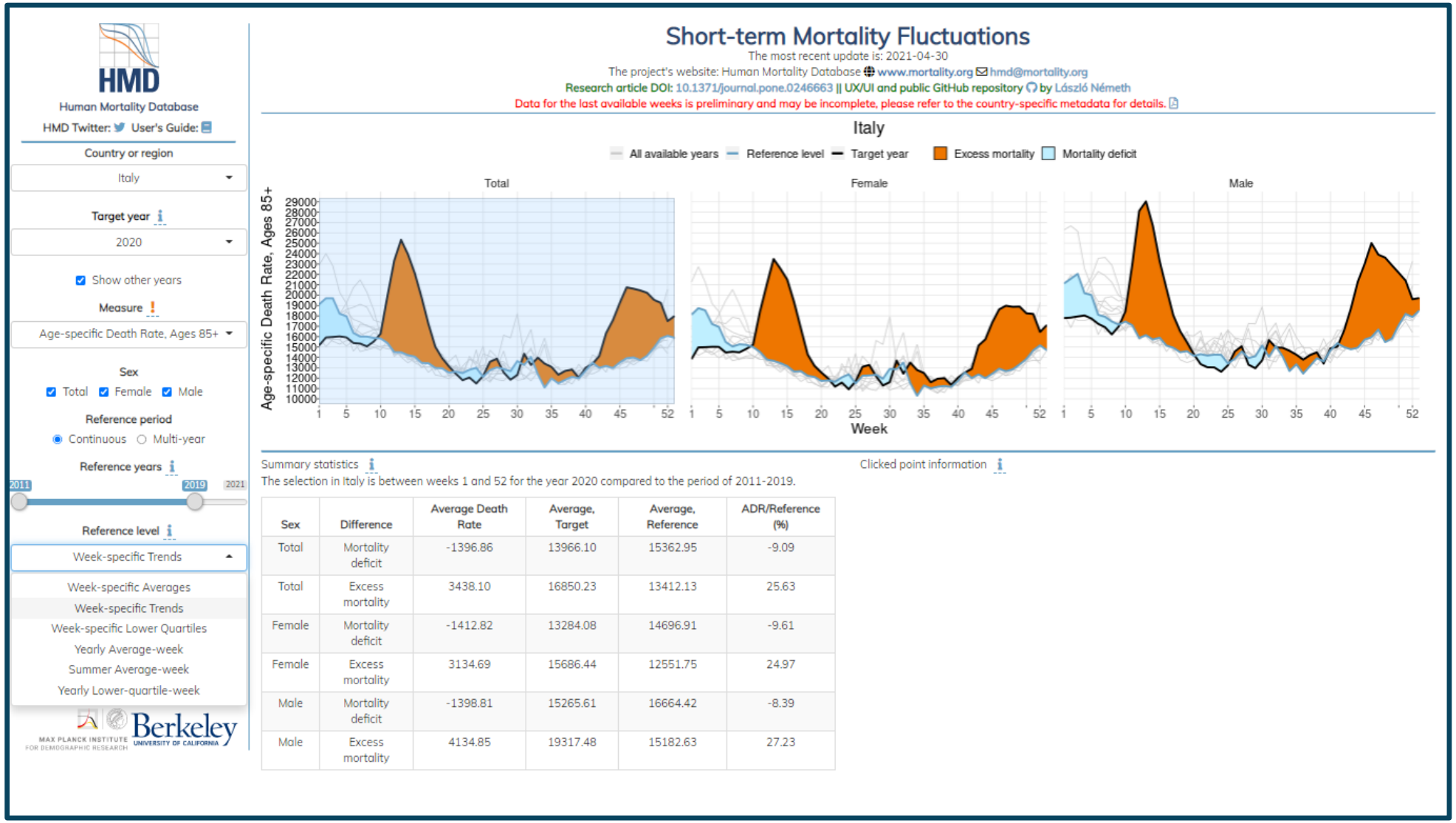
5. Metadata
6. **Toolkit to visualize excess mortality (6 methods)**

Human Mortality Database
www.mortality.org

Short-Term Mortality Fluctuation data series

WHAT DATA PROVIDES THE STMF?

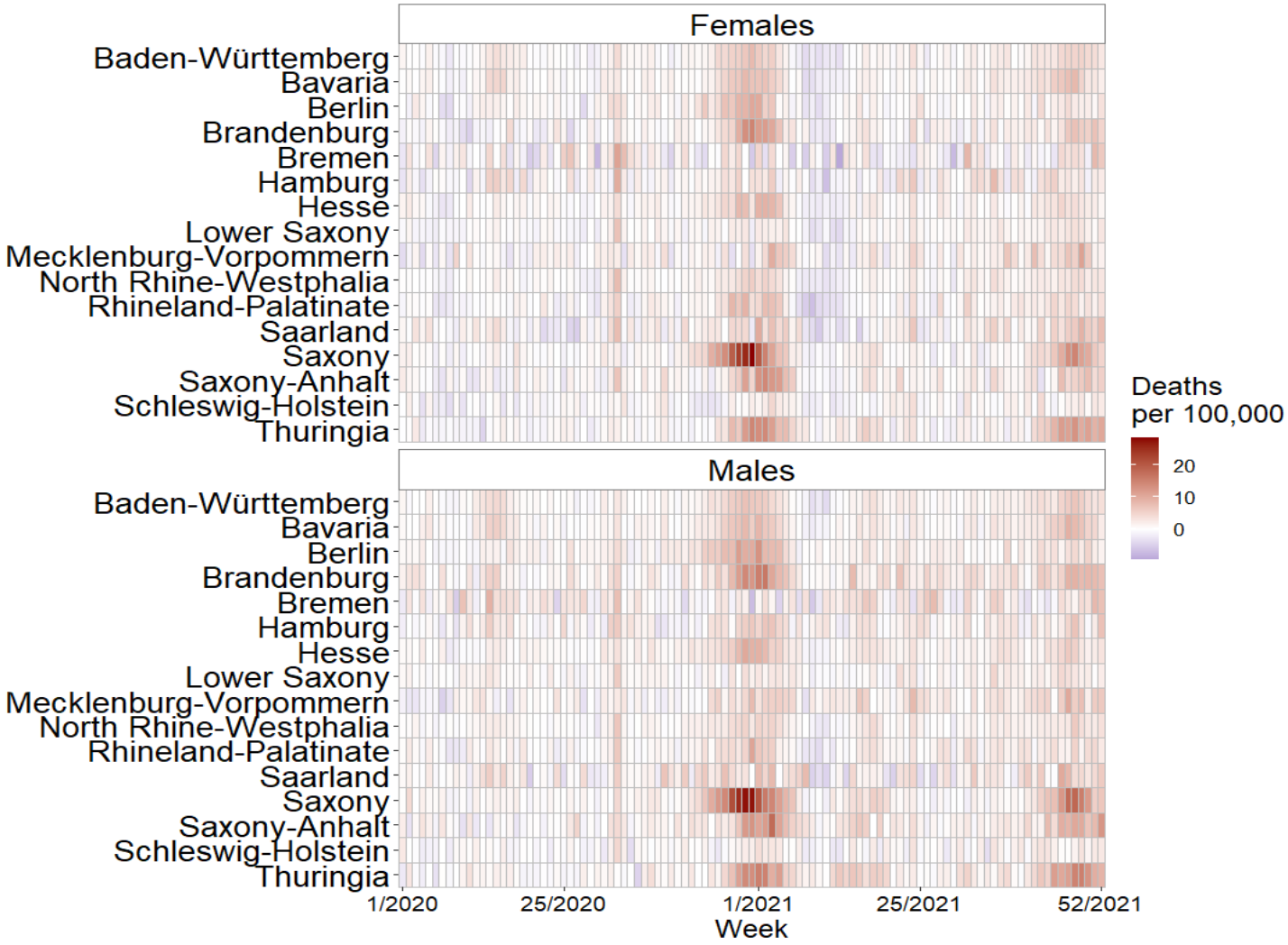
https://mpidr.shinyapps.io/stmortality/



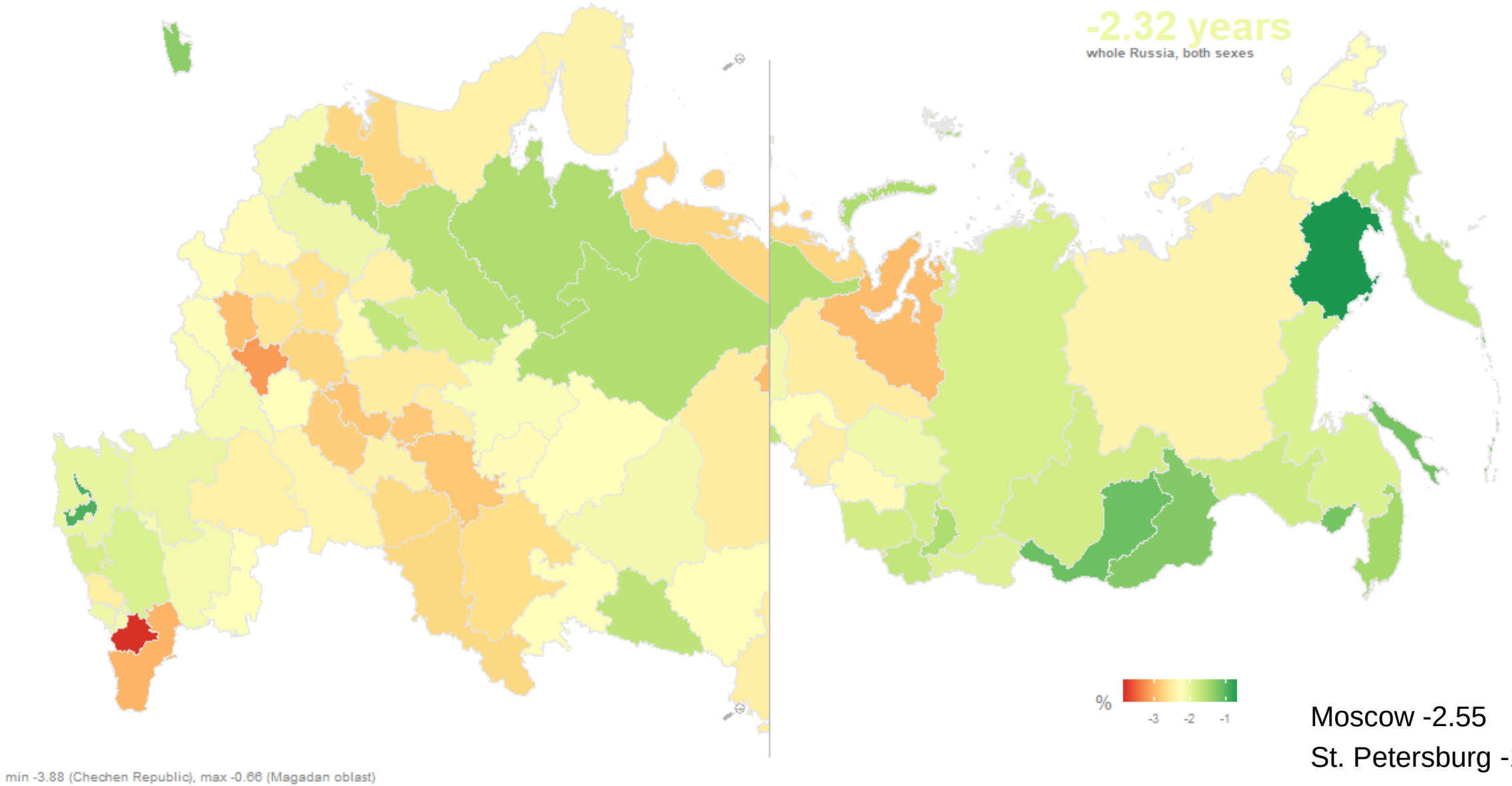
Sex	Difference	Average Death Rate	Average, Target	Average, Reference	ADR/Reference (%)
Total	Mortality deficit	-1396.86	13966.10	15362.95	-9.09
Total	Excess mortality	3438.10	16850.23	13412.13	25.63
Female	Mortality deficit	-1412.82	13284.08	14696.91	-9.61
Female	Excess mortality	3134.69	15686.44	12551.75	24.97
Male	Mortality deficit	-1398.81	15265.61	16664.42	-8.39
Male	Excess mortality	4134.85	19317.48	15182.63	27.23

Spatial inequality: Germany

Week-specific age-standardized excess death rates during the Covid-19 pandemic across federal states of Germany (per 100,000)
Source: Kolobova, Jdanov, Jasilionis, et al. (2021)



Life expectancy losses in 2020, males



Moscow -2.55

St. Petersburg -1.70