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VOICE AND ACCOUNTABILITY AND THE IMPACT OF VACCINES

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A Two Covid-19 Years Quartile Comparison of Official with Excess Mortality: Voice and Accountability and the Impact of Vaccines
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ABSTRACT

We evaluate the quartile ranking of countries during the Covid-19 pandemic using both official (i.e., confirmed) and excess mortality data. Contrasting countries' rankings using these two data sources reveal sharp and systematic differences. While higher GDP per capita is associated with a worse mortality ranking when using official Covid-19 mortality, there is no such sharp association when using excess mortality data. By the end of 2021, the quartile rankings of three-fifths of the countries in our sample differ when ranked by excess vs. official mortality. On average, countries that are 'doing substantially better' in the excess mortality dataset are characterized by lower population density; higher GDP/Capita; and higher scores on institutional and policy variables. To characterize these differences, we perform two sets of regressions, in which the ratio of Cumulative Excess to Official Covid-19 mortalities (E/O ratio) is regressed on a large set of covariates. Our sample composes over 140 countries, and the analysis is run both at the end of 2020 and the end of 2021. In the first, narrow experiment, we only control for GDP/Capita and vaccination rates. In the second, broad experiment, we add other institutional and policy variables. In the narrow experiment, by December 2021 the E/O ratio was smaller in countries with higher vaccination rates. In the broad experiment, the E/O ratio was smaller in countries with higher degree of voice and accountability. Our results suggest that the arrival of vaccines in early 2021 and voice and accountability had a discernible association with the gap between excess and official mortality.

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1. Introduction

As a benchmark, the paper opens by documenting the remarkable heterogeneity of countries' Covid-19 mortality experiences during the first two Covid-19 years, from 2020-2021. The heterogeneity in countries' performance is illustrated by Figure 1, which displays cumulative official Covid-19 deaths per million for high-, upper-middle, lower-middle, and low-income countries, as well as for the World overall.

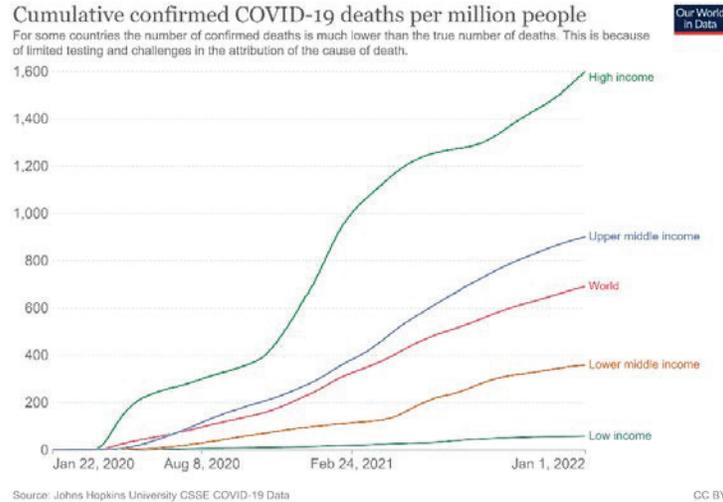


Figure 1: Cumulative official Covid-19 deaths per million, high-, upper-middle, lower-middle, low-income countries, and the World, 2020-2021.

At first glance, one may conclude that higher-income countries experienced a much worse pandemic. However, recent literature suggests that officially reported mortality may not reflect the true distribution of death tolls, since the limitations of official statistics and data infrastructures vary across the globe.¹ Countries have different levels of reporting and testing availability, or disparate definitions of 'Covid-19' deaths. This is due to the different abilities of medical systems to capture the totality of Covid-19 deaths. To gain further insight on data limitations associated with confirmed (i.e., officially reported) Covid-19 counts, we evaluate the quartile ranking of countries using both official and excess Covid-19 mortality data. Contrasting countries' ranking using these two data sources reveals sharp and systematic contrasts in mortality statistics. In particular, while higher GDP per capita is associated with a worse mortality ranking (i.e., a quartile with higher mortality) using the official Covid-19 mortality data, there is no such association in the excess mortality data.

Figure 2 plots the world excess and the official Covid-19 deaths during the first two Covid-19 years. It vividly shows the higher mean and standard deviation of the excess in comparison to the official deaths.

¹ See Karlinsky and Kobak (2021) and the Economist article "There have been 7m-13m excess deaths worldwide during the pandemic".

Global estimated excess deaths and official covid-19 deaths

— Official covid-19 deaths - - - Estimated excess deaths

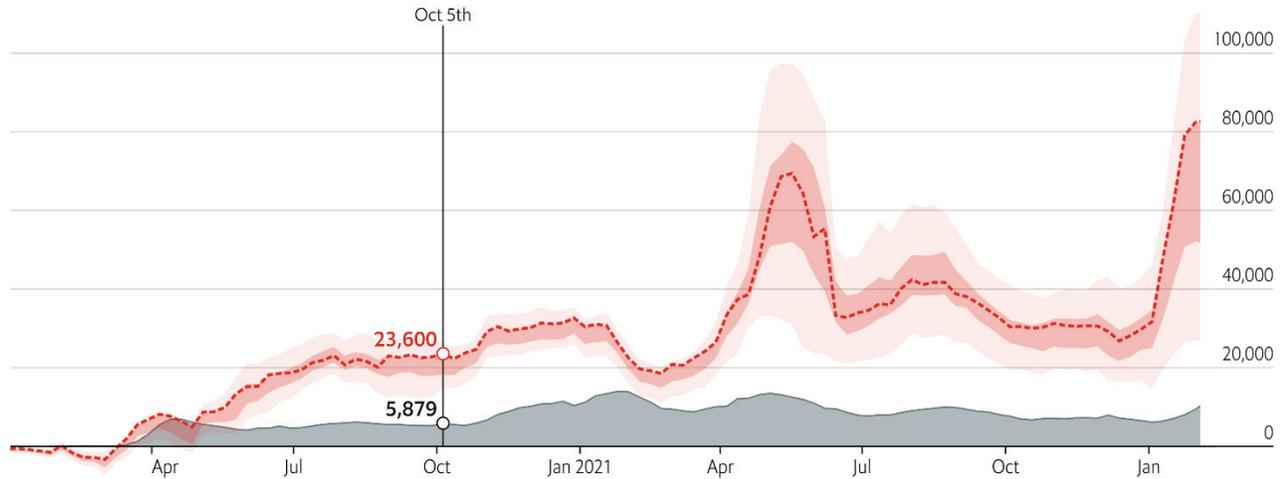


Figure 2: Global estimated excess deaths and official Covid-19 deaths, 2020-February 2022

Source: The Economist. February 4th, 2022.

To gain further insight, we perform two sets of regressions, in which the ratio of Cumulative Excess to Official Covid-19 mortalities (E/O ratio) is regressed on a large set of covariates. We focus on more than 140 countries with cumulative excess mortality higher than the official one, and the analysis is run both at the end of 2020 and the end of 2021. In the first, **narrow** experiment, we control only for GDP/Capita and vaccination rates. In the second, **broad** experiment, we add other institutional and policy variables. In the narrow experiment we find that by December 2021, Cumulative Excess/Official Covid-19 mortality ratios are smaller for countries with higher vaccination rates. In the broad experiment — both at the end of 2020 and at the end of 2021 — a higher urban population share and a higher score on voice and accountability are associated with lower Cumulative Excess/Official Covid-19 mortality ratios, but the vaccination variable at the end of 2021 becomes insignificant — probably due to multicollinearity with the other controls.

We close our analysis by contrasting the quartile rankings between the two data sets at the end of 2021. For 3/5ths of the countries in our sample, quartile rankings differ between the two data sets (e.g., a nation will have a quartile ranking of 3 based on the official mortality data, but a ranking of 1 based on the excess mortality data). We also contrast countries that are ranked substantially better to countries that are ranked substantially worse, based on their excess mortality as compared to their official Covid-19 mortality count. We classify countries that are “doing substantially better in excess” as any nation in the sample that recorded a ranking of *at least two quartiles better (i.e., ranked in a lower mortality quartile)* when using excess mortalities, as opposed to official mortalities. Conversely, we categorize countries that are “doing substantially worse in excess” as any

nation in the sample which recorded a quartile ranking of *at least two worse (i.e., higher mortality)* when using excess mortalities, as opposed to official mortalities. On average, the countries which are ‘doing substantially better in excess’ are characterized by lower population density; higher GDP/Capita; better rule of law, voice accountability, and government effectiveness; and substantially higher vaccination rates.

These results suggest that one should take official Covid-19 mortality counts with a grain of salt, and should supplement this information with excess mortality data. We also find that governance indicators, in particular, voice and accountability, and other structural variables (such as urban population share) may explain the ranking gaps between the two data sets. The arrival of vaccines in early 2021 was also correlated with the gap between excess and official mortality — the strength of this relationship likely varied by country. Notably, the heterogeneous impact of vaccines may also reflect the global shortages of vaccinations, resulting in unequal worldwide vaccination rates.

2. Data

Our full dataset is constructed by supplementing the *Our World in Data* database on Covid-19 with a few other datasets, including the World Development Indicator (WDI) database, the World Governance Indicator (WGI) database (Kraay and Mastruzzi, 2011), and *the Economist’s* tracker for Covid-19 excess deaths. The full dataset covers 170 countries at a weekly frequency from January 1, 2020, to December 31, 2021.

Specifically, from the *Our World in Data’s* Covid-19 database, we use cumulative officially reported Covid-19 mortality counts (per million population), the total number of Covid-19 vaccination doses administered per 100 people in the total population (Mathieu et al. 2021), population density, the share of aged 65+ population, and GDP per capita.

We use the share of urban population from the WDI database; and rule of law, voice and accountability, and government effectiveness from the WGI database. Rule of law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. The voice-and-accountability variable captures perceptions of the extent to which a country's citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and free press. Lastly, government effectiveness captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.

We also use cumulative excess mortality per million population from *the Economist’s* tracker for Covid-19 excess deaths, which is calculated by comparing all-cause mortality in a given country and time frame with a historical baseline from prior years. A linear trend is then fit for the year, accounting for long-term increases or

decreases in mortality, and a fixed effect is implemented for each week or month up to February 2020 to account for short-term fluctuations.

3. Quartile Evidence Contrasting Official versus Excess Cumulative Covid-19 Mortality, 2020-2021

We start by tabulating the quartile rank order of mortality per million during the first two Covid-19 years (from the beginning of 2020 to the end of 2021) using the two mortality measures, i.e., the official (or reported) mortality and the excess mortality. Next, we describe the large discrepancies of countries' ranking between the two mortality measures. To gain further insight, we present regressions accounting for these differences, and close with discussion and interpretations.

Table 1 reports the average statistics of countries in quartiles of cumulative official Covid-19 mortality per million up to December 31, 2021. Table 2 replicates Table 1, but for excess Covid-19 mortalities. Table 1A, relegated to the appendix, reports the country list within each quartile of official mortality. Table 2A (also in the Appendix) replicates Table 1A, but for excess mortality data. We order the ranks of the quartiles so that a lower quartile consists of countries with lower cumulative mortalities.

Contrasting the average statistics in each quartile of cumulative official Covid-19 mortality per million up to December 2021 (Table 1) with those in the same quartiles of cumulative excess mortality per million in December 2021 (Table 2) reveals disturbing fundamental differences between these two mortality measures and the resulting country quartile rankings.

Table 1 indicates that, on average, higher GDP/capita countries performed poorly relative to low- and middle-income countries in terms of their cumulative official Covid-19 mortality ranking. The average GDP/capita in the lowest mortality quartile is $\frac{1}{4}$ that of the higher mortality quartile. The second worst-performing quartile's average GDP/Capita exceeded the GDP/capita of the second-best performing quartile by about $\frac{1}{5}$. Similar observations apply to measures of institutional quality. Rule of law, voice and accountability, and government effectiveness are significantly higher for the worst-performing quartile.

Intriguingly, almost the opposite patterns characterize the quartiles of cumulative excess mortality, reported in Table 2. The lowest excess mortality quartile's average income/capita is the *highest* (\$25,293) of all quartiles. Meanwhile, the second-best performing quartile has the *lowest* average income/capita of all quartiles — less than half of the best performing quartile. Average income/capita in the worst excess mortality quartile is only $\frac{3}{5}$ of the average income/capita of the best performing quartile. The quartile with the lowest excess mortality is now characterized by the best rule of law, voice and accountability, and government effectiveness scores.

Table 1: Average Quartiles Statistics of Cumulative Official Covid-19 Mortality, December 31, 2021

Variable	1st Quartile (Lowest Cum. Mortality)	2nd Quartile	3rd Quartile	4th Quartile (Highest Cum. Mortality)
Population	66,246,385.5	72,137,531.6	27,555,946.7	37,762,631.6
Population Density	278.6	390.4	185.7	89.9
Urban Population Share	42.9	55.5	68.6	69.6
Aged 65+ Population Share	4.1	6.7	9.1	14.6
GDP per Capita	5310.4	20590.6	24297.7	22234.7
Rule of Law	-0.7	-0.2	0.1	0.2
Voice and Accountability	-0.8	-0.5	0	0.5
Government Effectiveness	-0.8	-0.1	0.2	0.3

Table 2: Average Statistics of Excess Mortality/Millions of Countries in Quartile, December 31, 2021

Variable	1st Quartile (Lowest Cum. Mortality)	2nd Quartile	3rd Quartile	4th Quartile (Highest Cum. Mortality)
Population	55,790,460.9	36,315,592.6	42,391,243.5	68,018,586.5
Population Density	530.1	122.2	182.7	116.7
Urban Population Share	63.3	48.4	66	60.2
Aged 65+ Population Share	8.8	6.2	9.1	10.7
GDP per Capita	25293	11369.8	20820.5	15622.5
Rule of Law	0.3	-0.5	-0.1	-0.3
Voice and Accountability	0.1	-0.5	-0.1	-0.3
Government Effectiveness	0.3	-0.4	0.0	-0.2

These observations raise fundamental concerns about the quality of confirmed (or official) cumulative mortality data in Covid-19 times. It also challenges simplistic interpretations and generalizations, like the notion that on average, OECD countries failed in dealing with Covid-19 challenges relative to low- and middle-income

countries. This view is supported by the quartiles' average statistics when measured using official Covid-19 mortality, but is mostly rejected when measured using excess mortality data. The sharp contrast between the two tables suggests that countries which ranked higher in terms of rule of law, voice, accountability, and government effectiveness are also countries where the (mainly positive) gap between the official Covid-19 mortality and the excess mortality is smallest.

4. Statistical Analysis of the Gap between Official and Excess Cumulative Covid-19 Mortality, 2020-2021

To obtain further insight on the gap between official and excess cumulative Covid-19 mortality, we run regressions accounting for the ratio of Cumulative Excess/Official Covid-19 mortalities (henceforth, **E/O ratio**) across countries. These regressions are run for two dates; at the end of 2020, and at the end of 2021. We focus on countries which see higher cumulative excess mortality than official mortality. This is the case for the vast majority of countries. The sample includes more than 120 countries as of end-2020, and more than 140 countries as of end-2021.

Table 3 provides the estimation of the E/O ratio on a set of structural regressors, including the level of income (as measured by GDP per capita), a set of demographic variables including population density, urban population share, aged 65+ population share, and a set of variables from the World Governance Indicators database measuring the quality of governance - including rule of law, voice and accountability, and government effectiveness; as well as a Covid-19 vaccination level (as measured by the number of Covid-19 vaccinations administered per hundred population).

Columns (1) and (3) of Table 3 shows the regression results with only the level of income (as measured by GDP per capita) and the level of vaccination (as measured by the number of Covid-19 vaccinations administered per hundred population), as of end-2020 and end-2021 separately. Results show that, at the end of 2020 and 2021, the associations between E/O ratio and GDP per capita are both negative but statistically insignificant. In 2021, however, as Covid-19 vaccines became widely available throughout the year for a large number of countries, the association between E/O ratio and the vaccination level in the international sample is significantly negative.²

Columns (2) and (4) of Table 3 shows the regression results with the addition of more structural variables. Column (2) shows that, at the end of 2020, the association between E/O and urban population share is significantly negative while the associations with other indicators are all insignificant. At the end of 2021, as

² Notably, this finding may also reflect the scarcity of quality vaccinations, and the resultant rationing.

shown in column (4), in addition to the significant and negative association with urban population share, E/O ratio is significantly and negatively correlated with voice and accountability. Notably, the vaccination level that had a significantly negative impact on the E/O ratio at the end of 2021 in column (3) is now insignificant despite of being still negative in the presence of the additional variables above. It is likely that this is due to a high degree of multicollinearity between vaccinations and other controls. Table 3A in the appendix presents a correlation matrix of our core variables which likely confirms these suspicions.

These results show that on average, countries which record higher perceptions of citizens' ability to participate in selecting their government, and rank higher on freedom of expression, freedom of association, and a free media are likely to see a smaller gap between their cumulative excess and official mortality.³ One possible explanation of this result is that it would be harder for a country with higher perceptions of voice and accountability to manipulate officially reported mortality. Relatedly, countries with a higher urban population share would find it harder to manipulate officially reported mortality because urban populations are likely to have better access to both domestic and international information.

³ Beyer, Hu and Yao (2022) find similar results on accounting for quarterly GDP growth, that a higher level of voice and accountability is associated with more precise quarterly GDP growth data.

Table 3: Broad Regressions of Cumulative Excess/Official Covid-19 Mortality across Countries with Additional Controls, 2020 and 2021.

	<i>Dependent variable:</i>			
	E/O Ratio			
	As of 12/28/2020		As of 12/27/2021	
	(1)	(2)	(3)	(4)
GDP per Capita	-2.6686 (2.0295)	1.9463 (3.9983)	-0.1997 (0.2891)	0.2863 (0.3989)
Population Density		0.0310 (0.0579)		0.0029 (0.0062)
Urban Population Share		-5.5506** (2.4280)		-0.7726*** (0.2440)
Aged 65+ Population Share		5.8361 (9.2033)		0.5666 (0.9277)
Rule of Law		-27.7983 (149.3108)		-2.0961 (13.6680)
Voice and Accountability		-84.4579 (78.5774)		-13.5901* (7.0054)
Government Effectiveness		27.3871 (126.6985)		3.3741 (12.7622)
Total Vaccinations per Hundred Population			-0.2125** (0.0835)	-0.1231 (0.0895)
Constant	108.9919** (50.1365)	272.3462* (139.9098)	39.0604*** (6.3520)	59.1727*** (13.9887)
Observations	124	122	147	145
R ²	0.0140	0.0828	0.0998	0.2007
Residual Std. Error	414.3277	413.2343	48.1915	44.7451
F Statistic	1.7290	1.4706	7.9864***	4.2687***

Note: *, **, *** correspond to 10%, 5% and 1% significance, respectively.

Table 4 reports the country mortality quartile as ranked by official (or reported) Covid-19 mortality (rows) against mortality quartile as ranked by excess Covid-19 mortality (columns) in a 4 by 4 matrix. The diagonal of this matrix reports 62 countries that are in the same mortality quartile under both the official and excess counts. This represents about 40% of the sample. In contrast, the ranking of countries that are further away from the diagonal differs more between their official and excess mortality counts. We proceed by

focusing on countries whose quartiles differ between these two metrics (official and excess) by at least two quartiles. For example, France ranks in the 4th quartile in terms of official mortality but ranks in the 2nd quartile in terms of excess mortality. Bangladesh is in the 2nd quartile in terms of official mortality but is in the 4th quartile in terms of excess mortality.

Table 4: Country official mortality quartile against excess mortality quartile.

Official Mortality Quartile (R) / Excess Mortality Quartile (C)	<i>1st Excess Mortality Quartile</i>	<i>2nd Excess Mortality Quartile</i>	<i>3rd Excess Mortality Quartile</i>	<i>4th Excess Mortality Quartile</i>
<i>1st Official Mortality Quartile</i>	15 Total Countries: Benin; Burkina Faso; Central African Republic; China; Eritrea; Ghana; Cote d'Ivoire; Hong Kong; Liberia; Madagascar; Mali; New Zealand; Papua New Guinea; Sierra Leone; Taiwan	18 Total Countries: Angola; Burundi; Cameroon; Chad; DR Congo; Ethiopia; Guinea; Guinea-Bissau; Haiti; Laos; Mozambique; Niger; Nigeria; Tajikistan; Tanzania; Togo; Uganda; Uzbekistan	3 Total Countries: Republic of the Congo; South Sudan; Yemen	2 Total Countries: Nicaragua; Sudan
<i>2nd Official Mortality Quartile</i>	15 Total Countries: Australia; Finland; Japan; Dominican Republic; South Korea; Lesotho; Malawi; Mauritius; Norway; Qatar; Senegal; Singapore; Syria; Thailand; Timor-Leste	11 Total Countries: Afghanistan; Algeria; Cambodia; Gabon Equatorial Guinea; Gambia; Kenya; Mauritania; Somalia; Vietnam; Zambia	6 Total Countries: Egypt; Rwanda; Myanmar (Burma); United Arab Emirates; Venezuela; Zimbabwe	6 Total Countries: Bangladesh; Djibouti; India; Nepal; Pakistan; Saudi Arabia
<i>3rd Official Mortality Quartile</i>	7 Total Countries: Canada; Denmark; Ireland; Israel; Oman; Malaysia; Mongolia	7 Total Countries: Austria; Costa Rica; Germany; Jamaica; Sri Lanka; Sweden; Switzerland	15 Total Countries: Bahrain; Botswana; El Salvador; Estonia; Guatemala; Indonesia; Iran; Jordan; Kuwait; Kyrgyzstan; Lebanon; Morocco; Namibia; Netherlands; Philippines	10 Total Countries: Albania; Azerbaijan; Belarus; Honduras; Iraq; Kazakhstan; Libya; South Africa; Swaziland; Turkey
<i>4th Official Mortality Quartile</i>	1 Total Country: Uruguay	2 Total Countries: France; Panama	15 Total Countries: Argentina; Belgium; Brazil; Chile; Colombia; Greece; Italy; Paraguay; Portugal; Slovenia; Spain; Trinidad and Tobago; Tunisia; United Kingdom; United States of America	21 Total Countries: Armenia; Bolivia; Bosnia and Herzegovina; Bulgaria; Croatia; Czech Republic; Ecuador; Georgia; Hungary; Latvia; Lithuania; North Macedonia; Mexico; Moldova; Peru; Poland; Romania; Russia; Serbia; Slovakia; Ukraine

Table 5 reports the average statistics for countries that are "doing substantially worse in excess" — any countries that recorded a quartile ranking *at least two worse* (i.e., *higher mortality*) when using excess mortalities as opposed to official mortalities (for example, Bangladesh) — and comparing them to countries that are “doing substantially better in excess” — any countries that recorded a quartile ranking *at least two better* (i.e., *lower mortality*) when using excess mortalities as opposed to official mortalities (for example, France).

When contrasting countries that are ranked substantially better to countries that are ranked substantially worse in excess mortality as opposed to official mortality, we find that, on average, the ‘doing substantially better in excess’ countries are: lower density [90 versus 240]; older (12% versus 4% of aged 65 and older); recording a substantially higher GDP/Capita (\$ 35,000 versus \$ 8000); scoring better in rule of law, voice accountability, and government effectiveness; and achieving substantially higher vaccination rates (as measured by the number of Covid-19 vaccinations administered per hundred population) [170 versus 40].⁴

Table 5: Summary Statistics of “Doing Better in Excess” Deaths and “Doing Worse in Excess” Deaths.

Variable	Mean	S.D.	Min.	25 th Percent	75 th Percent	Max.
Doing Better in Excess						
Population Density	92.4	119.4	2.0	16.2	116.0	402.6
Urban Population Share	79.7	10.8	63.2	70.3	87.0	95.3
Aged 65+ Population Share	11.7	6.3	2.4	6.7	16.4	19.7
GDP per Capita	34,920.2	15,856.7	11,840.9	23,402.3	42,664.6	67,355.3
Rule of Law	0.9	0.73	-0.3	0.6	1.5	1.9
Voice and Accountability	0.7	0.9	-1.2	0.4	1.4	1.5
Government Effectiveness	0.9	0.7	-0.3	0.3	1.4	1.9
Vaccinations per Hundred Population	170.0	32.0	100.6	163.5	189.7	204.3
Doing Worse in Excess						
Population Density	237.6	387.9	15.3	27.8	242.8	1,265.0
Urban Population Share	45.9	22.3	19.6	34.3	62.7	83.8
Aged 65+ Population Share	4.3	1.1	2.9	3.4	5.3	6.0
GDP per Capita	7,899.8	13,740.8	1,479.2	2,574.1	5,178.1	49,045.4
Rule of Law	-0.9	0.7	-1.9	-1.2	-0.5	0.2
Voice and Accountability	-1.1	0.7	-1.8	-1.5	-0.8	0.2
Government Effectiveness	-1.0	0.9	-2.3	-1.5	-0.6	0.4
Vaccinations per Hundred Population	41.4	50.4	0.0	1.64	70.8	141.4

Note: “Doing Substantially Better in Excess” is the sample of countries that recorded a ranking at least two better quartiles (i.e., quartiles with lower cumulative mortality) when using excess than official mortalities, and “Doing Substantially Worse in Excess” is the sample of countries which recorded a ranking at least two worse quartiles (i.e., quartiles with higher cumulative mortality) when using excess than official mortalities.

⁴ The association of higher share of aged 65 plus with ‘doing better’ may reflect higher life expectancy in countries where the older population affords retirement and greater isolation, and higher vaccination rates by the end of 2021.

These gaps support the view that better governance scores account for the countries with the largest gaps between excess and official mortality. Notably, these characteristics are also associated with higher GDP/Capita, older populations, and in, some experiments, with sufficiently high vaccination levels. The overall positive correlations between these variables, reported in Table 3A (see the Appendix), suggests that without more granular data, we are unable to rank the relative importance of these factors.

5. Concluding Remarks

As the Covid-19 pandemic has caused significant death tolls globally, cross-country analyses and global comparisons have been widely conducted to investigate Covid-19 mortality across many dimensions (i.e., economic, political, social, etc.). With most of these studies relying on official statistics on Covid-19 mortality as reported by countries, the quality of the underlying official mortality statistics plays a critical role in affecting the results obtained. Importantly, there are widely documented limitations in the official mortality statistics that mask the ranking of countries in terms of life preservation. Some of these limitations include differences in countries' capacities to test for Covid-19, determine the cause of death, and disparate definitions of death due to Covid-19.

To investigate the limitations of official Covid-19 mortality, we contrast this measure with excess mortality, which is calculated as the difference of all-cause mortality during the Covid-19 pandemic from a baseline trend modeled from historical mortality data. We show that countries' quartile rankings differ quite substantially between excess and official cumulative mortality. Countries who fare the best in terms of cumulative **excess** mortality record the highest income and institutional quality (as measured by rule of law, voice and accountability, government effectiveness), and countries faring the worse in terms of cumulative **official** mortality share similar characteristics. This evidence is further supported by a simple regression analysis of the ratio of excess to official mortality on country-specific indicators as well as a deeper examination of individual country's quartile movements between measures of official and excess mortality. Specifically, governance variables, in particular, voice and accountability, other structural variables (such as urban population share) explain the ranking gaps between the two data sets.

These results suggest that one should take the official Covid-19 mortality counting with some skepticism and that it should be supplemented by excess mortality data.⁵ However, it should be noted that excess mortality data is also subject to limitations that may affect its quality as well. Indeed, some limitations of the official mortality statistics have been mitigated, and therefore, the results in this paper may not solely be attributed to the quality of official mortality statistics (see Whittaker et al. 2021; Helleringer and Queiroz 2021).⁶ Notably, the growing importance of GDP/Capita and vaccination rates in explaining the cross-country variation of the cumulative excess/official Covid-19 death ratios at the end of 2021 is in line with WHO concerns about the global shortages of vaccinations, resulting in unequal worldwide vaccination rates.

This study has limitations. Firstly, to maximize the sample size, we rely on the mid-point estimates of excess deaths, whose upper and lower bounds vary with the underlying data and models (see Adam (2022) for comparisons). Secondly, our estimation focuses on contrasting Covid-19 excess and official deaths and their linear associations with several controls in a non-experimental setting. Thirdly, the types of vaccination and the variants of concern, both of which have evolved with the pandemic's path, are nuances in the relationships of variables studied. Due to current data limitations, they are currently beyond the scope of our analysis.

⁵ First, the infrastructure needed and capacity to register and report all deaths varies across countries. Second, there are delays in death reporting that make mortality data provisional and incomplete. The extent of the delay and counting capacity varies by country. See Aron et al. (2020) and Adam (2022).

⁶ The precision of official COVID-19 mortality statistics is subject to how well-resourced the medical system is, which tends to vary across countries and is likely to improve with learning-by-doing and the mobilization of public resources to the system. Challenges to the official mortality statistics include whether COVID-19 was the cause of death. Such determination is subject to the quality of, among other, to the medical-examiner system and the coroner system. More generally, countries have different systems of issuing death certificates, that involve technocrats, elected officials, and physicians. In the case of COVID-19, the quality of autopsies matters greatly as symptoms of acute respiratory distress inflammatory responses signaling a viral infection needs to be sorted into COVID-19 induced deaths and deaths due to other reasons. See also The Economist (2022).

6. Appendix

Table 1A: Country List of Quartiles of Cumulative Official Covid-19 Mortality, December 31, 2021

1st Quartile (Lowest Cum. Mortality)	2nd Quartile	3rd Quartile	4th Quartile (Highest Cum. Mortality)
Burundi	Somalia	Morocco	Bolivia
China	Australia	Kyrgyz Republic	Panama
New Zealand	Timor-Leste	Philippines	Uruguay
Chad	Kenya	Indonesia	France
Niger	Rwanda	Denmark	Serbia
South Sudan	Korea	Kuwait	Portugal
Tanzania	Senegal	Belarus	Ecuador
Tajikistan	Malawi	El Salvador	Spain
Benin	Equatorial Guinea	Iraq	Greece
Congo, Democratic Republic of the	Gabon	Mongolia	Trinidad and Tobago
Nigeria	Pakistan	Sri Lanka	Chile
Burkina Faso	Gambia, The	Oman	Russia
Sierra Leone	Algeria	Canada	Tunisia
Eritrea	Japan	Bahrain	United Kingdom
Central African Republic	Singapore	Azerbaijan	Italy
Côte d'Ivoire	Syria	Libya	Mexico
Hong Kong SAR	Bangladesh	Jamaica	Paraguay
Guinea	Cambodia	Guatemala	Ukraine
Togo	Mauritania	Israel	Moldova
Mali	Afghanistan	Malaysia	Latvia
Nicaragua	Venezuela	Kazakhstan	Belgium
Taiwan Province of China	Mauritius	Turkey	United States
Madagascar	Djibouti	Botswana	Poland
Ghana	Zambia	Honduras	Colombia
Uzbekistan	Egypt	Swaziland	Argentina
Lao P.D.R.	Qatar	Albania	Slovenia
Angola	United Arab Emirates	Ireland	Armenia
Liberia	Norway	Jordan	Lithuania
Ethiopia	Saudi Arabia	Netherlands	Brazil
Mozambique	Finland	Germany	Slovak Republic
Papua New Guinea	Lesotho	Lebanon	Croatia
Congo, Republic of	Thailand	Switzerland	Romania

Yemen	Vietnam	Namibia	Czech Republic
Haiti	Zimbabwe	Costa Rica	Georgia
Cameroon	India	Estonia	Macedonia, FYR
Uganda	Myanmar	Sweden	Hungary
Sudan	Dominican Republic	Austria	Bosnia and Herzegovina
Guinea-Bissau	Nepal	South Africa	Bulgaria
		Iran	Peru

Table 2A: Country List of Quartiles of Cumulative Excess Mortality/Millions of Countries, December 31, 2021

1st Quartile (Lowest Cum. Mortality)	2nd Quartile	3rd Quartile	4th Quartile (Highest Cum. Mortality)
New Zealand	Equatorial Guinea	Netherlands	Pakistan
Sierra Leone	Niger	Chile	Nepal
Taiwan Province of China	Nigeria	Bahrain	India
Benin	Sweden	Yemen	Bangladesh
Mauritius	Tanzania	Philippines	Swaziland
Australia	Algeria	Belgium	Nicaragua
Liberia	Uganda	Rwanda	Ecuador
Korea	Zambia	Lebanon	Libya
Madagascar	Angola	United Arab Emirates	Czech Republic
Japan	Togo	Kyrgyz Republic	Sudan
Singapore	Uzbekistan	Morocco	South Africa
Hong Kong SAR	Costa Rica	Greece	Azerbaijan
Ghana	Germany	Myanmar	Hungary
Papua New Guinea	Guinea	Venezuela	Djibouti
Central African Republic	Guinea-Bissau	United Kingdom	Latvia
Malaysia	Cambodia	Congo, Republic of	Moldova
Senegal	France	South Sudan	Turkey
Qatar	Haiti	Portugal	Kazakhstan
Malawi	Jamaica	Tunisia	Poland
Eritrea	Switzerland	Trinidad and Tobago	Croatia
Mongolia	Vietnam	Spain	Bolivia
Norway	Burundi	Slovenia	Ukraine
Denmark	Gambia, The	Paraguay	Slovak Republic
Timor-Leste	Lao P.D.R.	Guatemala	Honduras
China	Tajikistan	Estonia	Georgia
Canada	Gabon	Zimbabwe	Albania
Mali	Somalia	Indonesia	Mexico
Lesotho	Sri Lanka	Jordan	Saudi Arabia
Côte d'Ivoire	Mozambique	El Salvador	Armenia
Ireland	Mauritania	Italy	Romania
Dominican Republic	Congo, Democratic Republic of the	Iran	Iraq
Burkina Faso	Kenya	Egypt	Bosnia and Herzegovina
Finland	Cameron	United States	Belarus
Israel	Chad	Botswana	Peru

Syria	Afghanistan	Brazil	Lithuania
Oman	Panama	Argentina	Macedonia, FYR
Thailand	Austria	Kuwait	Russia
Uruguay	Ethiopia	Columbia	Serbia
		Namibia	Bulgaria

Table 3A: Correlation Matrix of Variables in the Estimation

	Vaccinations	Population Density	Urban Population Share	Aged 65+ Population Share	GDP per capita	Rule of Law	Voice & Accountability	Government Effectiveness
Vaccinations	1.00	0.18	0.59	0.56	0.67	0.66	0.47	0.71
Population Density	0.18	1.00	0.21	0.10	0.34	0.25	0.00	0.27
Urban Population Share	0.59	0.21	1.00	0.47	0.67	0.52	0.39	0.53
Aged 65+ Population Share	0.56	0.10	0.47	1.00	0.51	0.70	0.72	0.71
GDP per capita	0.67	0.34	0.67	0.51	1.00	0.76	0.41	0.75
Rule of Law	0.66	0.25	0.52	0.70	0.76	1.00	0.76	0.95
Voice and Accountability	0.47	0.00	0.39	0.72	0.41	0.76	1.00	0.72
Government Effectiveness	0.71	0.27	0.53	0.71	0.75	0.95	0.72	1.00

Note: Vaccinations is the number of Covid-19 vaccinations administered per hundred population.

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