

COVID-19 mortality data and level of democracy in post-communist countries: Data sources and accuracy

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Abstract

Emerging studies highlight the potential influence of different political regimes on COVID-19 mortality statistics reliability. This study has two objectives: first, to analyze COVID-19 mortality datasets and identify accurate sources for post-communist countries of the European Union and former Soviet Union; second, to examine the relations between COVID-19 mortality data quality and democracy levels in these countries. Given limited open access or transparent national data sources in some countries, this analysis seeks to help researchers identify optimal existing sources for these regions. Observed mortality levels during the pandemic were evaluated in relation to democracy levels to explore associations between governance and data reporting practices. Two mortality indicators (excess mortality and undercount ratio of deaths) were analyzed over 2020–2021 based on three international databases: World Health Organization (WHO), United Nations World Population Prospects (UN WPP), and World Mortality Dataset (WMD). These sources were crucial since some post-communist countries' national statistical offices do not publish mortality data publicly. The Democracy Index from The Economist Intelligence Unit (2019–2021) was used for democracy classification. Countries were grouped based on mortality characteristics, using cluster analysis. Results suggest that lower democracy levels may be a risk factor for transparency in health data reporting.

Keywords: COVID-19, public health, excess mortality, undercount ratio of deaths, democracy, censorship of mortality data

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1. Introduction

The COVID-19 pandemic exposed global disparities in mortality data reporting, with significant variations emerging across different political contexts. While all countries faced the unprecedented challenge of tracking pandemic mortality, substantial differences in excess mortality estimates have emerged across international databases. Post-communist countries present a particularly compelling case for examining associations between political governance and mortality data patterns. These nations, having undergone significant political transitions in recent decades, now exhibit varying degrees of democratic governance while sharing similar historical trajectories. This diversity provides a natural testing ground for exploring how democracy levels may be associated with transparency in health data reporting.

Concerns regarding data access and potential information restrictions in some former communist countries, notably Russia (Kobak, 2021), highlight the importance of examining multiple data sources. This study addresses this challenge by analyzing mortality indicators from three major international databases across seventeen post-communist countries: nine European Union (EU) member states with communist background and eight former Soviet Union (FSU) countries. The FSU region represents an area with particularly limited scientific attention, making the analysis of international data sources essential for understanding mortality patterns in this understudied region. Rather than

relying on national statistics alone, which are often unavailable or inaccessible from national statistical offices in several post-communist countries, this approach examines how different international organizations construct excess mortality estimates, providing insights into data consistency and potential reporting challenges across varying democratic contexts.

2. Theoretical background

The COVID-19 pandemic highlighted the critical importance of comprehensive excess mortality data as the most reliable measure of the pandemic's true impact on societies, capturing both direct and indirect consequences of the health crisis (Kobak, 2021; Aron & Muellbauer, 2022; Wang et al., 2022). Methods for estimating excess mortality, as well as data quality, improved over time during the pandemic period. Excess mortality, defined as deaths above expected levels for specific periods, serves as a central indicator of the pandemic's impacts, providing insights beyond official COVID-19 case counts which may be influenced by varying testing strategies, case definitions, and registration approaches across countries (Karlinsky & Kobak, 2021; Hulíková Tesárková & Džúrová, 2022).

It is crucial to consider the context of observed trends as well as data availability and reliability for proper evaluation of excess mortality extent. Among various factors including disease burdens, age structure, and health system resilience, estimates of mortality excess are highly affected by data quality. In some

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countries, excess mortality far exceeded the reported number of COVID-19 deaths, which may signal underreporting of COVID-19 victims during the pandemic (Dommaraju et al., 2023; Msemburi et al., 2023). Democracy is often associated with trust in government and advancements in public health, as suggested by Nazarov and Obydenkova (2022). They argue that transitioning from one regime to another can impact population health outcomes. Karlinsky and Kobak (2021) delve into the relationship between testing capacities, reporting methods, and the reporting of COVID-19 deaths. Through analysis of excess mortality and undercount ratios across various countries published in the World Mortality Dataset (WMD), their findings reveal a widespread lack of complete data on COVID-19 deaths globally.

The COVID-19 pandemic prompted extensive scholarly inquiry into factors influencing mortality rates across different countries. Among various factors under scrutiny, the role of political regimes, particularly the level of democracy, has emerged as a topic of significant interest. Studies have explored how democratic governance influences mortality rates during pandemics, suggesting that democratic nations are better equipped to implement evidence-based policies, leading to fewer instances of deaths (Karabulut et al., 2021). Democratic countries may react slowly in the short term but place higher value on human life and health. In contrast, FSU countries with weaker democratic foundations may encounter challenges in early pandemic response despite implementing lockdowns, experiencing high levels of underreporting and consequently contributing to high excess mortality as an aftereffect of low reporting accuracy (Nikolova & Bejan, 2022). This brings to light the challenges faced by post-communist countries related to data accessibility, which may be limited due to various factors, including governmental constraints (Nazarov & Obydenkova, 2022). The reliance on international databases becomes particularly critical in the former Soviet Union region, where limited scientific attention has been given to mortality patterns and where national data accessibility remains problematic.

Karabulut et al. (2021) emphasize that democratic countries prioritize life and health, even if their initial reactions appear slower. This reinforces the notion that democracies place substantial emphasis on public health and awareness, which can significantly influence strategies for addressing pandemics. Addressing the issue of undercounting COVID-19 deaths, Kobak (2022) sheds light on disparities in reported figures among different countries. Countries with a tendency to undercount often exhibit mortality data gaps, potentially resulting from intentional misreporting or limitations in testing and reporting capacities. Beaney et al. (2020) emphasize that evaluating the impact of COVID-19 extends beyond mere mortality statistics. The pandemic's effects ripple across various dimensions, necessitating standardized data systems for comprehensive collection, including out-of-hospital deaths and all causes of death. An analysis of COVID-19 cases and deaths by Nikolova and Bejan (2022) reveal that Western democracies outperformed Eastern European states in the COVID-19 crisis. Various types of Western European countries generally reported lower numbers of COVID-19 deaths when compared to post-communist EU and FSU countries. The effectiveness of Central and East European states at the onset of the pandemic was credited to their rapid implementation of lockdowns, but the eventual higher mortality rate was attributed to their weaker economic base.

Besley and Kudamatsu (2006) highlight that healthcare policy interventions excel within democratic systems. Rieger and Wang (2022) underline the significance of trust in responses to pandemics, highlighting how trust influences compliance with government measures and censorship issues. The study

contributed to understanding the determinants of political trust in early pandemic crisis management. Using survey data from the first wave of COVID-19, the study documented that higher political trust was generally associated with greater compliance with epidemiological regulations. A number of studies have focused on testing the assumption that autocratic governments have been more effective in implementing anti-pandemic measures. Annaka (2021) analyzes the relationship between political regimes, data transparency and mortality from COVID-19. Using data from 108 countries, the study tested the assumption that democratic governments are at a disadvantage in dealing with the pandemic because they cannot intervene in the lives of their citizens as aggressively as authoritarian regimes. The analysis concluded that some authoritarian countries may have manipulated COVID-19 death data. Historical divisions within Europe, characterized by varying social welfare systems, healthcare accessibility, and levels of economic progress, have substantially affected population health outcomes (Jasilionis et al., 2023). The COVID-19 pandemic highlighted these systemic flaws, worsening mortality disparities. The COVID-19 pandemic exposed these systemic vulnerabilities, revealing significant disparities in healthcare capacity and public health responses across these regions. The pandemic served as a stress test for healthcare systems, exposing significant differences in resilience throughout the studied regions.

Eastern European countries encountered persistent challenges including insufficient healthcare funding, logistical constraints, and eroded public trust in health institutions (Shkolnikov et al., 2023). Countries such as Romania and Bulgaria experienced some of Europe's highest COVID-19 mortality rates due to limited healthcare resources and widespread vaccine hesitancy (Yli et al., 2022). Gender disparities in pandemic impacts were particularly pronounced in these regions. Men in Eastern Europe and former Soviet states experienced elevated direct mortality rates during the pandemic, largely attributed to prevalent risky health behaviors and underlying health conditions (Shkolnikov et al., 2023). Women in these regions faced severe indirect consequences, including reduced access to routine healthcare, intensified caregiving responsibilities, and increased domestic violence risks during lockdown periods.

Vaccination campaigns revealed stark regional differences within the post-communist space. While some post-communist EU countries achieved moderate coverage, FSU countries faced significant procurement delays, distribution inefficiencies, and extensive vaccine hesitancy that exacerbated mortality risks. Public skepticism, fueled by misinformation and historical distrust of government health programs, particularly hindered vaccination efforts across former Soviet territories (Yli et al., 2022). In Central Asia, reductions in infectious disease mortality have improved early-life survival rates, but sustaining these gains requires stable healthcare infrastructure (Myrkassymova et al., 2018). The healthcare models in Western European democracies, like those in Sweden, Germany, and the Netherlands, offer frameworks for equitable health access. Ongoing investments in healthcare infrastructure, workforce training, and public health programs have guaranteed that even at-risk groups obtain crucial medical services. Post-communist EU and FSU countries still struggle with healthcare system deficiencies arising from post-socialist transformations. Privatization initiatives aimed at modernizing healthcare frequently led to underfunded and fragmented systems, disproportionately impacting rural and low-income communities (Scheiring et al., 2018).

During the pandemic outbreak, increased attention on acquiring accurate excess mortality data came into focus. However, concerns arise regarding access to information and potential censorship, particularly in Russia (Kobak, 2021) and other former communist countries. Additionally, some national

statistical offices simply do not produce or publish their mortality data publicly, creating gaps in available information. The challenge of accurately measuring pandemic mortality, combined with limited data availability from certain countries, has led to the development of multiple international databases by organizations such as the World Health Organization (WHO), United Nations World Population Prospects (UN WPP), and research initiatives like the World Mortality Dataset (WMD). In the countries of the FSU, these international sources have become especially valuable where national data is unavailable or inaccessible, particularly given that the former Soviet Union region has received limited scientific attention in mortality research.

The variations in reported excess mortality figures often reflect the differing methodological approaches used by various organizations, rather than necessarily indicating inconsistencies or deficiencies in the underlying national data quality. While some research suggests that democracies are better equipped to handle health crises due to accountability and transparency mechanisms, others argue that authoritarian regimes may implement more stringent measures to contain the virus. In the context of post-communist countries, limited research exists on how the level of democracy influences COVID-19 mortality data consistency across multiple international sources. The reported health data quality is key to making more effective and informed health decisions; this is particularly crucial during a health crisis such as the COVID-19 pandemic.

This study focuses on examining a group of post-communist countries with different democracy levels – nine European Union nations and eight nations of the former Soviet Union. The main aim was to investigate COVID-19 mortality data reporting in association with democracy levels in post-communist countries of EU and FSU, regions that have received limited scientific attention due to the previous influence of the Soviet authoritarian governance (Marat, 2021). Rather than relying on national statistics alone, which are often unavailable from national statistical offices that do not publish data publicly, this approach examines how different international organizations construct excess mortality estimates from three reputable databases (WHO, UN WPP, and WMD), providing insights into data consistency and potential reporting challenges across varying democratic contexts. The reliance on these international data sources was essential given the limited accessibility of national mortality data in several post-communist countries, particularly in the FSU region where scientific attention has been historically constrained. The differences in reported values of mortality measures within particular countries at least partly reflect the reliability and consistency of data reporting, which is vital to consider in the analysis.

3. Data and methods

3.1 Data sources

This study focuses on examining the association between democracy levels and COVID-19 mortality data transparency in post-communist countries, specifically analyzing how democratic governance may influence the accuracy and reliability of mortality reporting during the pandemic. The analysis is narrowed to address this primary research question, examining seventeen post-communist countries: nine European Union (EU) member states with communist background and eight former Soviet Union (FSU) countries. All mortality indicators below are expressed as bi-annual averages for the two pandemic years – 2020 and 2021.

The analysis employs mortality indicators derived from multiple international data sources to assess underreporting patterns, combined with democracy measures to examine their association with data transparency. Due to the limited accessibility of national mortality statistics in several post-

communist countries, where national statistical offices often do not publish comprehensive mortality data publicly, this study relies on three reputable international databases: the World Health Organization (WHO), the World Mortality Dataset (WMD), and the United Nations World Population Prospects (UN WPP). This approach is particularly crucial for the former Soviet Union region, which has received limited scientific attention in mortality research and where national data accessibility remains problematic. While these international databases ultimately derive from national mortality data, they employ different methodological approaches for estimating excess mortality, and importantly, they provide the most comprehensive and accessible source of mortality information for countries where national data is not readily available to researchers. The comparison across these sources allows for assessment of data consistency and potential reporting challenges, particularly relevant in contexts where transparency concerns may exist.

3.1.1 Excess mortality rates

The first measure, Excess mortality rates were calculated as the number of excess deaths per 100,000 population using data from three international sources:

- i. WHO Excess Mortality Rate – EMR(WHO): WHO publishes estimated numbers of excess deaths for 2020 and 2021, calculated in comparison to baseline periods of 2015–2019 for countries with monthly historical data and 2000–2019 for those with annual historical data (WHO, 2023a). Population size data was obtained from the same database. WHO methodology details are available at: <https://www.who.int/publications/m/item/methods-for-estimating-the-excess-mortality-associated-with-the-covid-19-pandemic>.
- ii. WMD Excess Mortality Rate – EMR(WMD): Weekly and monthly numbers of excess deaths published in the WMD dataset were aggregated for 2020 and 2021 (WMD, 2023). The WMD methodology is detailed in Karlinsky and Kobak (2021). This database provides crucial data for regions with limited scientific attention, including FSU countries.
- iii. UN WPP Excess Mortality Rate – EMR(WPP): Using data on all deaths during 2015–2019 and 2020–2021 from the UN WPP dataset (UN WPP, 2023), expected deaths for 2020–2021 were estimated as the annual average during 2015–2019. Excess deaths were calculated as the difference between observed and expected deaths. This UN source provides essential data for countries where national statistical offices do not make mortality data publicly available.

Two complementary undercount ratios were calculated to assess potential underreporting of COVID-19 mortality following the methodology established by Karlinsky and Kobak (2021). The first measure, the Undercount Ratio for COVID-19 Deaths (URC-19), represents the ratio of excess deaths to registered COVID-19 deaths. This indicator provides insight into the accuracy of COVID-19 mortality reporting, with values around 1.0 indicating correspondence between excess mortality and reported COVID-19 deaths. When values are significantly higher than 1.0, this suggests either potential underreporting of COVID-19 deaths or additional mortality from other pandemic-related causes.

3.1.2 Undercount Ratio for All Deaths

The second measure, the Undercount Ratio for All Deaths (URall), calculates the ratio of excess deaths to total registered deaths during the pandemic period. This broader indicator represents the share of excess deaths in total observed mortality, providing context for understanding the overall impact of reporting discrepancies beyond COVID-19 specific deaths. Together, these two ratios offer complementary perspectives on mortality reporting accuracy, allowing for assessment of both disease-specific and

general mortality reporting patterns. The undercount ratios were calculated using data from the World Mortality Dataset (WMD) and UN World Population Prospects (UN WPP), as the WHO database provides excess mortality and mean values of estimated deaths from all-causes. This multi-source approach enables comparison of undercount estimates derived from different methodological frameworks while accounting for data availability constraints in the studied post-communist countries.

3.1.3 Democracy Index

The Democracy Index (DI) from The Economist Intelligence Unit was used to measure democratic governance levels. To address potential reverse causality concerns (where pandemic responses might affect democracy scores), democracy levels from 2019 were used rather than pandemic-period scores. This pre-pandemic measure better captures baseline democratic governance that may influence transparency and data reporting practices. DI scores for 2020 and 2021 were analyzed to examine democratic governance during the pandemic outbreak years. The Democracy Index ranges from 0–10 (most democratic) and classifies countries into four regime types: Full Democracy (8.01–10.0), Imperfect Democracy (6.01–8.0), Hybrid Regime (4.01–6.0), and Authoritarian Regime (0.0–4.0).

3.2 Statistical Analysis

The statistical analysis was designed to examine the association between democracy levels and COVID-19 mortality underreporting through an exploratory, multi-step approach using mortality indicators from international databases. Given the limited availability of comprehensive national mortality data in FSU countries, this study utilized standardized international datasets to enable cross-national comparison across post-communist EU and FSU countries. All mortality variables (excess mortality rates from WMD, UN WPP, and WHO sources, plus undercount ratios from WMD and UN WPP) were standardized using Z-scores (mean = 0, standard deviation = 1) to enable meaningful comparison across different scales and measurement units. Democracy classifications were based on the 2019, 2020 and 2021 Democracy Index from The Economist Intelligence Unit to establish baseline democracy levels before potential pandemic-related changes to governance and civil liberties.

Factor analysis with Varimax rotation was conducted to reduce the dimensionality of the six mortality variables and identify underlying structural patterns. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were used to assess the appropriateness of factor analysis. This dimensional reduction technique created synthetic variables that captured the underlying structure of mortality data while minimizing redundancy between variables, facilitating subsequent cluster analysis. Hierarchical cluster analysis was performed using between-groups linkage method with squared Euclidean distances. The analysis generated a dendrogram with distances rescaled to 0–25 to enhance interpretability while maintaining proportional relationships between clustering steps. This approach enabled clear identification of natural country groupings based on similar mortality and democracy patterns during the pandemic. The between-groups linkage method was selected as it provides balanced cluster sizes and is less sensitive to outliers compared to single linkage methods. The dendrogram visualization facilitated determination of the optimal number of clusters by identifying meaningful distance thresholds where distinct country groups emerged (Džurová & Květoň, 2021).

Following cluster identification, each cluster was characterized using descriptive statistics for all original variables. Mean values for democracy scores, excess mortality rates, and undercount ratios were calculated for each cluster to identify distinguishing

features. This characterization provided insights into how democracy levels relate to mortality reporting patterns across different country groupings. The analysis specifically examined patterns of COVID-19 mortality underreporting across country clusters, characteristics of identified clusters in relation to democracy levels, regional differences between post-communist EU and FSU countries, and distinct mortality impact profiles during the pandemic. Democracy classifications were verified against original Economist Intelligence Unit reports for 2019 to ensure accuracy. The analysis was conducted using different data sources, including WMD and UN WPP where available, allowing for comparison across international databases. This multi-source approach was particularly important given the varying data availability from national sources in post-communist countries, especially in the FSU region where scientific attention has been historically limited. Statistical analyses were performed using SPSS software, version 20. This clustering methodology was selected over regression analysis because it allows for natural grouping of countries based on multiple mortality indicators without assuming linear relationships between democracy and underreporting. The approach better captures complex patterns and associations that may not be adequately represented through simple parametric models, particularly given the heterogeneous nature of post-communist countries and their varied experiences during the pandemic.

4. Results

Table 1 shows for selected countries the values of the six studied mortality indicators for the two years at the start of the pandemic, 2020 and 2021. It outlines the information by region, country, and different data columns. The excess mortality rate per 100,000 inhabitants is listed under three data sources: the WMD, UN WPP (WPP) and the WHO. Likewise, the undercount ratios, both for deaths caused by COVID-19 (URC-19) and all causes of deaths (URall), are shown based on data from the WMD and the WPP.

Table 1 demonstrates variations across the seventeen countries, exposing the impact of COVID-19 and the accuracy of mortality reporting. The higher the difference between the calculated indicators within one country, the higher the data discrepancy between the databases can be assumed. For example, based on WMD data, an excess death rate of 568 per 100,000 population was calculated for Armenia. According to UN WPP data, the figure was calculated to be 608 per 100,000 population. Based on the WHO data source, a figure of 715 per 100,000 population was calculated. With regards to the undercount ratios of reported deaths, it can be observed that FSU countries have the highest values of undercount. Specifically, Kyrgyzstan (5.19), Kazakhstan (4.43), Azerbaijan (3.92), and Russia (3.48). In turn, the results among the post-communist countries of the EU typically range between 1.0 and 2.3 for the indicators, except for Lithuania (2.26).

Table 2 provides a comprehensive overview of the Democracy Index scores and regime classifications for the analyzed countries during pre-pandemic (2019) and pandemic years (2020–2021). The most common regime type was 'Flawed Democracy' (11 countries), encompassing all post-communist EU member states plus Moldova and Ukraine from the FSU region. 'Hybrid Regime' was represented by three FSU countries (Armenia, Georgia, Kyrgyzstan), while 'Authoritarian Regime' included three FSU countries (Kazakhstan, Azerbaijan, Russia). Notably, none of the countries analyzed achieved 'Full Democracy' status during the study period.

Clear regional patterns emerge in the democracy scores. FSU countries averaged a Democracy Index of 4.54 in 2019, significantly lower than post-communist EU countries, which

Region	Country	Excess mortality rate			Undercount ratio		
		EMR (WMD)	EMR (WPP)	EMR (WHO)	URC-19 (WMD)	URall (WMD)	URall (WPP)
Former Soviet Union countries	Armenia	568	608	715	2.49	0.24	0.24
	Azerbaijan	324	708	327	3.92	0.22	0.36
	Georgia	552	371	612	1.48	0.19	0.13
	Kazakhstan	427	397	436	4.43	0.23	0.20
	Kyrgyzstan	219	153	222	5.19	0.18	0.12
	Moldova	598	280	532	1.53	0.18	0.09
	Russia	749	617	753	3.48	0.24	0.19
	Ukraine	407	625	430	1.86	0.13	0.19
Post-communist countries of EU	Bulgaria	801	798	875	1.86	0.21	0.19
	Czech Republic	392	349	412	1.14	0.15	0.14
	Estonia	220	296	257	1.51	0.08	0.11
	Hungary	371	357	402	0.92	0.12	0.12
	Latvia	387	356	412	1.60	0.11	0.09
	Lithuania	600	424	624	2.26	0.18	0.12
	Poland	420	439	426	1.63	0.16	0.17
	Romania	555	458	586	1.81	0.17	0.15
	Slovakia	455	454	480	1.49	0.19	0.18

Tab. 1: Excess mortality rates (EMR per 100,000 population) and undercount ratios for COVID-19 deaths (URC-19) and all deaths (URall) in post-communist EU and FSU countries in 2020–2021

Source: Author's calculation

Region	Country	Type of regime	DI 2019	DI (2020–2021)
Former Soviet Union countries	Armenia	Hybrid Regime	5.54	5.42
	Azerbaijan	Authoritarian Regime	2.75	2.68
	Georgia	Hybrid Regime	5.42	5.22
	Kazakhstan	Authoritarian Regime	2.94	3.11
	Kyrgyzstan	Hybrid Regime	4.89	3.92
	Moldova	Flawed Democracy	5.75	5.94
	Russia	Authoritarian Regime	3.11	3.28
	Ukraine	Flawed Democracy	5.90	5.69
Post-communist countries of EU	Bulgaria	Flawed Democracy	7.03	6.68
	Czech Republic	Flawed Democracy	7.69	7.71
	Estonia	Flawed Democracy	7.90	7.84
	Hungary	Flawed Democracy	6.63	6.53
	Latvia	Flawed Democracy	7.49	7.28
	Lithuania	Flawed Democracy	7.50	7.16
	Poland	Flawed Democracy	6.62	6.83
	Romania	Flawed Democracy	6.49	6.42
	Slovakia	Flawed Democracy	7.17	7.00

Tab. 2: Democracy index (DI) scores and political regime classifications in post-communist EU and FSU countries – Pre-Pandemic (2019) and Pandemic Years (2020–2021)

Source: The Economist Intelligence Unit Limited, 2022

averaged 7.17. This 58% difference highlights the divergent democratic trajectories between these regions since the end of communist rule. Among all evaluated countries, Estonia achieved the highest democracy score (DI = 7.84 in 2020–2021), while Azerbaijan recorded the lowest (DI = 2.68 in 2020–2021).

The temporal analysis reveals relatively stable democracy levels between 2019 and 2020–2021, with most countries showing minimal changes. However, some notable shifts occurred: Kyrgyzstan experienced a significant decline from 4.89 to 3.92, while Kazakhstan showed a modest improvement from 2.94 to 3.11. Among EU countries, most maintained stable scores, with Czech Republic showing slight improvement (7.69 to 7.71) and Lithuania experiencing a modest decline (7.50 to 7.15).

Within the FSU region, four countries (Armenia, Georgia, Moldova, Ukraine) achieved democratization levels comparable to some EU post-communist countries, while the three authoritarian regimes (Russia, Kazakhstan, Azerbaijan) showed the least democratic progress. Among post-communist EU countries, Estonia (7.84) showed the highest scores, followed by Czech Republic (7.71), while Romania (6.42) and Hungary (6.53) had relatively lower scores within the EU group, though still substantially higher than most FSU countries.

Factor analysis with Varimax rotation identified two underlying dimensions. Bartlett's test ($p < 0.001$) confirmed the appropriateness of factor analysis. Factor analysis revealed two primary dimensions. Factor 1 (loadings ranging from -1.09 to 2.25) appeared to differentiate countries by statistical reporting capacity, with former Soviet republics showing the highest positive loadings (Azerbaijan: 2.25, Kazakhstan: 1.69, Russia: 1.20). Factor 2 (loadings ranging from -1.96 to 2.22) captured a second dimension of variation, with Bulgaria (2.22) and Russia (1.35) showing high positive loadings, while Kyrgyzstan (-1.96) loaded strongly negative.

The hierarchical cluster analysis using between-groups linkage method with squared Euclidean distances resulted in four distinct clusters. A graphical output from the cluster analysis (Fig. 1), the dendrogram, provides a synthesizing view of the similarities and differences of the selected set of countries based on the Democracy indices and 6 observed mortality characteristics. The horizontal axis represents the rescaled dissimilarity distance (0–25), with the optimal cut point at distance 10.0 producing four meaningful clusters: Cluster 1 (Mixed Democracy Moderate Impact) comprising Moldova, Slovakia, Georgia, Romania, Lithuania and Ukraine; Cluster 2 (High Democracy Low Impact) including Hungary,

Latvia, Czech Republic, Estonia; Cluster 3 (Variable Democracy High Impact) containing Armenia, Russia and Bulgaria; and Cluster 4 (Low Democracy High Impact) encompassing Azerbaijan, Kyrgyzstan and Kazakhstan.

Countries are shown on the vertical axis of the graph. An imaginary cut was chosen at distance 10.0, creating four clusters of countries, the distribution of countries into clusters is shown in Table 3. It presents the comprehensive characteristics of the four distinct clusters identified through hierarchical cluster analysis, revealing systematic patterns linking democratic governance to COVID-19 mortality reporting quality across all measured variables.

Cluster 1 (Mixed Democracy Moderate Impact) consists of seven countries (Georgia, Moldova, Ukraine, Lithuania, Poland, Romania, Slovakia) representing a mixed group of FSU and EU countries with moderate democracy levels (mean DI 2019: 6.41, 2020–21: 6.32) and intermediate mortality patterns. This cluster exhibits moderate excess mortality rates (WMD: 512; WPP: 436; WHO: 527 per 100,000) and moderate undercount ratios (WMD: 1.72), with consistent transparency across data sources (URall WMD: 0.171; URall WPP: 0.147), highlighting discrepancies in mortality accounting across international databases.

Cluster 2 (High Democracy Low Impact) comprises four EU countries (Hungary, Latvia, Czech Republic, Estonia) with the highest democracy scores (mean DI 2019: 7.43, 2020–21: 7.34) and

the most favorable mortality outcomes. This cluster demonstrates optimal results with the lowest excess mortality rates (WMD: 343; WPP: 340; WHO: 371 per 100,000) and the lowest undercount ratios (WMD: 1.29), indicating high data transparency and reporting accuracy across all sources (URall WMD: 0.115; URall WPP: 0.115). These countries represent the benchmark for democratic governance and transparent health data reporting during the pandemic.

Cluster 3 (Variable Democracy High Impact) represents three countries (Armenia, Russia, Bulgaria) with heterogeneous democracy levels (mean DI 2019: 5.23, 2020–21: 5.13) and the highest mortality load. This cluster shows the highest excess mortality rates across all data sources (WMD: 706; WPP: 674; WHO: 781 per 100,000) while displaying elevated undercount ratios (WMD: 2.61) and variable consistency (URall WMD: 0.23; URall WPP: 0.207). The mixed composition of FSU countries (Armenia, Russia) and one EU country (Bulgaria).

Cluster 4 (Low Democracy High Impact) encompasses three FSU countries (Azerbaijan, Kazakhstan, Kyrgyzstan) characterized by the lowest democracy levels (mean DI 2019: 3.53, 2020–21: 3.24) and the most severe underreporting patterns. Despite showing moderate excess mortality rates (WMD: 323; WPP: 419; WHO: 328 per 100,000), this cluster exhibits the highest undercount ratios (WMD: 4.51), indicating significant transparency deficits in mortality reporting (URall WMD: 0.210; URall WPP: 0.227).

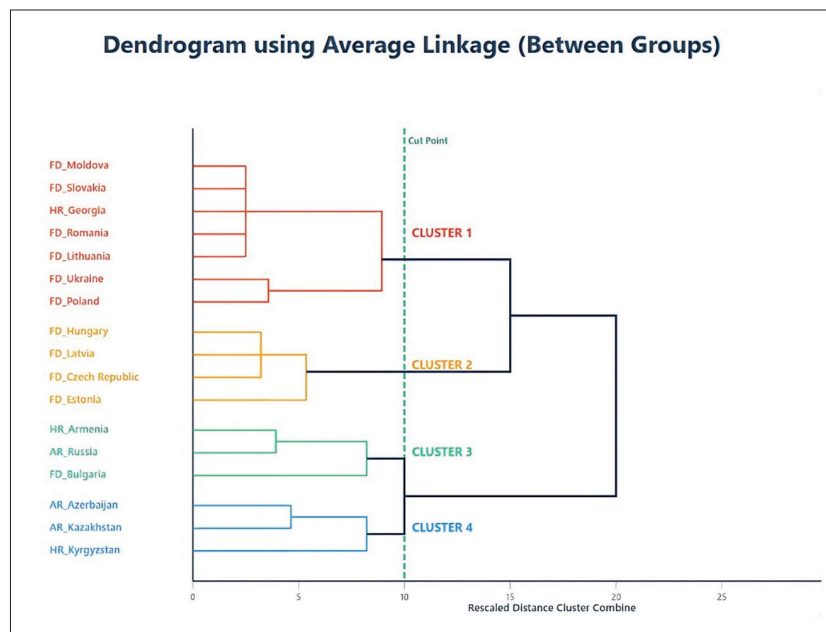


Fig. 1: Hierarchical clustering of post-communist EU and FSU countries

Note: Countries are color-coded by cluster membership. Distance scale rescaled 0–25 for interpretability

Source: Author's calculation, output of the IBM SPSS Statistical Software, version 20. Data visualization was enhanced using AI-assisted programming for improved clarity and presentation

Cluster/Countries (n)	Mean DI 2019	Mean DI 2020–2021	Mean EMR WMD*	Mean EMR WPP*	Mean EMR WHO*	Mean URC-19 WMD*	Mean URall WMD*	Mean URall WPP*
1/ Moldova, Slovakia, Georgia, Romania, Lithuania, Ukraine, Poland	6.41	6.32	512	436	527	1.72	0.171	0.147
2/ Hungary, Latvia, Czech Republic, Estonia	7.43	7.34	343	340	371	1.29	0.115	0.115
3/ Armenia, Russia, Bulgaria	5.23	5.13	706	674	781	2.61	0.23	0.207
4/ Azerbaijan, Kazakhstan, Kyrgyzstan	3.53	3.24	323	419	328	4.51	0.21	0.227

Tab. 3: Cluster characteristics – Democracy index scores, excess mortality rates, and undercount ratios by country groups in post-communist EU and FSU countries

Note: for abbreviations, see previous tables

Source: Author's calculation, IBM SPSS Statistical Software, version 20

The comprehensive analysis confirms an inverse association between democratic governance quality and mortality data underreporting. While Cluster 2 demonstrates the strongest democracy-transparency link (highest democracy scores, lowest undercount ratio), the mixed composition of other clusters reveals that this relationship operates alongside additional factors. Cluster 1's moderate performance despite including both FSU and EU countries, and Cluster 3's high mortality load despite variable democracy levels, suggest that regional, institutional, or pandemic impact factors also influence reporting patterns. Nevertheless, the democracy-transparency pattern remains consistent across different data sources, supporting the hypothesis that governance structures significantly influence public health data transparency.

5. Discussion

Previous research has largely focused on how democratic governance influences population health outcomes. Nevertheless, the reliability of underlying data remains fundamental to calculating accurate health indicators. This study examines the possible association between the state of democracy (assessed by the democracy index) and the reporting of death data in 17 countries based on global databases during the early phase of the pandemic.

Defining the quality of democracy as a history of independent statehood, the nature of state development, and the quality of state institutions, 'Flawed Democracies' are common in developing regions of Eastern Europe, Asia, Latin America, and Sub-Saharan Africa. Eastern Europe is unique due to its historical experiences and lacks a single 'Full Democracy.' 'Hybrid Regimes' and 'Authoritarian Regimes' are most concentrated in Sub-Saharan Africa, the Middle East, and to some extent in Asia, Latin America, and Eastern Europe, thus emphasizing specific countries which were under communist rule (The Economist Intelligence Unit, 2022). In contrast, there were no countries classified as 'Full Democracy' among the selected studied group. This classification method enabled me to unveil the actual situation regarding COVID-19 death reporting practices in various democracy regime types within two studied subregions.

The investigation ascertained the extent of underreporting and discrepancies of COVID-19 deaths. For this study, the excess number of deaths associated with the pandemic was estimated and the accuracy of reported data was identified. According to Msemburi et al. (2023), a unified concept of excess mortality that has been recognized for centuries was applied to all three data sources. It refers to the difference in the total number of deaths during a health crisis compared to those expected under normal circumstances. The information about the total number of deaths during and before the pandemic was required to determine the expected number of deaths, accounting for variations in reporting. A significant limitation of the study is clear – all three values of the excess mortality for all the countries are estimated not only using different data sources but above all different methodology. The use of international databases rather than national sources was necessitated by fundamental data availability constraints in FSU countries. Many FSU national statistical offices do not publish complete, standardized, or timely mortality data, making direct comparison of official national statistics either impossible or highly unreliable. This lack of transparency in authoritarian and hybrid regimes represents part of the phenomenon this study aims to demonstrate.

Specifically, the WHO uses binomial models to estimate expected mortality by considering monthly and annual data (WHO, 2023b), while WMD relies on country specific regression models based on weekly and monthly data (Karlinsky & Kobak, 2021). In contrast, excess mortality based on UN WPP data was estimated by comparing observed deaths with expected deaths derived from annual data. These differences in methodology pose challenges

in terms of comparability due to variations in data precision and statistical modelling approaches. As highlighted by authors (Aron & Muellbauer, 2022; Levitt et al., 2022; Msemburi et al., 2023), this study similarly underlines the relative comparability of statistical measures of excess mortality given these methodological differences. It's essential to recognize that not every countries' vital registration system can provide complete weekly or monthly data during pandemic years (Dommaraju et al., 2023).

Considering all the external factors affecting the total number of deaths during this period, individual approximations within the research context allowed to assess the transparency of COVID-19 death reporting. The findings revealed that the WMD has the most complete data for excess mortality rates given each country's unique circumstances. The outcomes concur with the comparative assessment results of Msemburi et al. (2023) and Karlinsky and Kobak (2021). The outcomes demonstrated discrepancies between the estimates based on data published by the UN WPP and those available from the WMD and WHO. Accordingly, the WMD considers all historical data – influenza outbreaks, excess deaths caused by military conflicts which affect excess mortality estimates in countries in their compilations. For instance, the data for Armenia and Azerbaijan was skewed due to their involvement in Nagorno-Karabakh armed conflict of 2020–2021. Karlinsky and Kobak (2021), accounted for deaths attributed to armed conflict in this case by subtracting 4,000 deaths from each country's total mortality rates due to COVID-19. Trilling (2021) similarly highlights the efficiency of the WMD by specifying that before the publication of their estimations, the FSU countries of Central Asia insisted on the existence of small errors, which was subsequently refuted by this dataset.

The study emphasized varying government regimes as playing a central role in finding and gaining access to accurate data. Free democratic regimes and accurate data correlate as opposed to countries with weakened representative democracies (Guasti, 2020). The research results highlight countries within FSU, those governed by AR and HR have shown higher undercount ratios of all deaths varying from 1.48 to 5.19 as compared to EU countries governed by FD among the post-communist countries. The factor analysis revealed two underlying dimensions, with the first factor distinguishing countries primarily by statistical reporting capacity (FSU countries showing highest loadings: Azerbaijan 2.25, Kazakhstan 1.69, Russia 1.20) and the second factor capturing pandemic impact variation (ranging from Bulgaria 2.22 to Kyrgyzstan – 1.96).

Of particular significance was the case of Georgia, an FSU country with a hybrid democracy. The undercount ratio of COVID-19 deaths for 2020–2021 was among the lower values in the mixed regime cluster. Such relative transparency may be attributed to intensive investments in public healthcare by the Georgian government in 2019 and the World Bank in 2020; particularly, its digitalization and the pandemic management (World Bank, 2021; Zoidze et al., 2021; WHO, 2020).

The hierarchical cluster analysis classified countries into four distinct groups based on democracy and COVID-19 mortality patterns. Cluster 1 consists of seven countries (Moldova, Slovakia, Georgia, Romania, Lithuania, Ukraine, Poland) representing a mixed EU-FSU composition with moderate democracy levels and intermediate reporting patterns (undercount ratio: 1.72). Cluster 2 comprises four EU countries (Hungary, Latvia, Czech Republic, Estonia) with the highest democracy scores and the most favorable mortality reporting indicators, demonstrating optimal transparency. Cluster 3 represents three countries (Armenia, Russia, Bulgaria) with variable democracy scores and the highest mortality load, showing elevated transparency deficits compared to more democratic clusters. Cluster 4 encompasses three FSU countries (Azerbaijan, Kazakhstan, Kyrgyzstan) with the lowest

democracy levels and the most severe underreporting patterns, reflecting authoritarian governance structures that reflecting governance structures associated with reduced transparency in public health data reporting.

Concurrent with these views, the following authors pointed out that centralized government types substantially influence public health statistics. For instance, Boräng et al. (2018) and Sandefur and Glassman (2015) provide insights into how government interference in data reporting can lead to discrepancies. The Coronavirus crisis has underscored the critical value of comprehensive excess mortality data in assessing the true impact of the pandemic on societies (Rieger & Wang, 2022; Aron & Muellbauer, 2022). This evolving field, marked by shifting perspectives, is particularly relevant to FSU countries. Suppression of truthful and accurate information and government skewed data ratios, noting the pressure on entities tasked with reporting health statistics was indicated as an undercount ratio of reported deaths above 1.0 by Kobak (2022).

The results reveal varying degrees of underreporting in documented COVID-19 deaths across countries indicating possible manipulation of data to hide the true impact of the pandemic. It's important to note that the presence of underreporting doesn't definitively prove data manipulation since other statistical anomalies can also indicate reporting inaccuracies. Developing nations with robust mortality tracking systems may have a significant number of unreported COVID-19 fatalities even without any anomalies in their reporting procedures (Kobak, 2022).

Examining the issues of underreporting of COVID-19 deaths in the context of democratization, this study provided insights into the influence of political governance and mortality outcomes. Through the analysis of countries in the EU and FSU, valuable perspectives emerge regarding the factors affecting excess mortality rates and undercount ratios during the Coronavirus. The findings underscore a discernible association between democracy and transparency of mortality statistics, indicating significantly lower levels of undercounts in EU Flawed Democracies compared to AR or HR in FSU countries. This research advocates for an evaluation of the accurate accounting of deaths reporting and an in-depth exploration of its association with specific levels of democratization, considering other potential factors affecting their transparency. This study will impact the advancement of mortality statistics for research institutions operating in countries characterized by heightened levels of censorship. While democratic practices contribute to effective pandemic responses, a myriad of factors collectively shape mortality outcomes. Transparent reporting of COVID-19 data emerges as vital for comprehending the pandemic's impact across countries. Democracy's role in enhancing data accessibility and its effect on mortality data reporting in FSU and post-communist EU nations underscores the importance of democratization.

6. Conclusions

This study fills a gap in current knowledge to what extent the level of democracy can be related to the reporting of health data in the relatively few studied countries of the blocs of former Soviet Union countries and post-communist countries of the EU. Through comprehensive analysis of multiple data sources, the World Mortality Database (WMD) was identified as the most reliable source for COVID-19 mortality data in these regions, providing researchers with a validated reference for future studies. The factor analysis identified two underlying dimensions differentiating countries, while hierarchical cluster analysis revealed four distinct country groupings based on democracy and mortality characteristics. Based on the observed differences between countries, the results suggest that some countries may have underreported the data during the COVID-19 pandemic.

The results demonstrate a clear inverse association between democracy levels and COVID-19 mortality data transparency, with lower levels of democracy consistently associated with reduced transparency in health data reporting. These findings suggest that a low level of democracy may be a risk factor for the transparency of health data reporting, with authoritarian FSU countries showing the highest undercount ratios compared to more democratic post-communist EU countries. Poor data quality creates systemic risks that hinder accurate crisis assessment with life-threatening consequences. This study highlights the critical value of independent international databases for accountability where national systems fail, and underscores the need for improved data coordination. Future research should further examine democracy's impact on health reporting during infectious disease outbreaks to enhance pandemic preparedness and response effectiveness.

6.1 Limitations

Several methodological considerations should be noted. This exploratory study identifies patterns between democracy and mortality reporting rather than establishing direct causal relationships. Future research employing larger samples and regression analysis could test specific causal hypotheses about democracy's effect on health data transparency. Data availability constraints affected some calculations. Undercount ratio calculations were constrained by data source limitations. COVID-19 undercount ratios could only be calculated using WMD data, as UN WPP provides annual total mortality data but lacks COVID-19 specific death counts necessary for these computations. While WHO provides excess mortality and mean values of estimated deaths from all-causes, undercount ratios were calculated exclusively from WMD and UN WPP sources.

The study recognizes inherent methodological differences between the three international databases, which necessitated averaged comparisons. While the reliance on international databases was necessary given limited national data availability in FSU countries, this approach constrains direct assessment of national reporting practices. The Democracy Index, while providing valuable regime classifications, may not comprehensively capture all governance factors affecting mortality underreporting, including administrative capacity and healthcare system organization. The use of 2019 DI scores addresses potential reverse causality concerns by establishing baseline democracy levels before the pandemic.

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