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The transition from COVID-19 infections to deaths: Do governance quality and corruption affect it?

Bartosz Gebka [a,*], Rama Prasad Kanungo [b], John Wildman [a]

[a] *Newcastle University Business School, Newcastle University, 5 Barrack Road, Newcastle upon Tyne NE1 4SE, UK*

[b] *UCL (University College London), Global Business School for Health, 7 Sidings Street, Stratford, London, E20 2AE, UK*

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Abstract

We investigate the impact of governance quality and corruption on the propensity of COVID-19 infections to result in deaths, while controlling for a wide range of socio-economic country characteristics, for 139 countries. Governance quality is negatively associated with mortality from COVID-19, for a given number of infections. This result holds for the aggregate governance index and for most of its components, in particular government effectiveness, rule of law, and control of corruption. Corruption among business executives, judges and magistrates, the legislature, and among government officials exerts the largest impact on COVID-induced deaths. We propose directions for future policy initiatives.

JEL Classification: D73; I18; K42

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* Corresponding author.
E-mail address: b.t.gebka@ncl.ac.uk (B. Gebka).

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1. Introduction

What are the public health costs of low governance[1] quality and high corruption[2]? An international comparison of COVID-19 mortality, due to the exogenous and simultaneous nature of the pandemic shock, lends itself particularly well to an analysis of this problem. A comprehensive empirical investigation allows us to arrive at robust conclusions and to derive a number of policy recommendations.

The emerging body of research on the determinants of COVID-19 health outcomes across countries suggests a number of factors contributing to the spread of, and mortality due to, the virus, including pre-existing health conditions, availability and quality of healthcare infrastructure and services, stringency of government responses to pandemic's outbreaks and their uptake by society, overall living standards, etc. (e.g., Bosancianu et al., 2020; Chaudhry et al., 2020; Funke et al., 2023; Wildman, 2021). Of particular interest is the fact that the evidence regarding whether governance and/or corruption exert a significant impact on COVID-related health outcomes is inconclusive, with some studies finding supportive evidence for such a relationship (e.g., Alfano et al., 2022a; Attila, 2020, for developing countries; Ezeibe et al., 2020; Feng et al., 2022; García, 2019) while others observe no such a link (e.g., Attila, 2020, for developed countries; Bosancianu et al., 2020; Chaudhry, 2020). Here, we aim to resolve this empirical puzzle by investigating how two policy-related factors, governance quality and corruption, affect the link between COVID infections and deaths. Hence, our focus differs from that in the literature which models infections or deaths directly.

Evidence linking governance, corruption, and COVID can be derived from three distinct sources: the medical profession,[3] governmental and non-governmental bodies,[4] and academic research. We can identify three channels through which corruption could be affecting health outcomes in general, and COVID mortality in particular. Firstly, corruption leads to misallocation and embezzlement of resources in the healthcare system, reducing its efficacy (Bruckner, 2019; Petkov & Cohen, 2016; WHO, 2020). Secondly, corruption erodes citizens' trust in public institutions (Anderson & Tverdova, 2003; Dincer & Gillanders, 2021; Elgar et al., 2020), which could lead to a diminished compliance with, or uptake of, otherwise reasonable policy measures such as social distancing, face covering, or lockdowns (Alfano & Ercolano, 2020; Alfano et al., 2022a; Bargain & Aminjonov, 2020; Bartscher et al., 2021;

[1] In this paper, we do not test any specific governance theory, rather, we seek to understand the impact of different aspects of governance and corruption on the COVID infections-mortality nexus on a global scale. We largely rely on the most comprehensive dataset of governance indicators, provided by the World Bank (see Kaufmann & Kraay, 2007).

[2] Kaufmann (2005) stresses that governance and corruption are related but not identical phenomena, and offers a narrow (the abuse of public office for private gain) and a broader (the privatization of public policy) definition of corruption; these ideas underly the measure of corruption we use. We also employ data on corruption from Transparency International who define this phenomenon as "the abuse of entrusted power for private gain".

[3] E.g., the *British Medical Journal* (Abbasi, 2020) explicitly links corruption, politicisation of science, and COVID-19 deaths in the UK; *The Oncologist* (Chabner, 2020) documents how science and the rule of reason were repressed and corrupted for political ends in the US, resulting in adverse public health consequences.

[4] Various international organisations warned that corruption could hamper the efforts to limit the spread and mortality of COVID-19. E.g., the United Nations' General Secretary issued a statement warning of the risk of rising corruption and a call for greater diligence and transparency (United Nations, 2020). The World Justice Project (2020) warned of the pandemic being a "perfect storm" for corruption, as immense additional resources were mobilised quickly without the time or matching capacities to scrutinise and monitor their use. Similarly, the OECD (2020) highlighted the heightened risk of corruption during the pandemic.

Funke et al., 2023; Kawachi et al., 2013). Thirdly, experience of corruption leads to deterioration of mental health (Achim et al., 2020; Sharma et al., 2021); hence, due to mental health problems negatively affecting physical heath (Prince et al., 2007), COVID infections in more corrupt environments should be expected to lead to higher mortality (especially so given that COVID experience leads to further deterioration of mental health: Lindert et al., 2021).

Prior to the COVID-19 crisis the link between corruption and health outcomes had been extensively highlighted, and calls for policy interventions were repeatedly made. For instance, in the aptly named report on 'The ignored pandemic' of corruption, Transparency International (Bruckner, 2019) reported that corruption in the healthcare sector worldwide causes losses of over US$500 billion per year and is responsible for 140,000 child deaths annually, among other damage. Healthcare systems are affected by 37 distinct types of corruption including medical staff's absenteeism, enforcement of informal payments from patients, direct theft and embezzlement, quality, availability and costs of service provision, favouritism, and manipulation of relevant data (Petkov & Cohen, 2016). These acts reduce the effectiveness and equity of healthcare provision, to the detriment of health outcomes (Achim et al., 2020).

Given the importance of this issue to societies and policy makers, we empirically study what factors affect COVID mortality rates. Faced with mixed findings regarding the link between COVID-19 and health outcomes, we propose that governance quality, including corruption levels, and other relevant factors do not necessarily affect COVID mortality directly, but rather influence the infection-deaths nexus. We hypothesise that inefficient governance and high levels of corruption increase the probability that COVID infections lead to deaths. Our empirical analysis of 139 countries in the pre-mass-vaccinations period of up to 30 April 2021 yields strong support for this hypothesis.

We make a number of contributions to the literature. Firstly, our results offer a potential resolution of the ongoing discussion on the impact of two aspects of political ecosystems, governance and corruption, on COVID mortality. Secondly, in a novel approach, we model corruption and governance as part of the infections-mortality nexus, rather than assuming their direct and unconditional impact on infections or deaths. Studies most conceptually similar to this approach are those which consider the fatality rate (Attila, 2020; Zimmermann et al., 2020); however, we make further contributions as we (i) analyse time-variations in the effects of corruption and governance over different stages of the pandemic, (ii) investigate the impact of aggregate governance quality as well as its subcomponents and, (iii) look closer into how corruption of different groups in the society drives our results. Lastly, we contribute to the broader debate on the societal impact of corruption in general: while most scholars would agree that corruption affects societies negatively (Abdulla, 2021; Knyazev, 2022), arguments have also been made that it fosters social cohesion, provides stability, and overcomes inefficient inertia ("greases the wheels") and boundaries (e.g., Krammer, 2019; Nye, 1967; see Castro et al., 2020, and Dimant & Tosato, 2018, for reviews of the corruption literature). Our results help both, to understand political forces driving public health outcomes, and to inform discussions about required policy and broader societal interventions.

2. Determinants of COVID-19 health effects

There is an emerging academic literature analysing how many COVID-19-related deaths are attributable to corruption and inefficient governance rather than other, health-related and broader socio-economic factors. For instance, Dincer and Gillanders (2021) demonstrate that people living in more corrupt US states are less likely to comply with confinement recommendations/policies, which suggests that corruption damages social capital and legitimacy of government policies such as confinement, ultimately leading to more infections and deaths. In a similar vein, Funke et al. (2023) show that voluntary social distancing was the dominant force behind effectiveness of confinement policies, and argue that such measures require credible communication and government's legitimacy to be effective. Elgar et al. (2020), who employ data for 84 countries on four dimensions of social capital: trust, group affiliations, civic engagement, and trust in state institutions, analyse a 30-day period following the recording of the tenth virus death. Their results show that mortality was positively related to trust, inequality, and group affiliations and negatively related to social capital from civic engagement and confidence in state institutions, after controlling for population size, age, and wealth. Bargain and Aminjonov (2020) demonstrate that the compliance with COVID-related containment policies is stronger in Europe for higher levels of trust in policy makers, while Alfano et al. (2022a) and Bartscher et al. (2021) show that higher levels of social capital are associated with lower infection and mortality rates. Bosancianu et al. (2020) analyse the economic and social determinants of COVID-19 deaths in up to 143 countries in April and late-May 2020 and find evidence of a positive impact of interpersonal and institutional trust and negative impact of bureaucratic corruption on reducing death rates. Similarly, Attila (2020) using data for 114 countries finds an impact of corruption on COVID-19 cases and deaths, although this effect appears to be driven almost exclusively by developing countries. For a sample of 100 countries, Feng et al. (2021) find that government effectiveness lowers COVID mortality. For Nigeria, Ezeibe et al. (2020) find that political corruption motivates large-scale political distrust that undermines public compliance with government recommendations and policies, limits the outcomes of government responses to COVID-19, and facilitates the spread of the virus. Overall, there is an emerging body of evidence that corruption, hence poor governance more generally, exacerbates the deadly impact of the COVID-19 pandemic on societies world-wide.

3. Data and methods

We use data on COVID-19 from the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU) as reported on the "Our World in Data" website.[5] The dependent variable, $Mortality_i$, is the cumulated COVID-induced mortality in country i (per million people) up to a certain timepoint. We measure the total cumulative number of COVID-19 infections in country i (in relation to its population), $Infect_i$, at the same timepoint. Both variables capture cumulative numbers since the pandemic's inception at four points in time, to allow for inference on short- versus long-term drivers of the infections-mortality nexus: 30 Apr. 2020, 31 Aug. 2020, 31 Dec. 2020, and 30 Apr. 2021; we use the latest one in our main analysis and the remaining dates in the analysis of shorter-term effects. To adjust for their skewed distribution and to reduce heteroskedasticity, their values are transformed using natural logarithms. In the main analysis we use data on 139 countries (listed in Table A1 in the Appendix), this changes in sub-analyses where varying data requirements and availability affect the sample size.

[5] While this COVID outcomes data may suffer from measurement errors, the data come from a reputable academic source and allows for a large sample and therefore credible results, ceteris paribus. It is widely used in research.

Our pandemic sample period starts on 22 Feb. 2020, when the JHU dataset reports first infections in early affected countries (for other countries first infections have taken place after that date), and ends on 30 Apr. 2021. This corresponds to roughly one year, which is important, as having a seasonally unbalanced period could contaminate the results by allowing the usual seasonal health effects (e.g., flu) to affect mortality. In addition, going beyond our sample period would allow for vaccination effects to interfere with the phenomena measured here; our sample covers a period when vaccinations only started to be rolled out worldwide and, hence, the impact of other factors we are considering was not being confounded by country-specific inoculation-driven effects on infections and mortality.[6]

Our main causal phenomenon of interest is governance quality in a country, with special attention paid to corruption. We also control for a wide range of socio-economic country characteristics, as suggested by the relevant aforementioned literature Table A2 in the Appendix contains the list of those variables as well as their descriptions and sources). To deal with high correlations and the high-dimensionality problem resulting from utilising a large number of variables, we conduct a preliminary grouping of those variables into categories and employ principal component analysis (PCA) to extract uncorrelated factors which are common to the variables in each category (determined by the rule of eigenvalues being significantly higher than one: Kaiser, 1960). Our choice of variables is driven by the literature, theoretical arguments, and data availability, as we aim to maximise the number of countries considered.

The "Governance quality including corruption" category of variables constitutes the core potential driver of the infections-deaths nexus which is of interest to us, and its inclusion into the analysis is theoretically justified by the three channels (misallocation and embezzlement of resources, impact on social trust, and on mental health) as discussed Section 1. Here, we include two measures of corruption: the control of corruption from World Governance Indicators (WGI) and the Corruption Perception Index (CPI) from Transparency International (TI). Higher values of each corruption-related variable imply good governance, i.e., lower levels of corruption. We also include: political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and voice and accountability as a range of other governance-related variables. As a more indirect measure of governance quality, we also include the ease-of-doing-business index.

PCA is applied to these highly correlated variables to extract common uncorrelated factors and we find one common dominant component that explains as much as 84.86% of the total variance, and records qualitatively equal loadings from all variables considered here.[7] We therefore employ this component, termed $GovQual_i$ henceforth, as a measure of governance quality. We also consider in further analysis the impact (i) of each of its individual components, especially of both corruption measures, and (ii) of perceived corruption among incumbents of specific groups, on the COVID infections-mortality nexus.[8]

We control for a wide range of country characteristics covering socio-economic pre-conditions, health pre-conditions, healthcare infrastructure, governmental COVID response as measured by the stringency of lockdowns, GDP, and population size. Table A3 in the Appendix

[6] Goel et al. (2021) and Usman et al. (2022) discuss avenues for corruption to affect the rollout of COVID vaccines, while Farzanegan and Hofmann (2021) show empirically that vaccinations rollouts were indeed slower in more corrupt countries.

[7] Full results of the PCA are available on request.

[8] CPI by IT contains separate corruption scores for business executives, judges and magistrates, legislature, government officials, the police forces, and religious leaders.

reports descriptive statistics for those variables which were generated as aggregate measures of the respective characteristics via the PCA and employed in the baseline regression model.[9]

All dependent variables, except for infections and stringency of COVID policies, are measured before the start of the pandemic, partly due to data availability, but also to avoid the problem of reverse causality. For instance, the most up-to-date observations for the Corruption Perception Index (CPI) are available for 2018, hence the COVID pandemic outbreak in 2020 could not have affected those CPI values, but CPI can affect observed subsequent COVID outcomes. Here, the assumption is that those factors are highly persistent such that if, e.g., high levels of corruption were observed in 2018, corruption will be high in 2020–21 as well.

4. Regression model

The predominant approach in the literature to modelling COVID-19 deaths assumes a direct, unconditional and orthogonal impact of infections and of each of the various socio-economics factors. In contrast, we propose that the infections-mortality link is conditional, and depends on the moderating influence of those other factors. More specifically, we postulate that the necessary condition for COVID-19 deaths to occur is for COVID-19 infections to had taken place first, which yields an initial model of the mortality from COVID-19 as a function of infections:

$$Mortality_i = \alpha_0 + \alpha_1 Infect_i + \varepsilon_i, \tag{1}$$

where $Mortality_i$ and $Infect_i$ are cumulated COVID-induced mortality and COVID-19 infections in country i, as defined above.

The infection-death link, given by α_1 in equation (1), is further hypothesised to be conditional on, i.e., be a function of, factors such as governance quality (or corruption specifically, in alternative settings), heath-related variables, socio-economic conditions, etc. This is shown in equation (2), whereby the way in which infections “transition” into deaths depends on country-specific factors; these factors do not affect COVID-19 deaths directly but through their interactions with COVID-19 infections:

$$\alpha_1 = \beta_0 + \beta_1 GovQual_i + \beta_2 Z_i + u_i, \tag{2}$$

where α_1 is the slope parameter from equation (1). $GovQual_i$ measures the quality of governance and is our key variable of interest, Z_i is a vector of control variables constructed via PCA: $SocioEc_i$, $PopDens_i$, $HealthPrecon_i$, $Diabetes_i$, $HealthInfra_i$, $HealthPrivate_i$, and $Stringency_i$. Substituting (2) into (1) yields the final model:

$$Mortality_i = \alpha_0 + \beta_0 Infect_i + \beta_1 Infect_i{*}GovQual_i + \beta_2 Infect_i{*}Z_i + \varepsilon_i, \tag{3}$$

[9] These include: the socio-economic factor ($SocioEc_i$) driven by life expectancy, years of compulsory schooling, and the UN Human Development Index; population density ($PopDens_i$); health pre-conditions ($HealthPrecon_i$) driven by cardiovascular death-rates and the percentage of population aged 65/70 or older; diabetes prevalence ($Diabetes_i$); healthcare infrastructure ($HealthInfra_i$) subsuming: healthcare expenditures (both in relative, i.e., as % of GDP, and in absolute, i.e., per capita PPP, terms), the number of nurses, doctors, and hospital beds in each country relative to its population, the Global Health Security (GHS) Index measuring the preparedness for pandemics, and the Universal Healthcare (UHC) Index; out-of-pocket healthcare expenditures (as proportion of total healthcare expenditures; $HealthPrivate_i$); and Stringency Index, a composite measure based on 9 response indicators including school closures, workplace closures, and travel bans ($Stringency_i$). We do not report the results for these controls, they are available on request.

Table 1
Estimation results for model (3).

Estimation method:	OLS		GDP/capita		Total population	
Variable:	Parameter	p-value	Parameter	p-value	Parameter	p-value
$Infect_i$	0.9263	0.000	0.8857	0.000	0.8064	0.000
$Infect_i$*$GovQual_i$	-0.0167	0.003	-0.0187	0.001	-0.0147	0.069
# Obs	139		139		139	
R^2	0.9112		0.9237		0.9608	

In this specification if COVID infections are zero, then COVID mortality is also zero; this is not the case in linear specifications prevalent in the literature. β_1 is our key parameter of interest and we expect it to be negative, i.e., countries with higher levels of governance quality should experience fewer deaths for a given level of infections.

Potential endogeneity issues are minimised by the fact that all of our right-hand side variables, except $Stringency_i$, are measured prior to the pandemic's outbreak, while mortality and infections are observed for the subsequent pandemic period, hence there cannot exist a reverse causality. As such, our model corresponds well with the original definition of causality by Granger (1969), and is well supported by the theoretical arguments outlined above.

To investigate robustness, model (3) is estimated using a number for different techniques. Our baseline method is ordinary least squares (OLS) with heteroskedasticity-consistent standard errors (White, 1980) to assure unbiasedness of standard errors. We also estimate quantile regressions, polynomial, and Bayesian models.[10]

5. Results

5.1. Baseline results

Table 1 presents the OLS results for model (3), with cumulated infections and mortality measured on 30 Apr. 2021. Our key parameter of interest (β_1) is that associated with the interaction between infections and governance quality ($Infect_i$*$GovQual_i$). For the linear OLS regression the estimate is -0.0167 [CI: $-.0275$, $-.0059$], or -1.67%. At the mean value of $Infect_i$, this implies around 27 (60) fewer deaths per 1000,000, or a decline by 14.5% (32%) following a one unit (one standard deviation) improvement in governance quality $GovQual_i$ (all evaluated at the mean value of $Mortality_i$). Alternative estimation methods (unreported) are in line with this baseline finding of higher government quality reducing the transition of COVID infections into deaths, and all models show very good model fit (high R^2 values). Models employing observations weighted by GDP-per-capita and by total population (Table 1) also support the beneficial impact of higher governance quality on reducing COVID mortality, for a given number of infections ($\beta_1 < 0$).[11]

[10] These alternative results are not reported to conserve space but available from authors on request.

[11] To conserve space and focus on core issues, we do not report or discuss results for socio-economic control variables subsumed in vector Z_i; these are available from the authors on request.

Table 2
Estimation results for model (3): Different measurement dates.

Timing:	Date 1: 30 Apr. 2020		Date 2: 31 Aug. 2020		Date 3: 31 Dec. 2020		Date 4: 30 Apr. 2021	
Variable:	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value
$Infect_i$	0.6274	0.000	0.9149	0.000	0.9099	0.000	0.9263	0.000
$Infect_i*GovQual_i$	-0.0314	0.018	-0.0167	0.024	-0.0201	0.001	-0.0167	0.003
# Obs	127		134		136		139	
R^2	0.7843		0.8793		0.9075		0.9112	

Our model appears to be well specified. Both versions of the Ramsey's RESET test for the OLS specification (not tabulated) fail to reject the Null hypothesis of no misspecification (p-values of 0.3580 and 0.7669). We also compute the Robustness Value (*RV*) for $Infect_i*GovQual_i$, following Cinelli and Hazlett (2020). This statistic describes the minimum strength of association that potential omitted variables would need to have, both with the treatment and with the outcome, to fully eliminate the impact of $Infect_i*GovQual_i$ on the infections-mortality nexus. The resulting estimate of $RV= 23.49\%$ is high compared to the variance unexplained by the model (1- R^2) being below 10%, which implies that there is very little scope for the existence of the omitted variable bias in our results.[12]

5.2. *Stages of the COVID pandemic pre-vaccinations*

To reflect the fact that the virus took time to affect all countries and so the link between infections and deaths may have changed over time, we estimate model (3) for three different time points of the pandemic period: 30 Apr. 2020, 31 Aug. 2020, 31 Dec. 2020, and compare the results with those discussed above for 30 Apr. 2021. The results for different stages of the pandemic (Table 2) indicate that the governance quality has had a consistently negative (i.e., dampening) effect on the number of deaths given the number of infections, although it appears to have been most important in the early days of the pandemic.

5.3. *Is corruption a stand-alone contributing factor? Corruption of whom?*

Since our measure of governance quality is a composite index, we additionally investigate how each of its individual components affects the COVID-19 infections-mortality transition. Table 3 presents results where the measure of governance quality is replaced, across the columns, by each of the individual governance sub-components (denoted $Sub\_GovQual_i$). The estimates range from between −4.26% and 0.01% and are mostly statistically significant.

[12] Further specification tests (result unreported) reveal that: (i) the variance inflation factors, being 3.36 on average and with the maximum of 6.27, indicate no issues with multicollinearity; (ii) there is no evidence that infection levels significantly affect the direct infections-deaths link; (iii) the results are not driven by a specific continent; and (iv) the impact of governance quality is not non-linear, i.e. our linear specification is supported by the data. In addition, we assess the effect size by calculate the value of Cohen's f^2 (Cohen, 1988); the resulting value of $f^2= 0.1160$ is closest to the "medium" size effect benchmark proposed by Cohen (1988) of 0.15 ("small" and "large" size effect benchmarks are 0.02 and 0.35, respectively), indicating that in our sample governance quality is an important determinant of the overall mortality from COVID, given the numbers of infections.

Table 3

Estimation results for model (3): Different components of governance quality ($GovQual_i$).

	$Sub\_GovQual_i$															
Governance quality variable:	*Government Effectiveness*		*Political Stability*		*Regulatory Quality*		*Rule of Law*		*Voice and Accountability*		*Ease of doing business*		*Corruption Perception Index*		*Control of Corruption*	
Variable:	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value
$Infect_i$	0.9156	0.000	0.9352	0.000	0.9286	0.000	0.9121	0.000	0.9295	0.000	0.9216	0.000	1.0011	0.000	0.9127	0.000
$Infect_i*Sub\_GovQual_i$	-0.0426	0.001	-0.0270	0.017	-0.0261	0.077	-0.0396	0.004	-0.0111	0.431	0.0001	0.896	-0.0021	0.000	-0.0377	0.000
# Obs	139		139		139		139		139		139		139		139	
R^2	0.9114		0.9095		0.9073		0.9111		0.9052		0.9045		0.9133		0.9125	

Measures of government effectiveness, rule of law, and of control of corruption seem to be of particular importance. Specifically, these results, evaluated at mean values of $Infect_i$ and $Mortality_i$, imply that a one standard deviation increase in the Corruption Perception Index is associated with a reduction in COVID-induced mortality by around 57 deaths per 1000,000 (a decline by almost 31%), while the corresponding values for the Control of Corruption are over 55 deaths per 1000,000 (30%). Therefore, we conclude that corruption in itself is a significant contributing factor to COVID mortality.

We further investigate whether perceived corruption among members of a specific group exerts a stronger impact on COVID mortality than for other groups. To this end, we replace the variable $GovQual_i$ in model (3) with one of the six group-specific corruption perception measures (for business executives, judges and magistrates, legislature, government officials, the police forces, and religious leaders) obtained from TI (denoted Sub_CPI_i). The results (Table 4) indicate that corruption among business executives and judges and magistrates exerted the largest (and statistically significant) impact on COVID-induced deaths, closely followed by perceived corruption of the legislature and among government officials. On the other hand, corruption of the police forces does not have a significant impact on COVID mortality outcomes, while corrupt religious leaders affect the result only at a margin of significance (p-value of 0.088).[13]

6. Discussion and policy implications

Using a comprehensive country-level data set, we provide robust evidence that countries with lower quality of governance and more corruption suffer more COVID-19 mortality for a given level of infections. These results hold after controlling for numerous socio-economic and health factors, and are robust to various specifications and across time periods. More specifically, measures of governance quality such as government effectiveness, political stability and freedom from violence, and rule of law contribute significantly to COVID-19 mortality, with the impact of governance quality having been stronger in magnitude at the very beginning of the pandemic, presumably as the less effective countries needed time to develop proportionate coping mechanisms to better organise themselves through resource and structural allocation.[14] We suggest that this arises because the inefficiency created by poor governance stops rapid governmental response from being effective. In fact, it is exactly at the point of the rapid adjustment to a pandemic that poor governance and corruption can be most felt. Furthermore, any public health measures would be less likely to be effective if there was distrust towards government among citizens, fuelled by corruption and mismanagement of public affairs. As the pandemic wore on, and the effects of COVID started to manifest themselves, it is more likely that populations started to adjust their behaviour, regardless of their trust in government.

Our results also highlight interesting patterns regarding the nature of corruption and who is trusted. It is noticeable that corruption in the judiciary matters, given its importance for fairness and impartiality. The literature notices that corruption in the judiciary is considered especially

[13] Further (unreported) results indicate that the finding of governance quality reducing the mortality of COVID infections is not affected by inclusion of variables capturing poverty, inequality, and national culture (Hofstede, 2011), although we also observe higher infections-to-mortality transition rates in more masculine societies.

[14] Alfano et al. (2022b) show that, among 14 European countries during the early pandemic stages, the non-pharmaceutical interventions followed a spatial diffusion process, with similar measures being implemented subsequently by different countries.

Table 4
Estimation results for model (3): Different components of the corruption perception index (CPI).

	Sub_CPI_i											
Component of the corruption perception index:	*Police*		*Legislature*		*Government officials*		*Business executives*		*Judges and magistrates*		*Religious leaders*	
Variable:	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value	Parameter	p-value
$Infect_i$	0.9092	0.000	0.8682	0.000	0.8785	0.000	0.8671	0.000	0.8293	0.000	0.9411	0.000
$Infect_i*Sub\_CPI_i$	0.0004	0.336	0.0009	0.013	0.0008	0.041	0.0014	0.002	0.0012	0.001	0.0010	0.088
# Obs	87		86		87		87		87		86	
R^2	0.9221		0.9267		0.9245		0.9267		0.931		0.9232	

malevolent, as this branch of government plays a special role in that it is also supposed to exercise oversight over the political sphere and the police (Warren, 2015). It is therefore noticeable that perceived corruption in the judiciary has a larger effect on outcomes than perceived corruption among politicians and government officials. As Rothstein (2000) notes, the social expectations regarding fairness are a priori higher of the legal than of the political system and, as such, form a much stronger basis for the building of trust. Corrupt politicians, government officials and business leaders are also seen to engage in "grand" corruption (Uslaner, 2015), which may explain why perceived corruption in these groups, especially the latter, also has such a large impact on COVID outcomes. Also in the health sphere, Ebola has been viewed as a business to act as a source of profit (Woskie & Fallah, 2019), leading to distrust in business leaders. However, perceived corruption among the police force and religious leaders (only marginal significance) had little effect on COVID mortality; this is mostly likely due to the fact that these types of corruption are seen as "petty" (Uslaner, 2015) and so not likely to affect health systems, or trust in government.

The findings presented here highlight some important policy implications. Most obviously, we should be aiming at improving countries' governance quality, predominantly at reduction in corruption levels, as well as limiting the spread and severity of health conditions which make affected individuals more susceptible to contagious diseases. However, we do acknowledge that these are very ambitious goals requiring a vast amount of globally coordinated efforts and resources, and should be therefore viewed as an ongoing aspiration for the long run.[15] With this aim, proposals have been made to treat corruption in healthcare as a public health risk factor itself, in order to mobilise forces against it and to leverage the UN's Sustainable Development Goals in the global struggle against corruption in healthcare (Clarke, 2020; Mackey et al., 2018). A correct mix of punishment (of corrupt bureaucrats) and reward (for citizens reporting incidences of corruption) could result in limiting corruption levels (Knyazev, 2022), as would improving democratic accountability and the rule of law (Brown & Shackman, 2007).[16] Enhancing governance quality and limiting corruption is a goal worth fighting for, as initial success could initiate a 'virtuous circle": lower corruption leads to higher economic growth long-term (Brown & Shackman, 2007), with the resulting improved life conditions leading to higher aversion against corruption among populations (Andriani & Ashyrov, 2022) as well as spillovers in (now less corrupt) practices and in anti-corruption legal actions to neighbouring countries (Goel & Saunoris, 2022; López-Valcárcel et al., 2017).

Our corruption results also highlight the need to take initiatives to combat corruption in particular areas of society. While it is always likely to be some distrust of politicians and political systems, corruption among the judiciary is particularly insidious. Similarly, business and business leaders, with the overhanging fear of globalisation and profiteering represent areas of corruption that can have a particularly damaging impact on societies, including public health. Targeting these groups as part of anti-corruption measures could see the greatest benefits in

[15] The cross-country coordination is even more important at the regional level, given that corruption tends to spread contagiously to the neighbouring polities, both across and within states (Goel & Saunoris, 2022; López-Valcárcel et al., 2017).

[16] Goel and Nelson (2023) demonstrate that higher female participation in the legislative, but not the executive, branch of the state limits corruption; however, if this process is forced upon societies by imposition of gender quotas it has the opposite effect. Hence, any policy recommendations must be considered with caution and awareness of potential unintended consequences.

terms of improving the effectiveness of health measures (in general) and future pandemic mortality more specifically.

However, pandemics and other public health emergencies will be occurring before we arrive at this long-term end-station of effective governance and at least satisfactory public health status. Hence, we also need to identify easier-to-reach, shorter-term measures. Based on the notion that corruption affected COVID mortality rates due to, among other channels, its erosive impact on the credibility of governments' measures and recommendations, (re)instating public's trust is crucial during pandemics.

The reality has often been running counter to this logic, however. COVID-19 has seen governments implementing emergency powers that are in many ways authoritarian and undermine the exact concept of good governance; there are a number of countries where COVID-19 legislation is eroding democracy (Thomson & Ip, 2020). However, any government response to a pandemic can only be effective if those powers are used wisely (Parmet et al., 2021). Towards that aim, all policies such as social distancing, confinement, or vaccination campaigns need to be plausibly legitimised by policy makers, for instance by transparent and consistent reliance on recommendations from health practitioners and scientists to highlight evidence-based, science-led nature of any government interventions, as well as their clear and well-timed communications (Funke et al., 2023). In other words, what is needed is an absence of repression and corruption of science and the rule of reason for political ends, otherwise the public's confidence is lost and any actions, including non-pharmaceutical interventions, are bound to fail (Parmet et al., 2021).[17] To boost public trust in, and engagement with, health policy-making and measures, we also propose devolved and iterative policy-making, to allow for improved localised reactions to local problems and to involve broader masses of the population into the decision-making processes and actions, thus improving people's feeling of control and involvement to boost social capital and pro-social behavioural patterns (see, e.g., Kim et al., 2020, for a review of theories and empirical evidence in support of this decentralisation-breeds-trust mechanism). While state subsidies may be inevitable to avoid dire economic consequences during the pandemic, the one-size-fits-all approach might not be effective and more tailored policies should be considered, to improve their effectiveness and also societal support (Olvera et al., 2022). In addition, our results which suggest that anti-COVID interventions appear to have been lagging, not preventing, the spread of the virus, also indicate that, instead of being reactive to the observed damage, governments should undertake more proactive anticipatory measures, should they face another pandemic like COVID-19.[18]

There are a number of limitations to our study which also offer potential avenues for future research. Firstly, we are only able to use national level aggregate data, therefore, we are not able to analyse differentiated effects of corruption, governance and other factors on COVID mortality within each country. Secondly, data is not available for all countries, and we had to balance the size of the sample with the quantity of data (variables) available. Thirdly, countries with more corruption may collect or report less reliable data, meaning that our results may be a conservative estimate of the association between poor governance and COVID-19 outcomes. In

[17] Especially that the outbreak of the pandemic itself has had a negative impact on trust, as reported by Shachat et al. (2021).

[18] For instance, Bollino (2023) designs a method to support policy-makers in decisions regarding the trade-off between saving lives and limiting economic loss, while Shami and Lazebnik (2023) propose creating an income-based tax-financed budget dedicated to fund additional government expenditures during a pandemic, while also implementing a scheme of training labour to be employable as "essential workers" should another pandemic occur.

addition, future research could try to identify empirically which of the three theoretical channels we highlighted (misallocation and embezzlement of resources, damage to public trust, damage to mental health) is the most pronounced mechanism for corruption to affect health outcomes and, hence, should be tackled as a priority via policy and societal interventions.

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Appendix

Table A1
List of countries.

Afghanistan, Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Bahamas, Bahrain, Bangladesh, Comoros, Costa Rica, Croatia, Cyprus, Czechia, Democratic Republic of Congo, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Finland, France, Gabon, Gambia, Georgia, Germany, Ghana, Greece, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, Iceland, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Kuwait, Latvia, Lebanon, Liberia, Lithuania, Luxembourg, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Montenegro, Morocco, Myanmar, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Nigeria,North Macedonia, Norway, Oman, Pakistan, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Rwanda, Saudi Arabia, Senegal, Seychelles, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sri Lanka, Sudan, Suriname, Sweden, Switzerland, Tanzania, Thailand, Timor, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Arab Emirates, United Kingdom, United States, Uruguay, Vietnam, Zambia, Zimbabwe.

Table A2
Data definitions and sources.

Variable Name	Description	Source
Control of corruption	Perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. Standardised estimates ranging ranging from approximately −2.5 to 2.5. 2019 data used.	Worldwide Governance Indicators (WGI), data collected from www.govindicators.org. Produced by Daniel Kaufmann (Natural Resource Governance Institute and Brookings Institution) and Aart Kraay (World Bank Development Research Group): Kaufman et al. (2010).
Corruption Perception Index	Perceived levels of public sector corruption, drawing on 13 expert assessments and surveys of business executives. Scale of zero (highly corrupt) to 100 (very clean): 2018 index values.	Transparency International: https://www.transparency.org.
Political stability and absence of violence/terrorism	Perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism. Estimate calculation as above. 2019 data.	WGI, as above.
Government effectiveness	Perceptions of the quality of public services, the civil service, and its independence from political pressures, the quality of policy	WGI, as above.

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Table A2 (*continued*)

Variable Name	Description	Source
	formulation and implementation, and the credibility of the government's commitment to such policies. Estimate calculation as above. 2019 data used.	
Regulatory quality	Perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Estimate calculation as above. 2019 data used.	WGI, as above.
Rule of law	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. Estimated as above. 2019 data.	WGI, as above.
Voice and accountability	Perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media. Estimate calculation as above. 2019 data used.	WGI, as above.
Ease of doing business	Ease of doing business score (0 = lowest performance to 100 = best performance). 2019 data used.	World Development Indicators (WDI), data collected from the World Bank, Doing Business project (http://www.doingbusiness.org/).
Life expectancy	Life expectancy at birth in 2019.	James C. Riley, Clio Infra, United Nations Population Division, obtained from "Our World in Data" website.
Population density	Number of people divided by land area, measured in square kilometres. Most recent year available used.	WDI, sourced from Food and Agriculture Organization and World Bank estimates, obtained from "Our World in Data" website.
Years of compulsory education	Years that children are legally obliged to attend school. 2019 data used.	WDI, data collected by the UNESCO Institute for Statistics.
Human Development Index (HDI)	A composite index measuring average achievement in three basic dimensions of human development—a long and healthy life, knowledge and a decent standard of living. Values for 2019.	United Nations Development Programme (UNDP), obtained from "Our World in Data" website.
Diabetes prevalence	Diabetes prevalence (% of population aged 20 to 79) in 2017.	WDI, sourced from International Diabetes Federation, Diabetes Atlas, obtained from "Our World in Data" website.
Cardiovascular death rate	Death rate from cardiovascular disease in 2017 (annual number of deaths per 100,000 people).	Global Burden of Disease Collaborative Network, Global Burden of Disease Study 2017 Results, obtained from "Our World in Data" website.
Aged 65 and older	Share of the population that is 65 years and older, most recent year available. Most recent year available used.	WDI based on age/sex distributions of United Nations World Population Prospects 2017 Revision, obtained from "Our World in Data" website
Aged 70 and older	Share of the population that is 70 years and older in 2015.	United Nations, Department of Economic and Social Affairs, Population Division (2017),

(*continued on next page*)

Table A2 (*continued*)

Variable Name	Description	Source
		World Population Prospects 2017 Revision, obtained from "Our World in Data" website.
Current health expenditure (% of GDP)	Level of current health expenditure expressed as a percentage of GDP. 2018 data used.	World Development Indicators (WDI), data collected from the World Health Organization Global Health Expenditure database (http://apps.who.int/nha/database).
Current health expenditure per capita, PPP	Current expenditures on health per capita expressed in international dollars at purchasing power parity (PPP time series based on ICP2011 PPP). 2018 data used.	WDI, as above.
Out-of-pocket healthcare expenditure	Household share of out-of-pocket payments of total current health expenditures. 2018 data used.	WDI, as above.
Number of nurses	Nurses and midwives (per 1000 people). Most recent available year from 2015-2019 used.	WDI, data collected from the World Health Organization's Global Health Workforce Statistics, OECD, supplemented by country data.
Number of doctors	Physicians (per 1000 people). Most recent available year from 2015-2019 used.	WDI, as above.
Number of hospital beds	Hospital beds (per 1000 people) Most recent available year from 2015-2019 used.	WDI, as above.
Global Health Security (GHS) Index	GHS Index assesses countries' health security and capabilities to deal with epidemics and pandemics across six categories: prevention, detection and reporting, rapid response, health system, compliance with international norms, and risk environment. Most recent available year from 2015-2019 used.	A project of the Nuclear Threat Initiative (NTI) and the Johns Hopkins Center for Health Security (JHU), developed with The Economist Intelligence Unit (EIU): https://www.ghsindex.org/.
Universal health care (UHC) service coverage index	Coverage index for essential health services (based on tracer interventions that include reproductive, maternal, newborn and child health, infectious diseases, noncommunicable diseases and service capacity and access). It is presented on a scale of 0 to 100. Most recent available year from 2015-2019 used.	World Development Indicators, data are from the World Health Organization, Global Health Observatory Data Repository (https://www.who.int/data/gho).
Stringency index	Government Response Stringency Index: composite measure based on 9 response indicators including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100 = strictest response).	Oxford COVID-19 Government Response Tracker, Blavatnik School of Government, obtained from "Our World in Data" website.

Table A3
Summary Statistics for Baseline Regression Variables.

Variable/Statistic:	Mean	Median	Std.Dev.	Min	Max	Skewness	Kurtosis
$Mortality_i$	5.2291	5.5948	2.0367	-1.0441	7.9554	-0.7248	2.8838
$Infect_i$	9.3792	9.8537	1.9387	2.1425	11.9516	-0.9241	3.5387

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Table A3 (*continued*)

$GovQual_i$	0.4441	0.1243	2.4988	-4.6218	5.4468	0.2327	2.2842
$SocioEc_i$	0.1140	0.5026	1.4613	-3.1347	2.6761	-0.5482	2.1612
$PopDens_i$	0.0169	-0.0549	1.1222	-1.4436	10.8559	6.6766	64.1114
$HealthPrecon_i$	0.2594	-0.1506	1.5151	-2.3655	4.5604	0.6209	2.2911
$Diabetes_i$	0.0365	-0.0986	0.9767	-1.8188	3.7577	0.7886	4.0669
$HealthInfra_i$	0.0795	0.0095	2.0989	-3.4043	6.1303	0.4379	2.5480
$HealthPrivate_i$	0.0728	0.1551	0.8324	-2.1188	3.3380	0.2834	4.3105
$Stringency_i$	56.2331	60.8646	18.2800	0.0000	86.8992	-1.7027	5.9818

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