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Critical country-level determinants of death rate during Covid-19 pandemic

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ABSTRACT

The COVID-19 pandemic has already led to over 94 million confirmed cases and over 2 million deaths globally (John Hopkins CSSE, 2021). Due to the magnitude of the socio-economic damage of COVID-19 all over the world, we analyzed the critical country-level determinants of the death rate during the COVID-19 pandemic. We have examined the effects of GDP (allocated to pandemics and health), education, gender, cultural factors, number of physicians (per 1000 of the population) on the death rate. A correlation between the death rate and socio-economic conditions has been observed. The finding shows that power distance, individualism, gender, and age affect the death rate more than other socio-economic factors we use. We have also performed the same analysis by using Lockdown levels as a moderator. Lockdown levels have a more significant moderating effect on cultural factors rather than the other socio-economic factors. However, due to the topic's sensitivity, we still need to pay attention to the socio-economic factors that may have lower levels of significant relationship with the death rate, since even 0.1 % of changes in coefficients of our other socio-economic variables could mean thousands of lives. The study results will help health organizations, administration, and policymakers take the necessary steps to combat and manage the pandemic.

1. Introduction

Pandemics are associated mainly with unusually high mortality rates, capable of depleting the human population, human capital, among others. For instance, HIV/AIDS, SARS, Ebola, and recently, the COVID-19 (coronavirus disease, 2019) scourge are global concerns for households, government, and businesses due to adverse effects on the global population and workforce. Several studies have reported death rates resulting from epidemic or pandemics impact using variables broadly group level into socio-economic and medical (health) factors, but not socio-cultural factors. Hence, following the COVID-19 pandemic outbreak, this study attempts to determine macro-level factors responsible for death rates, with a new insight of cultural dimension as a contribution to existing literature.

Lee and McKibbin [1] reported the direct consequences of the SARS epidemic in terms of medical expenditures or demographic effects, which seem to be relatively small, particularly when compared with those of other major epidemics such as HIV/AIDS or malaria. Lee and McKibbin [1] provided a global economic assessment of the impact of SARS and an approach to the estimation of the consequences of the outbreak globally. However, they kept constant the pre-macro-level costs such as medical costs and income opportunity costs to concentrate on the macro-level of the post effect of the epidemic in terms of change in households and firms' spending behaviors. Thus, their study focused on the consumption and investment dimensions of SARS and the attendant risks of conducting business and associated losses that well exceed the medical costs associated with combating the SARS scourge. The business disadvantage resulting from the outbreak of this epidemic in the short and long run revealed that businesses appear to be the worst-hit contrary to expectations and focus, which is usually on medical costs.

In 2002, China was plagued with the severe acute respiratory syndrome (SARS). Smith [2] argued that the present globalization phenomenon increases the probability that an epidemic that ravages one nation could spread quickly to another, just as we have witnessed in almost two decades leading to a stampede of nations with an unprecedented effect on economies of not only the affected countries but also, other countries of the world. SARS infected 10,000 people but only claimed 1000 victims, with an impact seen to be less severe health-wise compared to the fear that came with the epidemic but exerted a more disproportionate economic shift [2]. So, in effect, the aftermath of the SARS epidemic impacted the world's economies adversely than it did on

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health. The monetary value of the global economic loss adducible to the SARS epidemic stood between US$30 and 100 billion or US$3 and 1 million per case, with travel and tourism sectors being the worst hit [1, 2].

In a similar trend, another epidemic was the Ebola virus, which caused a severe hemorrhagic fever in humans. It caused high case fatality and significant epidemic potential. The Ebola outbreak in West Africa was also unprecedented in scale [3], which was more substantial than all previous outbreaks put together, with 28,646 reported cases and 11,323 reported deaths [4]. It was reportedly unique in its geographical distribution and multi-country spread. Coltart [4] admonished that the lessons learned from the world's largest Ebola outbreak must not be lost. Unfortunately, the lessons seem to have been lost as the COVID-19 metamorphosed from an epidemic to a pandemic, proving uncontainable.

However, a high mortality rate can be curbed by creating: "a dedicated 'Center for Emergency Preparedness and Response' with strong technical expertise; creating a Standing Emergency Committee with a strengthened ability to identify health risks, and declare public health emergencies appropriately independently; ensure a protected budget and contingency fund to support this new center and allow rapid deployment of emergency response when required; this would include annual contributions from the Member States, International Monetary Fund, World Bank, and other multilateral donors" [4]:19).

The fact that the COVID-19 hitherto ravages lives of human persons beyond China, France, Italy, Spain, and the U.S, with weak combatant skills displayed, depicts the non-adherence to advice encapsulated in relevant studies [2,4] where the purpose of the paper was a perception of risk, it is communication and management as it pertains to a similar epidemic like SARS that might arise in the future. Among other things, the study proposed a superior system that would help combat any future outbreak of an epidemic. Smith [2] concluded that following the response against SARS, it is expected that the subsequent epidemic outbreak would be easily and quickly contained if the current network that warred against SARS is sustained as SARS lasted only for 90 days. However, the COVID-19 pandemic had long outlived this window; thus, it is a cause for serious concern.

This study adds to the existing literature by including three novel variables that hitherto are still receiving burgeoning attention in pandemic mortality rate studies. Two are cultural variables (power distance and individualism). The third is the government stringency index variable (Lockdown), thus taking the independent variables in the specified regression model of the study to ten. Our models two insightful scenarios: (1) with Lockdown and (2) without Lockdown to uncover how lockdown moderates the relationship between other independent variables and death rate during a pandemic (COVID-19), which is yet to be tested in literature as far as we know.

Notably, power distance and individualism [5], and Lockdown (Oxford CGRT) are capable of affecting the death rate during a pandemic (COVID-19) in addition to the widely tested variables such as health expenditure to GDP, Pandemics expenditure to GDP, female, age, education, hospital beds, and physicians [6–14,72]. The study aims at ascertaining the critical country-level determinants of death rate during a pandemic such as the COVID-19 while holding constant other micro-level determinants of death rate like frequent hand-washing, face-mask wearing, social distancing, early testing if symptoms are observed, practicing general hygiene, and so on, which have been identified by health literature and other periodic circulars.

2. Literature

2.1. Allocation of GDP to health-related issues

Considering the allocation of GDP to health-related issues as a variable, we intend to uncover the degree or level of priority in which health care policymakers and their governments according to health and wellness of their citizens as reflected in the percentage of their budgets allocated to health matters. The percentage of GDP allocated to health-related expenditures is the proxy for the health variable in the model of this study [11]. Laaksonen et al. [12] found that behavioral health factors could explain socio-economic odds reflected in the educational level, responsible for mortality rate differentials within a socio-economic context. Mondal and Shitan [15]; in their study, among other factors, investigated the impact of health care availability on life expectancy (LE) among low and middle-income earners in selected countries and found that provision of necessary healthcare bundles with increased levels of socio-economic benefits could add to life expectancy.

In another health-related study, Toor [11] examined the factors that determine Pakistan's health care expenditure, such as GDP per capita, literacy level, and foreign aid. In a similar study relating to a developing nation, Boachie et al. [14] found evidence that public health expenditure in Ghana is positively associated with real GDP and enhanced health care policies proxied by life expectancy in the study. However, it was admitted that the intuition or craft of assigning a measure to health status in research is usually not perfect [14]. However, there seems to be a consensus in extant literature that health care expenditure has been reflected in lifestyle, which mediates the socio-economic status and health of the population [8].

2.1.1. Health expenditure as a percentage of gross domestic product (GDP)

"Total health expenditure as a percentage of GDP; total expenditure on health is the sum of general government health expenditure and private health expenditure in a given year, calculated in national currency units in current prices. GDP is the value of all goods and services provided in a country by residents and non-residents without regard to their allocation among domestic and foreign claims" [16].

World health expenditure as a percentage of GDP has been on the rise, standing at 9.8 % in general (World Bank). Several academic studies have been conducted to capture "health expenditure as a percentage of GDP." For instance, Piabuo & Tieguhong [17] reported a long-run relationship between expenditures in health and growth in the economy. In the determination of healthcare expenditure, some have argued that population aging is critical, but there is yet to be concrete empirical support for this. Advancement in technology, proximity to death, and non-centralization of healthcare are common independent variables used to specify the healthcare expenditure model [18].

In a similar study, Ke et al. [19]:1) found "results that suggest that health expenditure, in general, does not grow faster than GDP after considering other factors. The pace of health expenditure growth is different for countries at different levels of economic development".

An allocation of a more significant health expenditure percentage to a nation's total expenditure leads potentially to an increased GDP per capita, and extended average-time-expected-to-live is enhanced, thus, translating to a more lively, agile, and resulted-oriented labor force. Higher life expectancy and human capacity development are associated with the countries that invested above one-half of their total expenditure on their citizenry's healthcare, and those that did not invest up to half had a lower outcome [73]. Thus, we hypothesize that health expenditure as a percentage of GDP is associated with the death rate in a pandemic

such as COVID-19 and propose the following:

H1. Health expenditure as a percentage of GDP is negatively related to the death rate in a pandemic such as COVID-19.

2.1.2. Pandemics expenditure as a percentage of gross domestic product (GDP)

Economic conditions like behavioral, social, and cultural factors are considered crucial elements that substantially influence the healthcare system worldwide dealing with COVID-19 [20,21]. Financing in the health sector is a critical factor in developing the health care system and attaining universal health coverage goals [22]. In terms of having higher GDP per capita, more developed cities usually have better healthcare facilities to take care of patients, cure them, and reduce communicable disease transmission to others [21]. On the other hand, countries struggling financially and cannot adequately fund their healthcare sector will suffer setbacks such as lack of health care services, severe staff shortage, lower quality of infrastructure, and higher death rates [23,24]. Per capita GDP is the essential factor of per capita public health expenditure [25,26]. From the bidirectional perspective, public health expenditure can positively impact economic growth by reducing disease infection and mortality rate over a long time and even improving people's quality of life [27]. Bhat and Nishant Bhat and Nishant [28]; Rahman [29]; and Hooda [30] examined the relationship between GDP and health expenditure and found that per capita GDP has a positive influence on the per capita health expenditure. Thus, we can hypothesize that:

H2. Pandemics expenditure as a percentage of gross domestic product (GDP) has a negative relationship with the death rate.

2.1.3. Population density of hospital beds

Besides personal protective equipment, ventilators, and workforce in healthcare, the number of hospital beds also plays a pivotal role in representing a country's healthcare ability to respond to a pandemic, like COVID-19 [31]. Health specialists warned that a shortage of inpatient hospital beds tends to threaten the healthcare system. That is why every country worldwide rapidly responded to the concerns and expanded the number of hospital beds [31]. Every country has taken numerous measures to contain the spread of COVID-19, such as social distancing, hand washing, wearing facial masks, and so on, but a strategy to expand hospital capacity to serve many patients together is clearly needed [32]. Hospitals need to restructure their capacities to have more space for patients who are already hospitalized. Those are coming in because hospitals get different kinds of patients-some are more critical, and some are less critical [33]. The paucity of hospital beds for critical and non-critical patients has been among the significant challenges hospitals faced during the ongoing pandemic. This shortage of hospital beds is also responsible for having higher death rates in every country [34]. Based on these arguments, we can propose the following hypothesis:

H3. The number of hospital beds is negatively related to the death rate.

2.2. Educational level

Educational level has been identified in several studies as a variable or factor which impacts well-being and mortality [9,13]. Educational level has been used to capture the length or period an individual has remained in the educational hierarchy and the educational qualification attained, ranging from a most basic twelfth grade to a doctoral degree. Beine, Docquier, and Rapoport [35] asserted that brain drain syndrome (BDS) is a factor that leads to the depletion of educational level within an economy. Interestingly, the study found that a long-run migration plan to pursue "greener pasture" motivated educational level improvement in the short run. Perceived health status is positively related to educational level, such that the recent declines as the latter decreases [7].

In another study, the question of whether varying figures of premature death in different countries have a corresponding relationship with the various educational level was examined [13]. Avendano, Jurges & Mackenbach [36] and Das Gupta [37] found that health deterioration, chronic diseases, and disability, which ultimately lead to an increase in mortality rate, are associated with low education. The impact of educational level on poor health was most significant. Laaksonen et al. [12] investigated how health behaviors reflect the educational level in cardiovascular disease mortality. Educational level revealed a categorized relationship with all recorded death [10,12]. Rehkopf et al. [10] and Fujino [9] suggested that socio-economic differences noticed in death rates were trackable to various individual educational levels [38].

In the same study, Fujino [9] investigated the relationship between educational level and leading causes of mortality in Japan, acknowledged that earlier studies showed a correlation between socio-economic status and communicable diseases, and education was one of the indices used to reflect socio-economic standing. Weinblatt et al. [6] conducted a study and found that over three years, men with low educational levels are three times at risk of coronary mortality than their better-educated counterparts. Thus, following extant literature, the educational level impacts cumulative death in countries of the world, albeit mediated by factors such as lifestyle health and socio-economic status [8]. Therefore, we can propose the following hypothesis:

H4. The education level of people negatively affects the death rate.

2.3. Population density of physicians

Healthcare workers have one of the most critical roles in managing pandemics. Therefore, the number of healthcare workers per country would significantly impact death rates during pandemics and the country's infrastructure. The level of crisis planning has a colossal effect on pandemics. However, the number of physicians ready to deal with pandemics would also make emergency planning meaningful. Although countries may have good infrastructure and well-prepared emergency plans in place, if the government does not have enough healthcare workers, all the structural readiness could be pointless. Developing and developed countries have different issues to overcome, but one of the most indispensable factors is the available quantity of healthcare workers. Underdeveloped and developing countries lack adequate technology and/or vaccines; nonetheless, they could close that gap with sufficiently informed and capable healthcare workers. Therefore, it could be one of the issues underdeveloped and developing countries should focus on medical education and pandemic-related worker training.

According to the recent studies done by WHO, the number of healthcare workers, especially in Africa, could be stepped up by as much as 140 % to reach international health development targets, efficient deployment of healthcare workers, and evenly distributed healthcare workers throughout these countries. WHO also mentioned that the quality of healthcare workers has a critical role in handling pandemics. Still, in the long run, unqualified healthcare workers would be costlier to the country as the death rate during the pandemics will skyrocket. Governments play an essential role in having an appropriate labor force, supporting healthcare workers [39]. Based on these arguments, we

could conclude that countries with more physicians can fight comparatively more effectively against pandemics and, eventually, death rates. Thus, we can propose the following hypothesis:

H5. The number of physicians available in a country is negatively related to the death rate.

2.4. Effect of cultural differences

2.4.1. Power distance (PD)

Hofstede defines PD as "the extent to which the less powerful member of organizations and institutions (like the family) accept and expect that power is distributed unequally." When there is a higher degree of PD, it could easily be considered as there is an established hierarchy, and it is applied in society. In contrast, lower degree PD signifies a doubt about the authority and its power (Hofstede). We could easily see the different PD in many different norms [40] could lead to varying results during the pandemic in the U.S with the capitalist system, low power distance, which means 'fair play, freedom of speech, and the rights of the individual' [40]; p. 90), therefore most of the statistics in the U.S are more reliable. Thus, the precautions taken could be more accurate for the stage of the pandemic and more capitalist countries. High Power Distance where media messages tend to 'conform to the socio-cultural and political order' [40]; p. 86), depending on the social media and how it is always controlled, institutions in that country deal accordingly with the pandemic.

If the media does not emphasize certain precautions, people could easily take pandemic less seriously, where would generate unexpected results. Since traveling is part of our lifestyle nowadays, one country's wrong approach to an epidemic could quickly affect the whole world.

A global pandemic spreads without any relationship for national borders, but the perception of the risk various from nation to nation. Like any other socio-economic issue, pandemics are culturally built phenomena. According to the different cultural structures and perceptions, they become known to the public through media and government acknowledgments. Therefore, the results could also be significantly different [41–45]. Therefore, we can propose the following hypothesis:

H6. High power distance has a positive relationship with the death rate.

2.4.2. Individualism vs. collectivism (IND)

According to Hofstede, the IND index examines the "degree to which people in a society are integrated into groups. Individualistic societies have loose ties that often only relate an individual to their immediate family." They also emphasize the "I" versus the "we." Dealing with pandemics is group work; all the precautions must be taken as a group, where collectivism becomes a critical factor in controlling the pandemics. Acting individually will not help to manage and solve the issues of spreading pandemics. An epidemic is an infectious disease outbreak, rapidly spreads through human populations across a vast international region, potentially worldwide [16]. While pandemics have been examined for many years, the increase in global travel affects any infectious disease in one country to quickly spread to closer countries and become a global pandemic [2]. Germani et al. [46] noted that to contest the COVID-19 and reduced levels of psychological instability in maturity, individuals' cultural orientation, such as the request of mutual allotment aims with others, interdependence, and sociability must be underlined and encouraged as shielding factors. Encouraging collectivism could be a method to improve employment with attempts to diminish the spread of COVID-19 [47]. Cultural differences in collectivism could have become apparent by a method of natural selection as a shielding tool against pandemics [48]. Thus, we can propose the following hypothesis:

H7. The death rate from the pandemic of an individualistic society is higher than the death rate of a collectivistic society.

2.5. Importance of demographics

2.5.1. Age

International communities, the government of every country, policymakers, and all other concerned people are trying to reduce the transmission of coronavirus disease in 2019 by applying many means, like social distancing and travel restrictions. COVID-19's impact is strongly related to the population's demographic structure, specifically, the population age structure [49]. Age can provide new insight into how the pandemic is getting spread out and the type of measures needed to control pandemics [49]. According to a recent report, the COVID-19 mortality rate is highly concentrated at older ages, especially those who are above 80 [49]. The USA surpassed 25 million confirmed cases and 424,100 deaths, by far the highest reported total globally, in less than ten months after the first infection was reported in Washington state on January 31, 2020 [50].

The fatality rate is the ratio of the number of deaths and the number of individuals diagnosed over a defined period [51,52]. According to Worldometer, the USA's case fatality rate (CFR) is 48.70 % in the above 75 age group. In China, CFR for 40–49 years is 0.4 % but is 14.8 % for 80 and above [53]. CFR is 23 % for those above 65 years in Italy, and in South Korea, CFR is 18.31 % for those who are above 80 years old [49,53,54]. Recently, Brazil, among the South American countries, has become a hard spot for having many people infected by coronavirus disease, and the mortality rate in the older age group, 60 and above, is higher, which is around 69 % [55,56]. Based on the data published by different journals and hospitals, it is evident that the mortality rate from COVID-19 is higher in older age group patients than younger around the world. Therefore, we can propose the following hypothesis:

H8. The age of people has a positive relationship with the death rate.

2.5.2. Gender (female)

Gender-disaggregated data for COVID-19 shows a different number of cases between males and females so far in mortality and vulnerability to this disease worldwide [57]. Mortality and vulnerability data published from different countries show that more men than women die from COVID-19, basically due to sex-based immunological differences [58,59]. Immune system and engagement result in a less robust response in males and an increased mortality rate from viral respiratory illness due to sex hormones, estrogen, and testosterone [58]. Furthermore, even the X chromosome bears the most significant number of immune-related genes in the human body and also contributes to the

Table 1
Stringency index indicators used by OxCGRT.

Name	Type	Targeted/general
Containment – Closure		
School Closure	Ordinal	Geographic
Workplace Closing	Ordinal	Geographic
Cancel Public Events	Ordinal	Geographic
Restrictions on Gathering Size	Ordinal	Geographic
Close Public Transport	Ordinal	Geographic
Stay at Home Requirements	Ordinal	Geographic
Restrictions on Internal Movement	Ordinal	Geographic
Restrictions on International Travel	Ordinal	No
Economic Response		
Income Support	Ordinal	Sectoral
Debt/Contract Relief for Households	Ordinal	No
Fiscal Measures	Numeric	No
Giving International Support	Numeric	No
Health Systems		
Public Information Campaign	Ordinal	Sectoral
Testing Policy	Ordinal	No
Contact Tracing	Ordinal	No
Emergency Investment in Healthcare	Numeric	No
Investment in Covid-19 Vaccines	Numeric	No
Miscellaneous		
Other Responses	Text	No

female's strong immune system [60]. Alongside chromosome, social, behavioral, and cultural factors also affect current COVID-19 epidemiology.

Smoking and getting involved in public gatherings have been significant contributors to disease severity. The smoking rate in China, the USA, and Italy is much higher in men than in women, which means men smoke more than women [61]. In the USA, 17.6 % of smokers are men than 13.6 % of women, and in China, the men and women smoking ratio are 22.6:1 [62]. Women usually spend more time than men focused on their own and families' health and medical issues that help them be less susceptible to disease [63]. Usually, men are more likely to engross health-related risks, which has been another reason for being higher in mortality ratio with women [64]. Therefore, we can propose the following hypothesis:

H9. Gender (female) has a positive relationship with the death rate.

2.6. Lock down levels (stringency index)

COVID-19 is not the first pandemics that the world has faced and will not be the last one. Therefore, we need to understand how we can depend on ourselves as individuals, countries, and as a world from future pandemics. One of the significant steps for understanding the pandemics and taking precautions is to analyze the kind of government responses and their effect to control the pandemics' spread [65]. is one of the response tools that track government responses to Covid-19 systematically (daily). The data has indices that measure government responses with different dimensions (Table 1). These indicators examine the differences between the government responses worldwide, where enable us to analyze the effects of the various indicators on COVID-19 related deaths. According to OxCGRT, the stringency index provides us "a systematic cross-national, cross-temporal measure to understand how government responses have evolved over the full period of the disease's spread." Therefore, we can propose the following hypothesis:

H10a. During a pandemic (COVID-19), Lockdown will moderate the relationship between the death rate and all the other variables (H_1–H_9).

H10b. During a pandemic (COVID-19), Lockdown will not moderate the relationship between the death rate and all the other variables (H_1–H_9).

3. Methodology

3.1. Model and variables

We used in this study two separate path analysis to see the effect of education [12,13], GDP expenditure for health and pandemics [66], age [49], gender (female) [57], number of physicians [39], and cultural difference [41] on mortality rate during COVID-19, under lockdown conditions and without lockdown conditions.

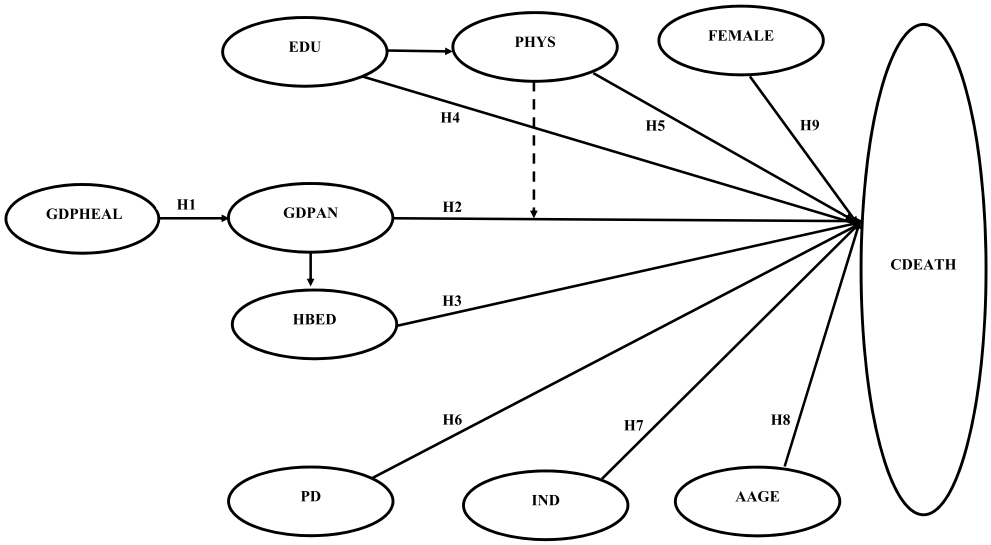
In this paper, the dependent variable is the percentage of death from the COVID-19. We collected the data from the World Health Organization. We have collected two data sets separately: the data of the number of deaths from COVID-19 and the data of confirmed cases from Covid-19. After obtaining the two separate data sets, we used the following formula and created our main dependent variable data.

CDEATH = (The number of deaths from COVID-19/ The number of Infected Cases from COVID-19) x 100

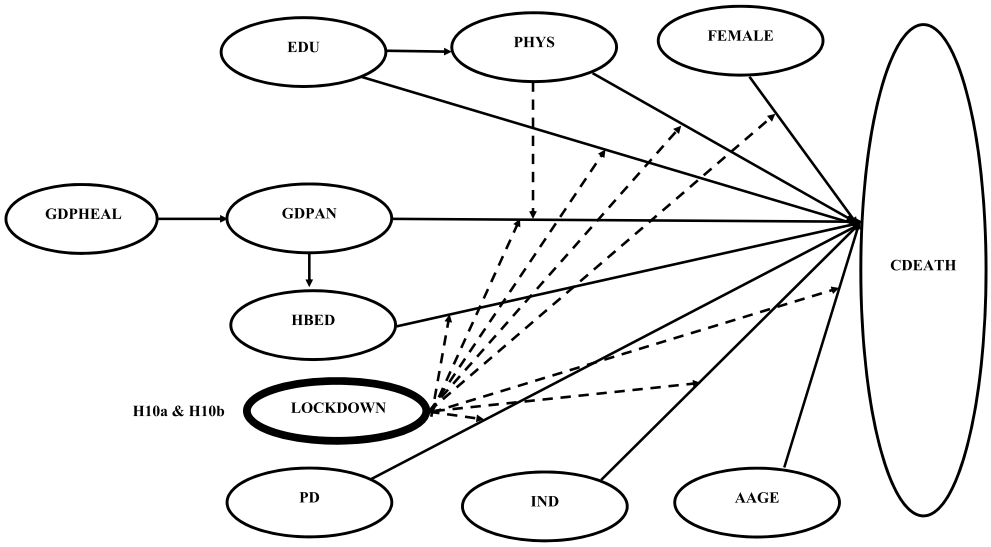
We used the stringency index to examine Lockdown's moderator effect; the index covered 246 days for all the countries we included in our study. We had to take an average of 246 days of stringency ratings for all the countries and created a new set of data, and we called LOCKDOWN.

We performed two PLS - Path Analyses using WarpPLS (7.0 version) software. The first model did not include the Lockdown variable. The second model had Lockdown to see Lockdown's moderator effect on the other variable's relationship with the dependent variable.

3.1.1. $Model_1$



3.1.2. $Model_2$ (lockdown moderator)



3.2. Data

This study collected annual data for the variables used in the model from various sources. We collected data on 168 countries from multiple reliable sources. Data on GDPPAN is obtained from the World Bank Database, data for gender (percentage of a female) (FEMALE), and the average age of people (AAGE) is collected from World Health Organization (WHO) 's website. Data for education (EDU) is obtained from the United Nations Website. The number of Physicians per 1000 (PHYS), percent of GDP used for health (GDPHEAL), and hospital beds per 1000 (HBED) are collected from the World Health Organization. Socio-cultural data- Power Distance (PD) and Individualism (IND) are obtained from Hofstede. The stringency index for 168 countries covering 246 days collected from Oxford COVID-19 Government Response Tracker (OXcGRT) (Tables 2 and 3).

4. Empirical results

4.1. $Model_1$ results

Average path coefficient (APC) = 0.263, P < 0.001, Average R-squared (ARS) = 0.293, P < 0.001, Average adjusted R-squared (AARS) = 0.278, P < 0.001, Average block VIF (AVIF) = 2.415 (acceptable if ≤ 5, ideally ≤ 3.3), Average full collinearity VIF (AFVIF) = 2.344 (acceptable if ≤ 5, ideally ≤ 3.3), Tenenhaus GoF (GoF) = 0.541 (small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36) Sympson's paradox ratio (SPR) = 0.750 (acceptable if ≥ 0.7, ideally = 1), R-squared contribution ratio (RSCR) = 0.955 (acceptable if ≥ 0.9, ideally = 1), Statistical suppression ratio (SSR) = 0.833 (acceptable if ≥ 0.7), Nonlinear bivariate causality direction ratio (NLBCDR) = 0.833 (acceptable if ≥ 0.7).

Table 2
Variables (Detailed).

Variables (Abbreviations)	Type of variables	Variables
CDEATH	Dependent	Percentage of death from the COVID-19
EDU	Independent	Educational Level
FEMALE	Independent	Gender (Female)
GDPHEAL	Independent	Health Expenditure as a Percentage of Gross Domestic Product (GDP)
PD	Independent	Power Distance
IND	Independent	Individualism vs. Collectivism
AAGE	Independent	Average Age
PHYS	Mediator	Population Density of Physicians
GDPPAN	Mediator	Pandemics Expenditure as a Percentage of Gross Domestic Product (GDP)
HBED	Mediator	Population Density of Hospital Beds
LOCKDOWN (Model 2)	Moderator	Lock Down Levels (Stringency Index)

4.2. $Model_2$ results

Average path coefficient (APC) = 0.228, P < 0.001, Average R-squared (ARS) = 0.308, P < 0.001, Average adjusted R-squared (AARS) = 0.284, P < 0.001, Average block VIF (AVIF) = 2.948 (acceptable if ≤ 5, ideally ≤ 3.3), Average full collinearity VIF (AFVIF) = 2.919 (acceptable if ≤ 5, ideally ≤ 3.3), Tenenhaus GoF (GoF) = 0.555 (small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36), Sympson's paradox ratio (SPR) = 0.800 (acceptable if ≥ 0.7, ideally = 1), R-squared contribution ratio (RSCR) = 0.952 (acceptable if ≥ 0.9, ideally = 1), Statistical suppression ratio (SSR) = 0.600 (acceptable if ≥ 0.7), Nonlinear bivariate causality direction ratio (NLBCDR) = 0.675 (acceptable if ≥ 0.7).

Table 3
Data sources.

Healthcare spending (%) in GDP	GDPHEAL	World Health Organization
Pandemic spending (%) in GDP	GDPPAN	World Bank Database
Hospital Beds Quantity per 1000 people	HBED	World Health Organization
Physiciancs Quantity per 1000 people	PHYS	World Health Organization
Female percentage in population	FEMALE	World Health Organization
Average age of the country	AAGE	World Health Organization
Power Distance	PD	Hofstede)
Individualism vs Collectivism	IND	Hofstede)
Lockdown levels	LOCKDOWN	Government Response Tracker (OXcGRT). Stringency Index (246 days-March-October 2020)
Death Rate; *The number of deaths from/The number of Infected *100*	CDEATH	World Health Organization

Table 4
Model$_1$ results (P values and path coefficients).

Variables	P values	Path coefficients
Dependent: CDEATH		
Relationship of the variables		
EDU→CDEATH	<0.01***	−0.22
EDU→PHYS	<0.01***	0.79
GDPPAN→CDEATH	0.01**	0.17
GDPHEAL→GDPPAN	<0.01***	0.53
GDPPAN→HBED	<0.01***	0.27
PD→CDEATH	<0.01***	0.22
HBED→CDEATH	0.35	−0.03
PHYS→CDEATH	0.33	0.03
*PHYS→(GDPPAN→CDEATH)	0.22	0.06
IND→CDEATH	<0.01***	0.32
FEMALE→CDEATH	0.02**	0.15
AAGE→CDEATH	<0.01***	0.35

*Moderator, P Values *** 99 % Significance, ** 95 % Significance, * 90 % Significance.

4.3. Model$_1$ and Model$_2$results comparison

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5. Discussion

Our first set of variables are health-related variables; GDPHEAL, GDPPAN, and HBED. GDPHEAL: Percentage of GDP allocated to Health. We have tested the country's percentage of GDP allocated to Health and how this allocation affects the death rate from COVID-19 (CDEATH). However, we used GDPPAN as a mediator. GDPHEAL has a positive significant relationship with GDPPAN. In Model$_1$, our P-value (p>|t|) is smaller than 0.01, and in Model$_2$ our P-value (p>|t|) is also smaller than 0.01, which are less than 0.05. The path coefficients in both models are 0.53. The increase in the expenditure on health also increases the expenditure on pandemics. GDPPAN: Percentage of GDP allocated to Pandemics. We have also tested the country's percentage of GDP allocated to Pandemics and how this allocation affects the death rate from COVID-19 (CDEATH). In Model$_1$, our P-value (p>|t|) is 0.01, and in Model$_2$ is 0.02 (Table 7), which are less than 0.05. The number of hospital beds (HBED) does not have any significant relationship with the death rate. It was also noted by Li et al. [67] that hospital beds capacity influences the containment of the COVID-19; however, it is not sufficient enough. In Model$_1$, our P-value (p>|t|) is 0.35, and in Model$_2$ is 0.33 (Table 7), which more than 0.05. The percentage of GDP allocated to Health and Pandemics has a positive significant relationship with the death rate; however, Lockdown reduces the significance of the relationship (Table 6). By examining countries like the USA, United Kingdom, France, Netherland, and Sweden, we could clearly see that while they spend more than 10 % of their GDP on health and pandemics, their death rates are still above 15 %. It means that when the ratio of GDP allocated to the health and pandemics increases, the death rate from COVID-19 gets affected significantly, which is the opposite of our expectation and existing literature. Therefore, we need further study of the relationship between GDP spending for pandemics, health, and the Death rate. H_1: Health expenditure as a percentage of GDP is negatively related to the death rate in a pandemic such as COVID-19. (Not supported in Model$_1$) (Not supported in Model$_2$). H_2: Pandemics expenditure as a percentage of gross domestic product (GDP) has a negative relationship with the death rate. (In both Model$_1$ and Model$_2$, not supported). H_3: The number of hospital beds has a non-significant relationship with the death rate. (In both Model$_1$ and Model$_2$, not supported).

Our second set of variables are Education (EDU) and Physicians (PHYS): The number of Physicians per 1000 people. We tested the effect of education levels on the death rate from COVID-19 (CDEATH); our P-value in Model$_1$ is (p>|t|) is smaller than 0.01 (Table 4), and in Model$_2$ is smaller than 0.01 (Table 5), which are less than 0.05. Education does have a negative significant relationship with the death rate. We also notice that with Lockdown (Model$_2$), the strength of the negative relationship increases the path coefficient increases from 0.22 to 0.23 (Table 8). Knowing low-income and education are significantly related, communities with more people of color are the communities that have primarily lower-income individuals where higher levels of preexisting health conditions and lower access to healthcare exist. The communities with lower education levels are less able to offer to exercise social distancing in the United States [68,69].

We have tested the effect of the number of Physicians per 1000 people on the death rate from COVID-19 (CDEATH); our P-value in

Table 5
Model$_2$ results (P values and path coefficients).

Variables	P values	Path coefficients
Dependent: CDEATH		
Relationship of the Variables		
EDU→CDEATH	<0.01***	−0.23
EDU→PHYS	<0.01***	0.79
GDPPAN→CDEATH	0.02**	0.16
GDPHEAL→GDPPAN	<0.01***	0.53
GDPPAN→HBED	<0.01***	0.27
PD→CDEATH	<0.01***	0.24
HBED→CDEATH	0.33	0.03
PHYS→CDEATH	0.44	0.01
*PHYS→(GDPPAN→CDEATH)	0.11	0.09
IND→CDEATH	<0.01***	0.36
FEMALE→CDEATH	0.03**	0.14
AAGE→CDEATH	<0.01***	0.38
LOCKDOWN→CDEATH	0.41	0.02

*Moderator, P Values *** 99 % Significance, ** 95 % Significance, * 90 % Significance.

Table 6
Path coefficients and P values of lockdown as a moderator of other variables.

Variables	Path coefficients	P values
Dependent: CDEATH		
Relationship between the variables		
LOCK→(EDU→CDEATH)	0.43	<0.01***
LOCK→(PD→CDEATH)	−0.16	0.02**
LOCK→(GDPPAN→CDEATH)	0.05	0.25
LOCK→(HBED→CDEATH)	0.03	0.33
LOCK→(PHYS→CDEATH)	−0.28	<0.01***
LOCK→(IND→CDEATH)	−0.22	<0.01***
LOCK→(FEMALE→CDEATH)	0.07	0.16
LOCK→(AAGE→CDEATH)	−0.08	0.13

P Values *** 99 % Significance, ** 95 % Significance, * 90 % Significance.

Table 7
P values comparison of Model$_1$ and Model$_2$.

Variables	P values (without Lockdown)	P values (with Lockdown)
Dependent: CDEATH		
Relationship of the variables		
EDU→CDEATH	<0.01***	<0.01***
EDU→PHYS	<0.01***	<0.01***
GDPPAN→CDEATH	0.01**	0.02**
GDPHEAL→GDPPAN	<0.01***	<0.01***
GDPPAN→HBED	<0.01***	<0.01***
PD→CDEATH	<0.01***	<0.01***
HBED→CDEATH	0.35	0.33
PHYS→CDEATH	0.33	0.44
*PHYS→ (GDPPAN→CDEATH)	0.22	0.11
IND→CDEATH	<0.01***	<0.01***
FEMALE→CDEATH	0.02**	0.03**
AAGE→CDEATH	<0.01***	<0.01***

*Moderator, P Values *** 99 % Significance, ** 95 % Significance, * 90 % Significance.

Table 8
Path coefficients comparison of $Model_1$ and $Model_2$.

Variables	Path coefficients (without Lockdown)	Path coefficients (with Lockdown)
Dependent: CDEATH		
Relationship of variables		
EDU→CDEATH	−0.22	−0.23
EDU→PHYS	0.79	0.79
GDPPAN→CDEATH	0.17	0.16
GDPHEAL→GDPPAN	0.53	0.53
GDPPAN→HBED	0.27	0.27
PD→CDEATH	0.22	0.24
HBED→CDEATH	−0.03	0.03
PHYS→CDEATH	0.03	0.01
[a]PHYS→ (GDPPAN→CDEATH)	0.06	0.09
IND→CDEATH	0.32	0.36
FEMALE→CDEATH	0.15	0.14
AAGE→CDEATH	0.35	0.38
LOCKDOWN→CDEATH		0.02

[a] Moderator.Table 1, 2, 3, 4, 5, 6, 7 and 8

$Model_1$ is (p>|t|) 0.33 (Table 4) and in $Model_2$ (p>|t|) 0.44(Table 5) which are above 0.05. The number of Physicians per 1000 people has no significant relationship with the death rate. However, under lockdown conditions, the significance of the relationship between PHYS and CDEATH decreases, the coefficient of the PHYS decreases from 0.03 to 0.01 (Table 8). H_4: The education level of people negatively affects the death rate. (Both in $Model_1$ and $Model_2$ supported). H_5: The number of physicians available in a country is negatively related to the death rate. (Both $Model_1$ and $Model_2$ are not supported).

Our third set of variables are cultural variables; Power Distance and Individualism vs. Collectivism. PD: Power Distance Index; we have tested power distance's effect on the death rate from COVID-19 (CDEATH), our P-value in $Model_1$ is (p>|t|) smaller than 0.01 (Table 4), and in $Model_2$ is (p>|t|) smaller than 0.01 (Table 5), which are below 0.05. Power Distance has a positive significant relationship with the death rate under both circumstances. When power distance increases, whether with Lockdown or without Lockdown, the death rate from COVID-19 also increases. We can also note that with Lockdown, the path coefficient increases from 0.22 to 0.24 (Table 8). IND: Individualism and Collectivism; we have tested the effect of Individualism and Collectivism on the death rate from COVID-19 (CDEATH), our P-value in $Model_1$ is (p>|t|) is smaller than 0.01 (Table 4), and in $Model_2$ is (p>|t|) is smaller than 0.01 (Table 5), which are less than 0.01. Individualism and Collectivism, under both circumstances, have a significant positive relationship with the death rate. When Individualism and Collectivism increases, the death rate from COVID-19 also increases. We can also note that with Lockdown, the path coefficient increases from 0.32 to 0.36 (Table 8). H_6: High power distance has a positive relationship with the death rate. (Both in $Model_1$ and $Model_2$, supported). H_7: The death rate from the pandemic of an individualistic society is higher than the death rate of a collectivistic society. (Both in $Model_1$ and $Model_2$, supported).

Our fourth set of variables are related to demographics; age and female. The Independent variable is AAGE: Average age. Our P-value in $Model_1$ is (p>|t|) is smaller than 0.01 (Table 4) and in $Model_2$ is (p>|t|) is smaller than 0.01 (Table 5) which are less than 0.01. The average age, under both circumstances, has a significant positive relationship with the death rate where was also noted by the United Nations [70] that elderly people are more vulnerable to raised numbers of stern viruses and death. When the average age level of people in a country increases, the death rate from COVID-19 also increases. We can also note that the path coefficient also increases from 0.35 to 0.38 (Table 8). We have tested how the female percentage of the total population in the country affects the death rate from COVID- 19 (CDEATH); our P-value in $Model_1$ is (p>|t|) 0.02 (Table 4), and in $Model_2$ is (p>|t|) 0.03 (Table 5), which are below 0.05. A female percentage of the total population, under both circumstances, has a significant positive relationship with the death rate. When the percentage of females in the total population is high, the death rate from COVID-19 is also high. We can also note that with Lockdown, the path coefficient reduces from 0.15 to 0.14 (Table 8). H_8: The age of people has a positive relationship with the death rate. (Both in $Model_1$ and Model 2, supported). H_9: Gender (female) has a positive relationship with the death rate. (Both in $Model_1$ and $Model_2$, supported).

The last variable that we included in $Model_2$ is Lockdown; Lockdown does not have a significant relationship directly with the death rate. However, Lockdown is a moderator between all variables and the death rate (Table 6). When we include Lockdown in our model, we clearly see the drastic changes in the significance levels as well as the coefficients of the other variables. H_{10a}: During a pandemic (COVID-19), Lockdown will moderate the relationship between the death rate and all the other variables (H_1–H_9). (in $Model_2$ Supported). H_{10b}: During a pandemic (COVID-19), *Lockdown will not* moderate the relationship between the death rate and all the other variables (H_1–H_9). (In $Model_2$ not supported).

The R-Squared value in $Model_1$ is 0.29, and $Model_2$ is 0.30, meaning that our independent variables are explaining 29 % of the dependent variable in $Model_1$ and 30 % of the dependent variable in $Model_2$. It sounds very low; however, especially in the health industry studies, low R-Squared is very common due to the high existence of possible independent variables that could affect the dependent variable [71].

6. Conclusion and future research

This paper examined the relationship between four sets of country-level variables and death rates from COVID-19. In addition to that, we also analyzed the effect of Lockdown as a moderator. Several articles have been published in the short period explaining the reasons for high and low mortality rates from the recent outbreak of novel coronavirus in different countries worldwide. Integrative research is essential to point out the reasons that are playing roles in the mortality rate from coronavirus in the recent outbreak. This paper has tried to bring many possible factors, from socio-economic and cultural perspectives, responsible for the mortality rate in different countries. This study identified ten factors that influence the mortality rate from coronavirus started in 2019 through literature review and experts' opinions. The study's findings suggest that even though the country's economic level (GDP allocation for health, pandemics, and hospital beds), education, and the number of physicians have a relationship with the death rate, cultural and demographical factors have a higher significant relationship with the death rates. Power distance, individualism, average age, and gender are significantly associated with the mortality rate of COVID-19. These factors are independently and interdependently found as essential factors that affect the death rate. So, effective management of these factors can significantly improve the health sector as a holistic approach to reduce the death rate.

One of the most crucial findings is the effect of Lockdown as a moderator on all relationships but especially on education, GDP spending on Pandemics, power distance, the number of physicians, individualism, female and age relationship with the death rate. Path coefficients related to these relationships have significantly changed, meaning that Lockdown has a very significant moderating effect on those relationships. Especially where the countries have excessive power distance or excessive individualism, the Lockdown has a very significant moderating effect on their relationship with the death rate up to 4 %,

which can equal hundreds of thousands of lives (Table 8). We can easily conclude that Lockdown needs to be practiced more strictly where the countries possess excessive power distance or excessive individualism.

Therefore, this paper can be used by policymakers and practitioners to manage the factors discussed since they are under human control. This paper has some limitations that can be improved in future studies, such as GDP spending for pandemics and the quality variables that need to be examined in more detail; at the same time, different types of health policies could also be analyzed separately.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Further reading

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