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Socioeconomic characteristics, government measures, and health outcomes of COVID-19

Características socioeconómicas, medidas gubernamentales y resultados sanitarios de COVID-19

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Abstract

The impact of pre-pandemic socioeconomic characteristics, as well as the measures taken by different governments to reduce the effects of the COVID-19 pandemic, are analyzed in order to examine their contribution to the number of cases and deaths. Two samples are used to analyze these proposals. Both samples are made up of data from 187 countries organized in a cross-sectional manner, the estimation method is Ordinary Least Squares. The results show evidence that the variables GDP per capita and health expenditure (DE) have a positive relationship with the total cases of COVID-19 per million. While the extreme poverty variable shows evidence of a negative relationship with respect to the number of cases and total deaths per million. On the other hand, there is evidence of a positive relationship between the number of total deaths per million (DM) and the variables government response index (IRG) and health expenditures.

JEL Code: C31, E00, E66, H51, H12
Keywords: socioeconomic characteristics; health outcomes; extreme poverty; COVID-19; containment and mitigation measures

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Resumen

Se analiza el impacto de las características socioeconómicas pre existentes a la pandemia, así como las medidas tomadas por los distintos gobiernos para reducir los efectos de la pandemia de COVID-19, con el fin de examinar su contribución al número de casos y decesos. Para analizar estas propuestas se emplean dos muestras. Ambas muestras se conforman con datos de 187 países organizados en forma transversal, el método de estimación es Mínimos Cuadrados Ordinarios. Los resultados muestran evidencia de que las variables PIB per cápita y gastos sanitarios (DE) tienen una relación positiva con los casos totales de COVID-19 por millón. Mientras que la variable pobreza extrema muestra evidencia de una relación negativa con respecto al número de casos y decesos totales por millón. Por otro lado, se encuentra evidencia de una relación positiva entre el número de decesos totales por millón (DM) y las variables índice de repuesta gubernamental (IRG) y gastos sanitarios.

Código JEL: C31, E00, E66, H51, H12
Palabras clave: características socioeconómicas; resultados sanitarios; pobreza extrema; COVID-19; medidas de contención y mitigación

Introduction

The first case of COVID-19 (an infectious disease caused by the new type of SARS-CoV-2 coronavirus) was detected in the city of Wuhan in November 2019 (although the exact origin of the disease is unknown because the virus may have been circulating elsewhere prior to its detection in Wuhan). Within a short time, this disease began to spread throughout the rest of China, and several months later, more cases were also detected in other countries. (Wu, 2021). Finally, on March 11, 2020, the World Health Organization declared the existence of a global pandemic caused by COVID-19. On April 1, 2020, the World Health Organization reported that approximately 823 626 confirmed cases and 40 598 deaths had been detected worldwide (Chaudhry et al., 2020). With the rapid global spread of the pathogen and the profound disruptions to social life, it soon became clear that COVID-19 has become the worst pandemic in over a century (Wu, 2021).

Given the unprecedented scale and severity of the COVID-19 outbreak, it is important to study the macro-level determinants of infectious disease risk (Morens & Fauci, 2020). Therefore, it is important to identify socioeconomic and health predictors to fine-tune social and economic measures for effective pandemic management (Wu, 2021).

One of these factors may be the growth of urban concentration and transport links. This means that once pathogens have infected human populations, these pathogens spread faster and have more impact than before (Alirol et al., 2011). As urban centers worldwide became epicenters of COVID-19 transmission, the difficulty of maintaining social distancing and other containment measures in densely populated areas became evident.

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On the other hand, urban population growth is often accompanied by the construction of communication infrastructure (railways, roads, airports, etcetera) on a large scale. Therefore, the world's urban centers have also become crucial nodes of international trade and travel (Wu, 2021). On the one hand, this has facilitated the rapid growth of trade, but on the other hand, it also facilitates the spread of SARS-CoV-2, as this could be associated with the development of trade and travel networks (Wu, 2021).

On the other hand, during the current pandemic, governments worldwide have taken non-pharmaceutical measures, implemented social restrictions, and provided financial support to varying degrees. These measures include school and workplace closures, international travel restrictions, and screening and monitoring policies. For government-led policies to significantly reduce the number of cases and the number of deaths, particularly among disadvantaged groups, it is necessary to identify and target the social and economic determinants of the population's health. For example, people living in precarious socioeconomic conditions are less likely to observe social distancing. Likewise, Lou et al. (2020) and Wright et al. (2020) find that compliance with stay-at-home orders during the COVID-19 pandemic varies significantly when individuals' income is considered. Moreover, they observe that people with low income are more exposed to the virus during their commute to work (Asharaf, 2020).

Due to the above reasons, it is important to identify socioeconomic and health predictors to fine-tune social and economic measures to effectively manage the current pandemic and others that may arise in the future (Javaheri, 2021). In the same vein, Braveman and Gottlieb (2014) state that socioeconomic factors, which may include income, wealth, employment, and education, among others, may be the essential drivers of health outcomes and highlight the need for further research on the impact of these factors (Ashraf 2020).

A higher mortality rate is associated with factors such as wealth, social class, and ethnicity, according to the work of Gkiouleka et al. 2018 and Bryan et al. 2020. In addition, Chen and Krieger (2020) found that disadvantaged groups have a higher risk of mortality from COVID-19 (Javaheri, 2021). An example of the above is that although 14% of people in England and Wales belong to Asian and other minority ethnic groups, about 35% of critically ill COVID-19 patients are members of these groups, according to House et al. (2020). This disparity is not unique to the present pandemic; in fact, a higher mortality rate is reported in countries with extreme poverty, according to Murray et al. (2006). Other studies relate high mortality indices to factors such as poverty (Mamelund, 2006), unemployment (Grantz et al., 2016), and the working class in industrialized countries (Bengtsson et al., 2018) during the 1918 influenza pandemic. During the H1N1 pandemic, high mortality indices were also reported in disadvantaged groups worldwide (Biggerstaff et al., 2014; Lowcock et al., 2012; Rutter et al., 2012; Charu et al., 2011).

Specifically, this study analyzes the impact of pre-pandemic socioeconomic characteristics of the different countries, such as health expenditure, tourism, extreme poverty, and per capita income, among others, in conjunction with the measures taken by the different governments to reduce the effects of the COVID-19 pandemic, in order to examine their contribution to the number of cases and deaths (Javaheri, 2021). Therefore, it was examined whether there is a positive link between pre-pandemic socioeconomic characteristics and the health outcomes of the COVID-19 pandemic (number of cases and deaths). It was also studied whether mitigation and containment measures are negatively related to the number of cases and deaths caused by the COVID-19 pandemic.

Two samples are used to analyze these proposals. Both samples are made up of data from 187 countries organized cross-sectionally. The estimation method is Ordinary Least Squares. The socioeconomic variables use pre-pandemic data. Mitigation and containment measures data recorded during the pandemic are used, specifically as of December 28, 2020.

Therefore, the present study contributes to the recent literature on the relation between health outcomes caused by the COVID-19 pandemic and socioeconomic characteristics in conjunction with mitigation and containment measures in three important ways: the first is through a large database consisting of 187 countries. The second contribution consists of using data updated up to December 28, 2020. The final one is that it combines pre-pandemic data on socioeconomic characteristics with containment and mitigation measures recorded during the COVID-19 pandemic.

The remainder of the paper is divided into the following sections: the review of the literature section presents works on the relation between pre-pandemic socioeconomic characteristics and the health outcomes of the COVID-19 pandemic. Likewise, this section considers papers that analyze the relationship between containment and mitigation measures and the health outcomes of the pandemic. The data section describes the variables and their basic statistics; the methodology section describes the estimation methods and the models to be estimated. The results section presents the findings and analysis of the estimated model. Finally, the conclusions include the main contributions of the study.

Review of the literature

The emergence of the COVID-19 pandemic has given rise to a branch of the literature studying the relation between COVID-19 health outcomes and socioeconomic factors. These studies, in some cases, also consider the nexus between health measures for the containment and mitigation of the effects of the COVID-19 pandemic. Some papers studying this relation include Javaheri (2020), Ashraf (2021), Wu (2021), Chaudhry et al. (2020), Stojkoski et al. (2020), and Nguimkeu and Tadadjeu (2021)

The work of Javaheri (2020) examines whether socioeconomic and health factors are correlated with the outcome of the COVID-19 pandemic. The data used are from the Lancet COVID-19 Commission for the five countries most affected by the pandemic. The analysis is performed using ridge and extreme gradient boosting regression models, and its results suggest that demographics and social disadvantage correlate with mortality per million caused by COVID-19. On the other hand, the work of Ashraf (2021) examines the impact of socioeconomic conditions on COVID-19 health outcomes. Likewise, the effect of government measures on socioeconomic conditions and COVID-19 health outcomes is studied. The data used in this study consists of 9529 daily observations from 80 countries from January 22 to May 20, 2020. The results show that socioeconomic circumstances have a strong negative association with confirmed cases and deaths per million people infected with COVID-19. Strict social distancing measures and generous income support programs are also found to help reduce cases and deaths in countries with poor socioeconomic conditions.

Wu (2021) examines whether intensifying environmental and socioeconomic factors are driving the emergence of new pandemics. The paper outlines how ecosystem conversion, meat consumption, urbanization, and transport links between cities and countries may help explain the dynamics of the COVID-19 pandemic. Research is also being conducted on policies that can mitigate the risks caused by the SARS-CoV-2 virus.

Using data from the 50 countries with the most COVID-19 cases, Chaudhry et al. (2020) conducted an exploratory country-level analysis to research the impact of the type and timing of implementation of health policies and measures undertaken concerning COVID-19 mortality and related health outcomes. Data collection included government action, national preparedness, and country-specific socioeconomic factors. The study results show that border closures, total lockdowns, and widespread testing were not associated with COVID-19-derived mortality per million people. However, it was also found that low levels of national preparedness, the scale of COVID-19 testing, and population characteristics were associated with an increased national case burden and overall mortality.

Using the Bayesian model averaging technique and country-level data, Stojkoski et al. (2020) explore whether socioeconomic characteristics can explain the outcome of the first wave of the COVID-19 pandemic. From this, they derive the aggregate map, which acts as a bridge between theoretical research and empirical observations and offers an alternative view of the importance of socioeconomic determinants when used to develop policies to prevent future epidemic crises.

Finally, the work of Nguimkeu and Tadadjeu (2021) discusses why the severity of the new coronavirus pandemic has remained relatively low in sub-Saharan Africa and to what extent demographic and geographic factors associated with the disease explain this phenomenon. They use publicly available data organized in cross-sections from 182 countries worldwide to analyze this issue. In addition, they employ regression analysis to factor in the possible misreporting of COVID-19 cases. Their findings show that the proportion of the population older than 65, population density, and urbanization are significantly positively associated with many active infected cases. In contrast, the mean temperature recorded in the first quarter of 2020 is negatively associated with this COVID-19 result.

Therefore, the present study focuses on analyzing this branch of the literature. For this purpose, socioeconomic variables are used at the country level with pre-pandemic data that are classified as follows: health expenditure, mobility, income, and economic activity. Likewise, the data are organized in a cross-sectional framework, which is the most common in epidemiological studies to analyze the prevalence[1] of disease, as in the works of Guo et al. (2021), Sasaki et al. (2021), and Callinan et al. (2021). In addition, a multiple regression analysis is specified in a linear framework, as in the work of Nguimkeu and Tadadjeu (2021), and Varkey et al. (2020).

Data

To properly manage the current health crisis, it is essential to identify the factors associated with the health outcomes resulting from the COVID-19 pandemic. This will enable the responsible authorities to support vulnerable communities with disproportionate burdens. One of the main limitations in determining the source of this disparity is the difficulty in obtaining patient-level data where individual health records and socioeconomic background of patients match disease severity and outcomes (Javaheri, 2021). A second problem in this area is that data on the socioeconomic conditions of the countries are not available daily.

An alternative approach to partially remedy these limitations is to use country aggregate data on the number of cases, COVID-19 mortality, pre-pandemic socioeconomic characteristics, and containment and mitigation measures adopted by different governments.

Based on the growing evidence and focusing on the idea that socioeconomic and health background is related to the health outcomes of the COVID-19 pandemic, this study: i) examines whether there is a positive relation between pre-pandemic socioeconomic characteristics and the health outcomes of the COVID-19 pandemic (number of cases and deaths); ii) also examines whether mitigation and containment measures exhibit a negative relation with the number of case and deaths caused by the COVID-19 pandemic. It addresses these questions using data from 187 countries organized cross-sectionally. Furthermore, the variables used are classified into two types: the first type of variables is socioeconomic, and the data are pre-pandemic. The second type of variable is data on mitigation and containment measures adopted by governments, and the records are obtained during the pandemic. Socioeconomic variables can, in turn, be classified as follows: health expenditures: government health expenditure as a percentage of government spending (ED); population mobility: international tourism (IT); income: GDP per capita per purchasing power parity (GDPpc) and extreme poverty (EP); and economic activity: GDP growth (GPIB). The records for the variables described above come from reliable

[1]Prevalence is the proportion of individuals in a group or population who exhibit a given characteristic or event at a given time.

databases such as the Development Indicators database developed by the World Bank (2020), Our World in Data created by Ritchie et al. (2021), and finally, the Oxford University COVID-19 Government Response Tracking (OxCGRT) database developed by Hale et al. (2021). Table (1) shows the name, abbreviation, source, year, and unit of measurement of the socioeconomic variables.

Table 1
Socioeconomic Indicators

Name	Abbreviation	Source	Year	Unit of measurement
Health expenses				
Government health expenditure as a percentage of total government spending	ED	World Health Organization	2018	%
Mobility				
International tourism	IT	World Development Indicators	2019	Number of arrivals
Income				
GDP per capita per purchasing power parity	PIBpc	World Development Indicators	2019	$
Extreme poverty	EP	Our World in Data	Compiled with the most recent year available since 2010	Percentage of the population living in extreme poverty
Economic activity				
GDP growth	GPIB	World Development Indicators	2019	%

Source: created by the author

The variables have been selected considering their possible influence on the occurrence of infectious diseases. The health expenditure measured by the variables (ED) allows a country's preparedness for the COVID-19 outbreak to be analyzed. A higher level of health spending would ensure that a country with an extensive health infrastructure, both physical and in terms of personnel, would cope more effectively with the outbreak. Mobility measured by the IT variable serves as a proxy for the movement of people out of the countries. Countries with higher rates of international travel may have received many COVID-19 cases in the initial phase of the pandemic and, consequently, faced more severe outbreaks later. The income evaluated by the GDPpc and the EP variables allows an approximate examination of the degree of compliance with the measures taken to prevent the spread of the COVID-19

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pandemic. The higher the income, the greater the possibility of complying with the measures; if the income is very low, the possibilities are lower and therefore, the risk of contagion increases. Economic activity is observed through the GDP growth of each country; higher economic activity would point to higher mobility and concentration of people, while lower growth would imply lower mobility of people and lower concentration of people in offices.

Table 2
Mitigation and containment measures

Name	Abbreviation	Source	Year	Unit of measurement
Government response rate	IRG	OxCGRT	2020	Number

Source: created by the author

On the other hand, to measure the response of governments to the COVID-19 pandemic, the government response index (IRG) is considered. The government response index is composed of the restrictions indices and the disease mitigation index by adding two additional indicators. These indicators are the government's support of the population's income and household debt relief programs. The restrictions index records information on measures of social distancing. It is calculated from 8 indicators: school closures, workplace closures, cancellation of public events, meeting restrictions, public transportation closures, stay-at-home requirements, internal movement restrictions, and travel restrictions. On the other hand, the disease mitigation index is constructed from 3 indicators: public awareness campaigns, testing policy, and contact tracing. Each of the three indices is a simple additive score of the underlying indicators and is reset to range from 0 to 100.

The indices are for comparative purposes and should not be interpreted as a rating of the adequacy or effectiveness of the country's[2] response to the COVID-19 pandemic (Hale *et al.*, 2020). The OxCGRT database is also the data source for the variables that allow the quantification of the health outcomes caused by the COVID-19 pandemic. These variables are total COVID-19 cases per million and deaths per million caused by COVID-19. Data on containment, mitigation measures, and health outcomes resulting from the COVID-19 pandemic were collected on December 28, 2020.

[2]More information on the composition of the indices of stringency, disease mitigation, and governmental response can be found in the work of Hale et al. (2020) and at: www.bsg.ox.ac.uk/covidtracker

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Table 3
COVID-19 Pandemic Health Outcomes

Name	Abbreviation	Source	Year	Unit of measurement
Total cases of COVID-19 per million	CM	Our World in data	2020	Number
Total deaths per million as a result of the COVID-19 pandemic	DM	Our World in data	2020	Number

Source: created by the author

Country-level health outcomes during the COVID-19 pandemic are analyzed with two variables: confirmed cases per million people and deaths per million people for each country. Higher values of these variables represent adverse health outcomes (higher number of cases and deaths) and lower values represent positive health outcomes (lower number of cases and deaths). Tables 4, 5, and 6 present the descriptive statistics of the variables used in the study. The countries that make up samples A and B can be seen in Table A1.

Table 4
Descriptive statistics for socioeconomic indicators

	ED	PIBpc	IT	EP	GPIB
Mean	10.5	23 534.8	13 096 522	13.4	2.7
Maximum	27.8	129 451	166 009 000	77.6	18.7
Minimum	1.8	784.9	12 000	0.1	−8.1
Standard deviation	5.2	24 285.4	26 335 305.1	19.9	3.1
Observations	172	173	150	120	175

Source: created by the author

Table 5
Descriptive statistics for mitigation and containment measures

	IRG
Mean	55
Maximum	85.1
Minimum	7.2
Standard deviation	15.4
Observations	179

Source: created by the author

Table 6
Descriptive statistics for pandemic health results

	CM	DM
Mean	16 016.3	309.9
Maximum	101 921.9	1 679.5
Minimum	3.2	0.1
Standard deviation	19 294.9	387.4
Observations	177	168

Source: created by the author

The Jarque-Bera test for normality of the error distribution was performed for samples A and B. The results for sample A show that the errors are normally distributed. On the other hand, the results for sample B present mixed evidence.

Methodology

Two samples are constructed with the data obtained. Data from 187 countries organized cross-sectionally are used for both samples. According to Sedgwick (2014), a cross-sectional study is particularly suited to estimate the prevalence of behavior or disease in a population, measured with the variable total COVID-19 cases per million. Cross-sectional studies are common in the epidemiological area, as in the works of Guo et al. (2021), Sasaki et al. (2021), and Callinan et al. (2021)

In addition, multiple regression analysis in a linear framework is specified to analyze both samples. Specifically, the Ordinary Least Squares method is used. The linear regression framework is the simplest tool for quantifying the relation between a given result and a set of possible determinants. Its advantage lies in the efficient and unbiased analytical inference of the strength of the linear connection (Stojkoski et al., 2020). As such, it has been widely used to model epidemiological phenomena results.

The first sample analyzes the relation between the number of cases and pre-pandemic socioeconomic variables in conjunction with COVID-19 pandemic mitigation and containment measures. This sample is referred to as sample A. The dependent variable used to analyze this sample is the number of total COVID-19 cases per million; the independent variables are the pre-pandemic socioeconomic characteristics and the containment and mitigation measures. The model is expressed as follows:

$$\mathrm{CM} = \mathrm{ED} + \mathrm{GDPpc} + \mathrm{TI} + \mathrm{EP} + \mathrm{GPIB} + \mathrm{IRG} + \mathrm{u} \tag{1}$$

Where CM is total cases of COVID-19 per million, DE is government health expenditures as a percentage of total government spending, GDPpc is GDP per capita by purchasing power parity, IT is international tourism, EP is extreme poverty, GPIB is GDP growth, IRG is government response rate, and u is the error term.

Sample B examines the relation between total deaths per million caused by COVID-19 and pre-pandemic socioeconomic characteristics, as well as the containment and mitigation measures employed by different governments. The model is expressed as follows:

$$\mathrm{DM} = \mathrm{ED} + \mathrm{GDPpc} + \mathrm{TI} + \mathrm{EP} + \mathrm{GPIB} + \mathrm{IRG} + \mathrm{u} \tag{2}$$

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DM is the number of total deaths per million due to the COVID-19 pandemic.

Tables A2 and A3 in the appendix show the correlation matrix, indicating no multicollinearity problems. Finally, the research involves a cross-country analysis so heteroscedasticity may influence the coefficients. Standard errors and covariances consistent with White-Hinkley heteroscedasticity are used to correct for the existence of heteroscedasticity.

Results

Two estimates were made, one for each sample. The Ordinary Least Squares method was used to make the estimates.

Table 7
Results for sample A

	Coefficient	Standard error	T-statistic	Probability
Socioeconomic Indicators				
ED	459.11^{*}	269.96	1.70	0.09
PIBpc	0.32^{***}	0.11	2.72	0.007
IT	.00003	.00006	0.51	0.60
EP	-145.37^{**}	57.98	−2.50	0.014
GPIB	−175.61	289.17	−0.60	0.54
Containment and mitigation measures				
IRG	96.73	59.54	1.62	0.107
Statistics				
R square	0.44			
Durbin-Watson statistic	2.06			

Note: *** statistically significant at 1%, ** statistically significant at 5%, and * statistically significant at 10%
Source: created by the author

Table 7 shows the results for sample A. The ED and GDPpc variables are statistically significant at 10% and 1%, respectively. A 1% increase in government health expenditures as a percentage of total government spending represents an increase of 459.11 total COVID-19 cases per million. On the other hand, a $1 increase in the GDPpc variable represents an increase of 0.32 cases of COVID-19 per million people. Likewise, the EP variable is statistically significant at 5%. A 1% increase in this variable means a decrease of 145.37 in COVID-19 cases. The rest of the variables in the sample are not statistically significant.

Table 8
Results for sample B

	Coefficient	Standard error	T-statistic	Probability
Socioeconomic Indicators				
ED	17.4^{7**}	6.67	2.61	0.01
PIBpc	0.001	0.002	0.87	0.38
IT	.000002	.000001	1.34	0.18
EP	-3.62^{***}	1.32	-2.74	0.007
GPIB	-13.70	11.11	-1.23	0.22
Containment and mitigation measures				
IRG	2.92^{**}	1.35	2.15	0.03
Statistics				
R square	0.33			
Durbin-Watson statistic	1.97			

Source: created by the author

The results for sample B are shown in Table 2. The ED variable is statistically significant at 5% for the socioeconomic variables. A 1% increase in the ED variable is related to an increase of 17.47 deaths per million caused by COVID-19. On the other hand, the extreme poverty variable is statistically significant at 5%. A 1% increase in the EP variable indicates a 3.62 reduction in the total deaths per million variable as a result of the COVID-19 pandemic. Likewise, the results for the variables that analyze containment and mitigation measures show that IRG is statistically significant at 5%. An increase of one unit in this variable means an increase of 2.92 in the DM variable. The rest of the variables are not statistically significant.

In the case of sample A, evidence was found to support the hypothesis of a positive link between pre-pandemic socioeconomic variables and the number of COVID-19 cases in the variables ED and

GDPpc. This suggests that countries with higher per capita income and higher health expenditure show higher records of COVID-19 cases. This can be explained by the fact that these countries have greater access to evidence, exhibit greater transparency in reporting, and have better national surveillance systems. Other possible reasons for the positive association could be the greater accessibility of air travel and international vacations in wealthier countries, as travel is an important contributor to the global spread of COVID-19 (Chaudhry et al., 2020). However, no evidence supported this premise since the IT variable is not statistically significant.

As for the EP variable, this variable demonstrates evidence against the existence of a positive link between pre-pandemic socioeconomic variables and the number of total COVID-19 cases per million. Varkey et al. (2020) find that poverty is related to the number of COVID-19 cases and consider that they could be explained in terms of economic growth as countries showing more economic activity are more affected by COVID-19 cases. Nevertheless, the results obtained in this study indicate no evidence of a positive link between economic activity as measured by GDP growth and total COVID-19 cases per million. Likewise, these results are consistent with the work of Nguimkeu and Tadadjeu (2021). They find that sub-Saharan African countries, which are predominantly poor, show a low number of COVID-19 cases, and these results hold even when it is assumed that these countries are underreporting.

The results for sample B indicate that the ED variable demonstrates evidence in favor of the hypothesis that pre-pandemic socioeconomic characteristics have a positive nexus with total deaths per million resulting from the COVID-19 pandemic. On the other hand, the EP variable demonstrates evidence against the previous hypothesis. These results are consistent with those of Javaheri's (2021) research, which indicate that while India has the highest number of people in extreme poverty per million and the lowest number of hospital beds, it has reported lower mortality per million than the United Kingdom, which exhibits the lowest extreme poverty and the highest number of hospital beds.

Javaheri surmises that this could be because the United Kingdom has a higher proportion of people aged 65 and over per million. Studies by Javaheri (2021) and Nguimkeu and Tadadjeu (2021) provide evidence to support this notion. This variable was not considered in this research.

Finally, the government response index variable demonstrates evidence in favor of a positive relation between containment and mitigation measures and the total number of deaths per million resulting from the COVID-19 pandemic. This evidence is consistent with that found in the work of Chaudhry et al. (2020), as their analysis shows that total closures and generalized COVID-19 testing were not associated with a reduction in the number of critical cases or overall mortality.

This could be explained by the fact that the data obtained are from December 28, 2020, when the individual epidemiological curve of each country was not yet in the "plateau" or decline phase. This result could also reflect the degree of noncompliance with these containment and mitigation measures. For example, in the United States, there have been problems enforcing closures, and citizens in several

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states have publicly protested public health measures to limit COVID-19 transmission and fomented open revolt (Chaudhry et al., 2020).

Conclusions

The relation between COVID-19 pandemic health outcomes and pre-pandemic socioeconomic conditions was analyzed. The impact of containment and mitigation measures on the health outcomes of the COVID-19 pandemic was also studied. Two samples, sample A and sample B, were used. In sample A, the dependent variable is the total number of COVID-19 cases per million. Sample B uses the total number of deaths per million resulting from the COVID-19 pandemic as the dependent variable. Both samples use pre-pandemic socioeconomic characteristics and containment and mitigation measures as independent variables. In addition, the two samples are constructed with data from 187 countries. Estimates were made using the Ordinary Least Squares method. Standard errors and covariances consistent with White-Hinkley heteroscedasticity are used to correct for the existence of heteroscedasticity.

In sample A, evidence was found to support the hypothesis of a positive nexus between pre-pandemic socioeconomic variables and the number of COVID-19 cases in the ED and GDPpc variables. The EP variable demonstrates evidence against a positive link between pre-pandemic socioeconomic variables and the number of total COVID-19 cases per million. The results for sample B indicate that the ED variable demonstrates evidence in favor of the hypothesis that pre-pandemic socioeconomic characteristics have a positive nexus with total deaths per million resulting from the COVID-19 pandemic. Furthermore, the EP variable demonstrates evidence against the above hypothesis.

The evidence obtained in sample A demonstrates that countries with higher per capita income and higher health spending have a higher number of COVID-19 cases, results that are consistent with the work of Chaudhry et al. (2020) and Nguimkeu and Tadadjeu (2021). The results are corroborated by the evidence of the EP variable that indicates that countries exhibiting higher percentages of extreme poverty are statistically related to fewer cases of COVID-19.

This can be explained by the fact that countries with higher per capita income provide greater access to evidence, exhibit greater transparency in reporting, and have better national surveillance systems. Performing this type of task is of utmost importance as it allows the pandemic's severity to be assessed and thereby reinforces compliance with containment and mitigation measures or the taking of stricter measures. Likewise, the results for sample B show similar conclusions for the EP and ED variables. On the other hand, the evidence for the IRG variable that evaluates mitigation and containment measures suggests a possible lack of compliance with these precepts on the part of individuals by exhibiting a positive relation with the total number of deaths. Policies to increase compliance with these containment and ED mitigation measures could reduce the number of deaths. Examples of these policies could be systems for monitoring compliance with containment and mitigation measures. Another example of such a policy is to disseminate these measures massively and to combat information not supported by scientific evidence. The present conclusions propose avenues for further discussion, research, and exploration of this topic. One of these ways is to thoroughly study compliance with the containment and mitigation measures adopted by the different governments.

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Appendix

Table A1

List of countries

Country					
Afghanistan	Canada	Germany	Lebanon	Oman	Suriname
Albania	Cape Verde	Ghana	Lesotho	Pakistan	Sweden
Algeria	Central African Republic	Greece	Liberia	Panama	Switzerland
Andorra	Chad	Greenland	Libya	Papua New Guinea	Syrian Arab Republic
Angola	Chile	Guam	Lithuania	Paraguay	Tajikistan
Antigua and Barbuda	China	Guatemala	Luxembourg	Peru	Tanzania
Arab Republic of Egypt	Colombia	Guinea	Macao	Philippines	Thailand
Argentina	Comoros	Guyana	Madagascar	Poland	Togo
Armenia	Costa Rica	Haiti	Malawi	Portugal	Tonga
Australia	Croatia	Honduras	Malaysia	Puerto Rico	Trinidad and Tobago
Austria	Cuba	Hong Kong	Maldives	Qatar	Tunisia
Azerbaijan	Cyprus	Hungary	Mali	Republic of Korea	Turkey
Bahamas	Czech Republic	Iceland	Malta	Republic of the Congo	Turkmenistan
Bahrain	Democratic Republic of the Congo	India	Mauritania	Romania	Uganda
Bangladesh	Denmark	Indonesia	Mauritius	Russian Federation	Ukraine
Barbados	Dominica	Iran	Mexico	Rwanda	United Arab Emirates
Belarus	Dominican Republic	Iraq	Moldovaavia	San Marino	United Kingdom
Belgium	East Timor	Ireland	Monaco	Saudi Arabia	United States of America
Belize	Ecuador	Israel	Mongolia	Senegal	Uruguay
Benin	El Salvador	Italy	Montenegro	Serbia	Uzbekistan
Bermuda	Equatorial Guinea	Ivory Coast	Morocco	Seychelles	Vanuatu
Bhutan	Eritrea	Jamaica	Mozambique	Sierra Leone	Venezuela
Bolivia	Estonia	Japan	Myanmar	Singapore	Vietnam
Bosnia and Herzegovina	Eswatini	Jordan	Namibia	Slovak Republic	YDjibouti
Botswana	Ethiopia	Kazakhstan	Nepal	Slovenia	Yemen
Brazil	Faroe Islands	Kenya	Netherlands	Solomon Islands	Zambia

http://dx.doi.org/10.22201/fca.24488410e.2021.3485

Brunei Darussalam	Fiji	Kiribati	New Zealand	Somalia	Zimbabwe
Bulgaria	Finland	Kosovo	Nicaragua	South Africa	
Burkina Faso	France	Kuwait	Niger	South Sudan	
Burundi	Gabon	Kyrgyz Republic	Nigeria	Spain	
Cambodia	Gambia	Laos	North Macedonia	Sri Lanka	
Cameroon	Georgia	Latvia	Norway	Sudan	

Source: created by the author

Table A2
Correlation matrix for sample A

	CM	IT	ED	EP	IRG	PIBpc	GPIB
CM	1	0.26	0.49	−0.44	0.44	0.61	−0.17
IT	0.26	1	0.18	−0.24	0.32	0.28	−0.07
ED	0.49	0.18	1	−0.48	0.19	0.51	−0.39
EP	−0.44	−0.24	−0.48	1	−0.44	−0.48	0.31
IRG	0.44	0.32	0.19	−0.44	1	0.44	−0.07
PIBpc	0.61	0.28	0.51	−0.48	0.44	1	−0.13
GPIB	−0.17	−0.07	−0.39	0.31	−0.07	−0.13	1

Source: created by the author

Table A3
Sample correlation matrix for sample B

	DM	IT	ED	PIBpc	GPIB	EP	IRG
DM	1	0.31	0.45	0.40	−0.24	−0.41	0.36
IT	0.31	1	0.15	0.27	−0.04	−0.24	0.32
ED	0.45	0.15	1	0.49	−0.37	−0.48	0.16
PIBpc	0.40	0.27	0.49	1	−0.10	−0.47	0.44
GPIB	−0.24	−0.04	−0.37	−0.10	1	0.31	−0.03
EP	−0.41	−0.24	−0.48	−0.47	0.31	1	−0.43
IRG	0.36	0.32	0.16	0.44	−0.03	−0.43	1

Source: created by the author