EXCESS MORTALITY AND THE EFFECT OF THE COVID-19 VACCINES: UPDATE ON THE EUROPEAN DATA

Peter Hegarty
Department of Mathematical Sciences
Chalmers University Of Technology and University of Gothenburg
41296 Gothenburg, Sweden
hegarty@chalmers.se

Abstract. Several months have elapsed since we wrote a paper investigating the relationship between all-cause excess mortality (EM) and Covid vaccination rates across 28 EU/EES countries, using data from both Eurostat and Our World in Data (OWID). As 2023 draws to a close, we now have a further 4 months of Eurostat data and a further 5-6 months of OWID data and, given the urgency of the subject matter, think it is time for an update. This paper contains updated versions of all the relevant tables and figures from the preprint, along with short comments. The bottom line is that the pattern that has been in place since April 2022, with EM and vaccination rates positively correlated across the EU/EES region, remains firmly in place. If current trends persist, then the aggregate correlation between the two, for the pandemic era as a whole (i.e.: since March 2020), will turn positive some time during 2024. This assertion applies to the raw EM data, as measured either by Eurostat or OWID. It remains the case that if we instead measure EM using the OWID model which projects mortality out from the baseline period, then the picture is shifted somewhat in favour of the vaccines, though the trend is the same. In particular, the *shift* in the correlation between EM and vaccination rates from the period before to that after the vaccine rollout continues to grow, no matter how we measure EM. In fact, for the raw EM data, the aggregate correlation in the post-rollout period has now turned positive.

1. Summary

This paper provides updated versions of tables and figures in our paper [2]. The several months of additional data now available provide no reason to modify our earlier analysis. This is illustrated most succinctly in Figure 2 below, which contains four additional data points compared to the corresponding figure in [2]. These show that the pattern which emerged after the first omicron Covid wave, with rates of all-cause excess mortality (EM) and rates of Covid vaccination being positively correlated across the EU/EES region, remains firmly in place.

Our overall conclusion in [2] was that, while the EM data was still consistent with a wide range of possible interpretations as far as the safety and efficacy of the Covid vaccines was concerned, those interpretations which implied their having already done net harm, along with a worsening trend, were more persuasive. Now we find ourselves even more persuaded of these negative conclusions, though the data does not yet point *unequivocally* in that direction and may not even do so by the end of 2024, depending on how EM rates are calculated. But the situation is already alarming, in particular given the recent award of the Nobel Prize in Medicine for an innovation whose benefit is so much in doubt.

2. Updated tables and figures using Eurostat data

As far as we know, no European country still *recommends* Covid vaccination to the general population, though those in "high-risk groups" are still recommended to take a booster shot of the most recently upgraded product. Hence, rates of full vaccination - meaning those who have

Date: December 23, 2023.
Key words and phrases. COVID-19, vaccination, all-cause mortality, excess mortality.

completed the primary schedule - are barely changing and the numbers in Table 1 are almost identical to those in [2].

Country	Vaccination rate	Last update	Country	Vaccination rate	Last update
Malta	88.42	7/11/23	Cyprus	72.11	22/2/23
Portugal	86.71	1/9/23	Sweden	71.98	19/3/23
Spain	85.66	24/5/23	Latvia	70.57	11/7/22
Italy	81.21	16/11/23	Lithuania	68.40	15/12/23
Ireland	80.89	28/8/23	Netherlands	67.08	1/9/23
Denmark	80.19	1/9/23	Czechia	65.69	16/9/23
Belgium	78.67	24/9/23	Estonia	65.04	11/12/23
Finland	78.47	1/2/23	Hungary	62.28	27/12/22
France	78.44	10/7/23	Slovenia	57.66	6/7/22
Iceland	77.82	29/3/22	Poland	56.83	10/11/23
Germany	76.24	7/4/23	Croatia	55.87	28/11/23
Austria	74.76	30/6/23	Slovakia	45.68	31/7/22
Norway	74.61	13/11/22	Romania	41.28	11/6/22
Greece	73.63	15/12/23	Bulgaria	30.64	29/8/23
AVERAGE				69.53	

TABLE 1. Most recently registered rates of full Covid vaccination, as a percentage of the population. Source: OWID. Data extracted 17/12/23.

EUROSTAT released its latest official EM report on December 15 [1]. Table 2 presents the list of EM rates for October 2023, as per EUROSTAT. Some idea of how little the "big picture" has changed in recent months is gotten by noting that the four worst-performing countries in Table 2 are the same as in the corresponding table of [2], though in a different order, while Bulgaria and Romania also remain as the two outstanding performers.

Country	EM rate 10/23	Country	EM rate 10/23	Country	EM rate 10/23
Finland	19.8	Estonia	7.0	Czechia	0.5
Ireland	17.8	Portugal	6.5	Iceland	0.1
Cyprus	17.4	France	6.2	Latvia	−0.6
Netherlands	15.1	Sweden	6.1	Croatia	−2.2
Malta	13.9	Greece	3.6	Italy	−2.3
Austria	10.7	Belgium	3.5	Slovakia	−2.3
Germany	10.7	Spain	3.4	Lithuania	−3.8
Denmark	9.8	Poland	0.9	Bulgaria	−6.6
Norway	9.0	Hungary	0.7	Romania	−9.6
Slovenia	8.8				

TABLE 2. Excess mortality rates in October 2023, compared to 2016-2019 average. Source: EUROSTAT. Data extracted 15/12/23.

Figure 1 plots the numbers in Table 1 (x-axis) against those in Table 2 (y-axis). The least squares fit $y = mx + c$ satisfies

$$m \approx 0.3171, \quad c \approx -16.9026.$$

In other words, in the least squares approximation, a totally unvaccinated population would have had an EM rate of about -16.90%, while a fully vaccinated one would have had an EM rate of about $-16.90 + 31.71 = +14.81\%$. These numbers are all quite similar to those in [2] for June 2023.

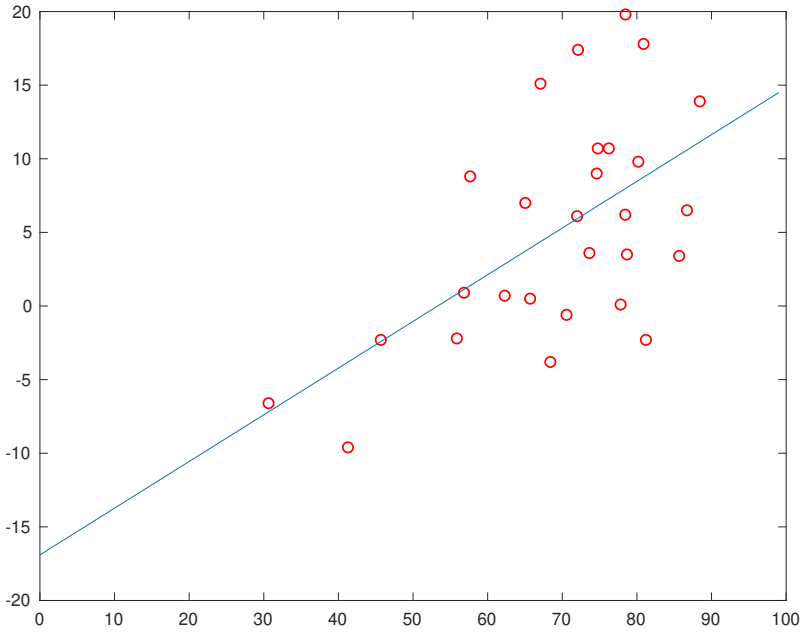

FIGURE 1. Excess mortality rates in October 2023 vs. vaccination rates for 28 EU/EES countries, along with the least-squares best fit.

As before, Figure 2 is the key one for our analysis. It contains four new data points, for the months of July through October 2023, compared to the corresponding figure in [2]. Clearly, the pattern that has been evident since April 2022, with EM and vaccination rates positively correlated across the EU/EES region, remains firmly in place. Indeed, the four months of additional data suggests no significant change in the trend whatsoever.

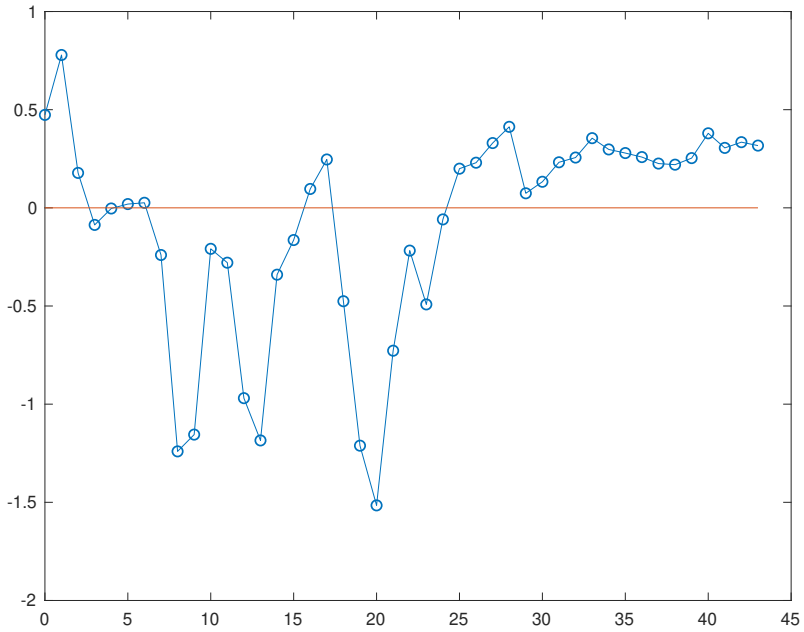

FIGURE 2. The plot shows how EM rates correlate with current rates of full vaccination for every month from March 2020 to October 2023.

The updated average rates of EM for the pandemic as a whole are presented in Table 3:

Country	Average EM rate 3/20 – 10/23	Country	Average EM rate 3/20 – 10/23	Country	Average EM rate 3/20 – 10/23
Cyprus	18.03	Romania	11.27	France	9.58
Malta	16.88	Spain	11.04	Lithuania	9.27
Slovakia	16.57	Portugal	10.91	Hungary	8.84
Poland	16.00	Italy	10.67	Iceland	8.66
Bulgaria	15.37	Croatia	10.12	Belgium	7.51
Czechia	13.36	Germany	9.93	Latvia	7.48
Slovenia	13.35	Finland	9.84	Denmark	6.68
Netherlands	12.78	Ireland	9.82	Norway	5.64
Greece	12.55	Estonia	9.78	Sweden	3.85
Austria	12.21				

TABLE 3. Estimated average rates of excess mortality during the period March 2020-October 2023. Source: EUROSTAT. Data extracted 15/12/23.

In Figure 3, the numbers in Table 1 are plotted against those in Table 3.
The least-squares fit $y = mx + c$ is now

$$m \approx -0.0832, \quad c \approx 16.7837. \tag{2.1}$$

In [2], we had instead $m \approx -0.1222$, $c \approx 20.1211$. In the intervening four months, the value of m has increased at a rate of about 0.01 per month and hence, if current trends persist, m will turn positive at some point during 2024. In other words, as things stand,

We expect the aggregate correlation of EM rates with vaccination rates, across the EU/EES region and for the pandemic as a whole, to turn positive at some point during 2024, using the

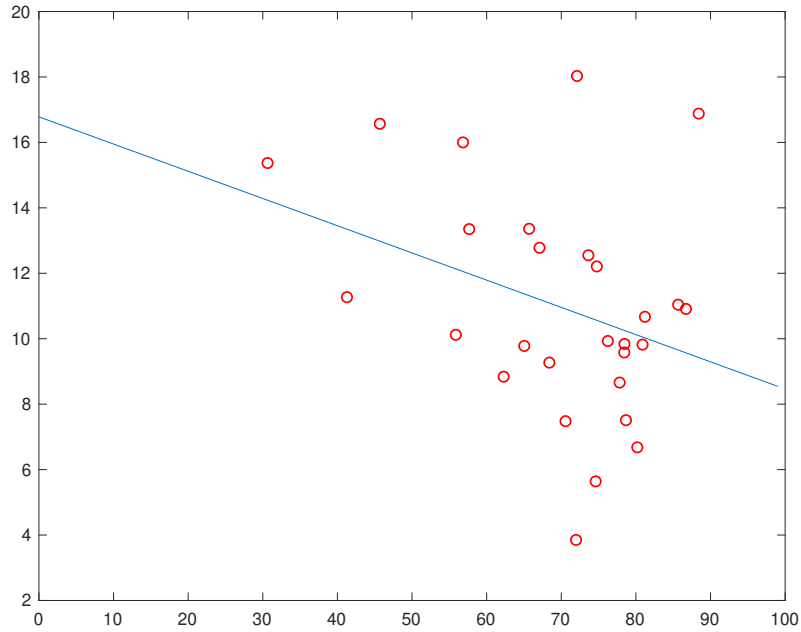

FIGURE 3. Average pandemic-era excess mortality rates vs. current rates of full vaccination, along with the least-squares best fit.

EUROSTAT *methodology for measuring EM.*

The least-squares fit now predicts an aggregate EM rate of about $16.78 - 100 \times 0.0832 = 8.46\%$ in a fully vaccinated population, whereas in June it would have predicted $20.12 - 100 \times 0.1222 = 7.70\%$. This is particularly alarming, as it suggests that EM rates are not falling at all in highly vaccinated countries, further adding to the evidence that the problems these countries are dealing with are chronic in nature.

Below are the updated versions of Figure 4 and Table 4 of [2].

Figure 4 illustrates that average rates of EM across the EU/EES region continue to be lower in 2023 than earlier in the pandemic. As the previous discussion indicates, this is primarily due to falling rates of EM in countries with lower vaccination rates. Indeed, most Eastern European countries are now consistently recording negative EM rates on a monthly basis.

Comparing Table 4 to the corresponding table in [2], only four countries now have a higher average EM rate in the period $5/21 - 10/23$ than they did in the period $5/21 - 6/23$: Iceland, Ireland, Malta and Portugal. All are highly-vaccinated. Comparison of the two tables also quickly reveals that average post-rollout EM rates are generally falling most rapidly in the countries with the lowest vaccination rates.

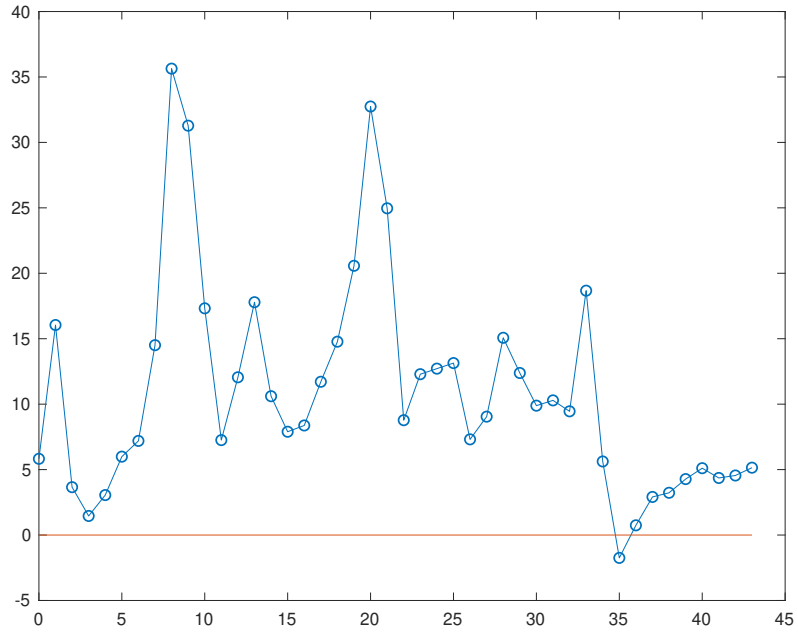

FIGURE 4. Average rate of excess mortality in 28 EU/EES countries (y-axis), for each month March 2020 - October 2023 (x-axis). All countries are given equal weight. A similar figure can be found on the website [1], but for the 27 EU countries (so Norway and Iceland are excluded, but Luxembourg included), and with countries weighted by population. The two figures look very similar, in particular the locations of the EM peaks are the same.

Country	Average EM rate $3/20 - 4/21$	Average EM rate $5/21 - 10/23$	Country	Average EM rate $3/20 - 4/21$	Average EM rate $5/21 - 10/23$
Austria	10.54	12.99	Ireland	5.18	11.98
Belgium	13.78	4.59	Italy	18.59	6.98
Bulgaria	22.76	11.92	Latvia	6.19	8.08
Croatia	11.94	9.27	Lithuania	13.54	7.28
Cyprus	11.41	21.11	Malta	17.69	16.50
Czechia	27.81	6.61	Netherlands	12.71	12.81
Denmark	1.24	9.22	Norway	-1.73	9.07
Estonia	8.51	10.37	Poland	26.70	11.01
Finland	2.67	13.19	Portugal	15.58	8.72
France	12.63	8.16	Romania	18.97	7.67
Germany	6.61	11.48	Slovakia	25.65	12.33
Greece	7.97	14.68	Slovenia	18.94	10.74
Hungary	16.22	5.39	Spain	17.81	7.88
Iceland	0.75	12.35	Sweden	7.47	2.16

TABLE 4. Average EM rates in the pre- and post-vaccine rollout periods. For Netherlands, Norway and Slovenia, the figures for the pre-rollout period differ from those in [2] because of adjustments since made to the EUROSTAT data.

The most succinct comparion of the pre- and post-rollout periods was provided by Table 8 in [2]. Below is the updated version of that table, along with the updated table of vaccination rates on which it is based.

Country	M1	M2	M3	M4
Austria	74.76	70.64	228.97	77.18
Belgium	78.67	75.78	254.86	79.51
Bulgaria	30.64	28.23	69.66	31.09
Croatia	55.87	48.47	133.35	57.64
Cyprus	72.11	68.35	200.74	74.91
Czechia	65.69	63.45	177.50	66.48
Denmark	80.19	76.72	254.56	80.79
Estonia	65.04	62.42	163.21	65.61
Finland	78.47	73.79	238.52	81.65
France	78.44	73.21	227.82	80.63
Germany	76.24	70.96	230.56	77.82
Greece	73.63	67.80	214.56	76.43
Hungary	62.28	60.01	167.56	64.42
Iceland	77.82	76.15	216.00	83.07
Ireland	80.89	77.30	221.49	81.80
Italy	81.21	75.73	244.94	86.28
Latvia	70.57	68.22	156.47	72.74
Lithuania	68.40	66.62	167.32	71.20
Malta	88.42	81.73	258.96	89.78
Netherlands	67.08	66.05	226.69	71.72
Norway	74.61	72.31	223.50	79.99
Poland	56.83	52.80	145.60	57.40
Portugal	86.71	83.13	274.53	95.33
Romania	41.28	39.76	85.60	41.65
Slovakia	45.68	43.85	101.96	46.00
Slovenia	57.66	56.09	141.36	59.71
Spain	85.66	79.79	222.55	86.95
Sweden	71.98	68.90	250.02	73.71
Average	69.53	66.01	196.39	71.84

Table 7. Four different measures of vaccination rates. Source: Owid, data extracted 21/12/23. Compared to the numbers in the corresponding table of [2], there are only very small differences and mostly in column M3. This reflects two things: On the one hand, many countries are no longer updating these numbers at all. On the other, primary vaccinations are in general no longer being recommended to those as yet unvaccinated and even continued boosting is only recommended to certain "high-risk groups".

Measure	m_1	c_1	m_2	c_2
M1	-0.2781	32.1258	$+0.0077$	9.6240
M2	-0.3009	32.6549	$+0.0008$	10.1102
M3	-0.0698	26.5047	-0.0009	10.3392
M4	-0.2650	31.8289	$+0.0085$	9.5515

TABLE 8. Correlation of EM and vaccination rates in the pre- and post-rollout periods, for four different measures of the vaccination rate and using EUROSTAT EM data.

The numbers m_1, c_1 differ slightly from those in [2] due to minor adjustments in the EUROSTAT data, as already referred to in the caption to Table 4. It is the changes to the numbers m_2 that are notable - in particular, with the exception of row M3, these numbers are now positive. In other words,

In the period since the vaccines were rolled out, the aggregate correlation between EM rates and vaccination rates across the EU/EES region has now effectively turned positive.

Furthermore, if we take row M1 for example, then the least-squares fit is now predicting an aggregate post-rollout EM rate of about $9.62 + 100 \times 0.0077 = 10.39\%$ in a fully vaccinated population. At the end of June, the prediction would have been $13.55 - 100 \times 0.0372 = 9.83\%$. This emphasises a point already made earlier, namely that the model is predicting that EM rates would still be increasing in a country with total vaccination coverage.

Finally, Figure 5 is the updated version of the corresponding figure in [2] and emphasises that our analysis continues to be robust to different ways of measuring vaccination coverage.

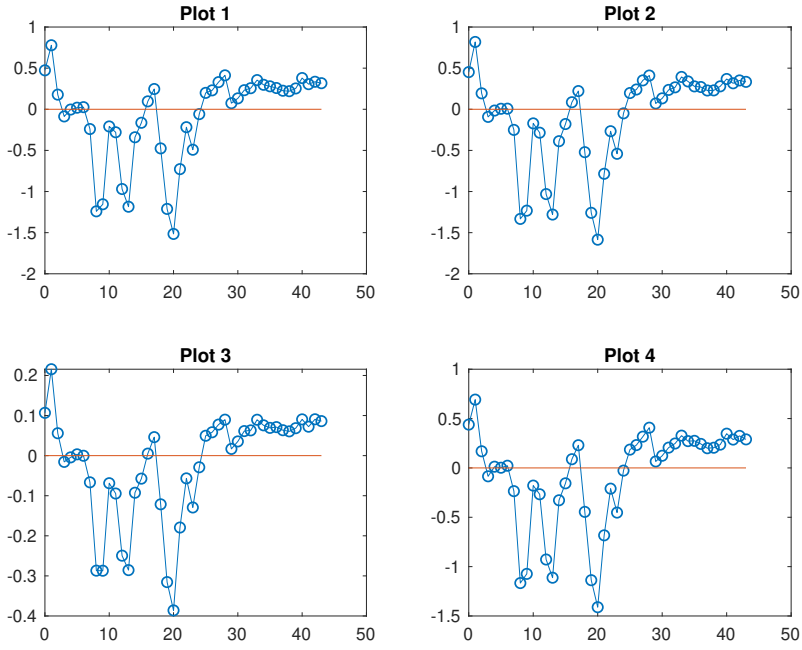

FIGURE 5. Month-by-month correlation of EM and vaccination rates, for four different measures M1-M4 of the latter and using EUROSTAT EM data.

3. **Updated tables and figures based on OWID data**

Recall that there are two main differences between how EUROSTAT and OWID compute pandemic-era EM rates for EU/EES countries:

(i) The baseline for the former is the average of the years 2016-2019, whereas in the latter 2015 is also included.

(ii) The former reports one EM number per month, the latter one per week.

In [2] we used OWID EM data up to May 2023. As of the time of writing, there is full data for all 28 countries up to September, only Spain and Sweden do not have full data for October and there are 6 countries with full data for November: Estonia, Finland, Germany, Netherlands, Norway and Poland.

The numbers in the tables and figures below are based on all the available data up to November 2023. As in [2], we assign an EM rate of zero to every month and country for which we don't yet have full data. Given that EM rates are currently positively correlated with vaccination rates, this results in slightly overestimating the performance of countries with higher vaccination rates.

The four plots in Figure 6 are updates of the corresponding figure in [2]. Note that the rightmost point in each plot does not indicate a sudden improvement in the relative performance of more highly-vaccinated countries but is simply because we have set the EM rate to zero for 22 of 28 countries in November. Other than that, the message is the same as in [2]: the four plots in Figure 6 all resemble both one another and the corresponding plots in Figure 5.

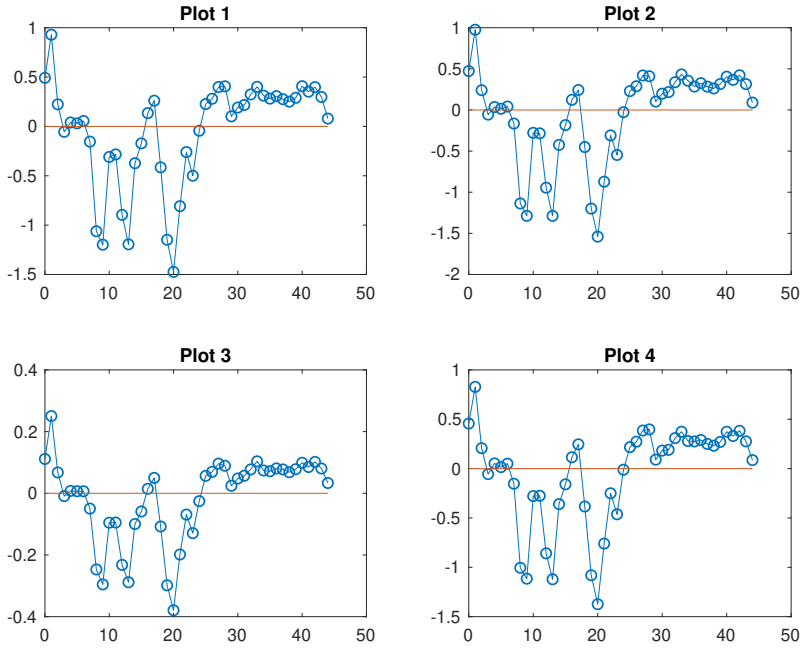

FIGURE 6. Month-by-month correlation of EM and vaccination rates, from March 2020 to November 2023, for four different measures of vaccination rates and using weekly OWID EM data. The data was extracted on 19/12/23.

The numbers in Table 9 are the updated values of those in the corresponding table of [2].

As noted in [2], inclusion of 2015 in the baseline results in slopes m_i that are a bit larger and "shifts" $100(m_2 - m_1)$ that are a bit smaller than the corresponding quantities in Table 8. In particular, all numbers m_2 in Table 9 are already clearly positive. For the pandemic as a whole,

Measure	m_1	c_1	m_2	c_2
M1	-0.2415	29.5250	$+0.0323$	7.9025
M2	-0.2614	29.9850	$+0.0281$	8.2931
M3	-0.0616	24.8210	$+0.0055$	9.0798
M4	-0.2323	29.4208	$+0.0318$	7.8676

TABLE 9. Correlation of EM and vaccination rates in the pre- and post-rollout periods, for four different measures of the vaccination rates and using weekly OWID EM data.

the least-squares fit analogous to (2.1) now satisfies

$$m \approx -0.0529, \quad c \approx 14.6295. \tag{3.1}$$

Since m is currently increasing at the rate of about 0.01 per month, the aggregate pandemic-era correlation between EM and vaccination rates across the EU/EES region is on course to turn positive by the middle of 2023, when EM rates are measured compared to a 5-year pre-pandemic baseline.

Now recall that OWID employs a second method to measure pandemic-era EM, which relies on using the baseline data to try to model underlying mortality trends. We noted in [2] that this results in the numbers m_i and $100(m_2 - m_1)$ all being shifted downwards quite signficantly, though the latter remain strongly positive. That was the case then and it remains so now and the quantitative differences between the two methods have changed little. The updated versions of Figure 7 and Table 10 from [2] are presented below.

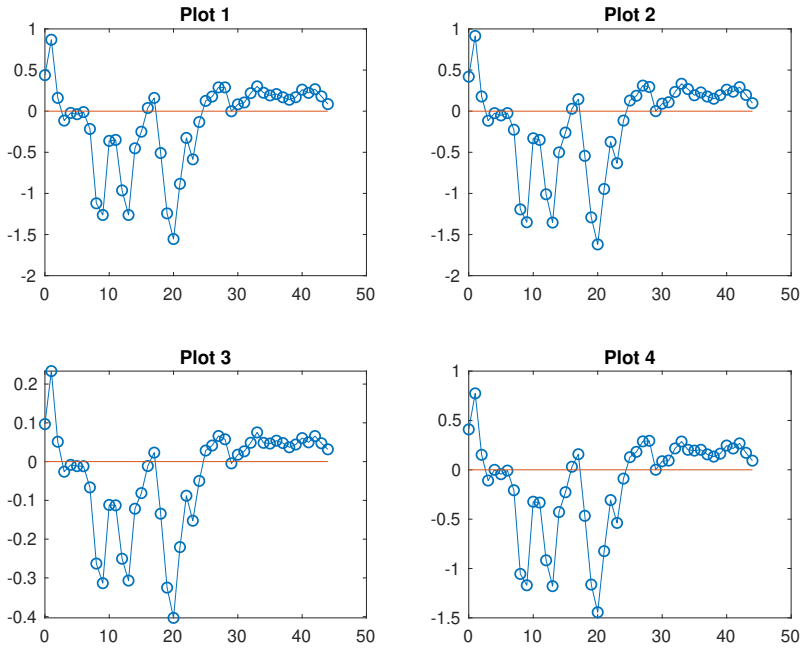

FIGURE 7. Month-by-month correlation of EM and vaccination rates, up to November 2023, for four different measures of the latter and using weekly OWID EM data. Raw EM rates have been adjusted based on a model of mortality trends extrapolated from the baseline.

Measure	m_1	c_1	m_2	c_2
M1	-0.3036	32.3596	-0.0653	12.4236
M2	-0.3225	32.5405	-0.0684	12.3953
M3	-0.0787	26.7068	-0.0217	12.1524
M4	-0.2863	31.8148	-0.0538	11.7470

TABLE 10. Correlation of EM and vaccination rates in the pre- and post-rollout periods, for four different measures of the vaccination rates and using weekly OWID EM data. Raw EM rates have been adjusted based on a model of mortality trends extrapolated from the baseline.

Note that, in this model, the numbers m_2 remain negative but are also on course to turn positive during 2024. In other words, the aggregate correlation between EM rates and vaccination rates *in the post-rollout period* is on course to turn positive during 2024, also in the model which adjusts pandemic-era EM rates based on trends in the baseline period.

On the other hand, for the pandemic era as a whole, the least-squares fit in this model analogous to (3.1) is currently

$$m \approx -0.1395, \quad c \approx 18.6259. \tag{3.2}$$

Even if current trends hold, this slope m will not turn positive until at least 2025. This is far enough into the future that all predictions must be taken with a large grain of salt. Hence, while the data is pointing ever more clearly towards an overall conclusion of vaccine failure, there remains a distinct possibility that time will show otherwise.

For the sake of completeness, we finish this section by providing updated versions of Tables 11 and 12 from [2]. The numbers for each country are based on the data available specifically for it. Thus, for Spain and Sweden, "present" means up to and including October 2023. For Estonia, Finland, Germany, Netherlands, Norway and Poland it means up to November 2023 and for every other country it means up to October 2023.

Country	Average EM rate $3/20-$ present	Country	Average EM rate $3/20-$ present	Country	Average EM rate $3/20-$ present
Lithuania	19.19	Netherlands	9.05	Slovenia	7.62
Bulgaria	16.21	Austria	9.00	Finland	7.50
Slovakia	14.76	Hungary	8.87	Iceland	6.74
Croatia	13.02	Ireland	8.85	Germany	6.56
Italy	10.93	Greece	8.63	Norway	6.25
Romania	10.34	Estonia	8.37	Malta	5.79
Spain	10.34	Cyprus	8.33	France	5.53
Czechia	10.14	Portugal	8.00	Sweden	5.30
Poland	9.77	Belgium	7.74	Denmark	2.64
Latvia	9.53				

TABLE 11. Average EM rates during the period March 2020 - present, using OWID data as of 19/12/23 and modelled mortality trends.

Country	Average EM rate $3/20-4/21$	Average EM rate $5/21-$ present	Country	Average EM rate $3/20-4/21$	Average EM rate $5/21-$ present
Austria	8.62	9.18	Ireland	6.35	10.01
Belgium	13.45	5.07	Italy	18.66	7.32
Bulgaria	22.65	13.20	Latvia	7.29	10.58
Croatia	13.30	12.88	Lithuania	20.17	18.73
Cyprus	5.21	9.79	Malta	9.55	4.03
Czechia	24.58	3.41	Netherlands	10.04	8.61
Denmark	−1.50	4.57	Norway	−1.69	9.84
Estonia	7.44	8.79	Poland	21.06	4.67
Finland	0.70	10.57	Portugal	12.94	5.70
France	9.66	3.61	Romania	17.59	6.95
Germany	4.00	7.71	Slovakia	24.32	10.30
Greece	5.11	10.27	Slovenia	14.55	4.38
Hungary	15.81	5.63	Spain	17.28	6.99
Iceland	−0.53	10.14	Sweden	8.41	3.81

TABLE 12. Average EM rates in the pre- and post-vaccine rollout periods, using OWID data as of 19/12/23 and modelled mortality trends.

4. **Pearson correlation**

In a comment to [2], a reader noted that, in using the term "(positive/negative) correlation" to refer to (the sign of) the slope of a least-squares linear fit, we were not employing the term as is perhaps most commonly assumed by statisticians. Instead what is usually meant is the so-called Pearson correlation coefficient, which for two vectors $\boldsymbol{u}$, $\boldsymbol{v} \in \mathbb{R}^n$ is the real number $\frac{\boldsymbol{u}^* \cdot \boldsymbol{v}^*}{||\boldsymbol{u}^*||\,||\boldsymbol{v}^*||} \in [-1, 1]$, where, for any $\boldsymbol{x} \in \mathbb{R}^n$, $\boldsymbol{x}^* = \boldsymbol{x} - \overline{x} \cdot \mathbf{1}_n$ and $\overline{x}$ is the average value of the components of $\boldsymbol{x}$.

Figure 8 is the analogue of Figure 2, but where the y-coordinates of the points are instead the Pearson correlations between EM and vaccination rates for that month's data.

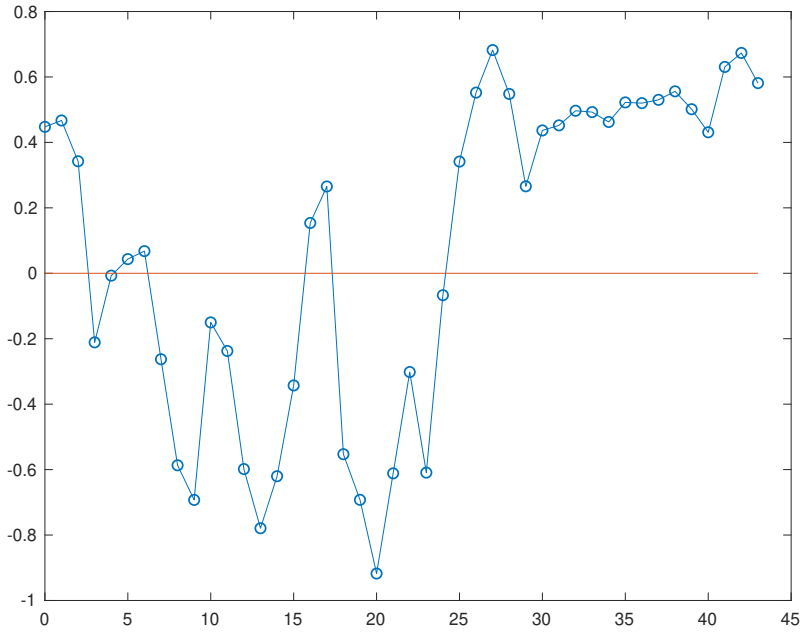

FIGURE 8. Month-by-month Pearson correlation of EM and vaccination rates, up to November 2023, using the same data as in Figure 2.

Figure 8 has basically the same shape as Figure 2. In particular, it shows a robustly positive correlation between EM and vaccination rates for every month since April 2022. Note, however, that in Figure 8, there is a suggestion of this correlation becoming even stronger as time goes on, something which is not evident in Figure 2. This further supports the overall thesis of this update, namely that evidence for the *hypothesis* of a causal link between mass Covid vaccination and (chronic) excess mortality is indeed crystallising over time, even if the *amount* of such excess mortality seems to be relatively stable. One can speculate that the former in turn could be due to the waning (randomising) influence of other measures introduced by different countries at the height of the pandemic.

5. **Relationship between Covid and all-cause mortality rates**

In [2] we observed that, throughout the pandemic to date, the correlation between Covid mortality rates and vaccination rates had closely tracked that between all-cause EM rates and the latter. Moreover, peaks in the absolute level of all-cause EM were closely aligned with peaks of Covid waves. What was particularly interesting was that this pattern seemed to persist post-omicron, despite the emergence of several new factors:

(i) Rates of Covid morality declined such that (official) Covid deaths could no longer account for anything but a small fraction of overall EM.

(ii) The correlation between EM and vaccination rates exhibited a profound shift post-omicron, as exhibited in Figures 2 and 8.

(iii) reporting of Covid data became ever more patchy.

In the intervening months, factor (iii) has become an ever greater issue, and we have reached the point where we feel the data still being reported at WORLDOMETERS can no longer be assumed to provide anything like a reliable indicator of the overall picture. Hence, we do not provide any update to Figure 8 from [2] here.

On the other hand, we have not seen anything to suggest a breakdown in the pattern whereby Covid and all-cause EM data closely track one another in the way described above. In particular,

the last couple of months have seen a new Covid wave wash over Europe (as well as other parts of the world), driven by the emergence of new variants such as JN.1, and early indications are that the last months of 2023 are also seeing an uptick in all-cause EM, driven by a surge in parts of Northern Europe which were also badly affected, by both Covid and in terms of all-cause EM, in the same period of 2022. For example, OWID has recorded EM of over 35% in Finland for November[1], clearly the highest monthly figure for that country since the pandemic began. Finland is one of those few European countries which had very little Covid at all pre-omicron, and it has one of the worst post-omicron trends, both in terms of Covid and all-cause mortality (see Table 4).

References

[1] Eurostat: Excess mortality - statistics.
https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Excess_mortality_-_statistics#Excess_mortality_in_the_EU_between_January_2020_and_December_2022.

[2] P. Hegarty, *Excess mortality data and the effect of the Covid-19 vaccines. Part 1: European data*. Preprint available at https://www.preprints.org/manuscript/202309.0674/v2

[3] Our World in Data: Excess mortality during the Coronavirus pandemic (COVID-19).
https://ourworldindata.org/excess-mortality-covid.

[4] Our World in Data: Coronavirus (COVID-19) Vaccinations.
https://ourworldindata.org/covid-vaccinations.

[5] Worldometers Coronavirus Tracker. https://www.worldometers.info/coronavirus.

[1] https://ourworldindata.org/grapher/excess-mortality-p-scores-average-baseline?country=~FIN