Excess death estimates from multiverse analysis in 2009-2021

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ABSTRACT (234 words, 250 words maximum)

Excess death estimates have great value in public health, but they can be sensitive to analytical choices. Here we propose a multiverse analysis approach that considers all possible different time periods for defining the reference baseline and a range of 1 to 4 years for the projected time period for which excess deaths are calculated. We used data from the Human Mortality Database on 33 countries with detailed age-stratified death information on an annual basis during the period 2009-2021. The use of different time periods for reference baseline led to large variability in the absolute magnitude of the exact excess death estimates. However, the relative ranking of different countries compared to others for specific years remained largely unaltered. Averaging across all possible analyses, distinct time patterns were discerned across different countries. Countries had declines between 2009 and 2019, but the steepness of the decline varied markedly. There were also large differences across countries on whether the COVID-19 pandemic years 2020-2021 resulted in an increase of excess deaths and by how much. Consideration of longer projected time windows resulted in substantial shrinking of the excess deaths in many, but not all countries. Multiverse analysis of excess deaths over long periods of interest can offer a more unbiased approach to understand comparative mortality trends across different countries, the range of uncertainty around estimates, and the nature of observed mortality peaks.

SIGNIFICANCE STATEMENT (119 words, 120 words maximum)

Excess death estimates are the ultimate assessment of the impact of multiple diseases and forces on the mortality of a population. However, their calculation can be notoriously unstable because it depends on a multitude of analytical choices. Other scientific fields have started using multiverse analysis approaches where all possible analytical choices are considered. We developed a multiverse analysis approach for excess death estimation. The approach is demonstrated with data from 33 countries for the period 2009-2021. Multiverse analysis offers a standardized way to demonstrate the sensitivity of estimates to analytic assumptions, to understand the presence of time patterns (rather than arbitrarily prespecify them), and to reveal consistent patterns that characterize excess deaths in a comparative fashion between different countries.

INTRODUCTION

Calculation of excess deaths is considered to be a very useful tool for estimating patterns of mortality changes over time in different countries and the impact of major events, such as pandemics (1-3). Excess deaths are meant to capture the composite sum of perturbations in disease incidence and other factors, including social, health care, lifestyle and natural catastrophes that may shape population fatalities in a given year. However, excess death calculations can lead to controversy with different teams of researchers generating markedly different estimates for the same country and year(s) (4-6). The reason is that the calculation of excess deaths requires making analytical choices for which there is no consensus. Specifically, one needs to select a reference baseline period (a time window in the past that will be used for extrapolating how many deaths would be expected in subsequent years) and a projected period (the time window for which an excess death estimate is made by comparing the observed versus expected number of deaths based on the past (reference) experience). Moreover, one should decide whether there are any time patterns and what is the form of these time patterns (e.g. whether overall mortality should be declining or increasing over time and, if so, in what form, e.g. linear or spline fit). Empirical work and simulations (4-10) have shown that these choices can make a substantial difference in the obtained excess death estimates.

When results depend on analytical choices, one methodological strategy is to explore the full range of results that can be obtained when a wide range of possible analytical choices and combinations thereof are considered (11-20). Analyses may range from a few dozen to several million different options (e.g. in selecting covariate sets in regressions) (15,17). Different terminology has been used for such approaches that generalize the concept of sensitivity analysis. Commonly used terms are “multiverse analysis” (11-14), “vibration of effects” (16-18) and “multi-analyst analysis” (19,20) (when multiple researchers are each asked to select

independently their preferred analysis). Here, we propose a multiverse approach for excess deaths. Instead of making unavoidably arbitrary choices in selecting reference baseline and projected periods, we consider all possible reference baseline periods and projected periods in consecutive year time windows during a lengthy period of interest. Instead of prespecifying time patterns, this multiverse approach allows the data to demonstrate what might be the time patterns and how sensitive the results are to different analytical choices. All possible choices are considered for reference baseline periods. The multiverse approach also allows us to understand to what extent excess death estimates may shrink when longer projected periods are considered, in the range of 1-4 years. If perturbations lead to excess deaths increases due to the demise of individuals with limited life expectancy (21), then excess death peaks that are seen with short projected periods (e.g. 1 year) will diminish or even disappear when longer projected periods are considered. People who died at some point due to the perturbation would have died very soon anyhow. Conversely, if perturbations result in mortality peaks due to deaths of people who had long life expectancy, extending the projected period window will not have the same impact.

We applied this approach to 33 high-income countries that have the most reliable data for mortality according to age-stratified groups for the extended period 2009-2021. This allowed us to examine whether there are consistent time patterns in different countries, how sensitive the results are to analytical choices, and whether larger projected period windows, especially in the COVID-19 pandemic and the years preceding it, shrink substantially any observed mortality peaks.

RESULTS

Variability of excess death estimates according to reference baselines

The absolute value of excess death estimates can vary a lot depending on the selection of reference years used for baseline. We considered all 66 possible time windows of whole consecutive calendar years (1 to 11 years long) in the years 2009-2019 as representing baseline values. Table 1 shows the average, standard deviation, minimum, maximum and range for estimates of relative excess deaths (expressed as percentage of expected deaths) for the two-year pandemic period 2020-2021 for each of the 33 countries. The average value is highly correlated with either the maximum or minimum value but not with standard deviation or range (correlation coefficients of 0.96, 0.95, -0.22 and -0.15, respectively). This happens as changing the reference time window shifts all years by approximately the same amount along the y-axis.

Stability of relative ranking for the pandemic years' excess deaths across 33 countries

The estimates of relative excess deaths (as percentage of expected deaths) can be used to compare different countries in a given time period. Despite large variabilities in the absolute estimates, the relative ranking of the 33 countries for a given period of interest was largely unperturbed, regardless of what reference baseline years were chosen. Table 2 shows the ranking of relative excess death estimates (as percentage of expected deaths) for the pandemic years 2020-2021 in all 66 analyses with different reference baseline windows. The USA had the highest estimates of relative excess deaths among all 33 countries in 49 of 66 analyses, the second highest in 16 analyses and the fourth highest in 1 analysis. Conversely, South Korea had the lowest estimates in 58 of 66 analyses, the second to lowest in 6, the third to lowest in 1, and the sixth to lowest in 1. Eastern European and Balkan countries closely followed the USA in the

top excess death ranks consistently. Scandinavian countries, Australia, and New Zealand consistently were placed among the lowest excess death ranks next to South Korea. Other Western European countries typically occupied middle ranks. Tables S1A and S1B show that the distribution of country ranks for projected periods of 1 year and 3 years are similar to that shown in Figure 1 for 2020-2021; summing over more years does blur the ranking of middle-ranked countries.

Diversity in time patterns across 33 countries

Figure 1 maps the emerging time patterns for mortality in each of the analyzed countries for the average of the 66 analyses using different reference baseline periods and the range of maximum and minimum estimates. Although the range of estimates of relative excess deaths for each given year is large, the rank of different years for a particular country is generally the same for the 66 different sets of reference years (Figure S1). Time patterns across different countries show large variability as well. Differences exist both in the presence and magnitude/steepness of time trends; and on the presence or not of peaks of mortality impact during the COVID-19 pandemic (2020, 2021, both, or neither). All countries had some decline in mortality over the period 2009-2019, but for the USA in particular the change was minimal (change from average of 1.34% in 2009-2010 to -1.25% in 2018-2019 for an overall decline of only 2.59%, using data in Table S2B). The other 4 countries with the smallest changes for the averages between 2009-2010 and 2018-2019 were Germany, The Netherlands, Canada and the United Kingdom, (changes of -6.65%, -8.34%, -8.44% and -8.49%, respectively). Conversely, the 5 countries with the largest declines for the averages between 2009-2010 and 2018-2019 were South Korea, Estonia, Denmark, Slovakia and Norway (changes of -23.4%, -19.7%, -17.1%, -16.0% and -

14.1%, respectively). For the pandemic period 2020-2021, the USA had the steepest increase (change in average 17.94% between 2018-2019 and 2020-2021). Steep increases were seen also in Eastern European and Balkan countries (changes in average from 10.18% to 17.42% between 2018-2019 and 2020-2021 for Slovenia, Hungary, Latvia, Croatia, Lithuania, Czechia, Slovakia and Poland). Most western European countries had more modest disruptions of the declining trend (changes for the averages from 2.03% to 9.96% between 2018-2019 and 2020-2021 for Luxembourg, Germany, Switzerland, France, The Netherlands, Belgium, Portugal, Austria, the United Kingdom, Spain and Italy). Some Scandinavian countries, Australia, New Zealand, and South Korea continued to have declining mortality trends during the pandemic (changes for the averages from -5.05% to -2.44% between 2018-2019 and 2020-2021 for New Zealand, South Korea, Iceland, Norway, Denmark and Australia). Figures S2A, S2B, and S2C map the time patterns shown in Figure 1 for periods of 1, 3 and 4 years, respectively.

The worst single year with the highest mortality was 2021 for 10 countries (Slovakia, Poland, United States, Latvia, Lithuania, Hungary, Croatia, Czechia, Chile and Greece), 2020 was the highest for 4 countries (United Kingdom, Italy, Spain and Belgium), 2010 was worst for Luxembourg and 2009 was worst for all other 18 countries (data from Table S2B). When considering 2-year periods, in 25 of the 33 countries, 2009+2010 were the worst pair of years. In 9 of the 33 countries (Chile, Czechia, Greece, Hungary, Italy, Lithuania, Poland, Slovakia and United States) the pandemic years 2020+2021 were the worst, and in all of them the years 2009+2010 were the second worst. (Table S2A & Table S3). In 16 countries, the pandemic years were not among the three worst years, which were always years between 2009 and 2016. When considering 3 or 4 year periods, in 31 of the 33 countries 2009-2011 and 2009-2012, were

the worst, respectively. Only in Poland or the United States were period 2019-2021 and 2018-2021, which include the pandemic years, the worst, respectively, (data from Tables S2C & S2D)

Excess death estimates in recent years using different projected period time windows

Table 3 shows the effect of changing the width of the projected period of interest from 1 to 4 years for the most recent years (2021 alone, 2020 alone, 2020-2021, 2019-2021, 2018-2021). As shown, there is substantial attenuation of the relative excess mortality between the single worse pandemic year and increasingly wider periods of interest. The attenuation was most prominent for Slovakia, Latvia, Lithuania, Poland, Estonia and Croatia, with relative drops of 18.73, 14.86, 12.65, 11.91, 11.87 and 10.91 percentage points, respectively. The attenuation was least prominent for Australia, Norway, Denmark, Iceland, New Zealand and South Korea, with relative drops of 0.19, -0.47, -0.80, -0.90, -1.02 and -1.39, percentage points, respectively. The USA maintained the most prominent peak even with a 4-year window.

With increasing projected periods, both the mean and standard deviation of the relative excess mortality declined substantially. For 2021, 2020-2021, 2019-2021, 2018-2021, the mean was 2.55%, 1.62%, -0.88%, and -1.57%, respectively. The standard deviation was 9.20%, 7.10%, 5.10%, and 4.11%, respectively.

DISCUSSION

Our application of a multiverse approach to excess death data shows that consideration of different periods for reference baseline resulted in major variability in the absolute magnitude of the exact excess death estimates, but it did not affect substantially the relative ranking of different countries compared to others for specific years. Moreover, there have been distinct time patterns across different countries during 2009-2021. Countries differed markedly on whether they had a substantial decrease over time or not during 2009-2021, on whether they had a peak during the 2020-2021 pandemic years, and, if so, how high, and in the relative contribution of 2020 and of 2021 to this peak. With longer time windows for the projected period of interest (1 to 4 years), the range of excess deaths across different countries in the pandemic years and the 2 years preceding the pandemic shrank substantially and excess death estimates became less variable across countries. However, peaks did not disappear and for the USA in particular, excess deaths remained prominent even with long projected periods of interest.

In the multiverse literature from other fields, some analytical choices may be considered more meaningful or relevant than others. When researchers are asked to select independently what analysis mode they feel is most sensible, not all analytical choices are selected (19,20) and some types of choices may seem to make more sense. This may apply also for excess death calculations. E.g. it may seem not so appropriate to use a reference window of 2009 alone for projecting mortality in 2021. Indeed, one should definitely not use the excess deaths estimate of 2021 based on the 2009 reference in isolation as a reliable measure of excess deaths in 2021. However, previous studies on excess death calculations for the COVID-19 pandemic have used extremely different reference periods, ranging from a single year to over a decade (6). While in

our own work (6) we used a 3-year reference period (2017-2019), it is difficult, if not impossible, to defend that shorter or longer reference periods would be less appropriate. The proposed multiverse approach removes the hurdle of this subjective choice and allows for consistency by considering all possible reference years and time windows. Thus, it allows one to get an objective comparative picture for the relative performance of each calendar year and an unbiased comparative picture for the presence and pattern of time trends.

The obvious heterogeneity of time patterns across different countries suggests that selection of specific time trends in modeling excess deaths may be a situation where one size does not fit all. Selection of specific anticipated time trend patterns may markedly affect the results in ways that are not verifiable for their appropriateness. E.g. selecting a model that anticipates a marked decrease in mortality over time makes it difficult for a country not to have excess deaths even if it does very well in a given year – but still falls short of an anticipated stellar improvement over time. There is no guarantee that mortality rates should continue declining, let alone markedly decline, over time with medical and other progress, even in the absence of major negative perturbation events such as pandemics or natural catastrophes (6). For advanced economies with aging populations, accumulating frailty and disease burden and restrictions or ceilings to progress and available resources, trends for decreased mortality may not be sustainable. The multiverse approach, when applied to multiple countries, allows a comparative assessment of the trajectory of different countries. This may be preferable and it may offer some genuine insights about which countries do well (short-term and long-term) and which do poorly – in comparison.

In this regard, some stark differences stand out for both long-term trends and for the pandemic years. The USA consistently performed very poorly with both stagnation in mortality

during the pre-pandemic years and a sharp increase during the pandemic. Eastern European and Balkan countries showed sharp decreases during the pre-pandemic years and a sharp increase during the pandemic. Most western European countries had sharp decreasing trends with modest disruption during the pandemic. All Scandinavian countries, Australia, New Zealand, and South Korea have had largely unperturbed declining mortality patterns. The markedly different patterns may reflect a combination of social, health care, and pandemic factors. The USA has an ailing health system with approximately 30 million uninsured people (22), large inequalities (23), many people with poor access to care (24), and major ongoing non-infectious epidemics, including obesity (25), opioid abuse and overdose (26), and violent deaths (27). Eastern European and Balkan countries have limited resources for their healthcare systems and lower social welfare than other European countries (28) and some countries like Greece have long suffered from austerity (29). The best performers are excelling in social welfare and health system functionality and resources, even if there are differences across countries. Exceptions may occur within circumscribed populations and adverse settings even in countries with overall excellent trajectories. For example, the dysfunctional consequences of privatization in nursing homes in countries like Sweden or Canada (30,31) translated to peaks of excess deaths during circumscribed periods in the long-term care settings (32).

Consideration of longer projected period time windows diminished substantially the range of excess deaths in some countries, but not in others. Overall, when longer periods are considered, differences between most countries become less pronounced. However, larger windows had minimal effect in the USA, and this may reflect that the problems that lead to unfavorable mortality patterns in the USA reflect chronic dysfunctions that might have been accentuated by the pandemic but pre-existed and which affect also people with long life

expectancy. Poverty, marginalization, homelessness, inequalities, drug overdoses, and violence affect indeed young and middle-aged populations. We have shown previously that the USA has had 40% of excess deaths contributed by the <65 age stratum, a higher percentage than all other highly developed countries (6). Conversely, in many other countries, large time windows for the projected period shrank substantially the excess death fluctuations. This suggests that in these countries excess deaths temporarily affect mostly people with relatively limited life expectancy (21).

Europe, while not a country, has historically aggregated excess death data in the EuroMOMO data base (https://www.euromomo.eu/) to include data from 21 countries in Europe plus Israel (33). If one were to aggregate data for the 19 of these 21 countries for which we have data (excluding Cyprus & Ireland), the fictional country composite that includes Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Israel, Italy, Luxembourg, Netherlands, Norway, Portugal, Slovenia, Sweden, Switzerland, and United Kingdom has a similar population to the USA (410 million versus 330 million) and the relative excess death of this European composite is only 2.46% for the pandemic years (2020+2021), which is in stark difference to the USA figures. It is also less than two year totals for 2009+2010 and 2010+2011, with values of 5.57% and 3.30% caused by elevated Influenza pandemics (34).

Some limitations should be acknowledged. First, there are some additional sources of analytical flexibility that can be considered in excess death calculations. These include the choice of age bins for age adjustment, and the use of additional adjustments for modeling the population profile over time. These would add additional variation with more multiverse options, but probably would not invalidate the major patterns that we observed. Second, we only modeled data from 33 countries that are the ones with the most reliable data. Extrapolations to

other countries would be precarious, given the unreliability of the mortality information. Time patterns observed in the 33 countries may not necessarily apply to the remaining countries around the globe and local circumstances may make a difference. Third, we considered yearly interval increments so as to capture all 4 seasons in the unit of time, but in theory, the multiverse process can be applied for smaller units of time as well. Fourth, data on population and population structure in each country on a yearly basis are typically inferred from census data collected on more sparse timing, therefore they carry some uncertainty. Fifth, the pandemic impact and its consequences as well as the consequences of aggressive measures that were taken has continued more prominently in 2022 in some countries than others (35). It would be interesting to see whether differences across countries get further attenuated and/or some countries continue to stand out prominently when longer pandemic and post-pandemic periods (e.g. 2020-2022 and 2020-2023) are considered. Preliminarily results based on the first 8 months of 2022, it seems that several countries with death deficit in 2020-2021 (e.g., Australia, New Zealand and South Korea), had considerable excess deaths in 2022, while some others continued to have limited deaths (e.g. Sweden) and some hard-hit countries like USA and Greece continued to do very poorly (6,35).

A multiverse approach to excess death calculations may offer bird's eye views on mortality patterns in comparative assessments of a large number of countries. These patterns may be more reliably informative than efforts to obtain isolated single-country estimates of excess deaths, which are subject to substantial uncertainty even in countries with the best-collected data. It may be best to avoid pre-specifying time patterns and to allow the data to show what time patterns may be emerging. Finally, observed time patterns may not necessarily

continue into the future and multiverse analyses can be updated accordingly for additional years moving forward.

MATERIALS AND METHODS

Data

All data comes from the Human Mortality Database (HMD) (36-38). The data for the most recent years comes from the Short-Term Mortality Fluctuation file stmf.csv downloaded from https://www.mortality.org/File/GetDocument/Public/STMF/Outputs/stmf.csv (last updated 20 July 2022). The data for earlier years extending back to 2009 was downloaded as the HMD archive file (see Supplementary Links to Data). By combining data from these two sources, full data for 13 years from 2009 to 2021, inclusive, is available for 34 countries. We focused on the 33 high-income countries with highly reliable death registration systems, excluding Bulgaria as done in previous work (6). The most recent data in the file stmf.csv is per week and uses five standard age-bands: 0-14, 15-64, 65-74, 75-84 and Over 85. The older data in the HMD archive uses 1-year age bands for annual all-cause deaths and annual populations are available for all 33 countries. We sum these 1-year bands to give the same five standard age bands used in stmf.csv. Because the older data is over-written by the newer data in stmf.csv, it does not matter much which older version we use (ours was downloaded on 25 May 2022). The annual death and population data taken from the hmd_statistics_20220812 archive is used to make a file in the same format as stmf.csv, which included weekly data for deaths and weekly data for mortality (deaths per population). Because the older data is for entire years, it is converted to weekly data by dividing the annual value into 52 equal weeks.

Excess death calculations

In order to be able to compare different countries and different time periods we focus on relative excess deaths expressed as the number of excess deaths divided by the number of

expected deaths. Specifically, the relative excess death p% is the actual all-cause death count D minus the estimated death count E expressed as a percentage of the estimated death count or $p\%=(D-E)/E$.

Systematic Variation of Assumptions for Multiverse Analyses

We consider all possible reference baseline spans of consecutive years in the period 2009-2019. This gives 11+10+..+1=66 different spans of length 1 to 11 years for the 66 reference baselines. For each reference period, we average the mortality of each of the five age bands. These averaged mortalities are then used to get the expected deaths in any year by multiplying the mortality of a particular age band by the population of that age band and then summing the estimated values over the five age bands to give the total estimated death count, E.

Projected time periods are also considered in all possible options of length 1 to 4 years, again considering consecutive calendar years.

Data availability

All data are in the manuscript, tables, and supplementary tables and in the publicly available databases listed in Supplementary Links to Data and deposited online at https://zenodo.org/record/7095753 .

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Table and Figure Legends

Table 1: Average, standard deviation, minimum, maximum and range for estimates of relative excess deaths (expressed as percentage of expected deaths) for the two-year pandemic period 2020-2021 for each of the 33 countries.

Table 2: Distribution of the country rank of the excess death estimates (from highest to lowest) in the pandemic 2-year period 2020-2021 expressed as a percentage of the expected deaths for the 33 countries as calculated for each of the 66 different reference baseline year sets. The countries are ordered by decreasing average rank (column 3); the standard deviation of the rank is also given in column 4. In most cases, the most common rank for a given year over the 66 reference years is on the diagonal. Exceptions are circled in green in the figure.

Table 3: Effect of changing the projected period of interest from 1 to 4 years for the most recent years (2021 alone, 2020 alone, 2020-2021, 2019-2021, 2018-2021).

Figure 1: Variation with year from 2009 to 2021 of the excess death estimate expressed as a percentage of the expected deaths. The expected deaths are estimated from the average mortality values of each of the 66 different reference year-sets, which are all combinations of one or more consecutive years from 2009 to 2019. The average over all the reference years is shown at the black solid line, the maximum and minimum values are shown by the shaded area. The y-axis of every panel extends from -30% to 30%. The plots for different reference year sets are almost identical but shifted along the y-axis by different amounts. The sum of two years, which is particularly significant as the complete pandemic years are 2020 and 2021, is shown here.

Supplementary Table and Figure Legends

Table S1: Distribution of the country rank of the excess death estimates in pandemic year 2021 expressed as a percentage of the expected deaths for the 33 countries as calculated for each of the 66 different reference baseline year sets. The countries are ordered by decreasing average rank (column 2); the standard deviation of the rank is also given in column 3. (A) Shows data for 2021 alone in Table S2A; (B) Shows summed data for 2019+2020+2021 in Table S2B; ; (C) Shows summed data for 2018+2019+2020+2021 in Table S2C. Such sums are labelled by their last year so all are marked as "2021". In most cases, the most common rank for a given year over the 66 reference years is on the diagonal.

Table S2: Variation with year from 2009 to 2021 of the average excess death expressed as a percentage of the expected death for all 33 countries studied here. The expected death is estimated from the average mortality values of each of the 66 different reference year sets, which are all combinations of one or more consecutive years from 2009 to 2019. The average over all the reference years is shown in each table. The four tables are (A) for the sum of two adjacent years recorded at the later year (the value for 2021 is 2020+2021), (B) for individual years, (C) for the sum of three adjacent years recorded at the later year (the value for 2021 is 2019+2020+2021) and (D) for the sum of four adjacent years recorded at the later year (the value for 2021 is 2018+2019+2020+2021). The shading is calibrated by range of values in all tables considered together. Each table is sorted by descending using value in the year column "2021".

Table S3: Comparing the percentage excess death in the pandemic years, 2020 and 2021, with that of other pairs of years between 2009 and 2019. In 9 of the 33 countries, the pandemic years, 2020+2021, marked as "2021" in red with yellow shading, were worse than any other pair of years.

Figure S1: Distribution of the year rank of the of the excess death expressed as a percentage of the expected death as calculated for each of the 66 different reference baseline year sets for 33 countries and for 12 pairs of years (2009+2010 to 2020+2021). The years are ordered by decreasing average rank (in column 2); the standard deviation of the rank is given in column 3. If the ranking for all 66 calculations were the same, all counts would be on the diagonal. This is true for 16 of the 33 countries. In the other 19 countries, the largest deviations from identical ranking occur for AUT (Austria) where the three years ranked in position 2 to 3 are 2011, 2013, and 2021. The mean rank for 2013 of 4.24 is not much less than that of 2021 of 4.52. Clearly the ranking of years for a given country are largely independent of the reference years used to calculate the expected deaths.

Figure S2 Variation with year from 2009 to 2021 of the excess death expressed as a percentage of the expected deaths as shown in Figure 1. The plots are for different projected periods (A) for individual years, (B) for the sum of three adjacent years (recorded at the latest year so the value for 2021 is 2019+2020+2021), and (C) for the sum of four adjacent years (recorded at the latest year so the value for 2021 is 2018+2019+2020+2021).

Table 1: Average, standard deviation, minimum, maximum and range for estimates of relative excess deaths (expressed as percentage of expected deaths, p%) for the two-year pandemic period 2020-2021 for each of the 33 countries.

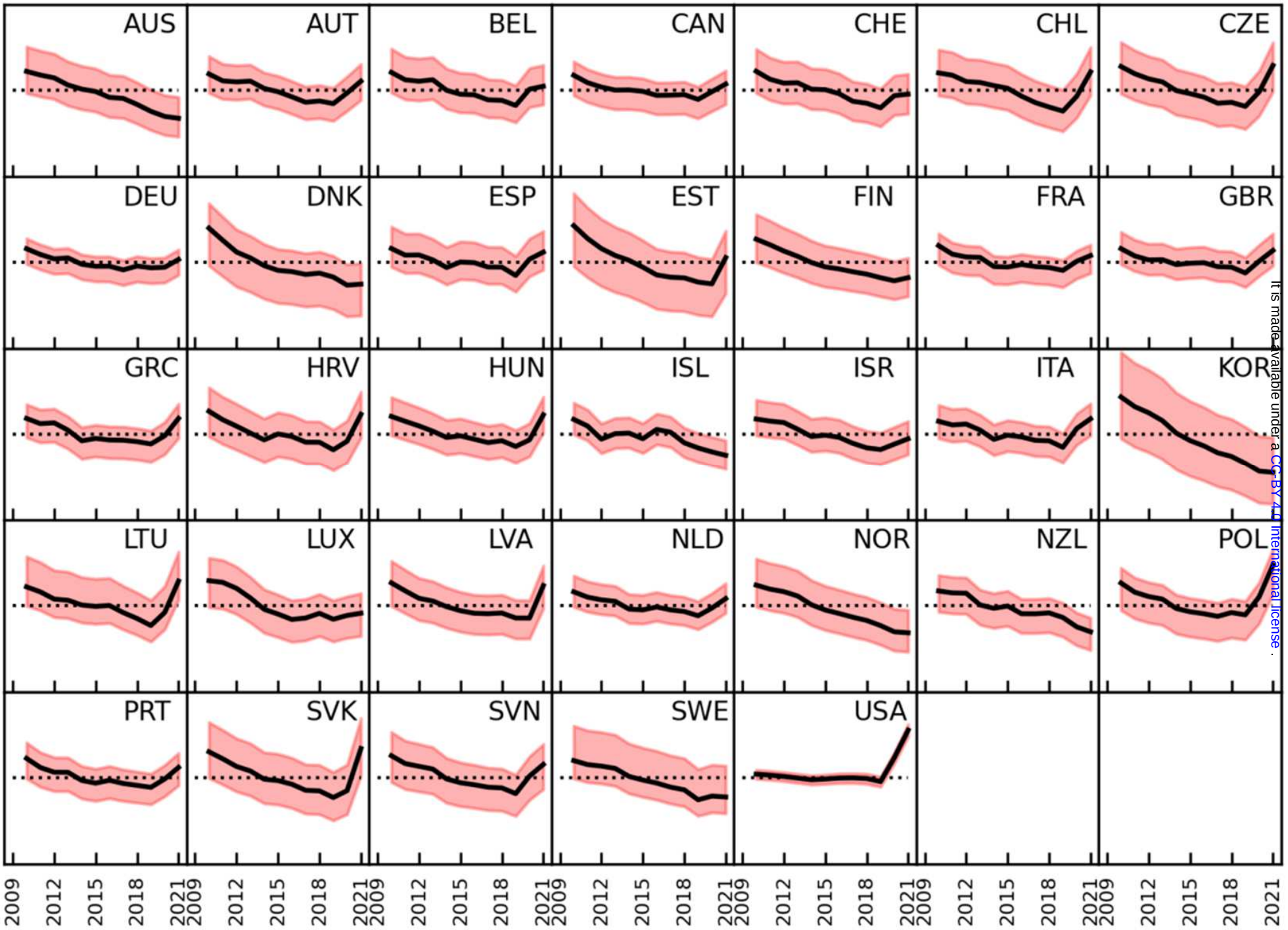
Country	Abbreviation	Average p%	SD of p%	Minimum p%	Maximum p%	Range of p%
Australia	AUS	-9.7	3.2	-16.2	-2.4	13.9
Austria	AUT	3.2	3.0	-3.4	9.2	12.6
Belgium	BEL	1.4	2.9	-5.0	8.8	13.8
Canada	CAN	2.2	2.0	-4.9	6.9	11.7
Switzerland	CHE	-1.3	3.1	-8.2	5.7	13.9
Chile	CHL	6.4	3.8	-1.7	15.1	16.8
Czechia	CZE	8.7	3.9	-0.5	16.7	17.2
Germany	DEU	1.0	1.9	-4.4	4.5	8.9
Denmark	DNK	-7.6	4.0	-18.6	-0.3	18.3
Spain	ESP	3.6	2.2	-2.6	10.9	13.5
Estonia	EST	1.7	4.8	-10.8	11.0	21.9
Europe	EUM	2.3	2.2	-3.7	7.4	11.1
Finland	FIN	-5.3	3.1	-11.9	1.6	13.4
France	FRA	2.4	2.0	-3.8	6.1	10.0
United Kingdom	GBR	4.2	1.9	-1.2	10.0	11.3
Greece	GRC	5.6	2.8	-1.3	10.6	12.0
Croatia	HRV	7.0	3.1	-1.2	14.8	16.1
Hungary	HUN	6.8	2.7	0.5	13.1	12.6
Iceland	ISL	-7.3	2.0	-12.2	-2.1	10.1
Israel	ISR	-1.5	2.9	-7.1	4.6	11.6
Italy	ITA	5.4	2.4	-0.5	10.8	11.2
South Korea	KOR	-13.5	5.2	-24.5	-1.1	23.5
Lithuania	LTU	8.6	3.2	2.0	18.8	16.8
Luxembourg	LUX	-2.6	3.9	-10.6	4.4	15.0
Latvia	LVA	7.0	3.1	-1.0	14.0	15.0
Netherlands	NLD	2.5	2.0	-2.5	7.8	10.4
Norway	NOR	-9.4	3.6	-16.1	-1.4	14.7
New Zealand	NZL	-9.1	2.5	-15.5	-4.2	11.3
Poland	POL	14.2	3.5	3.9	19.9	15.9
Portugal	PRT	3.6	2.4	-2.7	8.6	11.3
Slovakia	SVK	10.2	4.4	0.7	20.7	20.0
Slovenia	SVN	4.7	3.4	-4.0	11.8	15.7
Sweden	SWE	-6.7	3.4	-12.5	4.2	16.7
United States	USA	16.6	0.8	14.3	18.7	4.3

Table 2: Distribution of the country rank of the excess death estimates in the pandemic 2-year period 2020-2021 expressed as a percentage of the expected deaths p% for the 33 countries as calculated for each of the 66 different reference baseline year sets..

Location	LOC	Rank AVE	Rank SD	Rank in Sort from Highest p% to Lowest p% Summing Two Adjacent Years																																
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
United States	USA	1.29	0.54	49	16		1																													
Poland	POL	1.79	0.44	15	50	1																														
Slovakia	SVK	3.26	0.88	2		50	11	1		2																										
Lithuania	LTU	4.68	1.23			12	16	26	9		2	1																								
Czechia	CZE	4.73	1.05				34	23	6	1	1		1																							
Latvia	LVA	7.14	1.68				1	7	19	15	15	3	3	1	1	1																				
Croatia	HRV	7.21	1.57			1	1	4	12	27	10	6	3	1		1																				
Hungary	HUN	7.68	1.14					2	10	13	25	14	2																							
Chile	CHL	9.09	2.76			1	1	2	10	5	7	13	7	9	7	1	1			1	1															
Greece	GRC	10.23	1.84					1		1	4	16	22	10	7	2	1	1			1															
Italy	ITA	10.55	2.01			1	1			2	2	7	15	23	8	4	1	1	1																	
Slovenia	SVN	12.56	2.04										10	10	23	4	4	11	1	1	1															
United Kingdom	GBR	13.08	2.02									5	1	8	10	13	5	9	9	1																
Portugal	PRT	14.62	1.64											1	2	9	26	14	6	6		1	1													
Spain	ESP	14.86	1.99									1		2	2	12	9	19	6	11	2		1													
Austria	AUT	16.35	2.51												2	8	7	7	20	2	1	11	2													
Netherlands	NLD	17.97	1.83													1	1	1	8	17	17	4	5	1		1										
France	FRA	18.52	2.11														2	1	8	12	15	8	5	9												
Estonia	EST	19.11	4.54										2	1	3	5	6	1	2	7		8	6	6	16	2	4		1							
Canada	CAN	19.38	2.37												1		3	1	4	4	5	15	13	10		1										
Belgium	BEL	21.12	1.85																1	1	11	2	8	31	10	1										
Germany	DEU	22.17	1.38																		1	2	24	8	21	3	3	1								
Switzerland	CHE	24.35	0.93																						10	33	14	8	1							
Israel	ISR	24.76	0.85																					1	5	12	40	7	1							
Luxembourg	LUX	25.62	0.93																						1	12	4	43	6							
Finland	FIN	27.29	0.54																									1	49	16	2					
Sweden	SWE	28.95	1.09																								1		2	21	22	18	1			
Iceland	ISL	29.85	2.48																							1		4	6	11	10	10	7	4	5	2
Denmark	DNK	29.88	1.75																											17	19	8	5	2	4	
New Zealand	NZL	32.20	1.46																											2		3	23	9	6	6
Norway	NOR	32.39	1.31																													8	8	25	14	
Australia	AUS	33.21	0.98																												1	1	10	23	31	
South Korea	KOR	34.80	0.70																													1		1	6	58

Table 3: Effect of changing the width of the projected period of interest from 1 to 4 years for the most recent years (2021 alone, 2020 alone, 2020-2021, 2019-2021, 2018-2021).

		1 Year	1 Year	<2 Years>	<3 Years>	<4 Years>			
Location	LOC	2020	2021	2020 +2021	2019 +2020 +2021	2018 +2019 +2020 +2021	max (2020,2021) - <2 Years>	max (2020,2021) - <3 Years>	max (2020,2021) - <4 Years>
Australia	AUS	-10.7	-8.2	-9.5	-8.7	-8.4	1.3	0.5	0.2
Austria	AUT	3.7	2.8	3.3	0.5	-0.6	0.4	3.3	4.3
Belgium	BEL	7.6	-4.7	1.4	-1.3	-1.9	6.2	8.9	9.5
Canada	CAN	3.5	1.0	2.3	0.2	-0.3	1.2	3.3	3.7
Switzerland	CHE	3.0	-5.3	-1.2	-3.0	-3.6	4.2	6.0	6.6
Chile	CHL	3.6	10.2	6.7	2.2	-0.1	3.4	8.0	10.2
Czechia	CZE	5.5	11.6	8.6	3.6	1.7	3.0	8.0	9.9
Germany	DEU	-0.2	2.1	1.0	-0.3	-0.2	1.1	2.3	2.3
Denmark	DNK	-9.0	-6.9	-7.8	-7.4	-6.1	0.9	0.5	-0.8
Spain	ESP	8.8	-1.4	3.6	0.2	-0.4	5.2	8.5	9.2
Estonia	EST	-6.8	9.4	1.5	-1.7	-2.5	7.9	11.1	11.9
Finland	FIN	-6.1	-4.6	-5.4	-5.8	-5.3	0.8	1.2	0.6
France	FRA	3.8	0.6	2.3	0.5	-0.1	1.5	3.3	3.9
United Kingdom	GBR	6.2	2.3	4.2	1.1	0.4	2.0	5.0	5.8
Greece	GRC	1.0	9.9	5.6	3.1	1.4	4.3	6.8	8.6
Croatia	HRV	1.9	11.8	6.9	2.3	0.9	4.9	9.5	10.9
Hungary	HUN	1.6	11.8	6.7	2.7	1.4	5.1	9.1	10.4
Iceland	ISL	-6.9	-7.5	-7.2	-6.5	-6.0	0.3	-0.4	-0.9
Israel	ISR	-1.9	-0.8	-1.3	-2.5	-3.3	0.5	1.6	2.4
Italy	ITA	8.9	2.1	5.5	2.0	0.5	3.4	6.9	8.3
South Korea	KOR	-13.1	-13.0	-13.1	-12.8	-11.6	0.2	-0.2	-1.4
Lithuania	LTU	3.9	13.3	8.5	2.7	0.7	4.9	10.6	12.7
Luxembourg	LUX	-0.6	-4.8	-2.7	-3.8	-3.4	2.2	3.2	2.8
Latvia	LVA	-2.8	16.3	6.8	2.6	1.5	9.5	13.7	14.9
Netherlands	NLD	3.3	1.8	2.5	0.1	-0.4	0.8	3.2	3.6
Norway	NOR	-10.1	-8.6	-9.4	-8.9	-8.2	0.8	0.3	-0.5
New Zealand	NZL	-10.7	-7.5	-9.0	-7.3	-6.5	1.5	-0.2	-1.0
Poland	POL	10.2	17.8	14.2	8.2	5.9	3.6	9.5	11.9
Portugal	PRT	3.6	3.3	3.5	0.9	0.2	0.1	2.7	3.4
Slovakia	SVK	-0.3	20.7	10.2	4.1	2.0	10.5	16.6	18.7
Slovenia	SVN	7.5	1.8	4.7	1.1	-0.2	2.8	6.4	7.8
Sweden	SWE	-2.2	-10.6	-6.6	-7.9	-7.2	4.5	5.7	5.1
United States	USA	15.8	17.6	16.7	10.6	7.8	0.9	7.0	9.8



Year Between 2009 and 2021 (Summing Two Adjacent Years)

Figure 1

Table S1A: Country Rank Distribution of p%=X/E for Single Years

Location	LOC	Rank AVE	Rank SD	Rank in Sort from Highest p% to Lowest p% For Single Years																																
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Slovakia	SVK	1.26	0.47	50	15	1																														
Poland	POL	2.45	0.56		38	26	2																													
United States	USA	2.91	1.47	16	11	12	20	6			1																									
Latvia	LVA	3.55	0.56		2	26	38																													
Lithuania	LTU	5.20	0.94			1	6	48	5	3	2	1																								
Croatia	HRV	7.12	1.27					4	19	23	8	10	1	1																						
Czechia	CZE	7.23	1.17					4	20	5	32	4	1																							
Hungary	HUN	7.33	1.36					1	19	24	11	2	8	1																						
Estonia	EST	9.47	1.84					3		7	6	14	17	16	1	1			1																	
Greece	GRC	9.67	1.01						1		3	29	16	17																						
Chile	CHL	9.94	1.31						2	4	3	6	23	28																						
Portugal	PRT	12.56	1.18											1	46	9	6	2		1	1															
Austria	AUT	14.48	2.40												15	20	3	7	4	9	4	2	1													
United Kingdom	GBR	14.98	1.86												2	19	11	6	10	11	6															
Germany	DEU	15.35	2.03												1	6	22	13	10	5	3	2	1	1												
Italy	ITA	15.85	1.91											2	1	2	4	22	16	10	3	4	1													
Netherlands	NLD	16.70	1.37													2		10	17	18	15	2														
Slovenia	SVN	17.00	3.09													7	18	4	3	4	7	3	17	1												
Canada	CAN	19.45	1.77														2	2	2	3	4	30	14	2												
France	FRA	20.23	1.28																1	1	6	17	27	7												
Israel	ISR	22.06	1.35																1	1		2	3	30	26	1										
Spain	ESP	22.68	0.72																				2	24	34	5	1									
Finland	FIN	25.21	1.04																						1	13	34	10	5	3						
Belgium	BEL	25.52	1.22																							15	16	29	1	3	1					
Luxembourg	LUX	25.85	2.14																						5	23	5	10	6	5	4					
Switzerland	CHE	27.23	1.22																							1	5	6	29	20	1		1			
Denmark	DNK	29.00	1.92																									3	12	16	5	8	2	3	2	
Iceland	ISL	30.48	2.57																					1		1	1	1	3	6	12	11	4	15	1	3
New Zealand	NZL	30.62	1.48																									1	1	2	24	22	7	1	3	1
Australia	AUS	31.67	0.89																										1		1	17	41	5		
Norway	NOR	31.92	1.27																												14	8	9	34		
Sweden	SWE	33.95	0.61																												1			4	56	5
South Korea	KOR	34.77	0.62																														1	4	4	57

Table S1B: Country Rank Distribution of p%=X/E Summing Three Adjacent Years

Location	LOC	Rank AVE	Rank SD	Rank in Sort from Highest p% to Lowest p% Summing Three Adjacent Years																																		
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
United States	USA	1.27	0.54	50	15		1																															
Poland	POL	1.79	0.44	15	50	1																																
Slovakia	SVK	4.94	3.56	1	1	39	7	1	3	2	1	1	3	3			2	1			1																	
Czechia	CZE	5.58	2.15				34	8	6	4	6	5	1		1	1																						
Greece	GRC	6.00	2.95			11	8	20	7	8	3	2	1	1	2		2				1																	
Hungary	HUN	6.95	1.66				7	5	10	23	10	7	2	2																								
Lithuania	LTU	7.02	2.33			5	2	10	16	4	14	6	4	2	1	2																						
Latvia	LVA	7.85	2.69			2		8	11	12	13	6	6	4	1	1		1				1																
Croatia	HRV	8.76	2.47			2	3	3		8	7	23	11	2	2	3	1			1																		
Italy	ITA	9.77	2.94			4			8	2	1	8	16	12	8	2	2	1	1		1																
Chile	CHL	11.33	4.68			2	1	7	4		6	1	7	8	8	1	3	5	4	1	2	3	2														
United Kingdom	GBR	12.52	3.61				3	2	1	1	4	1	2	9	7	4	9	6	13	2	1																
Portugal	PRT	13.47	2.40					1				2	2	3	8	21	12	9	3	3					1												
Slovenia	SVN	14.24	3.80								1	2	4	11	15	2	5	8			4	5	7														
France	FRA	14.98	2.98							1		1	1	3	6	9	7	14	8	4	4	4	3	1													
Austria	AUT	16.92	3.33										1	2		10	8	6	7	2	4	8	15	1													
Spain	ESP	17.02	3.64					1				1	2	1	2	2	5	2	8	16	7	4	3	3	3	2											
Netherlands	NLD	17.91	2.71										1	1		1	1	7	9	11	5	9	3	3	2		1										
Canada	CAN	17.95	3.21										2		2	4	2	3	7	9	6	11	5	8	1	1											
Germany	DEU	20.38	2.45												1				4	2	5	9	18	5	5	3	4										
Estonia	EST	20.71	5.10							1				2	2	3	7	1		3			4	9	14	5	7	3	1	1	2						
Belgium	BEL	21.76	1.64																1		5		4	35	14	3	1										
Israel	ISR	23.83	1.55															1						1	17	29	13	3	1								
Switzerland	CHE	24.80	1.17																			1			7	14	26	17		1							
Luxembourg	LUX	25.64	1.73																			1	1		1	9	7	33	6	5							
Finland	FIN	27.53	0.82																									2	38	16	1						
Iceland	ISL	29.06	3.03																			1			1		2	7	12	12	6	5	6	2	6	2	
Denmark	DNK	29.92	2.05																										1	24	4	10	7	3	6		
New Zealand	NZL	30.38	1.73																									1	2	1	26	11	5	2	2	3	
Sweden	SWE	30.79	1.47																								1		1	2	8	19	24	2			
Australia	AUS	32.95	1.16																										1			1	11	33	18	1	
Norway	NOR	33.00	1.14																												1	10	7	18	30		
South Korea	KOR	34.83	0.69																												1			1	4	60	

Table S1C: Country Rank Distribution of p%=X/E Summing Three Adjacent Years

LOC	Rank AVE	Rank SD	Rank in Sort from Highest p% to Lowest p%																																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
USA	1.30	0.55	48	17		1																																
POL	1.79	0.48	16	48	2																																	
HUN	6.11	1.93			5	9	12	17	8	7	4	2	2																							
LVA	6.76	3.27			5	6	25	2	9	4	6	1	2	1	2		1		1		1															
CZE	6.97	4.03			6	23	7	3	7	2	2	3	1	2		5	1	4																		
SVK	7.12	5.74	2		25	11	2	2	3	3	1	1	2		2	1		1	3	3	1	2	1													
GRC	7.39	3.79			6	5	9	14	11	6	3	2	1	2	1	2	1		1		1			1												
LTU	9.33	3.42			2	2	4	5	8	6	12	4	8	4	4	2	2	1		1		1														
HRV	9.35	3.69			4	2		3	3	23	8	8	3	2	1	1	1	2	3		1		1													
ITA	10.44	3.84			2	2		6	6	2	9	12	4	3	7	6	1	2	1	1			1	1												
GBR	11.21	4.93			8	2	2	5	1		4	3	8	3	3	6	4	9	4	2	1		1													
PRT	12.18	2.93				1			2	2	5	5	11	14	11	2	5	4	1	2					1											
FRA	14.00	4.08					1	1	2	1	2	2	6	8	15	3	8	1	3	2	3	1	2	4		1										
CHL	15.17	6.07		1	1		3	6	1	1	1	3	3	3	3	2	1	2		3	10	5	13	2	1	1										
SVN	15.45	4.27								3		7	7	7	3	3	2	2	4	4	10	5	6	3												
CAN	16.09	4.62				1	1		2	2	1	3	2	1	1	5	7	6	9	5	2	4	7	4	2	1										
DEU	16.12	4.35							1	1	3	3	1	3	1	9	11	8	6	2	1	5	3	1	2	1	3	1								
NLD	16.41	3.48								2	2		1	4		7	8	11	7	7	7	3	2	1	3		1									
ESP	16.62	4.47				1		1	2			4	1	1	3	5	3	7	10	8	2	6	2	3	4	3										
AUT	17.56	3.75								1	1	2	2	5	2	3	3	1	4	3	7	18	12	2													
EUM	18.21	1.76													2	1	3	3	8	17	16	13	3													
EST	21.17	5.75						1			2	1	1	2	4	3	1	1		1	1	1		10	14	6	5	3	4	1	1	1	2				
BEL	21.65	1.81															1		1	5	2	1	7	31	14	3		1								
ISR	24.21	1.67															1						2		15	15	25	6	1	1							
LUX	24.83	2.84													1		1	1					2	2	3	18	5	17	9	5	2						
CHE	25.08	1.35																				1			6	12	21	22	1	2	1						
FIN	27.48	0.82																									1	2	36	18	9						
ISL	28.97	3.85												1										1	1	2	3	8	7	8	7	4	5	6	4	6	3
DNK	29.47	1.99																										2	3	25	10	4	12	5		5	
TWN	29.89	2.22																								3	1	3	2	2	15	7	19	8	6		
NZL	30.17	1.77																									1	1	1	2	14	30	6	6		2	3
SWE	30.74	1.76																					1						1	2	7	14	11	29	1		
NOR	32.58	1.13																														4	10	8	32	12	
AUS	33.36	1.14																											1			1	1	4	21	37	1
KOR	34.80	0.72																														1			2	4	59

Table S2A: Relative Excess Death (p%=X/E) Summing Two Adjacent Years for All Countries and All Years

Location	LOC	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
United States	USA	NA	1.34	0.97	0.53	-0.04	-0.64	-0.38	-0.04	0.03	-0.19	-1.25	7.10	16.69
Poland	POL	NA	7.83	4.62	3.11	2.21	-1.06	-2.19	-2.88	-3.79	-2.47	-3.26	3.01	14.16
Slovakia	SVK	NA	9.09	6.64	3.90	2.39	-0.48	-0.95	-2.23	-4.27	-4.55	-6.86	-4.47	10.22
Czechia	CZE	NA	8.25	5.73	3.95	2.89	-0.14	-1.20	-2.41	-4.54	-4.23	-5.64	-0.59	8.65
Lithuania	LTU	NA	6.44	4.70	2.18	1.78	0.12	-0.36	-0.04	-2.52	-4.57	-7.02	-2.48	8.48
Croatia	HRV	NA	7.89	4.94	2.69	0.29	-2.08	-0.01	-0.89	-2.88	-2.90	-5.52	-2.54	6.86
Latvia	LVA	NA	7.74	4.97	2.35	1.42	-0.56	-1.96	-2.85	-2.99	-2.77	-4.50	-4.53	6.81
Chile	CHL	NA	6.50	5.67	3.45	3.13	2.03	1.08	-1.67	-3.94	-5.50	-6.93	-1.78	6.74
Hungary	HUN	NA	6.13	4.43	2.81	0.99	-1.21	-0.64	-1.82	-2.98	-2.33	-4.35	-2.03	6.70
Greece	GRC	NA	5.65	3.83	4.11	1.56	-2.17	-1.34	-1.89	-1.97	-2.46	-3.28	-0.44	5.64
Italy	ITA	NA	4.61	3.34	3.63	1.55	-1.70	-0.24	-0.84	-2.05	-2.21	-4.49	2.09	5.47
Slovenia	SVN	NA	7.72	4.89	4.02	3.07	-0.39	-1.70	-2.41	-3.27	-3.50	-5.49	0.63	4.69
United Kingdom	GBR	NA	4.83	2.27	0.90	0.97	-0.73	-0.27	-0.09	-1.46	-1.64	-3.66	0.46	4.19
Spain	ESP	NA	4.86	2.56	2.61	0.88	-1.77	0.14	-0.08	-1.61	-1.64	-4.54	1.14	3.60
Portugal	PRT	NA	6.65	3.47	1.84	1.80	-1.03	-1.97	-0.98	-2.09	-2.75	-3.44	-0.51	3.52
Austria	AUT	NA	5.84	3.44	3.09	3.35	0.78	-0.35	-2.13	-4.04	-3.59	-4.51	-0.79	3.31
Netherlands	NLD	NA	4.86	2.99	2.07	1.55	-1.18	-1.43	-0.43	-1.44	-2.00	-3.48	-0.80	2.51
France	FRA	NA	5.74	2.75	1.77	1.63	-1.56	-1.73	-0.85	-1.55	-1.89	-2.90	0.29	2.29
Canada	CAN	NA	5.36	2.78	1.23	0.18	0.24	-0.26	-1.67	-1.60	-1.42	-3.08	-0.39	2.27
Estonia	EST	NA	12.57	8.10	4.59	2.18	0.50	-1.89	-4.58	-5.37	-5.61	-7.08	-7.68	1.46
Belgium	BEL	NA	6.27	3.67	3.18	3.69	0.01	-1.37	-1.57	-3.32	-3.49	-5.26	0.40	1.42
Germany	DEU	NA	4.76	2.76	1.24	1.54	-0.66	-1.35	-1.35	-2.61	-1.27	-1.90	-1.70	1.00
Switzerland	CHE	NA	6.84	4.05	2.69	2.81	0.58	0.40	-1.00	-3.66	-4.35	-5.95	-1.71	-1.19
Israel	ISR	NA	5.61	4.88	4.31	2.05	-0.52	-0.07	-0.82	-2.93	-4.50	-5.10	-3.22	-1.34
Luxembourg	LUX	NA	8.65	8.06	5.97	2.64	-1.32	-2.93	-4.85	-4.36	-2.70	-4.77	-3.44	-2.74
Finland	FIN	NA	8.01	6.05	3.88	2.03	-0.13	-1.65	-2.38	-3.35	-4.17	-5.42	-6.50	-5.39
Sweden	SWE	NA	6.09	4.69	4.16	3.35	0.57	-0.70	-1.75	-3.18	-4.12	-7.59	-6.31	-6.63
Iceland	ISL	NA	5.32	3.01	-1.56	0.33	0.53	-1.43	1.80	0.85	-2.87	-4.59	-6.04	-7.25
Denmark	DNK	NA	11.73	7.48	3.39	1.34	-1.35	-2.99	-3.42	-4.33	-3.95	-5.31	-8.14	-7.79
New Zealand	NZL	NA	5.30	4.63	4.51	0.43	-0.76	0.04	-2.66	-2.69	-2.38	-3.93	-7.26	-8.98
Norway	NOR	NA	7.24	5.83	4.96	3.44	0.38	-1.45	-2.67	-3.97	-5.09	-6.87	-9.06	-9.41
Australia	AUS	NA	6.98	5.69	4.70	2.19	0.75	-0.11	-2.16	-2.53	-4.63	-7.04	-8.84	-9.49
South Korea	KOR	NA	13.61	10.18	8.04	5.26	0.90	-1.73	-3.60	-6.04	-7.33	-9.81	-12.65	-13.12

Table S2B: Percentage Excess Death (p%=X/E) in a Single Year for All Countries and All Years

Location	LOC	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Slovakia	SVK	9.31	8.98	4.43	3.61	1.30	-2.12	0.29	-4.59	-4.02	-4.98	-8.61	-0.32	20.69
Poland	POL	9.39	5.92	2.97	2.88	1.20	-3.60	-1.15	-4.90	-3.02	-2.25	-4.57	10.18	17.77
United States	USA	1.75	0.97	1.00	0.08	-0.13	-1.11	0.37	-0.43	0.50	-0.85	-1.62	15.80	17.60
Latvia	LVA	7.55	7.85	2.03	2.60	0.17	-1.36	-2.63	-3.15	-2.91	-2.70	-6.37	-2.75	16.31
Lithuania	LTU	6.52	6.63	3.05	1.59	2.23	-1.71	1.24	-1.06	-3.72	-5.17	-8.61	3.89	13.33
Hungary	HUN	6.57	5.67	3.18	2.43	-0.46	-1.97	0.67	-4.29	-1.70	-2.97	-5.71	1.59	11.80
Croatia	HRV	8.77	6.97	2.89	2.43	-1.89	-2.33	2.23	-4.02	-1.80	-4.04	-7.03	1.86	11.80
Czechia	CZE	9.58	6.84	4.54	3.27	2.41	-2.73	0.21	-5.07	-4.12	-4.43	-6.92	5.55	11.62
Chile	CHL	4.67	8.70	3.15	4.18	2.53	1.95	0.63	-3.45	-4.04	-6.57	-6.94	3.58	10.15
Greece	GRC	6.66	4.32	3.01	4.84	-1.98	-2.68	-0.36	-3.71	-0.55	-4.64	-2.24	1.04	9.91
Estonia	EST	14.10	10.72	5.17	3.68	0.38	0.30	-4.35	-5.12	-5.93	-5.61	-8.83	-6.84	9.41
Portugal	PRT	6.97	6.22	0.67	2.87	0.63	-2.77	-1.28	-0.79	-3.46	-2.15	-4.80	3.61	3.33
Austria	AUT	6.89	4.77	2.09	4.02	2.65	-1.09	0.32	-4.57	-3.55	-3.68	-5.38	3.73	2.85
United Kingdom	GBR	5.65	4.11	0.54	1.33	0.69	-2.06	1.59	-1.63	-1.22	-1.98	-5.26	6.16	2.30
Italy	ITA	6.15	3.12	3.54	3.71	-0.57	-2.82	2.27	-3.91	-0.23	-4.18	-4.80	8.90	2.07
Germany	DEU	5.31	4.08	1.33	1.02	1.94	-3.30	0.45	-3.21	-2.13	-0.52	-3.36	-0.17	2.06
Slovenia	SVN	9.41	5.96	3.89	4.03	2.02	-2.84	-0.70	-4.17	-2.49	-4.59	-6.47	7.51	1.82
Netherlands	NLD	5.37	4.43	1.67	2.54	0.65	-2.89	0.06	-0.84	-1.96	-1.97	-4.90	3.28	1.81
Canada	CAN	7.23	3.47	1.98	0.38	-0.13	0.48	-1.13	-2.29	-1.03	-1.90	-4.33	3.47	1.01
France	FRA	6.58	4.70	0.63	2.67	0.41	-3.68	-0.03	-1.85	-1.45	-2.52	-3.47	3.81	0.61
Israel	ISR	6.15	5.08	4.67	4.09	0.05	-1.09	0.90	-2.51	-3.35	-5.64	-4.59	-1.90	-0.82
Spain	ESP	6.67	3.24	2.02	3.32	-1.37	-2.04	2.40	-2.40	-0.73	-2.41	-6.51	8.78	-1.44
Finland	FIN	8.13	7.94	4.26	3.56	0.59	-0.79	-2.46	-2.26	-4.38	-3.93	-6.85	-6.12	-4.63
Belgium	BEL	7.25	5.39	2.07	4.34	3.12	-2.97	0.29	-3.32	-3.25	-3.66	-6.76	7.57	-4.67
Luxembourg	LUX	8.05	9.29	6.93	5.10	0.31	-2.84	-3.07	-6.52	-2.20	-3.15	-6.31	-0.57	-4.78
Switzerland	CHE	7.85	5.88	2.29	3.10	2.55	-1.32	2.11	-4.01	-3.30	-5.35	-6.51	3.01	-5.33
Denmark	DNK	12.91	10.22	4.44	2.02	0.34	-3.33	-2.98	-4.17	-4.94	-3.28	-7.60	-8.95	-6.93
Iceland	ISL	5.39	5.36	0.83	-3.77	4.45	-3.20	0.40	3.26	-1.41	-4.19	-5.04	-6.93	-7.48
New Zealand	NZL	7.50	2.99	6.03	2.85	-2.11	0.37	-0.45	-4.97	-0.64	-4.25	-3.89	-10.68	-7.48
Australia	AUS	8.17	5.97	5.53	4.00	0.53	1.06	-1.12	-3.07	-1.92	-7.17	-6.83	-10.70	-8.22
Norway	NOR	7.74	6.87	4.94	5.11	1.92	-1.01	-1.76	-3.44	-4.37	-5.69	-7.91	-10.07	-8.65
Sweden	SWE	6.66	6.01	3.86	4.93	2.26	-0.64	-0.32	-2.72	-3.19	-4.61	-10.10	-2.16	-10.61
South Korea	KOR	15.53	12.16	8.59	7.82	3.10	-0.92	-2.25	-4.65	-7.11	-7.31	-11.99	-13.07	-12.96

Table S2C: Relative Excess Death (p%=X/E) Summing Three Adjacent Years for All Countries and All Years

Location	LOC	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
United States	USA	NA	NA	1.21	0.66	0.29	-0.41	-0.30	-0.40	0.13	-0.28	-0.69	4.47	10.61
Poland	POL	NA	NA	6.45	4.29	2.72	0.48	-0.84	-2.87	-2.69	-3.03	-2.95	1.51	8.22
Slovakia	SVK	NA	NA	7.59	5.69	3.13	0.93	-0.15	-2.12	-2.77	-4.50	-5.87	-4.58	4.12
Czechia	CZE	NA	NA	7.09	4.99	3.52	1.07	0.07	-2.43	-2.91	-4.42	-5.06	-1.76	3.63
Greece	GRC	NA	NA	4.84	4.28	2.12	0.20	-1.46	-2.06	-1.35	-2.79	-2.30	-1.74	3.13
Lithuania	LTU	NA	NA	5.24	3.59	2.14	0.54	0.43	-0.66	-1.33	-3.46	-5.98	-3.43	2.72
Hungary	HUN	NA	NA	5.23	3.85	1.80	0.08	-0.48	-1.78	-1.69	-2.89	-3.39	-2.26	2.68
Latvia	LVA	NA	NA	6.04	4.38	1.83	0.69	-1.06	-2.16	-2.67	-2.65	-3.77	-3.72	2.62
Croatia	HRV	NA	NA	6.32	4.21	1.25	-0.49	-0.52	-1.26	-1.09	-3.17	-4.19	-2.93	2.32
Chile	CHL	NA	NA	5.18	4.99	2.98	2.57	1.40	-0.65	-2.64	-4.98	-6.13	-3.46	2.17
Italy	ITA	NA	NA	4.18	3.41	2.14	0.01	-0.40	-1.54	-0.69	-2.82	-3.14	-0.02	2.03
United Kingdom	GBR	NA	NA	3.40	1.99	0.87	-0.02	0.08	-0.70	-0.44	-1.60	-2.83	-0.31	1.11
Slovenia	SVN	NA	NA	6.46	4.70	3.38	1.09	-0.45	-2.50	-2.39	-3.68	-4.47	-1.04	1.07
Portugal	PRT	NA	NA	4.79	3.45	1.60	0.42	-0.95	-1.40	-1.66	-1.95	-3.29	-0.89	0.94
France	FRA	NA	NA	4.15	2.88	1.45	-0.03	-0.89	-1.63	-0.92	-1.75	-2.29	-0.50	0.53
Austria	AUT	NA	NA	4.61	3.68	2.97	1.88	0.66	-1.76	-2.58	-3.88	-4.16	-1.71	0.46
Spain	ESP	NA	NA	3.85	2.78	1.22	-0.15	-0.39	-0.76	-0.34	-1.92	-3.33	-0.06	0.24
Canada	CAN	NA	NA	4.28	2.04	0.85	0.37	-0.14	-0.88	-1.37	-1.63	-2.34	-0.81	0.16
Netherlands	NLD	NA	NA	3.81	2.88	1.63	0.08	-0.71	-1.19	-0.91	-1.58	-2.95	-1.14	0.13
Germany	DEU	NA	NA	3.77	2.34	1.65	0.06	-0.12	-1.82	-1.45	-1.75	-1.82	-1.16	-0.28
Belgium	BEL	NA	NA	4.84	3.91	3.17	1.43	0.11	-2.02	-2.13	-3.43	-4.59	-0.93	-1.28
Estonia	EST	NA	NA	10.37	6.89	3.44	1.82	-0.88	-2.72	-4.77	-5.19	-6.44	-6.74	-1.69
Israel	ISR	NA	NA	5.21	4.53	2.82	0.90	-0.10	-0.97	-1.75	-3.91	-4.59	-4.07	-2.45
Switzerland	CHE	NA	NA	5.25	3.70	2.61	1.37	1.07	-1.13	-1.81	-4.26	-5.11	-2.92	-2.96
Luxembourg	LUX	NA	NA	8.11	7.24	4.20	0.92	-1.76	-4.04	-3.78	-3.79	-3.78	-3.20	-3.77
Finland	FIN	NA	NA	6.83	5.30	2.85	1.16	-0.84	-1.77	-2.97	-3.46	-5.00	-5.58	-5.78
Iceland	ISL	NA	NA	3.77	0.68	0.47	-0.89	0.47	0.15	0.67	-0.89	-3.63	-5.46	-6.55
New Zealand	NZL	NA	NA	5.56	4.03	2.26	0.41	-0.65	-1.67	-1.96	-3.21	-2.89	-6.27	-7.33
Denmark	DNK	NA	NA	9.65	6.01	2.73	0.13	-1.54	-3.03	-3.58	-3.67	-4.85	-6.22	-7.40
Sweden	SWE	NA	NA	5.18	4.61	3.37	1.85	0.12	-1.54	-2.39	-3.81	-6.29	-5.89	-7.90
Australia	AUS	NA	NA	6.31	4.95	3.11	1.65	-0.05	-1.27	-2.21	-4.25	-5.51	-8.42	-8.75
Norway	NOR	NA	NA	6.42	5.55	3.90	1.91	-0.37	-2.15	-3.27	-4.58	-6.08	-7.99	-8.95
South Korea	KOR	NA	NA	11.78	9.30	6.26	3.05	-0.25	-2.80	-4.88	-6.53	-9.00	-10.99	-12.80

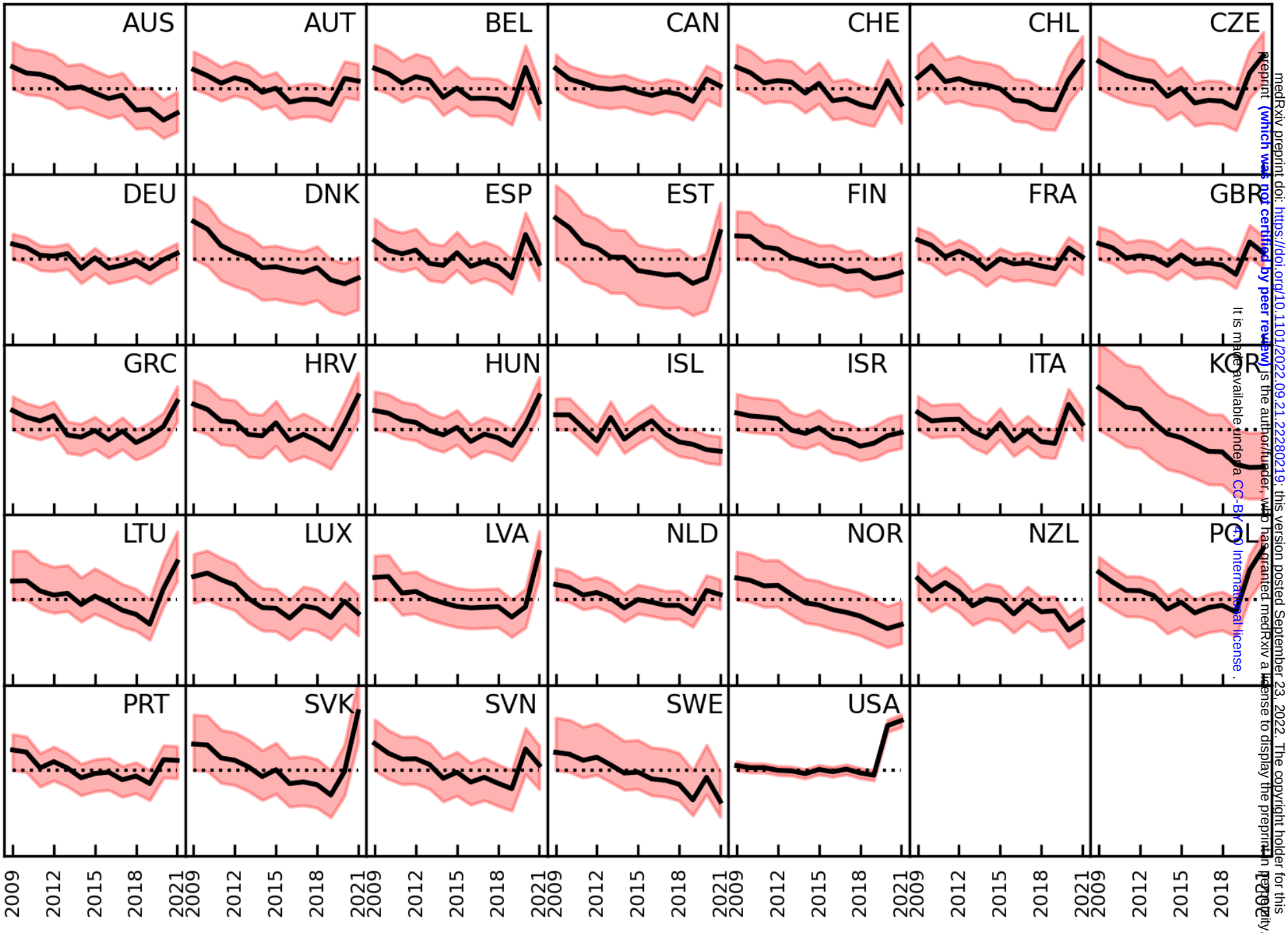
Table S2D: Relative Excess Death (p%=X/E) Summing Four Adjacent Years for All Countries and All Years

Location	LOC	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Australia	AUS	NA	NA	NA	5.65	3.75	2.53	0.87	-0.88	-1.48	-3.54	-4.96	-6.90	-8.41
Austria	AUT	NA	NA	NA	4.43	3.39	1.91	1.45	-0.72	-2.24	-2.88	-4.29	-2.18	-0.58
Belgium	BEL	NA	NA	NA	4.67	3.67	1.55	1.10	-0.81	-2.37	-2.56	-4.32	-1.53	-1.90
Canada	CAN	NA	NA	NA	3.37	1.58	0.85	0.09	-0.60	-0.82	-1.41	-2.24	-0.77	-0.26
Switzerland	CHE	NA	NA	NA	4.62	3.33	1.52	1.49	-0.31	-1.76	-2.79	-4.91	-3.08	-3.60
Chile	CHL	NA	NA	NA	4.70	4.15	2.51	1.87	-0.07	-1.73	-3.85	-5.67	-3.76	-0.08
Czechia	CZE	NA	NA	NA	6.19	4.41	2.00	0.93	-1.17	-2.78	-3.22	-4.98	-2.26	1.74
Germany	DEU	NA	NA	NA	3.20	2.37	0.49	0.28	-0.79	-1.78	-1.10	-2.04	-1.28	-0.23
Denmark	DNK	NA	NA	NA	8.02	4.88	1.49	-0.36	-1.91	-3.22	-3.21	-4.40	-5.63	-6.13
Spain	ESP	NA	NA	NA	3.71	1.71	0.38	0.51	-0.91	-0.75	-0.87	-3.11	-0.22	-0.41
Estonia	EST	NA	NA	NA	8.87	5.43	2.84	0.44	-1.76	-3.34	-4.79	-5.92	-6.35	-2.46
Finland	FIN	NA	NA	NA	6.05	4.14	1.97	0.28	-1.14	-2.38	-3.16	-4.27	-5.23	-5.28
France	FRA	NA	NA	NA	3.88	2.35	0.23	0.07	-1.04	-1.49	-1.23	-2.09	-0.64	-0.13
United Kingdom	GBR	NA	NA	NA	2.87	1.66	0.12	0.39	-0.35	-0.83	-0.83	-2.53	-0.53	0.36
Greece	GRC	NA	NA	NA	5.01	2.81	1.03	0.21	-1.89	-1.53	-2.05	-2.50	-1.31	1.36
Croatia	HRV	NA	NA	NA	5.46	2.78	0.46	0.33	-1.28	-1.27	-1.72	-4.03	-2.54	0.89
Hungary	HUN	NA	NA	NA	4.65	2.88	0.97	0.36	-1.33	-1.61	-1.90	-3.49	-2.00	1.40
Iceland	ISL	NA	NA	NA	1.77	1.60	-0.53	-0.61	1.14	-0.30	-0.63	-2.01	-4.53	-6.02
Israel	ISR	NA	NA	NA	4.87	3.31	1.75	0.86	-0.77	-1.63	-2.79	-4.12	-3.93	-3.25
Italy	ITA	NA	NA	NA	4.10	2.42	0.91	0.64	-1.26	-1.16	-1.54	-3.28	-0.03	0.55
South Korea	KOR	NA	NA	NA	10.64	7.57	4.27	1.57	-1.49	-4.01	-5.59	-8.04	-10.14	-11.57
Lithuania	LTU	NA	NA	NA	4.23	3.16	1.07	0.63	-0.03	-1.51	-2.38	-4.84	-3.58	0.68
Luxembourg	LUX	NA	NA	NA	7.71	5.69	2.61	0.12	-2.76	-3.32	-3.38	-4.21	-2.66	-3.40
Latvia	LVA	NA	NA	NA	5.34	3.49	1.19	0.01	-1.42	-2.19	-2.52	-3.45	-3.36	1.45
Netherlands	NLD	NA	NA	NA	3.51	2.33	0.48	0.10	-0.72	-1.37	-1.16	-2.42	-1.32	-0.36
Norway	NOR	NA	NA	NA	6.06	4.60	2.63	0.95	-1.18	-2.74	-3.91	-5.46	-7.13	-8.18
New Zealand	NZL	NA	NA	NA	5.02	2.60	1.92	0.34	-1.63	-1.26	-2.41	-3.25	-4.78	-6.46
Poland	POL	NA	NA	NA	5.77	3.73	1.31	0.28	-1.67	-2.69	-2.36	-3.22	0.61	5.86
Portugal	PRT	NA	NA	NA	4.37	2.79	0.55	0.05	-0.84	-1.87	-1.72	-2.62	-1.46	0.24
Slovakia	SVK	NA	NA	NA	6.64	4.63	1.85	0.83	-1.23	-2.55	-3.28	-5.50	-4.38	1.96
Slovenia	SVN	NA	NA	NA	5.91	4.08	1.84	0.70	-1.34	-2.43	-2.89	-4.33	-1.32	-0.24
Sweden	SWE	NA	NA	NA	4.98	3.88	2.21	1.17	-0.74	-2.09	-3.08	-5.55	-5.36	-7.22
United States	USA	NA	NA	NA	0.96	0.50	-0.03	-0.17	-0.30	-0.14	-0.09	-0.59	3.54	7.82

Table S3: Three Worst Pairs of Years, Plus 2021 If Not Already Included

Location	LOC	Year1	Year2	Year3	Year4	p1%	p2%	p3%	p4%	pd1%	pd2%	pd3%	pd4%
Australia	AUS	2010	2011	2012	2021	6.6	5.4	4.4	-9.7	16.4	15.1	14.1	0.00
Austria	AUT	2010	2011	2013	2021	5.7	3.3	3.2	3.2	2.5	0.1	0.0	0.00
Belgium	BEL	2010	2013	2011	2021	6.3	3.7	3.7	1.4	4.9	2.3	2.3	0.00
Canada	CAN	2010	2011	2021	NA	5.3	2.7	2.2		3.1	0.5	0.0	
Switzerland	CHE	2010	2011	2013	2021	6.7	3.9	2.7	-1.3	8.0	5.2	4.0	0.00
Chile	CHL	2021	2010	2011	NA	6.5	6.1	5.3		1.2	0.8	0.0	
Czechia	CZE	2021	2010	2011	NA	8.7	8.3	5.8		2.9	2.5	0.0	
Germany	DEU	2010	2011	2013	2021	4.8	2.8	1.5	1.0	3.8	1.8	0.5	0.00
Denmark	DNK	2010	2011	2012	2021	12.0	7.7	3.6	-7.6	19.6	15.3	11.2	0.00
Spain	ESP	2010	2021	2012	NA	4.8	3.6	2.6		2.3	1.0	0.0	
Estonia	EST	2010	2011	2012	2021	12.8	8.3	4.8	1.7	11.2	6.7	3.2	0.00
Finland	FIN	2010	2011	2012	2021	8.1	6.1	4.0	-5.3	13.4	11.5	9.3	0.00
France	FRA	2010	2011	2021	NA	5.9	2.9	2.4		3.5	0.5	0.0	
United Kingdom	GBR	2010	2021	2011	NA	4.8	4.2	2.2		2.6	1.9	0.0	
Greece	GRC	2021	2010	2012	NA	5.6	5.6	4.0		1.6	1.5	0.0	
Croatia	HRV	2010	2021	2011	NA	8.1	7.0	5.1		3.0	1.9	0.0	
Hungary	HUN	2021	2010	2011	NA	6.8	6.3	4.6		2.3	1.7	0.0	
Iceland	ISL	2010	2011	2016	2021	5.2	2.9	1.7	-7.3	12.5	10.2	9.0	0.00
Israel	ISR	2010	2011	2012	2021	5.4	4.6	4.1	-1.5	6.9	6.2	5.7	0.00
Italy	ITA	2021	2010	2012	NA	5.4	4.6	3.6		1.8	1.0	0.0	
South Korea	KOR	2010	2011	2012	2021	13.1	9.7	7.5	-13.5	26.5	23.1	21.0	0.00
Lithuania	LTU	2021	2010	2011	NA	8.6	6.6	4.8		3.8	1.7	0.0	
Luxembourg	LUX	2010	2011	2012	2021	8.8	8.2	6.1	-2.6	11.4	10.8	8.7	0.00
Latvia	LVA	2010	2021	2011	NA	8.0	7.0	5.2		2.8	1.8	0.0	
Netherlands	NLD	2010	2011	2021	NA	4.9	3.0	2.5		2.4	0.5	0.0	
Norway	NOR	2010	2011	2012	2021	7.2	5.8	4.9	-9.4	16.6	15.2	14.4	0.00
New Zealand	NZL	2010	2011	2012	2021	5.2	4.5	4.4	-9.1	14.2	13.6	13.5	0.00
Poland	POL	2021	2010	2011	NA	14.2	7.9	4.7		9.5	3.2	0.0	
Portugal	PRT	2010	2021	2011	NA	6.8	3.6	3.6		3.2	0.0	0.0	
Slovakia	SVK	2021	2010	2011	NA	10.2	9.1	6.6		3.6	2.5	0.0	
Slovenia	SVN	2010	2011	2021	NA	7.7	5.0	4.7		3.0	0.3	0.0	
Sweden	SWE	2010	2011	2012	2021	6.0	4.6	4.1	-6.7	12.7	11.3	10.8	0.00
United States	USA	2021	2010	2011	NA	16.6	1.3	0.9		15.7	0.4	0.0	

Figure S1



Year Between 2009 and 2021

Figure S2A

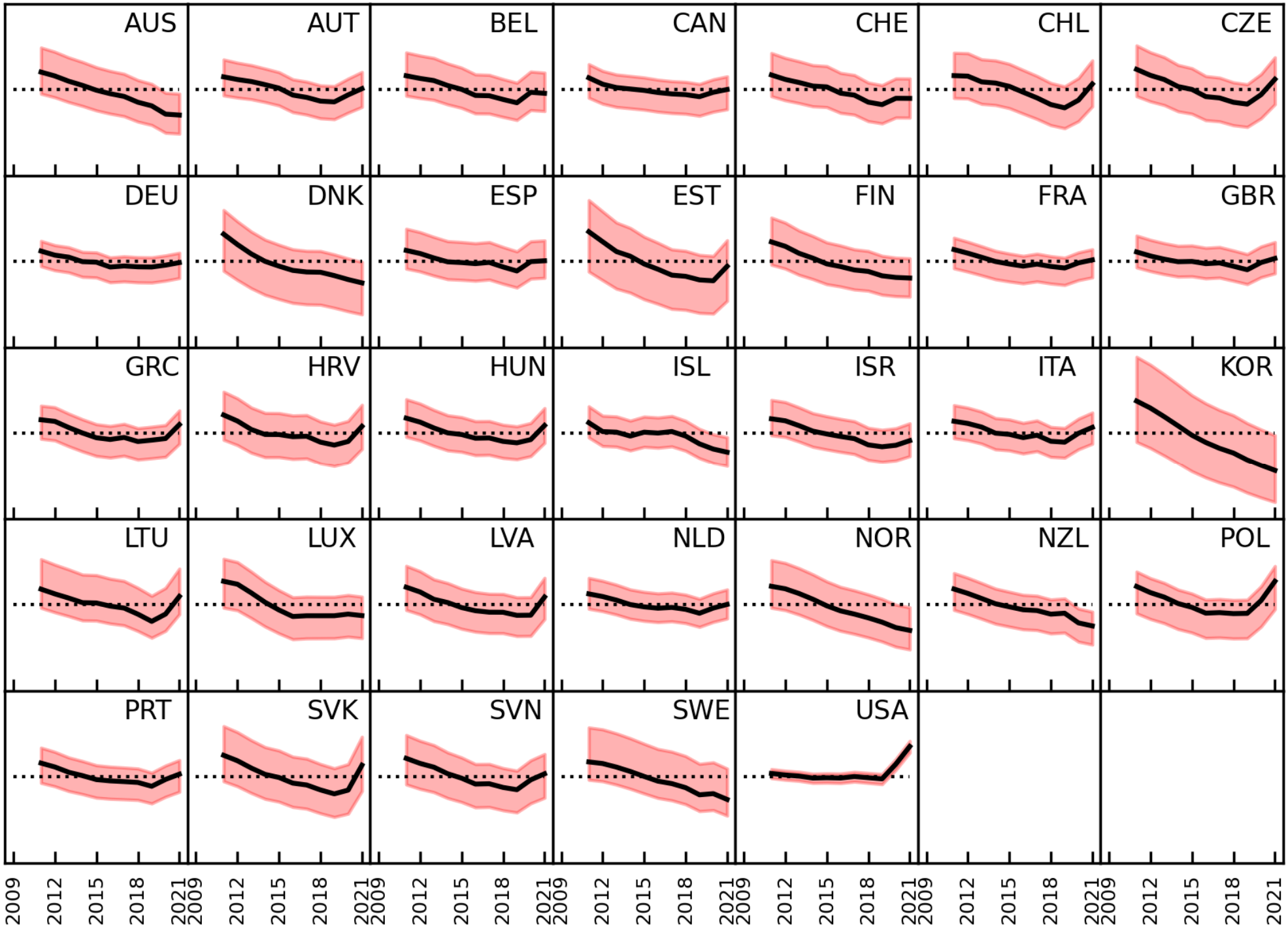
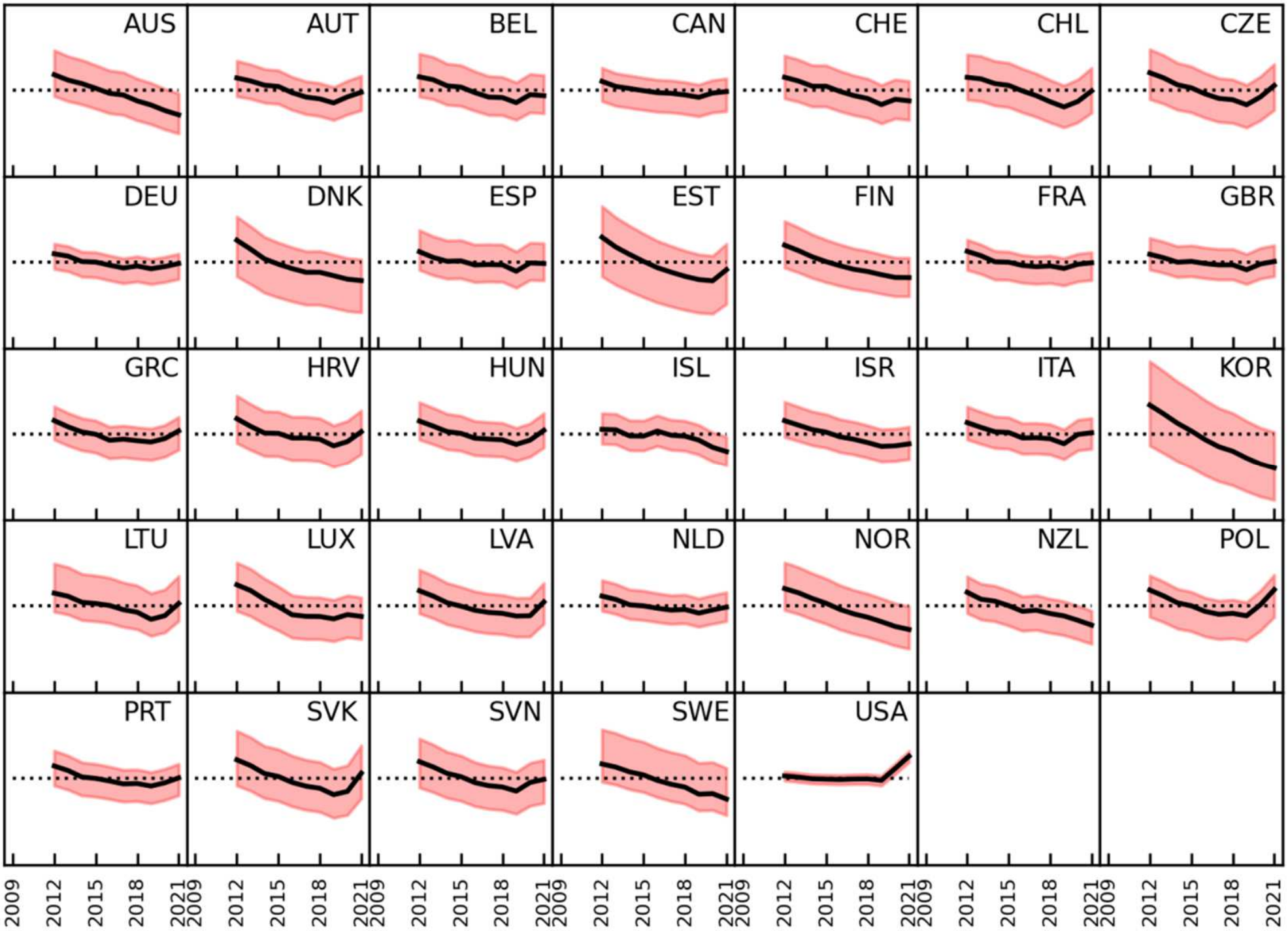


Figure S2B



Year Between 2009 and 2021 (Summing Four Adjacent Years)

Figure S2C

Supplementary Links to Data

Location	LOC	Death File Name	Last Modification Date	Population File Name	Last Modification Date	Death Download Link	Population Download Link
All HMD Short Term Mortality Fluctuations		stmf.csv	20-May-2022	stmf.csv	20-May-2022	https://www.mortality.org/File/GetDocument/Public/STMF/Outputs/stmf.csv	
Australia	AUS	Australia_Deaths_1x1.txt	22-Mar-2022	Australia_Population.txt	22-Mar-2022	AUS.Deaths_1x1.txt	AUS.Population.txt
Austria	AUT	Austria_Deaths_1x1.txt	30-Mar-2021	Austria_Population.txt	30-Mar-2021	AUT.Deaths_1x1.txt	AUT.Population.txt
Belgium	BEL	Belgium_Deaths_1x1.txt	25-Sep-2021	Belgium_Population.txt	25-Sep-2021	BEL.Deaths_1x1.txt	BEL.Population.txt
Canada	CAN	Canada_Deaths_1x1.txt	28-Sep-2021	Canada_Population.txt	28-Sep-2021	CAN.Deaths_1x1.txt	CAN.Population.txt
Switzerland	CHE	Switzerland_Deaths_1x1.txt	28-Oct-2021	Switzerland_Population.txt	28-Oct-2021	CHE.Deaths_1x1.txt	CHE.Population.txt
Chile	CHL	Chile_Deaths_1x1.txt	18-Apr-2022	Chile_Population.txt	18-Apr-2022	CHL.Deaths_1x1.txt	CHL.Population.txt
Czechia	CZE	Czechia_Deaths_1x1.txt	23-May-2021	Czechia_Population.txt	23-May-2021	CZE.Deaths_1x1.txt	CZE.Population.txt
Germany	DEU	Germany_Deaths_1x1.txt	17-Dec-2018	Germany_Population.txt	17-Dec-2018	DEUTNP.Deaths_1x1.txt	DEUTNP.Population.txt
Denmark	DNK	Denmark_Deaths_1x1.txt	22-Mar-2022	Denmark_Population.txt	22-Mar-2022	DNK.Deaths_1x1.txt	DNK.Population.txt
Spain	ESP	Spain_Deaths_1x1.txt	23-Feb-2022	Spain_Population.txt	23-Feb-2022	ESP.Deaths_1x1.txt	ESP.Population.txt
Estonia	EST	Estonia_Deaths_1x1.txt	21-Jan-2021	Estonia_Population.txt	21-Jan-2021	EST.Deaths_1x1.txt	EST.Population.txt
Finland	FIN	Finland_Deaths_1x1.txt	02-Aug-2021	Finland_Population.txt	02-Aug-2021	FIN.Deaths_1x1.txt	FIN.Population.txt
France	FRA	France_Deaths_1x1.txt	11-Apr-2022	France_Population.txt	11-Apr-2022	FRATNP.Deaths_1x1.txt	FRATNP.Population.txt
United Kingdom	GBR	UK_Deaths_1x1.txt	11-Jul-2020	UK_Population.txt	11-Jul-2020	GBR_NP.Deaths_1x1.txt	GBR_NP.Population.txt
Greece	GRC	Greece_Deaths_1x1.txt	08-Nov-2021	Greece_Population.txt	08-Nov-2021	GRC.Deaths_1x1.txt	GRC.Population.txt
Croatia	HRV	Croatia_Deaths_1x1.txt	24-Feb-2022	Croatia_Population.txt	24-Feb-2022	HRV.Deaths_1x1.txt	HRV.Population.txt
Hungary	HUN	Hungary_Deaths_1x1.txt	30-Nov-2021	Hungary_Population.txt	30-Nov-2021	HUN.Deaths_1x1.txt	HUN.Population.txt
Iceland	ISL	Iceland_Deaths_1x1.txt	02-Apr-2020	Iceland_Population.txt	02-Apr-2020	ISL.Deaths_1x1.txt	ISL.Population.txt
Israel	ISR	Israel_Deaths_1x1.txt	31-Oct-2018	Israel_Population.txt	31-Oct-2018	ISR.Deaths_1x1.txt	ISR.Population.txt
Italy	ITA	Italy_Deaths_1x1.txt	11-Apr-2022	Italy_Population.txt	11-Apr-2022	ITA.Deaths_1x1.txt	ITA.Population.txt
South Korea	KOR	Republic_of_Korea_Deaths_1x1.txt	15-Nov-2019	Republic_of_Korea_Population.txt	15-Nov-2019	KOR.Deaths_1x1.txt	KOR.Population.txt
Lithuania	LTU	Lithuania_Deaths_1x1.txt	29-Jan-2022	Lithuania_Population.txt	29-Jan-2022	LTU.Deaths_1x1.txt	LTU.Population.txt
Luxembourg	LUX	Luxembourg_Deaths_1x1.txt	21-Jan-2022	Luxembourg_Population.txt	21-Jan-2022	LUX.Deaths_1x1.txt	LUX.Population.txt
Latvia	LVA	Latvia_Deaths_1x1.txt	11-Mar-2021	Latvia_Population.txt	11-Mar-2021	LVA.Deaths_1x1.txt	LVA.Population.txt
Netherlands	NLD	Netherlands_Deaths_1x1.txt	31-Mar-2021	Netherlands_Population.txt	31-Mar-2021	NLD.Deaths_1x1.txt	NLD.Population.txt
Norway	NOR	Norway_Deaths_1x1.txt	15-Apr-2021	Norway_Population.txt	15-Apr-2021	NOR.Deaths_1x1.txt	NOR.Population.txt
New Zealand	NZL	New_Zealand_Deaths_1x1.txt	26-Sep-2017	New_Zealand_Population.txt	26-Sep-2017	NZL_NP.Deaths_1x1.txt	NZL_NP.Population.txt
Poland	POL	Poland_Deaths_1x1.txt	13-Apr-2021	Poland_Population.txt	13-Apr-2021	POL.Deaths_1x1.txt	POL.Population.txt
Portugal	PRT	Portugal_Deaths_1x1.txt	01-Aug-2021	Portugal_Population.txt	01-Aug-2021	PRT.Deaths_1x1.txt	PRT.Population.txt
Slovakia	SVK	Slovakia_Deaths_1x1.txt	29-Oct-2021	Slovakia_Population.txt	29-Oct-2021	SVK.Deaths_1x1.txt	SVK.Population.txt
Slovenia	SVN	Slovenia_Deaths_1x1.txt	01-Nov-2021	Slovenia_Population.txt	01-Nov-2021	SVN.Deaths_1x1.txt	SVN.Population.txt
Sweden	SWE	Sweden_Deaths_1x1.txt	12-May-2022	Sweden_Population.txt	12-May-2022	SWE.Deaths_1x1.txt	SWE.Population.txt
United States	USA	USA_Deaths_1x1.txt	17-Mar-2021	USA_Population.txt	17-Mar-2021	USA.Deaths_1x1.txt	USA.Population.txt

All Deaths_1x1.txt and Population.txt files are downloaded as a zip file at **https://www.mortality.org/File/Download/hmd.v6/zip/all_hmd/hmd_statistics_20220812.zip**, where the Version shown here is "hmd_statistics_20220812" and changes frequently. The relevant files for Deaths and Population are in directories **/<Version>/deaths/Deaths_1x1/** and **/<Version>/population/Population/** respectively. More generally, the download button for the latest version is marked "All HMD Statistics" and is at the bottom of the page linked by **https://www.mortality.org/Data/ZippedDataFiles**