Economic Inequality and COVID-19 Deaths and Cases in the First Wave: A Cross-Country Analysis

JAMES B. DAVIES
Department of Economics, University of Western Ontario, London, Ontario, Canada

À partir d'un échantillon formé de différents pays à l'échelle de la planète, cette recherche étudie la relation entre d'une part les taux de cas d'infection et de décès liés à la maladie à coronavirus 2019 (COVID-19) lors de la première vague pandémique et d'autre part, l'inégalité des revenus et la pauvreté mesurées précédemment, en tenant compte d'autres facteurs sous-jacents. Si les associations estimées sont interprétées comme causales, le coefficient de Gini pour le revenu a un effet positif significatif sur les cas d'infection et de décès per capita pour les régressions utilisant l'échantillon complet et sur les cas d'infection, mais non sur les décès, lorsque les échantillons des pays membres et des pays non membres de l'Organisation de coopération et de développement économique (OCDE) sont traités séparément. Le coefficient de Gini pour la richesse a un effet positif significatif sur les cas d'infection et non sur les décès dans les deux sous-échantillons et dans l'échantillon complet. La pauvreté a, en général, de faibles effets positifs dans l'échantillon complet et dans celui des pays non membres de l'OCDE, mais la mesure de la pauvreté relative a un effet positif élevé sur les cas d'infection des pays membres de l'OCDE. L'analyse de l'écart entre les cas d'infection et de décès per capita dus à la COVID-19 lors de la première vague au Canada et les taux plus élevés aux États-Unis indique que 37 % de l'écart des cas et 28 % de l'écart des décès peuvent être attribués à un plus haut Gini des revenus aux États-Unis selon les régressions de l'échantillon complet.

Mots clés : cas d'infection, COVID-19, décès, inégalité, maladie à coronavirus 2019, pauvreté, revenu, richesse

The cross-country relationship of coronavirus disease 2019 (COVID-19) case and death rates with previously measured income inequality and poverty in the pandemic's first wave is studied, controlling for other underlying factors, in a worldwide sample of countries. If the estimated associations are interpreted as causal, the Gini coefficient for income has a significant positive effect on both cases and deaths per capita in regressions using the full sample and for cases but not for deaths when Organisation for Economic Co-operation and Development (OECD) and non-OECD sub-samples are treated separately. The Gini coefficient for wealth has a significant positive effect on cases, but not on deaths, in both sub-samples and in the full sample. Poverty generally has weak positive effects in the full and non-OECD samples, but a relative poverty measure has a strong positive effect on cases in the OECD sample. Analysis of the gap between COVID-19 first-wave cases and deaths per capita in Canada and the higher rates in the United States indicates that 37 percent of the cases gap and 28 percent of the deaths gap could be attributed to the higher-income Gini in the United States according to the full-sample regressions.

Keywords: COVID-19, cases, deaths, inequality, poverty, income, wealth

Introduction

Disadvantaged minorities and some low-income groups have been hit hard by coronavirus disease 2019 (COVID-19), suggesting that its severity within countries may have been affected by their degree of economic inequality. Such an impact would be in line with the considerable body of evidence on the impact of inequality on health. This article asks to what extent differences across countries in COVID-19 case and death rates were related to their pre-existing differences in economic inequality and poverty in the first global wave of the pandemic, which ended in August 2020. This is done controlling for other important underlying factors.

doi:10.3138/cpp.2021-033

The death rate studied here is the crude mortality rate, that is, the cumulative total of officially reported COVID-19 deaths divided by population as of a particular date.[1] This rate is referred to simply as the *death rate* or the *mortality rate*. To control for the length of time the pandemic was present, the case and death rates used are those observed 150 days after total confirmed cases in a country had reached 10.

The empirical work reported in this article controls for pre-existing factors other than income inequality and poverty that are expected to be associated with COVID-19 case and death rates. These additional variables reflect health, geographic, economic, and political characteristics. COVID-19 severity in the first wave was, of course, also affected by a host of proximate factors, including testing, contact tracing, lockdowns, mask wearing, social distancing, and travel. Although it would be interesting to study their impact, and others have done so, that is not the purpose of this article. The goal here is to look at the pre-existing underlying factors that may have partly worked through such proximate causes.

This article confines attention to the first global wave of COVID-19 for a couple of reasons. One is that by the second wave, which began in Fall 2020, differences in inequality and poverty across countries had time to change from their pre-existing patterns, for example because relief payments and other measures significantly countered distributional impacts in most rich countries but less so elsewhere. Another reason is that, at the time that this research was conducted, the second wave was still in progress and had become more complex than the first wave in key ways, for example with the rise of new variants of the virus and the onset of vaccination programs in many countries at different times and different rates.

Although this study finds significant relationships between COVID-19 case and death rates and inequality, and to a lesser extent poverty, it does not necessarily establish causation. On one hand, the results could be taken as merely describing the empirical relationship between these variables. On the other hand, the explanatory variables are all predetermined, so some of the usual concerns about endogeneity are absent. There may then be an interest in using the results to ask how much of the difference in COVID-19 severity between certain countries might plausibly be attributed to differences in inequality, as is done in this article in a Canada-versus-United States comparison.

Significant positive effects of the Gini coefficient for income on the COVID-19 death rate have been found in a worldwide sample of countries by Helliwell et al. (2021) and in the Organisation for Economic Co-operation and Development (OECD) countries by Wildman (2021), who also finds an effect of inequality on cases. This article adds to their work by examining the impacts of poverty as well as inequality, by considering cases as well as deaths in a global sample of countries, and by considering the impact of wealth inequality as well as income inequality. Such inquiry is urgent not only in light of the seriousness of the COVID-19 pandemic and the possibility of future similar pandemics occurring, but also in view of the strong upward trend in income and wealth inequality seen in many countries around the world in recent decades (Davies and Shorrocks 2021).

The article proceeds as follows. The next section provides a brief and selective review of relevant literature. The modelling is then discussed, and the data are described. Regression results and a counterfactual exercise are provided in the Results section, and the final section concludes.

Literature

This brief overview of some of the most relevant literature begins by looking at studies on the effect of economic inequality, including poverty, on pandemics and on health in general. Existing evidence concerning the relationship between COVID-19 severity and inequality is then examined.

There has long been interest in the relationship between inequality and pandemics (Campbell 2016; Scheidel 2017; Slack 1985; Snowden 2019). That interest has tended to focus on the effect of a pandemic on inequality, which remains true today (Alfani forthcoming; Deaton 2021; Furceri et al. 2020). However, the impact of inequality on pandemics has also had some study. In a sociological analysis, Farmer (1996, 2001) argued that social inequalities played a key role in fostering modern epidemics of Ebola, tuberculosis, and HIV. Anbarci, Escaleras, and Register (2012) studied cholera outbreaks in 55 poor countries over 1980–2002, finding that both cases and deaths were negatively related to the availability of clean water, which in turn was reduced by inequality. Cummins, Kelly, and Ó Gráda (2016) found that in many outbreaks of plague in London over the period 1560–1665, elevated mortality began in poor suburbs rather than in the docks as previously thought, implying an important impact of poverty.

There is a well-developed literature on the impact of inequality on health more generally. The Whitehall studies in the United Kingdom that began in 1967 found that civil servants of higher rank had less heart disease and other chronic conditions, controlling for smoking, physical activity, obesity, and other risk factors (Pickett and Wilkinson 2009, 2015). Status in itself appeared to have a positive impact on health, in part because low-status individuals were subject to more job stress. These observations contributed to interest in the relative income hypothesis, which posits that health depends on income relative to others in society in addition to or possibly rather than on absolute income. A string of public health studies confirmed the relative income hypothesis. Results were reviewed and summarized in Wagstaff and van Doorslaer (2000), Karlsson et al. (2010), and Pickett and Wilkinson (2015).

 doi:10.3138/cpp.2021-033

Some economists have concluded that there is not yet convincing evidence that income inequality per se generally has a negative effect on health, although poverty and other factors that are correlated with income inequality, such as unequal health care and government services and racial injustice, do harm health (Case and Deaton 2017; Deaton 2003, 2013). These conclusions do not, of course, imply that one should not investigate the relationship between income inequality and COVID-19 severity. It could be that in this case there is an impact distinguishable from that of poverty. Because income inequality is known to be correlated with a range of inequities that have been proven to be related to health, it can at the least serve as a useful proxy for data on those inequities, which are not as readily available.

COVID-19 health impacts among disadvantaged minority groups have received attention in several countries. In the United States, Black, Hispanic, and Indigenous people have suffered more than Whites (APM Research Lab 2020; Foundation for AIDS Research 2020; Stafford, Hoyer, and Morrison 2020). Gross et al. (2020) examined the health-related data for 28 states that reported race- and ethnicity-stratified COVID-19 mortality. Controlling for differences in age structure, they found that the risk of death for Blacks was 3.6 times that of Whites, whereas the corresponding ratio for Hispanics was 1.9. Similar death rate differentials have been found in the United Kingdom among Black, Asian, and Middle Eastern groups (Office for National Statistics 2020; Public Health England 2020) and have been noted widely for minority groups in other countries, including Indigenous people in the Americas and Australia (APM Research Lab 2020; Engels 2020; Yashadhana et al. 2020).

The incidence of COVID-19 cases and deaths is higher in US counties with relatively more non-Whites, but the pattern for poverty is more complex. Samrachana et al. (2020) find that both cases and deaths are higher in substantially non-White counties that have greater poverty but that the opposite is true for substantially White counties. Jung, Manley, and Shrestha (2020) find a U-shaped pattern of cases and deaths according to poverty rates in counties with high population density but a unidirectional positive impact of poverty on cases and deaths in counties with low population density.

Banik et al. (2020) examined the impact of poverty and other underlying factors on COVID-19 outcomes across countries. They studied 29 countries selected as representative of developed and developing countries, finding that the absolute poverty rate has an insignificant negative effect on the COVID-19 case fatality rate except when an interaction with the bacillus Calmette-Guérin (BCG) tuberculosis vaccination rate is introduced. In the latter case, poverty has a significant positive effect except in countries with a relatively high BCG vaccination rate, where the relationship is negative. Sannigrahi et al. (2020) study the determinants of COVID-19 severity in Europe, finding a negative association of poverty with both cases and deaths.

The mixed evidence on the impact of poverty on COVID-19 severity in the United States and internationally, including indications of a negative effect in some cases, is notable. The present study also finds weak effects of poverty. The reasons for this are not clear and remain a topic for future research. One conjecture is that many poor people may be relatively socially isolated because of lack of employment or the means to engage in much market activity. This could militate against infection in the case of an airborne disease such as COVID-19. In cross-country comparisons, it may also be that countries with more poor people tend to be less integrated into networks of global commerce and travel, again reducing the spread of the disease.

A number of articles have examined the impact of other underlying social or economic factors on COVID-19 severity in cross-country studies. The rate of infection has been found to rise with urban population (Moosa and Khatatbeh 2021), the level of tourist travel (Farzanegan et al. 2021; Stojkoski et al. 2020), and the country's having a prior history of severe acute respiratory syndrome (SARS; Di Matteo 2021). Factors that have been shown to increase case fatality rates include the percentage of elderly people (Moosa and Khatatbeh 2021; Sorci, Faivre, and Morand 2020), obesity (Stojkoski et al. 2020), size of a country's population (Cao, Hiyoshi, and Montgomery 2020; Sannigrahi et al. 2020), and percentage of female smokers (Cao et al. 2020), as well as gross domestic product (GDP) per capita (International Monetary Fund 2020; Sorci et al. 2020) and a democracy index (Sorci et al. 2020). Death rates have been shown to be higher with an older population or one with a higher percentage of elderly people and if a country or its neighbours have a history of SARS (Di Matteo 2021; Helliwell et al. 2021). Number of hospital beds has been found to have a negative effect on COVID-19 case fatality rates (Sorci et al. 2020) and death rates (Banik et al. 2020; Di Matteo 2021), whereas BCG vaccination appears to have had a negative effect on those rates (Banik et al. 2020; International Monetary Fund 2020; Miller et al. 2020).

At least two previous studies have explicitly examined the impact of income inequality on COVID-19. Using cross-country regressions with a large sample of countries, Helliwell et al. (2021) find that the Gini coefficient for income has a significant positive effect on COVID-19 deaths per million population in 2020. Wildman (2021) finds a significant positive effect of the Gini coefficient for income on both cases and deaths per million in OECD countries.

Modelling

Why would one expect COVID-19 case or crude death rates to depend on the level of income inequality? The effects can be either direct or indirect. An indirect effect could arise if, for example, governments were more sensitive to the wishes of people with high incomes. There are more high-income people in more unequal countries, and they would tend to have more influence on policy, at least in democracies. If support for public health programs falls with income, greater inequality could therefore lead to less expenditure on such programs. It could also be that public education is underfunded and of lower quality in countries with higher inequality, leading to poor public understanding of science-based recommendations for measures to combat infection. It has also been suggested that high inequality may erode trust, both in other people and in public institutions, which could lead to failure to cooperate with public health guidelines.

A positive direct effect of income inequality on the overall case or death rate can be obtained via Jensen's inequality if the probability of infection or mortality, respectively, is a convex function of income. For simplicity in the following analysis, I illustrate the argument for the case of death rates. Consider two people who have the same income and the same mortality probability. Take income from one and give it to the other. Income inequality rises, and if the crude chance of dying from COVID-19 is a strictly convex function of income, the average probability of dying for these two individuals goes up. This is true whether the mortality probability is rising or falling with income.

Income inequality could potentially be measured with any one of several standard measures of inequality (Cowell 2011; Sen 1997). The most popular measure is the Gini coefficient, which has a well-known relationship with the Lorenz curve, a fundamental tool in inequality measurement. Estimates of the Gini for a large number of countries are included in the World Development Indicators published annually by the World Bank. Those are the estimates used in this article.

Conceptually, the comparison of two countries' income distributions and case or mortality situations can be broken into two components: differences in mean income and differences in inequality. Take the death rate again as the example. Whether a higher mean leads to a lower crude death rate depends simply on whether the death rate for individuals is falling or rising with income. That is not the case on the inequality side. As mentioned earlier, whether higher inequality reduces or increases the overall death rate from COVID-19 depends on whether the probability of being infected and dying from the disease is concave or convex in income. Thus, it is not necessary for the death rate (or case rate) to fall with income for higher inequality to cause a higher death rate. This means that the way in which inequality affects the case rate or death rate is fundamentally different from how it is affected by poverty. Higher poverty will only raise these rates if the probability of catching or dying from the disease declines with income; concavity or convexity is not the issue.

Some major factors that are relevant to COVID-19 case or death rates are demographic. Among those, the fraction of elderly people in a population may be important. If elderly people have less social contact, they may have a lower probability of becoming infected, but because the case fatality rate goes up strongly for people at advanced ages, they could nevertheless have a higher COVID-19 crude death rate. This study finds that there are also some effects from the rate of urbanization, perhaps as a result of the greater congestion in urban areas as well as air pollution, that increase infections.[2] So individual infection or mortality chances may depend not just on income but on age and rural–urban location at the least. Hence, population composition according to these factors may affect a country's overall case and death rates.

Age and income can each be lumped into two categories, creating binary variables to go along with the urban–rural split. Old versus young, lower versus higher income, and urban versus rural location divide a population into six groups, ranging from rural–young–non-poor to urban–old–poor. The implications for an estimating equation can be illustrated for the case of death rates. Total COVID-19 deaths, D, in a country over a given period of the pandemic can be related to the crude death rates, m_{ijk}, and population numbers, N_{ijk}, for these six groups by

$$D = \sum_{i=1}^{2}\sum_{j=1}^{2}\sum_{k=1}^{2} m_{ijk} N_{ijk}, \quad i, j, k = 1, 2, \tag{1}$$

where $i = 1$ stands for rural and $i = 2$ for urban, $j = 1$ for young and $j = 2$ for old, and $k = 1$ for non-poor and $k = 2$ for poor. Let

$$\begin{aligned} & m_{ijk} = m_{111} + p_{ijk}, \\ & m_{111} \geq 0, p_{111} = 0, -m_{111} \leq p_{ijk} \leq -m_{111}, \end{aligned} \tag{2}$$

where p_{ijk} is a premium on the mortality rate for the urban, old, or poor. Note that p_{ijk} could be negative.

A particularly simple model is obtained if one assumes that the death rate premiums for being urban, old, or poor are additive. Letting the additive components be π_u, π_o, *and* π_v, respectively, in that case we have

$$\begin{aligned} m_{ijk} = m_{111} + p_{ijk} = m_{111} + (i-1)\pi_u + (j-1)\pi_o \\ + (k-1)\pi_v, \; i, j, k = 1, 2, \end{aligned} \tag{3}$$

and Equation (1) becomes

$$D = m_{111} N + \pi_u N_u + \pi_o N_o + \pi_v N_v, \tag{1'}$$

where N is the size of the total population and N_u, N_o, and N_v are the number of urban, old, and poor people, respectively. Dividing by N, we have the death rate equation

 doi:10.3138/cpp.2021-033

$$d = \frac{D}{N} = m_{111} + \pi_u n_u + \pi_o n_o + \pi_v n_v, \quad (4)$$

where n_u, n_o, and n_v are the fractions of the population that are urban, old, or poor. An advantage of this formulation for applied work is that data on d, n_u, n_o, and n_v are readily available. Note also that there is a directly analogous case rate equation in which the right-hand side mortality variables would be replaced by the base rate of infection and infection premiums for the different population groups.

How do mean income, income inequality, and other underlying factors work into the analysis? If such factors only shift the base mortality rate, m_{111}, up or down, they can be accommodated by simply adding other variables to Equation (4) in an estimating equation. It is possible that the additional factors could affect the m_{ijk}s non-uniformly, creating interactions between them and n_u, n_o, or n_v.

This discussion points to the use of the following estimating equation:

$$d = a_o + a_1 Gini + a_2 Pov + a_3 Age + a_4 Urban + a_5 X + \varepsilon, \quad (5)$$

where *Gini* and *Pov* are, of course, the Gini coefficient and a poverty index, and *Age* and *Urban* are, respectively, the number of elderly and urban residents as a percentage of the population. *X* is a vector of other underlying factors. No strong assumption is made on the distribution of ε other than it has mean zero and finite variance and is not necessarily homoscedastic.

Data

Table 1 lists the variables used in the regressions reported in the next section, along with their descriptive statistics. The data are for the most recent year available before 2020.[3] The first two variables are the dependent variables, deaths and cases. They are the cumulative totals of recorded COVID-19 deaths and cases per million population, respectively, in the first 150 days of the pandemic in a country, counting from the date on which at least 10 confirmed cases were first reported.[4] The deaths and cases observation date for 93 countries is in August, the last month of the first COVID-19 wave.[5] Another 29 countries' totals were observed in July, and all but three of the remaining countries' totals were observed in late June or in September.

There is high variation in deaths across countries. Eight countries, including, for example, Tanzania, Thailand, and Sri Lanka, had fewer than one recorded COVID-19 death per million, whereas, at the other extreme, Belgium, Spain, and Peru had more than 600. Although at the extremes for the world as a whole, these countries were not such outliers in their own regions or among their peers. Five of the ten countries with the fewest recorded deaths per million were in Sub-Saharan Africa, and six European countries were in the top ten. No OECD countries were in the bottom 20, whereas eight were in the top ten.[6]

Like deaths, the variable cases varies widely across countries. Cases also tend to vary across regions and between OECD versus non-OECD countries, similarly to deaths. However, the correlation coefficient for the two variables is only 0.65, reflecting that the ratio of deaths to cases is not constant across countries. This could result from many factors, including the quality of care for those with severe cases of the disease, as well as measurement error.

The variable Gini, which is the Gini coefficient for income recorded by the World Bank, ranges from 24.2 in Slovenia to 63.0 in South Africa. Among G7 countries, the lowest Gini coefficients are seen in France (31.6) and Germany (31.9), and the highest are found in Italy (35.9) and the United States (41.4). Among large emerging market countries, Russia (37.5) and India (37.8) are at the low end, and Brazil (53.9) and South Africa (63.0) are at the high end. Many countries in Africa and Latin America have quite high income inequality; the median Gini coefficient in Sub-Saharan Africa is 44.5, and in Latin America and the Caribbean, it is 46.1. High-income countries in Northern Europe and the Asia-Pacific region, however, tend to have relatively low Gini values.

GiniW is the Gini coefficient for wealth in 2019 estimated by Shorrocks, Davies, and Lluberas (2021) in the Credit Suisse Global Wealth Databook. As is well known, wealth inequality is much greater than income inequality. GiniW ranges from 50.3 in the Slovak Republic to 88.6 in Lesotho. The only other country with an extremely low GiniW is Iceland (50.9). Countries with very high GiniW include Russia (87.3), South Africa (88.1), and Brazil (88.2). There is a positive correlation of Gini and GiniW, but it is imperfect; the correlation coefficient is 0.59.

Pov is the poverty headcount ratio published by the World Bank, calculated using a poverty line of US$1.90 in income or consumption per person per day (2011 purchasing power parity [PPP]). Measures using poverty lines of US$3.20 and US$5.50 are also available but performed less well than Pov in the regressions reported in this article. Researchers in the Development Data Group at the World Bank have recently developed a societal poverty measure, referred to here as SocPov (Jolliffe and Prydz 2021; Schoch, Jolliffe, and Lakner 2020). It uses a poverty line equal to US$1.00 plus 50 percent of country median income or consumption, with a lower bound of US$1.90 (2011 PPP). Although it is a hybrid between relative and absolute poverty measures, because the lower bound is binding for only seven of the countries considered here, it is for the present purposes close to a relative poverty measure.

Percentage of the population aged 65 years or older (the variable age) ranges widely, from 1.2 percent (United Arab Emirates) to 28.0 percent (Japan). Regionally, it is lowest in

Table 1: Data Characteristics

Variable Group and Names	Description	Source	No.	Mean	Median	*SD*	Range (Min–Max)
Dependent variables							
Deaths	Cumulated COVID-19 deaths per million persons, 150 days after 10th confirmed case	OWID	143	96.8	27.4	155.7	0.1–848.7
Cases	Cumulated COVID-19 cases per million persons, 150 days after 10th confirmed case	OWID	143	2,756.9	1,250.8	3,370.9	8.3–18,298.6
Inequality and poverty							
Gini	Income Gini coefficient, 2018	WDI	143	38.5	36.7	8.2	24.2–63.0
GiniW	Wealth Gini coefficient, 2019	CS	143	77.1	78.2	7.0	50.3–88.6
Pov	% of population with < $1.90 income or consumption per day (US$, 2011 PPP), 2018	WDI	141	13.6	2.1	20.1	0.0–77.6
Pov5.5	Same as Pov but with US$5.50 poverty line	WDI	141	39.1	27.8	35.5	0.0–97.7
SocPov	"Societal poverty" headcount; see text for details	WB	142	27.3	24.0	15.3	3.0–75.8
Demography							
Age	% of population aged 65 y or older, 2019	WDI	143	9.5	7.0	6.7	1.2–28.0
Urban	Urban population as % of total population 2019	WDI	143	60.3	61.9	21.1	13.3–98.0
Health							
BCG	Country has a universal BCG vaccination policy	BCGWA	142	0.820	1	0.384	0–1
Beds	Hospital beds per 1,000 people, 2015	WDI	143	2.8	2.1	2.4	0.1–13.4
Obesity	% with BMI ≥ 30, adults	WHO	141	18.0	20.2	8.3	3.6–36.2
Geography							
Density	Population density	WDI	143	153.9	82.2	242.5	3.0–1,719.0
FromEq	Distance from equator (km)	Harvard	143	2,978	2,648	1,933	0–7,186
Island	1 if island, 0 otherwise	Harvard	143	0.140	0	0.347	0–1
Season of COVID-19 start							
Winter	1 if winter start, 0 otherwise	OWID	143	0.594	1	0.491	0–1
Spring	1 if spring start, 0 otherwise	OWID	143	0.210	0	0.407	0–1
Summer	1 if summer start, 0 otherwise	OWID	143	0.098	0	0.297	0–1
Fall	1 if fall start, 0 otherwise	OWID	143	0.098	0	0.297	0–1
Economy							
GDPpc	GDP per capita (US$ PPP), 2019	WDI	143	20,521	13,574	20,717	984–121,293
Tourism	Tourist arrivals by air per 100,000 population, 2019	WDI	136	6.7	0.3	1.1	0.0–68.7
Government							
Democracy	2020 Democracy Index	EIU	139	5.6	5.9	2.1	1.1–9.8
TrustGovt	% indicating confidence in their national government	Gallup	36	44.1	41.5	13.5	16–81

Notes: Data are unweighted. COVID-19 = coronavirus disease 2019; OWID = Our World in Data (2021); WDI = world development indicators (World Bank 2020); CS = Credit Suisse (2021); PPP = purchasing power parity; WB = World Bank staff; BCG = Bacillus Calmette-Guérin; BCGWA = BCG World Atlas (2021); BMI = body mass index; WHO = World Health Organization (2021); Harvard = Harvard WorldMap (n.d.); GDP = gross domestic product; EIU = Economist Intelligence Unit (2021); Gallup = Gallup world poll as reported by OECD (2021)

Source: Author's compilation.

Sub-Saharan Africa, where the median is just 3.3 percent, and highest in Europe, where the median is 18.6 percent.

The variable urban is the percentage of population living in urban areas. It ranges from 13.3 percent in Papua New Guinea to 98.0 percent in Belgium. Other countries with very low urbanization include many in Africa (e.g., Niger, Malawi, and Rwanda) and a few in Asia–Pacific (Nepal and Sri Lanka). Countries that are almost as highly urbanized as Belgium include Argentina, Israel, and Uruguay.

The health group includes two variables that have been found in previous studies to have a significant negative effect on COVID-19 outcomes—universal BCG tuberculosis vaccination (BCG) and hospital beds per 1,000 people (beds), as well as obesity, which has a positive effect on COVID-19 cases and deaths. Countries without universal BCG vaccination make up 18 percent of the sample here. They are found mostly in the rich world, where tuberculosis is no longer a widespread threat.

Beds may reflect partly the quality of a country's health care system and partly its capacity to handle a surge of patients during an epidemic. The number of hospital beds varies considerably, even when mean income is similar. For example, it is 2.8 per 1,000 in the United Kingdom but 8.3 in Germany. Across regions, it ranges from a median of 1.0 in Sub-Saharan Africa to 4.8 in Europe. Obesity ranges from 3.6 percent in Bangladesh to 36.2 percent in the United States. It is positively but imperfectly related to GDP per capita, with a correlation coefficient of just 0.48. Quite high obesity rates are found in some low- or lower-middle-income countries, whereas low rates are found in some high-income countries such as Japan and Korea.

The geography group includes variables for population density, distance from the equator (FromEq), a dummy indicating an island country (island), and dummies for the season of the year in which the pandemic arrived in a country according to the ten-cases criterion.[7] Density is potentially an indicator of crowding, although it is clearly an imperfect indicator, for example because some highly urbanized countries with crowded major cities have large uninhabited areas and low overall density (e.g., Australia, Canada, and Russia). FromEq is correlated with temperature, which could perhaps affect viral spread. Island is included because island countries may be able to seal their borders more easily than other countries.

The economic variables included are GDP per capita in PPP terms and tourist arrivals by air per 100,000 people in 2018 (tourism).[8] GDPpc ranges from $984 in the Central African Republic to $121,293 in Luxembourg. The country mean is $4,037 in Sub-Saharan Africa, $6,610 in South Asia, $49,629 in Europe and North America, and between $15,300 and $18,400 in the other world regions. Tourism can be a key sector of the economy and appears to have been an important avenue by which COVID-19 spread to some countries in the early stages of the pandemic. Although France, Spain, and the United States receive the largest absolute number of visitors (in that order), the countries in the sample with the highest values of the tourism variable, that is, tourist arrivals relative to population, are the small island countries of Iceland, Malta, and Cyprus. France ranks only 19th highest, Spain 16th, and the United States 74th. The bottom of the list is dominated by low- and lower-middle-income developing countries without significant tourism.

The government-related variables are indexes for democracy and confidence in government—TrustGovt. Alternative indexes are available for democracy. Here the index published annually by the Economist Intelligence Unit (EIU; associated with *The Economist* magazine) is used. This index is based on assessments of the quality of the electoral process, the degree of pluralism, how well government functions, political participation and culture, and civil liberties. Unlike some alternative indexes, such as Polity IV used by Banik et al. (2020), it recognizes differences in the quality of democracy among some rich countries that cannot reasonably be regarded as equally democratic.[9]

The variable TrustGovt, provided by the OECD for its member countries,[10] is the percentage of adults surveyed in a Gallup poll who indicated that they had confidence in their national government. Two countries stand out as having an especially high fraction of people with trust in government: Luxembourg (78 percent) and Switzerland (81 percent). At the other extreme are Italy (22 percent), Latvia (20 percent), and Greece (16 percent). Straddling the median of 41.5 percent are Israel (42 percent) and Japan (41 percent).

Table 2 provides information on the regions identified. The regional breakdown is conventional for Latin America and the Caribbean, Sub-Saharan Africa, South Asia, and East Asia and the Pacific. Central Asia is added to the Middle East and North Africa on the grounds of cultural and socio-economic similarity as well as broadly similar COVID-19 experience. In the same way, Europe and North America (including only Canada and the United States) are put together.

One sees wide differences in COVID-19 deaths across regions in Table 2. Europe–North America and Latin America–Caribbean have shares of COVID-19 deaths that are more than three times their share of the global population. At the other extreme, South Asia has a death share equal to about one-quarter of its population share, and both East Asia and the Pacific and Sub-Saharan Africa have a death share less than one-sixth of their population share. Gini and Pov also vary widely across the regions.

Results

Table 3 shows regression results for both deaths and cases, for the full sample of countries and for non-OECD countries. Table 4 shows the results for OECD countries. The regressions use ordinary least squares, weighted by country population. Both the Gini coefficient and the poverty index that performs best are used. In Table 3, the latter is the US$1.90 per day measure, Pov, but for the OECD it is the societal measure, SocPov.

Full Sample

Consider first the regression results for the full sample.[11] If the estimated associations are interpreted as causal, the Gini coefficient has a significant effect on both deaths and cases—at the 10 percent level for deaths and at the 1 percent level for cases. The coefficients on the poverty variable are positive, but its effects are insignificant, even at the 15 percent level.[12] For deaths, the demographic and health variables have the expected signs and are all significant, although BCG vaccination is significant only at the 15 percent level. Having an older, more urbanized, or more obese population leads to more COVID-19 deaths, and more hospital beds reduces them. For cases, among the demographic and health variables, only obesity has a

Table 2: Characteristics of Countries Grouped by OECD Membership and by Region

Country Group	% Share of World . . . Population	COVID-19 Deaths	COVID-19 Cases	Mean Income Gini	Mean Poverty Rate Pov	Pov5.5	SocPov
OECD	18.5	59.7	37.7	33.2	0.5	3.0	13.8
Non-OECD	81.5	40.3	62.3	40.3	17.9	51.1	31.8
East Asia and the Pacific	29.8	2.1	2.4	37.1	5.3	29.7	21.5
Europe and North America	14.6	51.3	35.1	31.9	0.8	4.6	13.8
Latin America and the Caribbean	8.7	31.5	34.0	46.1	6.3	29.5	26.8
Middle East, North Africa and Central Asia	7.7	5.8	8.1	33.9	5.5	35.0	21.6
South Asia	24.7	6.9	14.6	34.6	9.3	62.8	25.4
Sub-Saharan Africa	14.6	2.4	5.8	44.1	37.8	79.5	45.7
All countries	100.0	100.0	100.0	38.5	13.6	39.1	27.2

Notes: Means for the Gini coefficient and poverty rates are unweighted. For definitions and sources, see Table 1. COVID-19 = coronavirus disease 2019; OECD = Organization for Economic Co-operation and Development.

Source: Author's calculations.

Table 3: Regression Results for First-Wave COVID-19 Deaths and Cases per Million, All Countries and Non-OECD Countries

Variable Group and Name	All Countries Deaths	All Countries Cases	Non-OECD Deaths	Non-OECD Cases
Inequality and poverty				
Gini	5.22*	205.95***	4.10	161.43**
Pov	0.26	7.50	0.43	26.00†
Demography				
Age	14.58**	84.94	12.73	99.40
Urban	2.80***	26.46	1.35	34.18
Health				
BCG	−144.07†	766.52	112.79†	4,019.68**
Beds	−26.34**	−115.12	−10.12	238.10
Obesity	4.00***	128.81***	5.68***	161.83***
Geography				
Density	0.05	1.63†	0.05†	2.44***
FromEq	1.04	57.21*	−0.36	23.52
Island	−29.83	−1,789.14**	−34.65†	−1,058.61*
Season of COVID-19 start				
Spring	69.58**	1,772.48**	59.30*	2,352.49**
Summer	47.61	2,377.71*	61.48	1,669.39
Fall	15.48	−524.42	9.55	−418.59
Economy				
GDPpc	−2.74	−14.39	−0.64	35.41
Tourism	1.47	−722.41	−79.46**	−1,900.73*
Government				
Democracy	11.42**	439.36***	13.32**	651.99***
Constant	−320.18*	−14,330.50	−497.37**	−18,449***
N	127	127	92	92
R^2	0.709	0.703	0.641	0.724

Notes: Robust standard errors are in Appendix Table A.1; see Table 1 for variable definitions. COVID-19 = coronavirus disease 2019; OECD = Organization for Economic Co-Operation and Development; BCG = bacillus Calmette-Guérin.

† $p < 0.15$; * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Source: Author's calculations.

significant effect—positive and significant at the 1 percent level.[13]

Among the geographic, seasonal, or economic variables, only a spring start to the pandemic has a significant effect in the deaths regression. In contrast, these variables are generally significant for cases. Being an island country has a strong negative effect on cases. Winter is the omitted seasonal pandemic start variable. A spring start leads to more severe outcomes for both deaths and cases, whereas a summer start has a significant positive impact only for cases. An implication is that winter and fall were the "best" seasons for pandemic arrival. Of 143 countries, 85 had a winter arrival, and 14 had a fall arrival. Spring saw 30 arrivals and summer 14. There was a winter start in all the European and North American countries in the sample and in all but three OECD countries—Australia, Chile, and New Zealand. (The latter had their start at about the same time, but because they are south of the equator, it was summer.) All fall arrivals were in Sub-Saharan countries. Among Brazil, Russia, India, China, and South Africa, Russia, India, and China had a winter start, whereas Brazil and South Africa saw a summer onset (again because they are in the southern hemisphere).

The economic variables, GDPpc and tourism, are insignificant for both deaths and cases, but GDPpc has the expected negative coefficient, and for deaths it is close to being significant (p-value = 0.159). Democracy has a significant positive effect on both cases and deaths, perhaps indicating that leaders who had to concern themselves more with maintaining popular support took less aggressive action against the pandemic.

Non-OECD Countries

Separate results for non-OECD countries, shown in the last two columns of Table 3, generally show less significance than the full-sample results. Thus, for example, although Gini was significant in the deaths and cases regressions for the full sample at the 10 percent and 1 percent levels, respectively, it becomes insignificant for deaths and significant at the 5 percent level for cases. Exceptions to this rule are provided by obesity, which remains significant at the 1 percent level for both deaths and cases; by density, which becomes more significant in both regressions; and by tourism, which is now significant, whereas it was not for the full sample of countries. Note also that the absolute size of the regression coefficients rises for each of these variables whose significance is higher for the non-OECD sample.

OECD Countries

Table A.1 in the appendix includes regression results for OECD countries that parallel those shown in Table 3 for the full sample and the non-OECD countries. Neither inequality nor poverty have significant coefficients in those OECD regressions, which is due in part to the high correlation of Gini and SocPov for these countries—their correlation coefficient is 0.90. There are relatively few other significant variables, which appears to reflect a lack of degrees of freedom. Only 33 OECD countries have all the variables required to run the Table 3–type regressions, and there are 16 regressors. Table 4 presents the results of parsimonious regressions for the OECD that include only explanatory variables that are significant in at least one of the four regressions and that use inequality and poverty regressors separately rather than together. In these runs, 36 countries can be included, and there are only seven regressors, increasing degrees of freedom considerably.

The Table 4 regressions show positive impacts of both SocPov and Gini on cases that are significant at the 5 percent and 1 percent levels, respectively. However, neither inequality nor poverty has a significant effect on deaths. The effects of the other variables are similar to those seen for the full sample and non-OECD countries in Table 3, with a couple of exceptions. In Table 3, obesity had a highly significant effect on both cases and deaths, but it is not significant, even at the 15 percent level, for the OECD countries and so is excluded from Table 4. Also, TrustGovt appears in Table 4 and has an impressively significant negative effect on deaths, but it has an insignificant effect on cases.

Outliers

Outliers have some effects on the regression results. Illustrating this, Appendix Table A.3 records the main outlier effects found in the full-sample regressions. Despite its small population, removing Belgium has a distinct effect on the estimated impacts of the Gini, raising its deaths coefficient from 5.22 to 5.64 and the cases coefficient from 205.95 to 208.00. Also, the significance level in the deaths regression changes from 10 percent to 5 percent. These effects are due to Belgium having the highest value of deaths in the sample (849 deaths per million population) and a high value of cases (5,810 per million), combined with a low Gini (27.4). Belgium also has a very low value of Pov (0.1). Removing it almost doubles the coefficients on (the insignificant) Pov.

Madagascar and the Democratic Republic of the Congo have similar outlier status to each other. They have the two highest values of Pov in the sample (77.6 and 76.6, respectively) but quite low deaths and cases. Removing them both from the sample has relatively small effects on the Gini, whose coefficient falls from 5.22 to 5.12 in the deaths regression, for example. However, the Pov coefficients rise sharply, although less than when Belgium was removed.

The largest outlier effects are found for South Africa, which has very high values for both Gini (63.0) and Pov (18.9). The biggest impacts of removing South Africa are on the coefficient for Gini, which rises from 5.22 to 7.59 for deaths and from 205.95 to 256.03 for cases. These strong

Table 4: Regression Results for First-Wave COVID-19 Deaths and Cases per Million in OECD Countries

	Deaths		Cases	
Variable Group and Name	Using Gini	Using SocPov	Using Gini	Using SocPOv
Inequality and poverty				
Gini	−3.00		486.48***	
SocPov		1.50		354.69**
Demography: urban	8.03**	7.60**	65.28	114.20*
Health: beds	−37.17***	−34.11***	−110.99	−291.96*
Geography				
FromEq	7.17*	8.39**	143.88**	77.39†
Island	−62.31	−60.80	−2,605.69***	−1,903.71*
Government				
Democracy	34.94**	39.52**	1,243.76***	1,030.30**
TrustGovt	−11.28***	−11.11***	−38.21	−31.07
Constant	−166.86	−372.95	−31,986.25***	−18,973.90**
N	36	36	36	36
R^2	0.722	0.721	0.711	0.605

Notes: Robust standard errors are provided in Appendix Table A.2; see Table 1 for variable definitions. COVID-19 = coronavirus disease 2019; OECD = Organisation for Economic Co-Operation and Development.

† $p < 0.15$; * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Source: Author's calculations.

impacts suggest that the effects of inequality suggested by the Table 3 regressions are not exaggerated. They may be understated.

Wealth Inequality

Table 5 shows the coefficients for GiniW and poverty obtained in regressions using the same additional independent variables as in Tables 3 and 4. Results are fairly similar to those using the income Gini. However, although the income Gini was significant at the 10 percent level in the deaths regression for the full sample, GiniW is insignificant. Also, whereas Gini was significant at the 5 percent level for cases in the non-OECD sub-sample in Table 3, GiniW is only significant at the 10 percent level in the corresponding regression in Table 5. The poverty measure becomes insignificant even for cases in the non-OECD sub-sample, whereas it was significant at the 15 percent level in Table 3. It thus appears that the income Gini is somewhat more relevant than the wealth Gini for understanding the relationships of COVID-19 severity with inequality and poverty

Table 5: Coefficients of Gini and Poverty in Regressions Using Wealth Gini (GiniW)

Country Group and Variable Name	Deaths	Cases
All countries		
GiniW	1.67	190.88***
Pov	0.102	−12.99
R^2	0.695	0.690
Non-OECD		
GiniW	3.60	131.21*
Pov	−0.019	10.10
R^2	0.758	0.802
OECD		
GiniW	−3.20	162.73***
R^2	0.728	0.646

Notes: Robust standard errors are provided in Appendix Table A.4; see Table 1 for variable definitions. OECD = Organization for Economic Co-Operation and Development.

* $p < 0.10$; *** $p < 0.01$.

Source: Author's calculations.

Counterfactuals

If the relationships shown by the regression equations here were causal, counterfactual calculations could in principle be performed to estimate how much a country's COVID-19 first-wave cases or deaths would be affected if they had alternative values of the Gini coefficient. For example, one could ask how outcomes in the United States would have differed, according to such an exercise, if instead of having its recorded Gini of 41.4 it had the Canadian Gini of 33.8, which, incidentally, is the median Gini for the G7 countries.

Using the full-sample regression results shown in Table 3, reducing the US Gini to the Canadian level would have lowered US cases by 1,565 per million and deaths by 40 per million—that is, by 22 percent and 11 percent, respectively. In the first wave, the United States had cases of 7,100 and deaths of 375, whereas Canada's numbers were 2,834 and 234. Hence, the cases gap between the countries was 4,266 and the deaths gap was 141. The counterfactual reductions in US cases and deaths resulting from having the Canadian Gini would thus have been 37 percent of the cases gap and 28 percent of the deaths gap. The reduction in these gaps would have been the same if one had asked, alternatively, how much Canadian deaths and cases would rise if Canada had the US Gini of 41.4. However, in proportional terms the effects on Canadian deaths and cases, at 55 percent and 17 percent, respectively, would have been larger than those for the United States when its Gini was reduced to the Canadian level.

Conclusion

This study of the cross-country relationship of COVID-19 case and death rates with previously measured income inequality and poverty in the pandemic's first wave has found significant relationships. If these relationships are interpreted as causal, the Gini coefficient for income has a significant positive effect on both cases and deaths according to regressions using the full sample of countries, but only on cases when OECD and non-OECD sub-samples are treated separately. The Gini coefficient for wealth has a significant positive association with cases in both sub-samples and the full sample, but it has a weaker influence than the income Gini, being insignificant in the deaths regression for the full sample, for example. Poverty generally has weak positive effects in the full and non-OECD samples, but the World Bank's new societal poverty measure, which is highly correlated with the income Gini, has a strong positive association with cases in the OECD sample.

The possible quantitative importance of the relationships studied was illustrated using counterfactual calculations of the impact of inequality differences on the gap between Canadian and American cases and deaths in the pandemic's first wave, assuming the regression results show causal relationships. According to the World Bank data used here, Canada had a pre-pandemic Gini coefficient for income of 33.8, whereas the United States had a Gini of 41.4. At 7,100 cases and 375 deaths per million, the United States had worse COVID-19 outcomes than Canada, which had 2,834 cases and 234 deaths per million. The counterfactual calculation indicates that 37 percent of the gap in cases and 28 percent of the gap in deaths between the two countries could be attributed to their difference in income inequality.

Although it was not the specific purpose of this study to determine the importance of underlying factors other than inequality and poverty, the effects of the other covariates are indeed of interest. The number of hospital beds per capita has a negative impact, and the level of democracy has a positive effect, on both cases and deaths in all the regressions. Although the effect of hospital beds is not surprising, that of democracy is perhaps so and generates an interesting question for political economy. Could it be that fear of backlash from voters leads to weaker lockdowns and other measures? In the full sample and non-OECD countries, obesity has a significant positive effect on both cases and deaths, but it has an insignificant effect in the OECD countries, which is again puzzling. Also surprising is that although in the full sample having more elderly people raises the death rate, the effect is insignificant in the OECD and non-OECD sub-samples. Unpuzzling results are that urbanization raises deaths and that trust in government reduces them. Also, the negative impact of being an island country on cases and deaths throughout the regressions is intuitive.

Overall, the results of this study make a strong case for a positive relationship between inequality and COVID-19 severity in the first wave and provide some evidence that poverty also had such a relationship. It is perhaps surprising that although inequality is significant in the deaths regression using the full sample, it is insignificant in the deaths regressions for both the OECD and the non-OECD sub-samples. The explanation for this contrast is unclear. Trying to find it could be an interesting avenue for future research.

Acknowledgements

Comments on earlier versions of this article or other help were provided by Charles Beach, Jessica Davies, Samantha Goertz, Herbert Emery, Michael Hoy, Dean Jolliffe, Rodrigo Lluberas, Anthony Shorrocks, and Wayne Simpson. Thanks are also due to three anonymous referees. Responsibility for any errors or omissions is my own.

Notes

1 As discussed in the next section, some recent research has focused on the effect of demographic and social factors on countries' case-fatality rates without studying the effect of inequality. It would be interesting to extend that work to examine the impact of inequality, but that is beyond the scope of this article.

2 Using global data, Pozzer et al. (2020) find that air pollution makes a significant contribution to COVID-19 mortality.

3 For some variables, not all countries had an observation for the year indicated in the table. In those cases, the most recent previous available year was used.

4 The date of the first confirmed case is not a reliable indicator of when the pandemic began in a country. Several countries reported a single case for many days before numbers began to increase, which may indicate that the initial case was contained and spread of the virus had not begun.

5 Globally, new COVID-19 cases reached their trough in the third week of August, when the daily average number of new cases was 257,396. After that, numbers began to slowly increase week by week. Deaths reached their trough in the second week of September, with an average of 5,066 deaths per day. See European Centre for Disease Prevention and Control (2021).

6 The five Sub-Saharan countries in the bottom ten were Botswana, Mozambique, Rwanda, Tanzania, and Uganda. The six European countries in the top ten were Belgium, France, Italy, Spain, Sweden, and the United Kingdom. Together with Chile and the United States, they make up the eight OECD countries in the top ten.
7 These seasonal dummies are deemed "geographic" here because they reflect not only the date the virus arrived but also whether a country is in the northern or southern hemisphere.
8 Although in principle it would be good to take tourist departures into account as well, those data are only available for 83 countries, compared with the 136 for arrivals indicated in Table 1.
9 For example, the Polity IV democracy index rates both Norway and the United States at 10 on a 10-point scale. In contrast, the EIU index places Norway at 9.81, the highest score awarded, and the United States at 7.92, which appears more appropriate given the differences in these countries' electoral practices and systems.
10 The OECD also publishes these data for four non-OECD countries: Brazil, Indonesia, Russia, and South Africa.
11 Note that n = 127 in these regressions, which is less than the 143 countries that have most of the variables shown in Table 1. The omitted countries each had at least one missing explanatory variable.
12 The estimated coefficients for Pov remain insignificant in regressions omitting the Gini variable
13 The inclusion of obesity in these regressions has relatively little quantitative effect on the estimated coefficients for Gini and poverty and no impact on their significance classifications. For example, in the full-sample deaths regression, omitting obesity raises the coefficient on Gini from 5.223 to 5.463 and reduces that on Pov from 0.259 to 0.112. Gini remains significant at the 10 percent level, and Pov remains insignificant.

References

Alfani, G. forthcoming. "Epidemics, Inequality and Poverty in Preindustrial and Early Industrial Times." *Journal of Economic Literature*.

Anbarci, N., M. Escaleras, and C.A. Register. 2012. "From Cholera Outbreaks to Pandemics: The Role of Poverty and Inequality." *American Economist* 57(1):21–31. https://doi.org/10.1177/056943451205700102.

APM Research Lab Staff. 2020. "The Color of Coronovirus: COVID-19 Deaths by Race and Ethnicity." At https://www.apmresearchlab.org/covid/deaths-by-race.

Banik, A., T. Nag, S.R. Chowdhury, and R. Chatterjee. 2020. "Why Do COVID-19 Fatality Rates Differ Across Countries? An Explorative Cross-Country Study Based on Select Indicators." *Global Business Review* 21(3):607–25. https://doi.org/10.1177/0972150920929897.

BCG World Atlas. 2021. "A Database of Global BCG Vaccination Policies and Practices." At http://www.bcgatlas.org/index.php.

Campbell, B.M.S. 2016. *The Great Transition: Climate, Disease and Society in the Late-Medieval World*. Cambridge: Cambridge University Press.

Cao, Y., A. Hiyoshi, and S. Montgomery. 2020. "COVID-19 Case-Fatality Rate and Demographic and Socioeconomic Influencers: Worldwide Spatial Regression Analysis Based on Country-Level Data." *BMJ Open* 10(11):e043560. https://doi.org/10.1136/bmjopen-2020-043560.

Case, A., and A. Deaton. 2017. "Mortality and Morbidity in the 21st Century." *Brookings Papers on Economic Activity* 2017(Spring):397–443. https://doi.org/10.1353/eca.2017.0005.

Cowell, F.A. 2011. *Measuring Inequality*, 3rd edition. Oxford: Oxford University Press.

Cummins, N., M. Kelly, and C. Ó Gráda. 2016. "Living Standards and Plague in London, 1560–1665." *Economic History Review* 69(1):3–34. https://doi.org/10.1111/ehr.12098.

Davies, J., and A. Shorrocks. 2021. "Comparing Global Inequality of Income and Wealth." In *Inequality in the Developing World*, ed. C. Gradin, M. Leibrandt, and F. Tarp, 49–73. Oxford, UK: Oxford University Press.

Deaton, A. 2003. "Health, Inequality and Economic Development." *Journal of Economic Literature* 41(1):115–38. https://doi.org/10.1257/002205103321544710.

Deaton, A. 2013. *The Great Escape: Health, Wealth and the Origins of Inequality*. Princeton, NJ: Princeton University Press.

Deaton, A. 2021. "COVID-19 and Global Income Inequality." NBER Working Paper 28392, National Bureau of Economic Research, Cambridge, MA. At https://www.nber.org/papers/w28392.

Di Matteo, L. 2021. "Global Storm, the Effects of the COVID-19 Pandemic and Responses around the World." Vancouver: Fraser Institute. At https://www.fraserinstitute.org/sites/default/files/global-storm-effects-of-COVID-19-pandemic-and-response-around-world.pdf.

Economist Intelligence Unit. 2021. "Democracy Index 2020: In Sickness and in Health?" London: Economist Intelligence Unit. At https://pages.eiu.com/rs/753-RIQ-438/images/democracy-index-2020.pdf.

Engels, Z. 2020. "South America's Indigenous Populations Combat COVID-19." *Borgen Magazine*, 3 November. At https://www.borgenmagazine.com/indigenous-populations-combat-COVID-19/.

European Centre for Disease Prevention and Control. 2021. "Historical Data (to 14 December 2020) on the Daily Number of New Reported COVID-19 Cases and Deaths Worldwide." At https://www.ecdc.europa.eu/en/publications-data/download-todays-data-geographic-distribution-COVID-19-cases-worldwide.

Farmer, P. 1996. "Social Inequalities and Emerging Infectious Diseases." *Emerging Infectious Diseases* 2(4):259–69. https://doi.org/10.3201/eid0204.960402.

Farmer, P. 2001. *Infections and Inequalities: The Modern Plagues*. Berkeley: University of California Press.

Farzanegan, M.R., M. Feizi, and H.F. Gholipour. 2021. "Globalization and the Outbreak of COVID-19: An Empirical Analysis." *Journal of Risk and Financial Management* 14(3):105. https://doi.org/10.3390/jrfm14030105.

Foundation for AIDS Research. 2020. "COVID-19 Racial Disparities in U.S. Counties." At https://ehe.amfar.org/disparities.

Furceri, D., P. Loungani, J.D. Ostry, and P. Pizzuto. 2020. "Will COVID-19 Affect Inequality? Evidence from Past Pandemics." *COVID Economics* 12:138–57.

Gross, C.P., U.R. Essien, S. Pasha, J.R. Gross, S.-Y. Wang, and M. Nunez-Smith. 2020. "Racial and Ethnic Disparities in Population Level COVID-19 Mortality." *Journal of General Internal Medicine* 35(10):3097–99. https://doi.org/10.1007/s11606-020-06081-w.

"Harvard WorldMap." n.d. At https://worldmap.maps.arcgis.com/home/index.html.

Helliwell, J.F., R. Layard, J.D. Sachs, J.-E. De Neve, L.B. Aknin, and S. Wang. 2021. "World Happiness Report, Sustainable Development Solutions Network." At https://worldhappiness.report/ed/2021/.

International Monetary Fund. 2020. "COVID-19 in Latin America and the Caribbean: A High Toll on Lives and Livelihoods." In *Regional Economic Outlook for Western Hemisphere*. Washington, DC: International Monetary Fund. At https://www.imf.org/en/Publications/REO/WH/Issues/2020/10/13/regional-economic-outlook-western-hemisphere.

Jolliffe, D., and E.B. Prydz. 2021. "Societal Poverty: A Relative and Relevant Measure." *World Bank Economic Review* 35(1):180–206.

Jung, J., J. Manley, and V. Shrestha. 2020. "Coronavirus Infections and Deaths by Poverty Status: Time Trends and Patterns." *COVID Economics* 31. At https://cepr.org/content/COVID-economics-vetted-and-real-time-papers-0.

Karlsson, M., T. Nilsson, C.H. Lyttens, and G. Leeson. 2010. "Income Inequality and Health: Importance of a Cross-Country Perspective." *Social Science and Medicine* 70(6):875–85. https://doi.org/10.1016/j.socscimed.2009.10.056.

Miller, A., M.J. Reandelar, K. Fasciglione, V. Roumenova, Y. Li, and G.H. Otazu. 2020. "Correlation between Universal BCG Vaccination Policy and Reduced Mortality for COVID-19." *medRxiv*. Preprint, submitted 24 September. https://doi.org/10.1101/2020.03.24.20042937.

Moosa, I.A., and I.N. Khatatbeh. 2021. "Robust and Fragile Determinants of the Infection and Case Fatality Rates of COVID-19: International Cross-Sectional Evidence." *Applied Economics* 53(11):1225–34. https://doi.org/10.1080/00036846.2020.1827139.

Office for National Statistics. 2020. "Updating Ethnic Contrasts in Deaths Involving the Coronavirus (COVID-19), England and Wales: Deaths Occurring 2 March to 28 July 2020." Newport, UK: The Office. At https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/articles/updatingethniccontrastsindeathsinvolvingthecoronavirusCOVID19englandandwales/deathsoccurring2marchto28july2020#main-points.

Organisation for Economic Co-Operation and Development (OECD). 2021. "OECD-Stat Database." Paris: OECD. At https://stats.oecd.org/.

Our World in Data. 2021. "Case Fatality Rates of COVID-19 by Age." Accessed 2 January 2021 at https://ourworldindata.org/mortality-risk-COVID.

Pickett, K.E., and R.G. Wilkinson. 2009. *The Spirit Level*. New York: Bloomsbury Press.

Pickett, K.E., and R.G. Wilkinson. 2015. "Income Inequality and Health: A Causal Review." *Social Science and Medicine* 128:316–26. https://doi.org/10.1016/j.socscimed.2014.12.031.

Pozzer, A., F. Dominici, A. Haines, C. Witt, T. Munzel, and J. Lelieveld. 2020. "Regional and Global Contributions of Air Pollution to Risk of Death from COVID-19." *Cardiovascular Research* 116(14):2247–53. https://doi.org/10.1093/cvr/cvaa288.

Public Health England. 2020. *Disparities in the Risk and Outcomes of COVID-19*. London: Public Health England. At https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/908434/Disparities_in_the_risk_and_outcomes_of_COVID_August_2020_update.pdf.

Samrachana, A., N.P. Panteleo, J.M. Feldman, O. Ogedegbe, L. Thorpe, and A.B. Troxel. 2020. "Assessment of Community-Level Disparities in Coronavirus Disease 2019 (COVID-19) Infections and Deaths in Large US Metro Areas." *JAMA Network Open* 3(7):e2016938. https://doi.org/10.1001/jamanetworkopen.2020.16938.

Sannigrahi, S., F. Pilla, B. Basu, A.S. Basu, and A. Molter. 2020. "Examining the Association between Socio-Demographic Composition and COVID-19 Fatalities in the European Region Using Spatial Regression Approach." *Sustainable Cities and Society* 62:102418. https://doi.org/10.1016/j.scs.2020.102418.

Scheidel, W. 2017. *The Great Leveler: Violence and the History of Inequality*. Princeton, NJ: Princeton University Press.

Schoch, M., D.M. Jolliffe, and C. Lakner. 2020. "A Quarter of the World Lives in Societal Poverty." World Bank Blogs, 2 December. At https://blogs.worldbank.org/opendata/quarter-world-lives-societal-poverty.

Sen, A. 1997. *On Economic Inequality, Expanded Edition*. Oxford: Oxford University Press.

Shorrocks, A.F., J.B. Davies, and R. Lluberas. 2021. "Credit Suisse Global Wealth Databook." Zurich: Credit Suisse Research Institute. At https://www.credit-suisse.com/about-us/en/reports-research/global-wealth-report.html.

Signorelli, C., and A. Odone. 2021. "Age-Specific COVID-19 Case-Fatality Rate: No Evidence of Changes over Time." *International Journal of Public Health* 65(8):1435–36. https://doi.org/10.1007/s00038-020-01486-0.

Slack, P. 1985. *The Impact of Plague in Tudor and Stuart England*. London: Routledge.

Snowden, F.M. 2019. *Epidemics and Society: From the Black Death to the Present*. New Haven, CT: Yale University Press.

Sorci, G., B. Faivre, and S. Morand. 2020. "Explaining among-Country Variation in COVID-19 Case Fatality Rate." *Nature Research: Scientific Reports* 10(1):18909. https://doi.org/10.1038/s41598-020-75848-2.

Stafford, K., M. Hoyer, and A. Morrison. 2020. "Racial Toll of Virus Grows Even Starker as More Data Emerges." *Associated Press News*, 18 April. At https://apnews.com/article/8a3430dd37e7c44290c7621f5af96d6b.

Stojkoski, V., Z. Utkovski, P. Jolakoski, D. Tevdovski, and L. Kocarev. 2020. "The Socio-Economic Determinants of the Coronavirus Disease (COVID-19) Pandemic." *MedRxiv*.

Preprint, submitted 17 April. https://doi.org/10.1101/2020.04.15.20066068.
Wagstaff, A., and E. van Doorslaer. 2000. "Income Inequality and Health: What Does the Literature Tell Us?" *Annual Review of Public Health* 21:543–67. https://doi.org/10.1146/annurev.publhealth.21.1.543.
Wildman, J. 2021. "COVID-19 and Income Inequality in OECD Countries." *European Journal of Health Economics* 22(3):455–62. https://doi.org/10.1007/s10198-021-01266-4.
World Bank. 2020. "World Development Indicators." At https://databank.worldbank.org/source/world-development-indicators.
World Health Organization. 2021. "Prevalence of Obesity among Adults, BMI ≥ 30 (Age-Standardized Estimate (%)." *Global Health Observatory*. Accessed 10 June 2021 at https://www.who.int/data/gho/data/indicators/indicator-details/GHO/prevalence-of-obesity-among-adults-bmi-=-30-(age-standardized-estimate)-(-).
Yashadhana, A., N. Pollard-Wharton, A.B. Zwi, and B. Biles. 2020. "Indigenous Australians at Increased Risk of COVID-19 Due to Existing Health and Socioeconomic Inequities." *Lancet Regional Health Western Pacific Commentary* 1:100007. https://doi.org/10.1016/j.lanwpc.2020.100007.

Appendix

Table A.1: Regression Results for First-Wave COVID-19 Deaths and Cases per Million, with Common Regressors for All Country Types and Robust Standard Errors

	All Countries		Non-OECD		OECD	
Variable Names	Deaths	Cases	Deaths	Cases	Deaths	Cases
Gini	5.22*	205.95***	4.10	161.43**	−5.80	−324.05
	(2.68)	(67.21)	(3.25)	(76.15)	(19.09)	(268.51)
Pov	0.26	7.50	0.43	26.00†		
	(0.47)	(14.66)	(0.66)	(17.22)		
Pov5.5					8.05	
					(8.59)	
SocPov						394.06†
						(232.07)
Age	14.58**	84.94	12.73	99.40	1.21	120.40
	(6.48)	(116.74)	(8.04)	(206.37)	(9.36)	(94.93)
Urban	2.80***	26.46	1.35	34.18	6.68†	22.72
	(1.05)	(21.69)	(0.97)	(25.20)	(4.12)	(51.53)
BCG	−144.07†	766.52	112.79†	4,019.68**	−213.73	−799.03
	(94.88)	(1,434.39)	(73.49)	(1,856.98)	(149.37)	(1,229.43)
Beds	−26.34**	−115.12	−10.12	238.10	−50.28**	−521.91**
	(11.80)	(185.87)	(9.63)	(266.92)	(22.79)	(206.14)
Obesity	4.00***	128.81***	5.68***	161.83***	−12.29	−20.23
	(1.34)	(29.01)	(1.63)	(42.63)	(10.63)	(114.94)
Density	0.05	1.63†	0.052†	2.44***	−0.06	−1.57
	(0.04)	(1.00)	(0.035)	(0.93)	(0.36)	(4.25)
FromEq	1.03	57.21*	−0.36	23.52	5.09	−122.05†
	(1.46)	(30.16)	(1.52)	(36.82)	(6.03)	(71.43)
Island	−29.83	−1,789.14**	−34.65†	−1,058.61*	41.03	801.69
	(56.28)	(691.57)	(20.88)	(615.06)	(75.19)	(861.05)
Spring	69.58**	1,772.48**	59.30*	2,352.49**		
	(27.23)	(712.55)	(31.44)	(932.37)		
Summer	47.61	2,377.71*	61.48	1,669.39	−292.28*	−5,276.11***
	(48.40)	(1,284.11)	(50.24)	(1,256.72)	(154.03)	(1,707.97)
Fall	15.48	−524.42	9.55	−418.59		
	(36.81)	(910.80)	(31.55)	(833.20)		
GDPpc	−2.74	−14.39	−0.64	35.41	4.37	113.77***
	(1.93)	(38.61)	(2.43)	(71.86)	(4.37)	(26.55)
Tourism	1.47	−722.41	−79.46**	−1,900.73*	−13.29	−893.44
	(38.64)	(575.93)	(38.54)	(1,044.32)	(124.05)	(841.04)
Democracy	11.43**	439.36***	13.32**	651.99***	−45.62	−524.97
	(5.33)	(116.02)	(6.15)	(158.86)	(54.00)	(462.21)
TrustGovt					−9.26***	6.58
					(2.13)	(28.52)
Constant	−320.18*	−14,330.50	−497.37**	−18,449.51***	855.27	12,744.91
	(171.74)	(4,186.49)	(191.13)	(5,036.11)	(1,404.94)	(9,436.48)
N	127	127	92	92	33	33
R^2	0.709	0.703	0.641	0.724	0.808	0.904

Notes: Robust standard errors are in parentheses; see Table 1 for variable definitions. COVID-19 = coronavirus disease 2019; OECD = Organization for Economic Co-Operation and Development.

† $p < 0.15$; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Source: Author's calculations.

Table A.2: Parsimonious Regression Results for First-Wave COVID-19 Deaths and Cases per Million in OECD Countries, with Robust Standard Errors

	Deaths		Cases	
Variable Names	Using Gini	Using SocPov	Using Gini	Using SocPov
Gini	−3.00		486.48***	
	(10.32)		(144.90)	
SocPov		1.50		354.69**
		(15.33)		(142.62)
Urban	8.03**	7.60**	65.28	114.20*
	(3.63)	(3.36)	(49.79)	(57.21)
Beds	−37.17***	−34.11***	−110.99	−291.96*
	(9.28)	(8.66)	(125.19)	(146.22)
FromEq	7.17*	8.39**	143.88**	77.39†
	(3.52)	(3.90)	(61.46)	(47.55)
Island	−62.31	−60.80	−2,605.69***	−1,903.71*
	(75.73)	(80.12)	(737.69)	(984.26)
Democracy	34.94**	39.52**	1,243.76***	1,030.30**
	(16.20)	(18.51)	(377.31)	(376.21)
Trust	−11.28***	−11.11***	−38.21	−31.07
	(2.76)	(2.82)	(30.45)	(37.81)
Constant	−166.86	−372.95	−31,986.25***	−18,973.90**
	(536.72)	(543.19)	(10,209.07)	(7,228.09)
N	36	36	36	36
R^2	0.722	0.721	0.711	0.605

Notes: Robust standard errors are in parentheses; see Table 1 in main text for variable definitions. COVID-19 = coronavirus disease 2019; OECD = Organization for Economic Co-Operation and Development.

† $p < 0.15$; * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Source: Author's calculations.

Table A.3: Effect of Removing Outliers from Regressions, All Countries

Countries Removed and Outlier Characteristics, Variable	Deaths	Cases
None		
Gini	5.22*	205.95***
	(2.68)	(67.21)
Pov	0.26	7.50
	(0.47)	(14.66)
R^2	0.709	0.703
Belgium: high deaths, low Gini		
Gini	5.64**	208.00***
	(2.68)	(67.61)
Pov	0.26	7.51
	(0.47)	(14.71)
R^2	0.719	0.704
Madagascar & DRC: high poverty, low deaths and cases		
Gini	5.12*	208.60***
	(2.74)	(68.59)
Pov	0.365	13.34
	(0.572)	(14.53)
R^2	0.708	0.704
South Africa: high Gini		
Gini	7.59***	256.03***
	(2.57)	(76.21)
Pov	0.294	8.23
	(0.495)	(15.86)
R^2	0.719	0.702

Notes: Robust standard errors are in parentheses; see Table 1 for variable definitions. DRC = Democratic Republic of the Congo.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Source: Author's calculations.

Table A.4: Coefficients of Gini and Poverty in Regressions Using Wealth Gini (GiniW), with Standard Errors

Country Groups and Variable Names	Deaths	Cases
All countries		
GiniW	1.67	190.88***
	(3.06)	(60.75)
Pov	0.10	−12.99
	(0.617)	(17.22)
N	127	127
R^2	0.695	0.690
Non-OECD		
GiniW	3.60	131.21*
	(2.81)	(77.50)
Pov	−0.02	10.10
	(0.792)	(22.17)
N	92	92
R^2	0.758	0.802
OECD		
GiniW	−3.20	162.73***
	(4.14)	(39.90)
N	36	36
R^2	0.728	0.646

Notes: Robust standard errors are in parentheses; see Table 1 for variable definitions. OECD = Organization for Economic Co-Operation and Development.

* $p < 0.10$; *** $p < 0.01$.

Source: Author's calculations.

doi:10.3138/cpp.2021-033