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COVID Vaccination and Age-Stratified All-Cause Mortality Risk

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Abstract

Accurate estimates of the rates of COVID vaccine-induced severe adverse events and deaths are critical for risk-benefit ratio analyses of vaccination and boosters against SARS-CoV-2 coronavirus in different age groups. However, existing surveillance studies are not designed to reliably estimate life-threatening events, or vaccine-induced mortality risks. Here, regional variations in the vaccinations were used to predict all-cause mortality and non-COVID deaths in subsequent time periods using two independent, publicly available datasets from the US and Europe (month- and week-level resolutions, respectively). Vaccination correlated negatively with European mortality 6-20 weeks post-injection, while vaccination predicted all-cause mortality 0-5 weeks post-injection in almost all age groups and with an age-related temporal pattern consistent with the US vaccine rollout. Results from fitted regression slopes ($p < 0.05$ corrected for false discovery rate) suggest a US national average vaccination mortality rate (VMR) of 0.04% (0.0244, 0.0474 95% CI) and higher VMR with age (lower bound estimates of VMR=0.005% (0.0028, 0.0080 95% CI) in ages 0-17 increasing to 0.06% (0.0108, 0.0859 95% CI) in ages >75 years), and 146K to 187K vaccine-associated US deaths between February and August, 2021. Notably, adult vaccination correlated with increased subsequent mortality of unvaccinated younger people (<18, US; <15, Europe), possibly reflecting adverse effects indirectly caused by shedding of vaccine components. Comparing our estimates with the CDC-reported vaccine-induced mortality risk (0.002%) suggests VAERS deaths are underreported by a factor of at least 20. Comparing our age-stratified VMRs with published age-stratified coronavirus infection fatality rates suggests the risks of the COVID vaccines and boosters outweigh claimed benefits especially in children, young adults, and older adults with low occupational risk, or with previous coronavirus exposure.

Keywords: *adverse events, all-cause mortality, COVID-19 infection rate, COVID-19 mortality, ecological regression, medical ethics, risk-benefit ratio, SARS-CoV-2, vaccine induced mortality rate, vaccine safety*

Introduction

In June, 2021 the US FDA added a warning to Fact Sheets for Healthcare Providers Administering Vaccines, noting that "reports of adverse events suggest increased risks of myocarditis and pericarditis, particularly following the second dose and with onset of symptoms within a few days after vaccination" (Office of the Commissioner, 2021). Subclinical myocarditis is associated with some, perhaps many, of the vaccine-induced deaths in men up to age 50 (Rose & McCullough, 2021; Patone et al., 2021, 2022; Sharff et al., 2021; Oster et al., 2022). COVID vaccinations may have caused many cases of venous and arterial thrombosis (Al-Maqbali et al., 2021; Andraska et al., 2021; Hippisley-Cox et al., 2021; Hunter, 2021; Lai et al., 2021; Merchant, 2021; also referred to as "amyloidogenesis" by Nyström & Hammarström, 2022, "cerebral thrombotic syndromes" by Rogers et al., 2024; and "clots" by Grixti et al., 2024 and Santiago & Oller, 2023). A systematic review of autopsy findings published through May, 2023 revealed 240 deaths (73.9%) were independently adjudicated as directly due to or significantly contributed to by COVID-19 vaccination, of which the primary outcomes include sudden cardiac death (35%), pulmonary embolism (12.5%), myocardial infarction (12%), VITT (7.9%), myocarditis (7.1%), multisystem inflammatory syndrome (4.6%), and cerebral hemorrhage (3.8%) (Hulscher et al., 2024).

The Pfizer post-marketing safety data which FDA relied on to approve the Pfizer vaccine (marketed as Comirnaty) was released in 2022 following a federal court order. It shows that 42,086 adverse events against the Pfizer vaccine were reported in the first 3 months of the Pfizer vaccine rollout, including 1,223 deaths and life-threatening adverse events (i.e. 932 hematological and 1,403 cardiovascular events) occurring within a median of 1 day or <24 hours post-injection, evidencing a causal link between vaccination and death or other severe adverse events. Data-driven estimates of severe vaccine adverse event rates as well as all-cause mortality risk are critical for cost-benefit ratio analyses of COVID vaccination in various age groups.

By our reading, the vaccine clinical trials (~15-20K participants in each arm) and safety surveillance studies (Klein et al., 2021) are either underpowered or did not include adequate safety assessments and follow-up with respect to severe adverse events and deaths (see **Discussion** for brief review). In the US, real-world vaccine safety signals and mortality incidence rates have relied on the Centers for Disease Control (CDC) Vaccine Adverse Events Reporting System (VAERS) database (*VAERS - Data*, 2021) and the Vaccine Safety Datalink (Baggs et al., 2011). The CDC has used VAERS data to report a vaccine mortality risk (VMR) of ~0.002%, estimated by dividing the number of reported VAERS deaths by the total number of vaccine doses administered in the US [1]. However, the VAERS system has several limitations, including 1) reported incidents are not independently verified or confirmed to result from vaccination, and 2) VAERS only receives, but does not collect, reports from individuals and/or health professionals and organizations and thus its coverage is diminished by under-ascertainment/underreporting biases (Lazarus & Klompas, 2011).

The quality of detailed reports of adverse events believed to be caused by COVID-19 injections, which constitute the vast majority of all those in the whole record system going back to the National Childhood Vaccine Injury Act (NCVIA) of 1986, is very good as verified by Chandler (2025). However, many of the detailed clinical reports were apparently scrambled, with some entered dates that are decades prior to the time of filing. Moreover, many more injuries are occurring than are reported because of the obstacles standing in the way of those wanting to report

[1] https://archive.cdc.gov/www_cdc_gov/coronavirus/2019-ncov/vaccines/safety/adverse-events.html

and explain the details of the adverse events that doctors, clinicians, and pharmacists are observing (Block, 2023).

Another database created following the National Childhood Vaccine Injury Act (NCVIA) of 1986 is the Vaccine Safety Datalink (VSD). Launched in 1990, it is is a multisite vaccine safety dataset based on millions of US medical records (Baggs et al., 2011) with oversight by the CDC and the US Food and Drug Administration (FDA). This latter database is even less accessible than VAERS because the VSD is not publicly available to any researchers outside the CDC (*VSD Data Sharing Program Guidelines | Vaccine Safety | CDC*, 2020). Alongside VAERS, the VSD has even more limited transparency, reproducibility, validity, and reliability of published findings (Klein et al., 2021; Xu, 2021). This is especially important given that previous VSD studies may have underreported, or inaccurately reported, risks for adverse events including acute myocardial infarction, pulmonary embolism, and death (Klein et al., 2021; Xu, 2021; see **Discussion** for more details). A recent re-analysis of VSD data (subset from Kaiser Permanente) used more sensitive methods to detect myopericarditis cases following COVID vaccination and reported its risk may be one to two orders of magnitude higher than previously reported in the US (i.e., 195 cases per million after the second doses in males ages 12-39, or about 1 in 5K; Sharff et al., 2021). These findings are consistent with and supported by a recently published study that reported a 25% increase in cardiac event emergency calls among ages <40 yrs following vaccination campaigns using Israeli National Emergency Medical Services data (Sun et al., 2022). Finally, the time window for reporting adverse vaccine events is relatively narrow — for example the window was "up to 30 days after their second dose of an mRNA vaccine to identify encounters for myocarditis, pericarditis or myopericarditis" in the Sharff et al. study — whereas studies of the modified mRNA products coding for spike protein show the frame-shifted spike products may persist in the blood and tissues of recipients for at least 180 days (Boros et al., 2024) and even up to 709 days (Hulscher, 2025). This suggests injuries from the mRNA products are possible over a very much longer time frame.

Methodology for the Present Study

Here, two independent, publicly available data sources from the US and Europe were used to test whether region-to-region variation in vaccination rates predicts or correlates with region-to-region variation in future (following weekly or monthly) mortality rates. We focused on mortality risk, because data for specific severe adverse events such as myopericarditis, myocardial infarction, and thromboembolism, etc., are not publicly available. Using the European data, we asked whether COVID vaccination correlates with deaths at short and long intervals after-injection stratified by 6 age groups (0-14, 15-44, 45-64, 65-74, 75-84, and 85+). With the US data, multiple linear regression was used to test whether we could observe short term effects similar to those seen in the European data. The US data was stratified by 8 age groups (0-17, 18-29, 30-39, 40-49, 50-64, 64-74, 75-84, and 85+). These models adjusted for COVID deaths as well as seasonality effects and interregional variation in mortality due to other factors by adjusting for same-month 2020 deaths. Using same month deaths from 2020 (as opposed to 2019 or earlier) also should help to eliminate any interregional differences in pandemic public health measures before the vaccination campaigns began.

Our second aim was to estimate a US national average vaccine mortality rate (VMR) and age-stratified rates using significant regression slopes for the vaccination term in the regression model. The European data reports age-stratified mortality rates on a weekly basis and allows for more granulated temporal resolution, but mortality rates are z-scored normalized and hence effect-size estimates in real units are not possible. The units of the US data allow for such estimates since the

US system records raw numbers of administered vaccine doses and death counts in each jurisdiction, but at a coarser (monthly) temporal resolution relative to the European data. Finally, we compared our estimates with previously published US national average and age-stratified SARS-CoV-2 infection fatality rates (IFRs) for risk-benefit ratio analysis of vaccinations stratified by age.

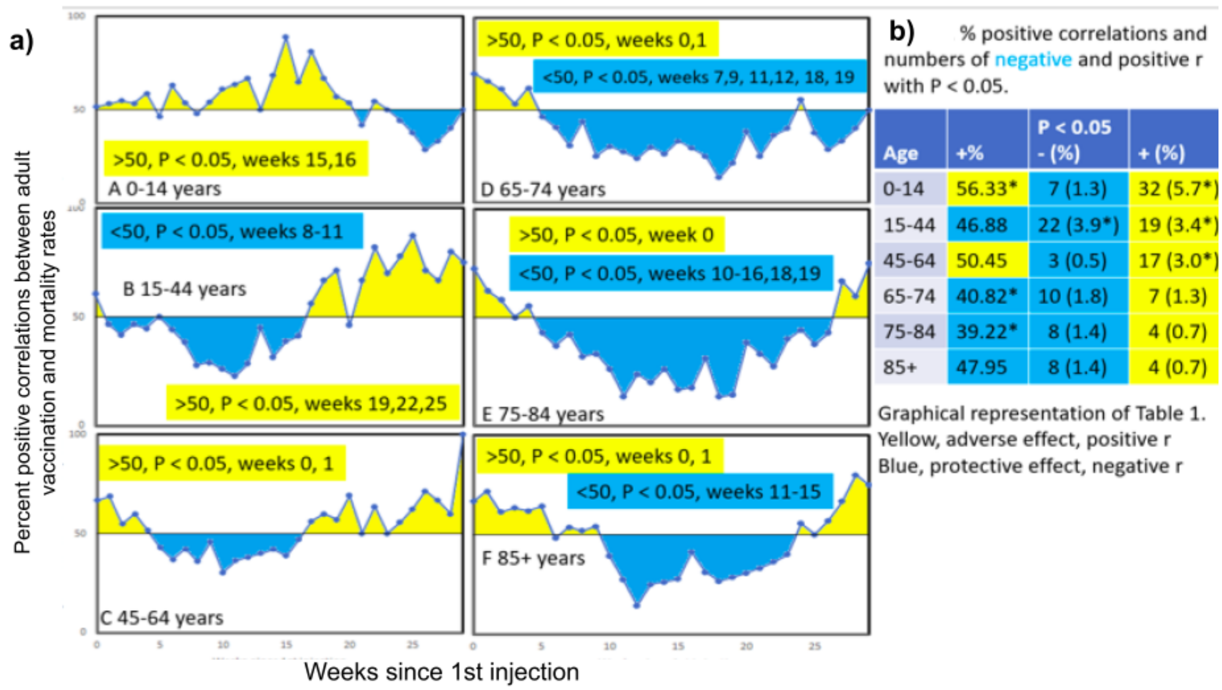
The analyses presented here were conducted in the fall of 2021 and thus present data through August of 2021 (Pantazatos & Seligmann, 2021a). In the **Discussion** section below, we compare the results from 2021 to similar, more recent analyses of data from 2022 and 2023 (Pantazatos, 2025). We also offer there a brief summary of other studies (see Table 4 below), some of them published in this same journal, that show an alarming trend of increasing all-cause mortality after the rollout of the COVID-19 vaccines.

Results

ASSOCIATIONS BETWEEN WEEKLY VACCINATION AND MORTALITY DATA FROM EUROPE AND ISRAEL

For each week since the start of 2021 for 23 European countries, weekly increases in percentages of the total population who received at least one injection were extracted from Coronavirus (COVID) Vaccinations — Statistics and Research — Our World in Data, and correlated with varying time lags (0–28 weeks post vaccination) with weekly age-stratified mortality data extracted from euromomo.eu. The overall description of results requires distinguishing between the age group 0-14 which were unvaccinated during the period analyzed, and ages above 14. For ages above 14, there is a positive association (correlation) between vaccination and mortality rates during the first few weeks after the first injection (Table 1, lags 0-5 and Figure 1 leftmost yellow peaks). Overall, mortality above age 14 correlates at near zero, or negatively, with vaccination for mortality later than 5-6 weeks after vaccination (see Table 1 lags 5-20 weeks, and in Figure 1 refer to the middle blue troughs).

These results coincide with known clinical developments of vaccination, as found in the VAERS data: most reported deaths that are discoverable within the system occurred within the first few weeks after vaccination, and vaccine protection is supposed to begin about the sixth week after the first dose. For age groups 15-44 and 45-64, the overall tendency is that estimated putative protective vaccine effects (meaning negative associations between mortality and vaccination) disappear about 20 weeks after the first injection. After week 20, there might be a tendency for adverse effects of vaccination, meaning positive r values between mortality beyond week 20 with a vaccination event at least 20 weeks before (see Table 1, Lags >20 weeks and in Figure 1, see the rightmost yellow peaks). For the unvaccinated age group 0-14, most associations between mortality and vaccination in adults are positive (among 39 r values with unadjusted two-tailed t-tests $p < 0.05$, 32 are positive and 7 are negative). This tendency for positive correlations increases from the week of the first vaccination until week 18, then disappears. This fact suggests indirect adverse effects of adult vaccination on the mortality of children of ages 0-14 during the first 18 weeks after vaccination. Example correlation plots for ages 15-44 are shown in Figure 2.



Age	+%	P < 0.05 - (%)	+ (%)
0-14	56.33*	7 (1.3)	32 (5.7*)
15-44	46.88	22 (3.9*)	19 (3.4*)
45-64	50.45	3 (0.5)	17 (3.0*)
65-74	40.82*	10 (1.8)	7 (1.3)
75-84	39.22*	8 (1.4)	4 (0.7)
85+	47.95	8 (1.4)	4 (0.7)

Figure 1. This is a graphical representation of the European results reported in Table 1. Estimated adverse effects are highlighted in yellow, above the horizontal line, and estimated protective effects are marked in blue, below the horizontal line. Results of correlation analyses for all age classes and all combinations of weeks, with mortality occurring the same week or after the injection week are plotted. In a), the percent of positive correlations between vaccination rates and mortality is plotted against time since the 1st injection for the 6 age groups (A 0-14 years, B 15-14 years, C 45-64 years, D 65-74 years, E 75-84 years, and F 85+ years). Percentages >50% are shaded yellow, <50% shaded blue. An asterisk indicates $p < 0.05$ corrected for the sign test (see **Methods**). In b), the percent of positive correlations (left column) and numbers of negative and positive correlations with $p < 0.05$ uncorrected (middle and right columns). Note that the X-axis represents time since the first injection, independent of the date of injection.

Table 1
Correlations Between COVID Vaccination Rates and Mortality as a Function of Lag (Number of Weeks Post-Injection) and Age Group†

Lag	0	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
n	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5
%																													
0-14	52	53	55	53	59	46	63	54	48	54	61	64*	67	50	68	89*	65	81*	67	57	54	42	55	50	44	38	29	33	40
15-44	61	47	42	47	45	50	44	38	28*	29	26*	23*	29	45	32	39	41	56	67	71	46	67	84*	70	78	88*	71	67	80
45-64	67*	69*	55	60	52	43	37	42	36	46	30	36	38	40	42	39	47	55	60	57	69	50	64	50	56	63	71	67	60
65-74	70*	66*	61	53	62	46	41	31	44	25*	30	27*	24*	30	26*	33	29	25*	13*	21*	38	25	36	40	56	38	29	33	40
75-84	73*	62	58	50	55	43	37	42	32	33	26*	14*	24*	20*	26*	17*	18*	31	13*	14*	38	33	27	40	44	38	43	67	60
85+	67*	72*	61	63	62	64	48	54	52	54	39	27*	14*	25*	26*	28	41	31	27	29	31	33	36	40	56	50	57	67	80
p																													
0-14	1	0	0	1	1	1	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0-14	1	2	2	3	1	1	0	2	1	1	2	1	1	1	1	2	1	0	3	1	1	1	1	1	0	1	0	0	0
15-44	1	1	1	0	1	0	2	0	0	1	1	0	0	2	2	2	1	1	1	1	1	0	1	1	0	0	0	0	1
15-44	2	3	2	1	2	0	1	1	0	0	0	0	0	0	1	0	0	0	3	1	0	1	1	0	0	0	0	0	0
45-64	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
45-64	3	4	2	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	1	0	1	1	0	0	0	0	0
65-74	0	0	1	0	1	1	0	0	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
65-74	2	2	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75-84	0	0	0	0	0	0	0	2	2	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
75-84	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85+	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	1	2	1	0	0	0	0	0	0	0	0	0	0
85+	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

† Each cell summarizes the Pearson correlation coefficients between weekly increase in percent vaccinated and weekly mortality in 23 European countries. In the top header row: "Lag" consists of the number of weeks between mortality and injection, and *n* is the number of correlations summarized. The middle matrix labelled "%" shows the percentage of positive correlations for that lag in weeks among *n* correlations. The bottom matrix labelled "*=$p < 0.05$" gives the number of negative and positive correlations significant at $p < 0.05$, uncorrected. Cells highlighted in blue show what may be interpreted as an overall protective effect (more injections leading to lower mortality), whereas those highlighted in yellow suggest an overall adverse effect (more injections leading to higher mortality).

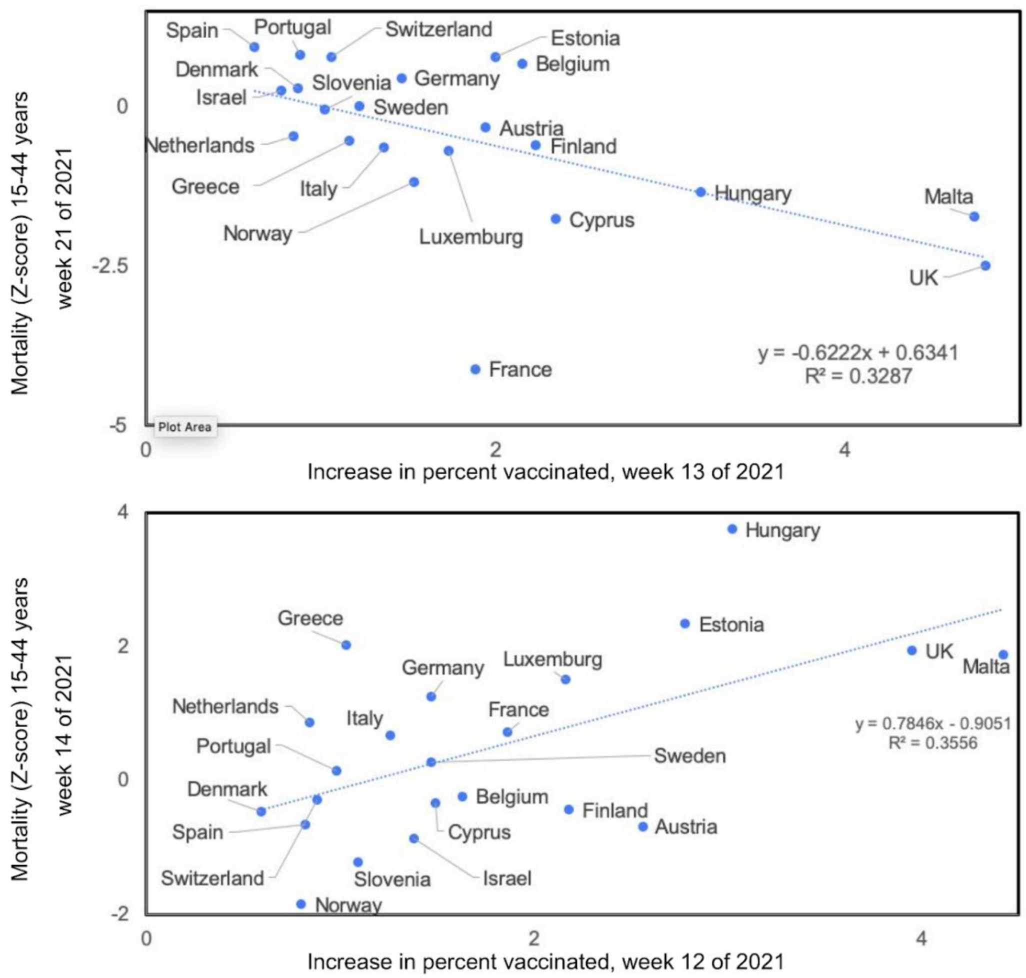


Figure 2. Example of correlation plots from the European dataset. Top: Z-score of weekly mortality for ages 15-44 in 23 countries on week 21 of 2021 as a function of the increase in percent vaccinated in these countries, during week 13 of 2021. For this correlation, the time lag between injection and mortality consists of weeks 21 to 13 inclusive, or 8 total weeks. The association suggests either beneficial injection effects, or effects of harvesting/mortality displacement and/or healthy vaccinee effect, at two after injection. Bottom: Z-score of weekly mortality for ages 15-44 in 23 countries on week 14 of 2021 as a function of increase in percent vaccinated in these countries, during week 12 of 2021. For this correlation, the time lag in weeks between injection and mortality consists of weeks 14 to 12, or a total of 3 weeks. The association suggests adverse injection effects during the first weeks after injection.

US RESULTS

The following analyses used publicly available US data on vaccination, mortality, and age-stratified population size in each US state. The data were obtained from either the CDC or US Census Bureau (see **Data Sources** section in **Supplementary Materials** in Pantazatos & Seligmann, 2021a). Our analyses focused on whether we could replicate the higher mortality within the first 5 weeks of vaccination observed in the euromomo.eu data. Since US mortality data were limited to month-level resolution, we tested whether monthly vaccination rates predicted mortality during the same month or during the next month. Multiple linear regression was used to predict the total number of deaths among 8 age groups (0-17, 18-29, 30-39, 40-49, 50-64, 65-74, 75-84, >85 years) for 7 months (February, March April, May, June, July and August 2021). For each month and age group, the following equation was fitted:

$$log(Y21\_deaths) = \beta_0 + \beta_1 \text{log}(\text{Y20\_deaths}) + \beta_2 \text{log}(\text{Vax}) + \varepsilon \quad (1)$$

Where $Y21\_deaths$ and $Y20\_deaths$ are the number of total deaths for that month in year 2021 and 2020, respectively, and Vax is the number of vaccine doses administered in the previous month (or current month).

Table 2
Regression Weights and *p*-Values for the Vaccination Term Predicting Same or Next Month Deaths Using US CDC Data*

	February		March		April		May		June		July		August	
Ages	*beta*	*p-val*	*beta*	*p-val*	*beta*	*p-val*	*beta*	*p-val*	*beta*	*p-val*	*beta*	*p-val*	*beta*	*p-val*
0-17	0.12	0.2145	0.01	0.9192	-0.03	0.7727	0.08	0.164	0.04	0.4979	0.25	0.0004	0.72	0.0015
18-29	0.12	0.282	0.07	0.4607	0.00	0.9828	0.24	0.0006	0.17	0.0017	0.42	0.0007	0.47	0.0187
30-39	0.11	0.1956	0.12	0.2716	0.06	0.5532	0.13	0.0613	0.15	0.0027	0.34	0.006	0.41	0
40-49	0.16	0.0832	0.09	0.146	0.10	0.2631	0.03	0.6951	0.05	0.2599	0.28	0.0004	0.40	0
50-64	0.07	0.2946	-0.03	0.5487	0.03	0.6703	-0.03	0.6104	0.03	0.5088	0.02	0.6669	0.06	0.726
65-74	0.05	0.5296	0.00	0.9752	0.03	0.7672	0.03	0.628	-0.03	0.4472	0.03	0.5518	0.13	0.3314
75-84	0.08	0.1995	0.04	0.3463	0.66	0	0.05	0.4973	-0.02	0.6506	0.08	0.2925	0.07	0.5904
85+	0.15	0.0001	0.18	0.0004	0.70	0	0.20	0.0037	-0.01	0.7658	0.06	0.4708	-0.04	0.7079

* For each month in 2021 and each age group, beta weights and uncorrected *p*-values are listed for the vaccination term, β_2, in equation (1).

An additional analysis using log(Y21_deaths)-log(Y20_deaths) instead of log(Y21_deaths) as the dependent Y variable was confirmed to yield the same results as the above models. We have ruled out confounding factors such as population size, reported COVID cases and COVID deaths elsewhere (see **Supplementary Materials** in Pantazatos & Seligmann, 2021a, see also Pantazatos, 2025).

Number of administered doses during the prior month, or in the current month, predicted reported monthly total deaths in most age groups. The beta coefficient for the vaccine term was significant in 15 out of 56 regression models ($p < 0.05$ corrected for false discovery rate using the Benjamini-Hochberg procedure; see the boxes highlighted in yellow in Table 2).

Most vaccination regression slopes were positive while there were no terms with negative slopes significant at $p < 0.05$ corrected for false discovery rate, nor the more liberal threshold of $p < 0.05$ uncorrected for false discovery rate. In older age groups (>75 years), the beta weights were highest in the beginning of the year, while in younger ages they were higher later in the year. This is consistent with the fact that the vaccination campaign first targeted nursing homes and older age groups before younger age groups became eligible for vaccination. With vaccination counts from the same month as deaths (instead of the previous month), seven models survived the applied significance threshold where the original models did not and all seven of the significant models were found in younger age groups, all of them <50 years of age (see the light gray boxes in Table 3).

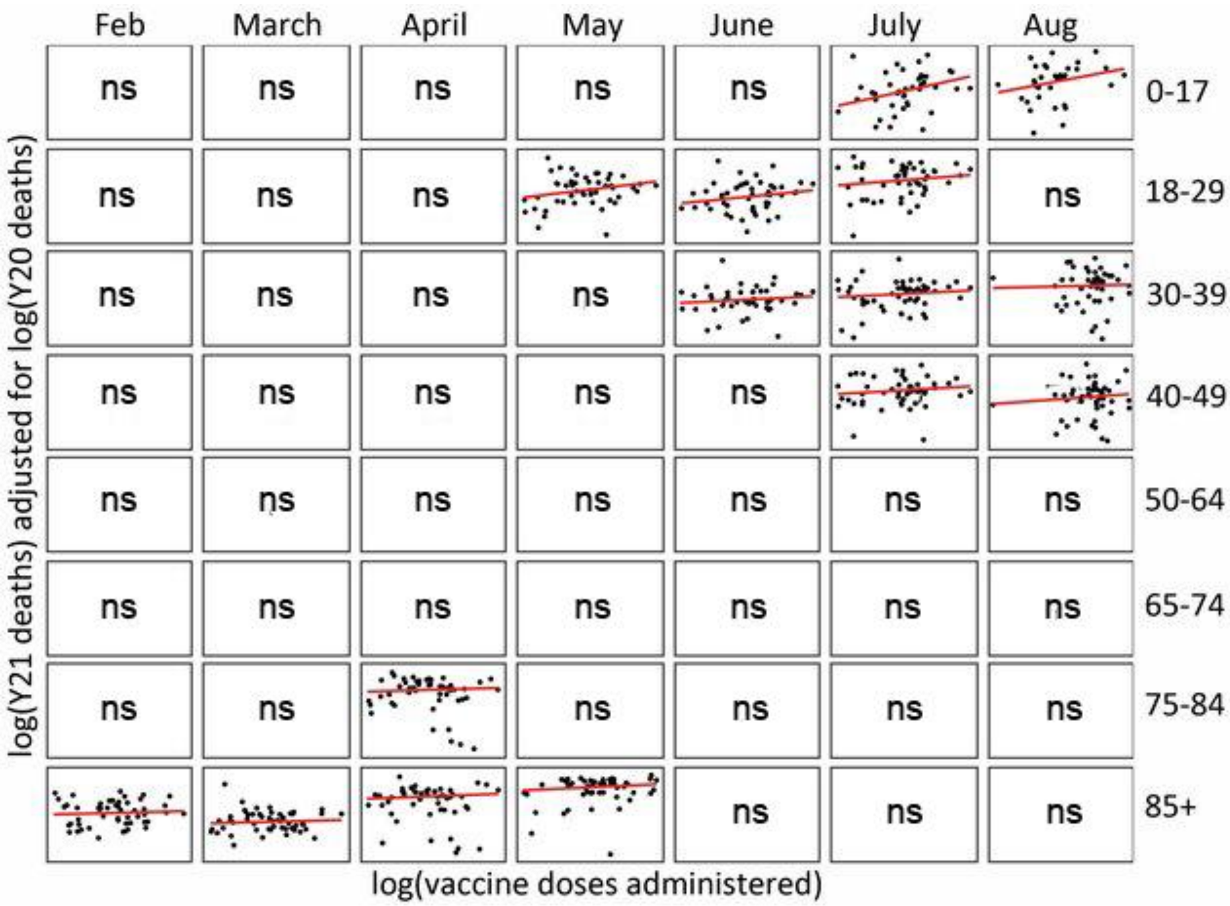


Figure 3. Scatter plots of monthly vaccination doses versus deaths during the subsequent month with best fit regression lines from the US CDC dataset. The graph plots log(administered vaccine doses) versus log(residual 2021 deaths) after adjusting for log (2020 deaths) for each month (top) and age group (right), for each regression model in which the β_2 term survived $p < 0.05$ corrected for false discovery rate (see Table 2), NS means not significant. For higher resolution plots viewable in a web browser see (Pantazatos & Seligmann, 2021a and Pantazatos & Seligmann, 2021b).

Using age-specific vaccination rates also increased detection of significant effects for 2 models (Table 3, dark gray boxes) where effects were not detected in the previous 2 models. Adjusting for the number of newly reported COVID cases during the previous month did not significantly alter these results. Moreover, the results were similar when predicting non-COVID associated deaths as reported by Pantazatos and Seligmann (2021a). Note that because COVID-associated deaths are rarer in younger age groups, the latter analyses had much less power because few states had made data available from which to compute non-COVID deaths for the ages 0 to 49. Scatter plots and best fit lines of significant vaccination values ($p < 0.05$ corrected for false discovery rate) are shown in the yellow boxes of Table 2 and in Table 3) for each month, and the breakdown by age groups appears in Figure 3.

Significant β_2 coefficients in Table 2, significant at $p < 0.05$ corrected for false discovery rate, were used to estimate vaccine-induced mortality rate and total deaths for each age group and month. If a model using vaccinations from the same month (not the previous) was significant and the equivalent model using vaccinations from the previous month was not, then death estimates from those particular models were used instead (light gray boxes in Table 3). Similarly, if a model using age-specific vaccination (i.e. doses administered to people who were more than 65 years old) was significant and the equivalent model using all vaccine doses administered was not, then death estimates from that model were used instead in each case (see the dark gray boxes in Table 3). See **Methods** in Supplementary Materials in Pantazatos & Seligmann, 2021a for vaccine-induced mortality rate definitions and calculations. In each cell where NS appears, it means not significant at $p < 0.05$ corrected for false discovery rate, and NA means not available.

Cumulating the monthly model-estimated deaths across all significant results from the original models and from an additional 9 results from the two model variations mentioned above yielded a total of 146,988 deaths attributed to COVID vaccinations between February and August of 2021 (lower right cell of "Estimated Deaths" in Table 3). Applying the same procedure while thresholding the results at a more liberal significance level ($p < 0.05$ uncorrected) yielded an estimated 168,908 vaccine-related deaths (Supplementary Table S7 in Pantazatos & Seligmann, 2021a). The same procedure applied using standard linear regression with a more stringent threshold ($p < 0.05$ corrected) yielded 133,382 deaths attributed to vaccination (see Supplementary Table S8 in Pantazatos & Seligmann, 2021a, while thresholding these regression weights more liberally (at $p < 0.05$ uncorrected) yielded an estimation of 187,402 vaccine associated deaths in February through August of 2021 (see Supplementary Table S9 in Pantazatos & Seligmann, 2021a).

Results from the *robustfit* regression models thresholded at $p < 0.05$ corrected for false discovery rate were used to estimate the vaccine-induced mortality rate (see Figure 4). Dividing the total number of model-estimated deaths by the total number of vaccine doses administered between January and August yielded an estimated US national average vaccine-induced mortality rate of 0.04% (bottom of Table 3). Lower bound estimates of age-stratified vaccine-induced mortality rates were acquired by averaging the vaccine-induced mortality estimates (see Equation 5 in **Supplementary Materials** and **Methods** in Pantazatos & Seligmann, 2021a) across all months and for all 3 models when thresholding regression slopes at $p < 0.05$ uncorrected. These yielded estimated vaccine-induced mortality rates of 0.0045% for ages 0-17 years, 0.0065% for 18-29 years, 0.0091% for 30-39, 0.0165% for 40-49, 0.0157% for 50-64, 0.0445% for 65-74, 0.0604% for 75-84, and 0.0577% for 85-plus (see Table 3 for the 95% CI). Note we consider these to be lower bound estimates since the denominator (see Equation 5 in **Supplementary Materials** and **Methods** in Pantazatos & Seligmann, 2021a), is vaccine doses administered in a given month across all ages (the preferred number would be vaccine doses stratified to the same age groups as the mortality data, but those

Table 3
Model-Estimated Deaths Attributed to COVID Vaccination for Each Age Group and Month, Using US CDC Data*

Ages	Jan	Feb	March	April	May	June	July	Aug	Totals	aVMR (%) [95% CI]
0-17	NA	NS	NS	NS	NS	NS	648	1,227	1,875	0.0045 [0.0028, 0.0080]
18-29	NA	NS	NS	NS	1,355	861	2,139	NS	4,355	0.0065 [0.0040, 0.0095]
30-39	NA	NS	NS	NS	NS	1,101	2,422	2,567	6,090	0.0091 [0.0040, 0.0136]
40-49	NA	NS	NS	NS	NS	NS	3,067	3,979	7,046	0.0165 [0.0090, 0.0231]
50-64	NA	NS	NS	NS	NS	NS	NS	NS	0	0.0157* [0.0018, 0.0370]
65-74	NA	NS	NS	NS	NS	NS	NS	NS	0	0.0445* [0.0167, 0.0743]
75-84	NA	NS	NS	41,316	NS	NS	NS	NS	41,316	0.0604 [0.0108, 0.0859]
85-plus	NA	11,613	13,181	48,186	13,326	NS	NS	NS	86,306	0.0577 [0.0298, 0.0802]
							Total Vax Deaths		**146,988**	

	Number of Vaccine Doses Administered								**Row Totals for Vax Doses**	
>65 yrs	NA	NA	NA	13,976,806	4,828,493	3,049,434	1,900,683	2,828,670	**26,584,086**	**Total Doses for those >65**
<65 yrs	NA	NA	NA	75,378,921	47,699,930	28,417,091	16,264,971	21,739,318	**189,500,231**	**Total Doses for those <65**
All ages	26,512,804	45,991,745	76,292,536	89,355,727	52,528,423	31,466,525	18,165,654	24,567,988	**364,881,402**	**Total Doses for Everyone**

Estimated Vax Mortality Rate = (Total Vax Deaths/Total Vax Doses) **0.04%**

* Robust regression did not yield significant results in these age groups, so the estimates reported were derived from ordinary least-squares regression. In this table , NS means "not significant" and NA means "not available".

Light gray indicates models estimated using same, not previous, month vaccinations.

Dark gray indicates models estimated using vaccines administered > ages 65.

Light blue indicates significant results when predicting deaths in ages <1 years. The model estimated 708 infant deaths.

https://doi.org/10.56098/rbvsmw07

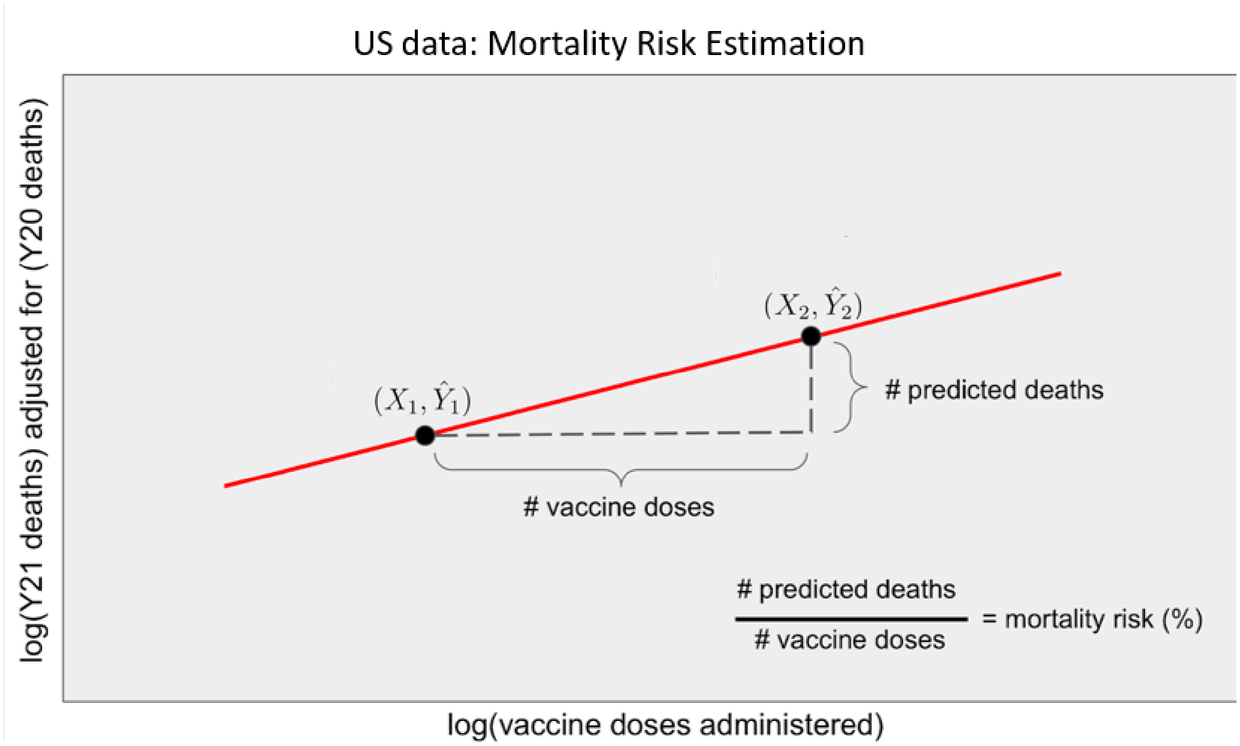


Figure 3. Method to estimate COVID vaccination mortality risk using publicly available US CDC data. The cartoon plot shows a schematic of the method to estimate COVID vaccine mortality risk using regional variation in vaccine doses administered and all-cause mortality. Vaccine-induced mortality risk is expressed as the ratio of model-predicted deaths over vaccine doses (i.e. "rise" over "run"). Predicted deaths are estimated as the difference between $\hat{Y}_2$ and $\hat{Y}_1$ for a given increase (i.e. 10%) in vaccine doses at $\hat{Y}_1$. The approach is completely data-driven and does not rely on assumptions about reporting bias as with other methods.

numbers were not available; see our **Limitations and Future Directions** section, below). Using age-stratified (versus total population) vaccine doses as the independent variable would make the denominator smaller which could theoretically increase the estimated regression slopes.

Note that the results for age group 0 to 17 are presumed to reflect vaccinations in ages >12 years (Murthy, 2021) as well as indirect effects in ages <1 year. We should keep in mind that no COVID vaccine was authorized for the ages of 0 to 11 over the time periods examined in this paper. For that reason, significant mortality in that age range, after the vaccination campaign got underway in the US and Europe, is likely attributed to indirect effects of that worldwide effort. Note that whole-population (not age-specific) administered doses, is the appropriate independent variable when examining both direct and indirect effects of COVID vaccination.

Discussion

In this study we have found statistically significant evidence that variations in regional vaccination rates predict mortality in subsequent time periods. The mortality data from euromomo.eu confirm previously known patterns in the vaccinated: a positive association with adverse events, including death, up to 5-6 weeks after the first injection, followed by a decrease in recorded deaths associated with vaccination 6-20 weeks post-injection. The decrease may be attributed to protective effects of vaccination, which is supposed to begin about 6 weeks after the first injection, or may be due to a combination of other factors including harvesting/mortality displacement, and healthy vaccinee effect. The end of the protective vaccine period as observed in our data, at about 20 weeks based on the numbers that were available to us, corresponds approximately with the end of the protective vaccine period at about 4-6 months (according to Levin et al., 2021), and as is generally claimed by adherents to the mainstream narrative.

Notably, our data reveal an unexpected increase in mortality in children (which are unvaccinated) as adult vaccination rates mount up in the preceding period. It is notable that this indirect adverse vaccination effect was independently observed in both US CDC and euromomo.eu datasets. This result is consistent with other recent results suggesting indirect "shedding" effects, such as data showing that injections in teenagers associate with increased adult mortality, including cancers and cardiovascular diseases in 2021 (Seligmann & Taravel, 2025a, 2025b, 2025c, 2025d), and data showing menstrual abnormalities associated with proximity to COVID vaccinated individuals (Peters et al., 2024).

The most deaths in the <18 years age group occurred in infants <1 years, and a significant effect of vaccination on infant mortality was detected when the US CDC data was restricted to that age group. It is unclear to what extent the observed effects relate to abnormally high mortalities around delivery, and/or infants, and/or in older children and/or young adolescents. Note several important concerns and errors have been raised in response to previously published studies claiming safety of vaccination in pregnant women (see **Supplementary Discussion** in Pantazatos & Seligmann 2021a) and Thorp and colleagues have since confirmed higher risk of fetal loss following COVID vaccination (Thorp et al. 2022, Thorp et al. 2023).

It might be argued that the increased mortality in the first 0-6 weeks post-injection may be due, at least in part, to increased COVID infectivity before vaccine protection takes effect. A re-analysis of a large real-world study of vaccine effectiveness (Dagan et al. 2021) suggests infectivity in vaccinated persons increases 3-fold approximately 7 days following the first dose of the Pfizer vaccine (Seligmann, 2023). Figure 2 in Jara et al., (2021) suggests a similar pattern with the CoronaVac vaccine. Likewise, the euromomo.eu data also suggest a tendency for adverse effects caused by the vaccine in those above age 14 beginning 20 weeks after the first injection, potentially indicating that antibody-dependent enhancement (Arvin et al., 2020; Wan et al., 2020; Wen et al., 2020), pathogenic priming (Lyons-Weiler, 2020; Vojdani et al. 2021), and/or other related effects kick in after any protective vaccine effects dissipate. Alternatively, the increase in adverse effects observed after week 20 may instead be due to short term mortality arising from booster campaigns which began in late summer or fall.

The US CDC data allowed for estimation of VMR and vaccine-induced deaths. Importantly, our calculations do not rely on VAERS and its associated limitations. Our estimated US national average VMR of 0.04% (see Table 3) is ~20-fold greater than the CDC reported VMR of 0.002% over the same period, suggesting vaccine-associated deaths were underreported by a factor of 20 in VAERS. Our estimate is based only on significant effects detected in our analysis, and hence likely represents a lower bound on actual underreporting. The studies in Table 4 are consistent with the theory that the COVID-19 gene therapy products on the whole caused worldwide increases in all-cause mortality. Our data are relatively granular, enabling more detailed interpretations on a temporal scale. Similar VMR estimates were more recently obtained when applying the same approach to yearly, instead of monthly, resolution data (i.e., using 2021 doses to predict 2022 deaths; Pantazatos, 2025).

Interestingly, our estimates of 133K to 187K vaccine-related deaths are also similar to recent, independent estimates, adjusted for underreporting, in US VAERS data through August 28th, 2021 by Rose and Crawford (2021). They reported a range of estimates depending on different credible assumptions about the VAERS underreporting factor and percentages of VAERS deaths definitely caused by vaccination based on autopsy findings. The authors compared a previously reported incidence rate of anaphylaxis in reaction to mRNA COVID vaccine (~2.5 per 10,000 vaccinated) from Blumenthal et al. (2021) to the number of events reported to VAERS to estimate an underreporting factor for anaphylaxis of 41. This factor, multiplied by the number of reported VAERS deaths and the percentage of VAERS deaths believed to be caused by vaccination based on pathologists' estimates, yields various estimates with an average around 180K deaths. Our estimate does not rely on VAERS however, but uses independent publicly available data, and thus contributes additional convergent evidence closely approximating their estimate of vaccine-induced deaths.

Others have also reported consistent results using different data and other methods. For example, Skidmore and colleagues derived comparable numbers of vaccine-induced deaths using social circle surveys (Skidmore, 2023; Skidmore & Alfaro, 2024). Aarstad and Kvitastein applied a similar ecological regression approach to European data and reported that every 1% increase in vaccination coverage was associated with a ~0.1% increase in mortality the following year (Aarstad & Kvitastein, 2023). Similar to the works of Rancourt et al. (see Table 4), who compared excess deaths during pre- and post-vaccine rollout periods across time using weekly/monthly data, our per dose mortality risk estimates increase with age (Rancourt, et. al. 2023). Rancourt et. al. report overall higher per dose mortality rates, reaching up to 5% in 90+ in Chile (Rancourt, et. al. 2023). These differences may (at least partially) be attributable to the fact that Rancourt et. al. do not appear to explicitly account for deaths caused by COVID-19 when estimating these rates as was done here (i.e., by including COVID cases as a nuisance regressor and by using non-COVID deaths, as defined by the CDC, as an alternative outcome measure) in order to ensure that effects cannot be *solely* attributed to COVID infection. That we still observed significant effects of vaccination with non-COVID deaths further bolsters our results considering that COVID deaths are loosely defined (i.e., they include deaths in individuals *with* COVID, not necessarily from COVID).

Death and severe adverse events attributable to the COVID vaccines appear to be mediated in part by cytotoxicity of the spike protein and its cleaving from transfected cells and biodistribution in organs outside the injection site (European Medicines Agency, n.d.; Pfizer Confidential, n.d.; Hunter, 2021; Kostoff et al., 2021; Merchant, 2021; Ogata et al., 2021; Santiago, 2022, 2024). Vaccination, even assuming it provides some protection, might contribute to a higher COVID infection fatality rate before any alleged vaccination protection can kick in and also after it wears off. Additionally, there is the possibility of antibody dependent enhancement and pathogenic priming (Wen et al., 2020; Arvin et al., 2020; Seneff & Nigh, 2021; Lyons-Weiler, 2020; Vojdani et al. 2021). The apparent infection fatality rate effect may be related to enhanced respiratory disease observed in preclinical studies of SARS and MERS vaccines (Agrawal et al., 2016; Baden et al., 2021; Cardozo and Veazey, 2021). An additional or alternative mechanism may stem from quality control issues related to production, handling, and distribution of the vaccines. The website https://www.howbadismybatch.com allows users to identify specific batch numbers of Pfizer, Moderna and Janssen vaccines that are associated with the highest rates of adverse reactions.

Table 4
Non-exhaustive Chronology of Works Showing Increases in All-Cause Mortality Linked to COVID-19 Gene Therapy Products

Period Examined	Work (Published or Preprint)	Date	Data Sources	Summary of Main Findings
First 32 weeks of 2021	Rose, J. & Crawford, M. (2021); Kirsch, S., Rose, J. & Crawford, M. (2021)	2021-09-24	USA (CDC VAERS)	Around 150k fatalities attributed to COVID-19 vaccines
First 32 weeks of 2021	Pantazatos, S.P. & Seligmann, H. (2021a)	2021-10-16	USA (CDC Surveillance Data)	More all-cause deaths with more doses, 0.04% avg. mortality risk
2021	Dowd, E. (2022).	2022-05-22	USA actuarial data	Excess deaths up about 20% overall
2020-2021	Rancourt, D., Marine Baudin, & Mercier, J. (2022)	2022-08-02	USA	Higher excess all-cause deaths post vs. pre-vaccine rollout, all ages
2021	Skidmore, M. (2023) and Skidmore, M. & Alfaro, F. (2024)	2023-01-24	USA (social survey)	Around 278k fatalities attributed to COVID-19 vaccines
2021-2022	Aarstad, J., & Kvitastein, O.A. (2023)	2023-03-01	Eurostat	+1% vaccination in 2021 led to 0.1% increase in 2022 mortality
December 14, 2020 to December 31, 2023	Santiago, D., & Oller, J. W. (2023)	2023-04-05	Connecticut and US Medicare, CDC and US Census	Higher all-cause mortality rates post vs. pre-vaccine rollout*
2019-2022	Rancourt, D. G., Baudin, M., Hickey, J., & Mercier, J. (2023).	2023-09-17	Southern Hemisphere, 17 countries	Higher excess all-cause deaths post vs. pre-vaccine rollout, all ages
2021, 2022, 2023	Dowd, E., Becker, G. de, & Kennedy, R. F., Jr. (2024)	2024	USA actuarial data	Excess deaths up 40% in working people ages 18-64
2019, 2020, 2021	Sorli, A. S., (2025)	2025-03-07	Our World in Data	6M+ global excess deaths attributed to COVID vaccinations

* Santiago & Oller 2023 also present an analysis claiming the shots significantly shortened the lifespan of the vast majority of Medicare recipients over 65. However, this conclusion is confounded by selection bias (i.e., restricting analyses to recipients who died before January 1, 2023) and failure to adjust for the time that elapsed between unvaccinated start date and successive vaccination/booster dates.

EXISTING SAFETY AND SURVEILLANCE STUDIES ARE NOT DESIGNED TO RELIABLY ESTIMATE COVID VACCINE-INDUCED DEATH RISK

A recent safety surveillance analysis of mRNA vaccines against COVID using the Vaccine Safety Datalink (Baggs et al., 2011) claimed COVID vaccines were safe because event rates for 23 serious health outcomes were not significantly higher for vaccinated individuals 1 to 21 days after vaccination compared with vaccinated individuals at 22 to 42 days after vaccination (Klein et al., 2021). However, this is not compelling since we now know that the spike protein and modified mRNA persist for up to 6 months in the blood post-vaccination (Brogna et al., 2023; Boros et al., 2024) and the main comparison of interest is the background rate of adverse events in the *unvaccinated*. If the severe adverse event rate is similar 1-21 days post-vaccination as it is 22-42 days post-vaccination, then no difference in risk (safety signal) will be detected. The authors include an analysis using an unvaccinated comparator group in Supplementary eTable 6 (Klein et al., 2021). Surprisingly, the table reports significantly *reduced* risk of thrombosis with thrombocytopenia syndrome ($p = 0.004$), hemorrhagic stroke ($p < 0.001$), pulmonary embolism ($p < 0.001$), and acute myocardial infarction ($p < 0.001$) in the vaccinated 1-21 days post injection compared to the unvaccinated comparator group. This is interesting because these adverse events are precisely the events known to be associated with both the viral vector-based and mRNA COVID vaccines based on CDC VAERS data (749 results for "acute myocardial infarction", 4,579 results for "thrombosis" or "thrombocytopenia", 98 results for "hemorrhagic stroke", and 2,395 results for "pulmonary embolism" for mRNA vaccines as of Oct 22nd, 2021) and published case reports (Flower et al., 2021; Hippisley-Cox et al., 2021; Hunter, 2021; Sung et al., 2021). The authors do not devote any discussion to how or why their results provide strong evidence that COVID vaccination appears to protect against the very adverse events that were previously associated with vaccination. We speculate it is more likely that the groups were mislabeled due to human or technical error, though intentional misleading may be a more likely possibility.

A recent paper by Xu et al., also based on the Vaccine Safety Datalink (VSD) cohorts used in Klein et al., reported significantly reduced mortality risk in vaccinated vs. unvaccinated (Xu, 2021). As with Klein et al. that found significantly reduced risk for severe adverse events in vaccinated people (discussed above), the finding of reduced standardized mortality rates ($p < 0.001$) in the vaccinated compared with unvaccinated is unexpected, especially since the groups were matched for "similar characteristics" and standardized mortality rates were adjusted for age, sex, race and ethnicity. The authors suggest "This finding might be because of differences in risk factors, such as underlying health status and risk behaviors among recipients of mRNA and Janssen vaccines that might also be associated with mortality risk" (Xu, 2021). However, this does not comport with recent findings from a large survey study that found PhD-holders are among the most vaccine hesitant groups (King et al., 2021), as are women looking to become pregnant, religious people, and people who practice yoga/"wellness" culture (Osborne-Crowley, 2021). Given that the study is based on the same sites/cohorts used in Klein et al. 2021, which found significantly *reduced* risk in the vaccinated for the same severe adverse events that have associated with COVID vaccination in VAERS data and published case reports (see discussion above), we speculate their findings may be due to a similar technical or human error involving group labeling or coding. Note that their study data is not publicly accessible (in contrast to our study), and two authors report receiving funding from Pfizer.

Finally, we now know that the "counting window" bias (i.e., the common practice of censoring or categorizing study participants within 14 or 21 days post-vaccination as "unvaccinated"), greatly exaggerated perceived COVID vaccine safety and effectiveness (Fung et al., 2024; Lataster, 2024).

VACCINE COST-BENEFIT RATIO

According to a recent meta-analysis of studies assessing infection fatality rates, up to 90% of the variation in any population-wide coronavirus infection fatality rate is explained by age composition and the extent to which older people (and groups of them) are exposed to the virus (Levin et al., 2020). The meta-analysis by Levin et al. reports the infection fatality rate for age 10 at 0.002%, for age 18 years at 0.005%, for age 25 it is about 0.01%, for age 45 it is 0.1%, at 55 four times greater at 0.4%, at 65 years it is estimated at 1.4%, which is fourteen times greater than at 45 years, and at 75 years it more than triples to 5%, and triples again to 15% for people >85 years of age (Levin et al., 2020). Calculations based on 61 studies (74 estimates) and eight preliminary national estimates by Ioannides suggest a median of 0.05% and an upper bound infection fatality rate of 0.3% for ages <70 (Ioannidis, 2021). This latter estimate is similar to an estimated US national average infection fatality rate of 0.35% based on a Bayesian evidence synthesis model that averaged age-specific infection fatality rates weighted by the fraction of the population in each age group across US states (Chitwood et al., 2021). A comparison of previously published age-stratified infection fatality rates (A. T. Levin et al., 2020) with our age-stratified vaccine mortality rates shows they have similar orders of magnitude below age 45, indicating that any possible benefits of vaccination do not outweigh the risks, especially in anyone at age 45 or younger (Figure 5). We first reported this conclusion in 2021 (Pantazatos, 2021; Pantazatos & Seligmann, 2021a), which has been corroborated by many studies including a 2024 study showing that university COVID vaccine/booster mandates are unethical because their harms outweigh their benefits (Bardosh et al., 2024).

An individual's overall risk of dying from COVID is also a function of infection risk, which theoretically varies based on lifestyle, location, time, occupation, and behavior (i.e. social distancing, effective masking with N95, etc.), as well as the possible presence of comorbidities. In the vaccine clinical trials (when social distancing and masking measures were in place), ~1 to 2% of the participants contracted symptomatic COVID in the placebo group over a period of a few months (Baden et al., 2021). Infection risk calculators (in theory at least) allow someone to estimate their risk of infection based on attending an event of a certain size (Chande, 2020). For example, a 55-year-old attending events over a given period with 10% infection risk has a 0.1*0.4% = 0.04% chance of dying from COVID, which is similar to the odds of vaccine-induced death for that age (~0.01%).

The estimated infection fatality rate (>1%) for earlier coronavirus variants was one or two orders of magnitude greater than our estimated vaccine-induced mortality rate of 0.06% in ages 75 years and older (Levin et al., 2020; Axfors, & Ioannidis, 2022). Assuming the vaccine offered some (temporary) protection against death from COVID-19, the benefits of vaccination may therefore have outweighed the risks in individuals ages 75 years and older with no previous exposure and natural immunity. The benefits may also have outweighed the risks in ages older than 45 with high COVID risk (several or more comorbidities and no previous coronavirus exposure) where the infection fatality rate of 0.1% was an order of magnitude higher than the estimated vaccine-induced mortality rate of 0.01% (Kostoff et al., 2021). However, data on in-patient deaths within 60 days of a positive COVID-19 test from the UK Office for National Statistics show no appreciable benefit of COVID-19 vaccinations in the elderly (Oller & Santiago, 2022). Unfortunately, systemic biases in the UK Office for National Statistics data prohibit direct, quantitative comparisons between vaccinated and unvaccinated mortality rates (Alessandria et al., 2024). An early analysis applied Bayesian Causal Impact analysis and found an *increase* in COVID-19 cases and COVID-19 deaths following vaccine rollout using data from 145 countries in Our World in Data (Beattie, 2021). Moreover, a recent application of the current approach found that higher 2021 COVID-19 vaccine coverage predicted increased COVID-19 deaths in 2022 (Pantazatos, 2025). Given that more recent variants (Omicron) are ~90% less lethal than previous variants (Lewnard et al., 2022) and the lack of sufficient safety data on boosters (Arbel et al., 2021), additional COVID boosters should be contraindicated in all age groups until and unless their safety can be well established.

IMPLICATIONS FOR PUBLIC HEALTH POLICY

There is little to no evidence that vaccines reduce community spread and transmission. In fact, it appears they increased infectivity 3-fold in the first week post-injection (Seligmann, 2021). The vaccine clinical trials used symptomatic, not asymptomatic COVID, as a clinical endpoint. Since they did not require weekly coronavirus testing in their participants, they were not designed to estimate vaccine efficacy in reducing infection and hence transmission of the virus in pre- and/or asymptomatic persons. A recent July CDC study in Barnstable, Massachusetts reported a majority (75%) of COVID infections were among fully vaccinated people in an area with 69% vaccination

Comparing mortality risk of infection vs. vaccination

Age-stratified coronavirus infection fatality rates (previously published)*

Age group	COVID-19 IFR (95% CI)
0–34	0.004 (0.003–0.005)
35–44	0.068 (0.058–0.078)
45–54	0.23 (0.20–0.26)
55–64	0.75 (0.66–0.87)
65–74	2.5 (2.1–3.0)
75–84	8.5 (6.9–10.4)
85 +	28.3 (21.8–36.6)

≈

Estimated age-stratified vaccine fatality rates (current study)

Ages	aVMR (95% CI)
0-17	0.0045 (0.0028, 0.0080)
18-29	0.0065 (0.0040, 0.0095)
30-39	0.0091 (0.0040, 0.0136)
40-49	0.0165 (0.0090, 0.0231)
50-64	0.0157 (0.0018, 0.0370)
65-74	0.0445 (0.0167, 0.0743)
75-84	0.0604 (0.0108, 0.0859)
85-plus	0.0577 (0.0298, 0.0802)

Figure 5. Simple cost-benefit analysis of COVID vaccination stratified by age. The lower bound estimates of age-stratified vaccine mortality rates from the current study on the right side of the figure, have similar orders of magnitude as previously published coronavirus infection mortality rates shown at the left side of the figure. The left panel is adapted from a meta-analysis of 27 studies that were aiming to estimate age-stratified coronavirus infection fatality rates (see Levin et al., 2020). See also Axfors & Ioannidis, (2022) who report lower infection fatality rates (2.9-4.5%) in community-dwelling elderly populations. IFR=infection fatality rate; aVMR=age-specific vaccine mortality rate.

coverage, with similar viral loads between vaccinated and unvaccinated (Brown et al., 2021). The US CDC recognized that the vaccines do not prevent transmission or spread of the virus as early as July, 2021 (Walensky, 2021). Given that vaccines do not reduce community spread and that the risks to the individual outweigh the benefits for most age groups, vaccine mandates in workplaces, colleges, schools and elsewhere are ill-advised. We do not see much benefit in vaccine mandates other than increasing the size of the serviceable obtainable market for the vaccine companies. See Pantazatos

(2021) and Kostoff et al., (2021) for a more in-depth discussion and literature review on why the mandates were never based on sound science given the relatively low COVID risk in healthy middle-aged and young adults and growing evidence base for alternative prevention and early treatment options for COVID.

LIMITATIONS AND FUTURE DIRECTIONS

Ideally, our analyses would use age-stratified vaccination to predict age-stratified mortality within the same age groups. However, the European and Israeli vaccination data are not age-stratified, and the US vaccination data only provide some age-specific numbers starting in later months (i.e., vaccines administered to ages >65, >18, and >12 years). In addition, while the US vaccination and COVID cases are updated daily, the age-stratified death counts are per-month, thus preventing analyses using shorter time windows. The additional information may have increased our sensitivity to detect significant effects in more age groups and time periods. Such a scenario would increase our mortality estimates, in which case the death estimates presented here based only on significant effects ($p < 0.05$ corrected) constitute a lower bound on the estimated deaths attributed to COVID vaccination. The current study focused on vaccine-attributed deaths within 5-6 weeks of vaccination. Future work should examine later periods to estimate whatever lives, if any, were saved by vaccination versus potential vaccine associated mortality after touted protective effects wane.

Conclusion

In both euromomo.eu and US data, all-cause mortality in unvaccinated children (<15 for Europe and <18 for US) increased significantly with adult vaccination rates. In the euromom.edu data, we find that COVID vaccination correlates positively with mortality at 0 to 5 weeks after vaccination, before associating with lower mortality in weeks 6 to 20 after vaccination. The US data allowed us to estimate a US national average vaccine-induced mortality rate of 0.04% and age-stratified vaccine-induced mortality rates within 1-month post-vaccination. Significant regression terms estimate that 130K to 180K US deaths can be attributed to vaccination between February and August of 2021. These estimates converge with independent estimates based on the Vaccine Adverse Events Reporting System (VAERS) and suggests VAERs deaths are underreported by a factor of 20. Comparison of our age-stratified vaccine-induced mortality rates with age-stratified infection fatality rates suggests the risks of COVID vaccination outweigh the benefits in children, young and middle-aged adults, and in older age groups with low COVID risk, previous coronavirus exposure, and access to alternative prophylaxis, and early treatment options. Our findings raise important questions about mass COVID vaccinations strategies that warrant further investigation and review.

Data and Resource Sharing

All data used in this study are publicly available. The European dataset consisted of data from Coronavirus (COVID) Vaccinations — Statistics and Research — Our World in Data (https://ourworldindata.org/covid-vaccinations) and from euromomo.eu. The US dataset consisted of spreadsheets for vaccinations, COVID-19 and total deaths, COVID-19 case rates, and age-stratified populations estimates. See **Data Sources** subsection in the **Methods** for more detailed descriptions of the raw data. The extracted data (minimally preprocessed spreadsheets and intermediate results) for both European and US datasets is available in the provided Github repository which is publicly available. The repository also contains all MATLAB code used for the US dataset analyses. Readers who would like to inspect and replicate the results or reanalyze the data may find it easier to first double check the intermediate table files (in Table subfolder of the Github repo at https://github.com/spiropan/CoVMR) against the original CDC data and then work from these tables with their software of choice. In addition, readers are referred to the comments section on the preprint of this article which has functioned as an open pre-publication peer review with responses from the authors (see https://www.researchgate.net/publication/355581860_COVID_vaccination_and_age-stratified_all-cause_mortality_risk/comments).

Author Contributions

Spiro P. Pantazatos analyzed US data and drafted the manuscript; Hervé Seligman analyzed European and Israeli data and drafted relevant text.

Conflict of Interest

Hervé Seligman has no relevant conflicts of interest to report. Spiro P. Pantazatos held a short position on Moderna stock.

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