The Effect of International Level COVID-19 Stay-at-Home Orders on Death Rates

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Biographies

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Valeriia Manchak, graduate student, public policy major. Undergraduate and master's degree received back in Ukraine though National Law University in legal studies/law concentration. Playing hockey for D1 Women's hockey team. Career plans - working for the INGOs such as United Nation or European Union with a concentration Ukraine-USA-Russia Relationship. Next year planning to pursue PhD online at Liberty University in foreign policy and MA in Strategic Communication, maybe keep playing hockey for two more years.

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Currently hold a B.A. in Political Science and Government from the University of Texas at Austin, currently a second-year graduate student in the Master of Public Policy program and will graduate in May of 2021, research and field interests include foreign policy, international relations, and national security, among others.

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Introduction

In this paper, we document and compare data gathered from more than 50 countries with different demographic characteristics, lockdown policies, health systems, and different varying timelines to combat COVID-19. After discussing the variables and their impact on the mortality numbers, we will make a recommendation concerning the different lockdown policies for future use. The main objective of this paper is to investigate connections between government policies, population age, age density, smoking rate, IQ air pollution, forms of greeting, death rate, obesity/health index, mean age, face coverings, contact tracing, international travel control level, etc. and how these independent variables might affect future policy creation. This paper will include recommendations and criteria of success for other countries in the world based on the provided qualitative and quantitative research through testing hypothesis with literature review, gathering, comparing, and interpreting the data.

Problem Overview

The world is enmeshed in a global health emergency that is exacting enormous medical and economic loss upon humanity. The SARS-CoV-2 that has caused the current COVID-19 pandemic is thought to have originated in bats and transferred to humans via a pangolin or similar animal from a "wet market" in Wuhan, China. Within months, this highly infectious virus spread throughout China and around the world, spreading to at least 185 countries and territories, leaving a wake of catastrophe and COVID 19 was declared a pandemic on the 11th of March 2020 (Amaro 2020). The world's medical community is on the front lines dealing with the immediate human health challenges of this briskly evolving crisis and are trying to develop therapies and vaccines. Countries and their leaders are attempting to mitigate the overwhelming societal and economic destruction that is unfolding through different policies (World Health Organization 2020). The economic impact has been disastrous across many countries in Europe, America, and Africa. Unemployment rates increased in the wake of the COVID 19. Different presidential and legislative efforts vary sharply in an attempt to combat the spread. These policies include closing manufacturing plants, closing restaurants, mask wearing, and advisories like 1.5-meter social distancing. These dynamics in the activities of people, working, income, and healthcare costs of research and treatment of COVID have had major negative effects on economies (Jones, Palumbo and Brown, 2020). For example, Sweden suffered a drop in its GDP between March and June of 8.6% and unemployment, according to a BBC report, increased from 7% to 9.2%. Sweden depends on exports which were hit by a lack of demand from overseas causing the negative economic impact. (Savage 2020). Italy was one of the most hard-hit countries by the pandemic. According to Wijffelaar's research, the economy shrunk by 17% in the first quarter (Wiijffelaars 2020). Their industrial production was hit so extremely that no car was sold in April despite the fact that Italy is one of the leaders in producing vehicles for the world market. Almost everything came to a standstill mainly from a decrease in the demand of cars caused by social distancing which stopped factory operations, and only allowed for the minimal movement of people that affected local businesses, tourism, the hospitality industry, and corporate functions (IBISWorld 2020).

However, like other countries, the UK is facing a major challenge of recession caused by the adverse effects of the COVID-19 pandemic. Raw material availability coupled with a slowdown in global demand has affected the whole production capability of the country. As a result, the manufacturers of machinery and equipment in the country have been temporarily shut down (Business Wire 2020). In Iceland, the IMF expects this trend to be heavily affected by the negative economic impact of the COVID-19 pandemic; the rate is currently estimated to increase to 8% in 2020 and decrease slightly to 7% in 2020 (Import Export Solutions 2020). The economy is expected to contract sharply this year, dragged down by a collapse in tourism and a fall in marine product exports (Focus economics 2020).

In this paper, we document and compare numbers from fifty different countries with different demographic characteristics, lockdown policies, health systems, and different varying timelines to combat COVID-19. After discussing the countries and their results, we will make a recommendation concerning the different lockdown policies for future use. The main objective of this paper is to investigate connections between government policies, population age, population density, and how these independent variables might affect future policy creation. This paper will include recommendations and criteria of success for other countries in the world based on the provided qualitative and quantitative research through testing the hypothesis with literature review, gathering, comparing, and interpreting the data.

Root causes, impacts, and symptoms

Across the whole of Europe, there have been over 4.6 million confirmed cases of COVID-19 affecting every part of the continent differently with, policy responses varying from country to country (Flaxman and Mishra 2020). Possible root causes in the spread and mortality of the COVID 19 pandemic between countries are population density, higher average age, cultural preferences, pollution, and lockdown stringency. Population density is important since humans living in closer proximity have more chances to transfer illness to each other. Higher average age is included since humans have more comorbidities as they age and have been shown to die from other diseases at a higher rate. Another root cause that might affect the mortality rate of a population is degree of interpersonal contact, a cultural preference which may increase a disease's spread. This paper also examines the differences in policies implemented by countries with the focus on lockdown strategies as the Covid 19 response. Lockdown measures are compared with a stringency index which is a calculation based on restrictions the governments placed on their citizens (Flaxman and Mishra 2020). The higher the score, the stricter the lockdown is. Another possible root cause is that countries such as United Kingdom and Italy, which have higher levels of pollution, are likely to have worse outcomes than others. Our data has been collected in the chart at the end of this paper for reference.

Lockdown Policies

Lockdown policies are regulations set in place by governments to thwart a certain action or occurrence. They are named "lockdown" policies because they place restrictions on citizens by limiting businesses, citizen contact, curfew, and travel. As data accumulates, different effects of the coronavirus and lockdown policies can be examined in countries with different approaches.

Business Lockdowns

Business lockdowns have caused recessions for economies all around the world, during COVID-19, but they have also been effective in avoiding the rapid spread of the virus. Germany has mitigated the economic damage while handling the coronavirus by taking a proactive approach. While most countries lack hospital resources, Germany had health and safety officials already in place in case of an oncoming pandemic. These preparations helped the country battle COVID-19 to the best of its ability. Chancellor Angela Merkel had "radical measures" such as closure of all religious institutions, museums, exhibitions, movie theatres, casinos, gyms, swimming pools, playgrounds, bars, clubs, theaters, opera houses, and brothels. (Stelzenmüller and Denney 2020). Restaurants operated under restrictions and were to be closed by 6pm. Essential shops were allowed to remain open with no restraints and included: supermarkets, pharmacies, banks, and post offices. The United Kingdom put operating restrictions on businesses selling food or drink (including cafes, bars, pubs and restaurants), social clubs, casinos, bowling alleys, amusement arcades (and other indoor leisure centers or facilities), funfairs, theme parks, adventure parks and activities, and bingo halls. The former businesses were required to close between 10pm and 5am (Cabinet Office 2020). The viral spread also impacts the governments' decision to reopen business conferences, exhibition halls, and large sporting events. Italy's business lockdowns did notable damage to its economy because Italy's small and medium businesses are its backbone. In contrast, Sweden and Iceland enacted minimal precautions for the Covid-19 epidemic. Sweden did not adhere to a lockdown and day care centers and primary schools remained open. While most countries took severe measures to combat COVID-19, Swedes could be seen chatting in cafés and working out at the gym (Vogel 2020). Iceland responded with limited closures to contain COVID-19. In early March 2020, hospitals and nursing homes closed to visitors, and schools eventually went online as the pandemic progressed while essential institutions, such as the Parliament and the Courts continued to run, adapting their schedules and procedures in line with the measures (Harvard Law 2020).

Social Distancing

Social distancing measures are limitations on events and gatherings as they attempt to stop viral spread by limiting contact between individuals (Stelzenmüller and Denney 2020). Germany was proactive with social distancing measures to tackle the pandemic's spread. On March 10, mass gatherings with more than 1,000 participants were prohibited and in mid-March the federal states started to close schools (Stelzenmüller and Denney 2020). On March 22, Chancellor Angela Merkel announced that the federal states and national government had both decided to implement a "contact ban," limiting public gatherings to two people (outside families), requiring physical distance of at least and approximately 5 feet (1.5 meters), and closing many businesses (Stelzenmüller and Denney 2020). The United Kingdom implemented social distancing measures where people were to stay 2 meters apart where possible, or 1 meter with extra precautions like wearing masks (Cabinet Office 2020). Italy's social distance standard was one meter when out of the house and 2 meters while exercising (CNBC Newsletter 2020). Initial adherence to social distancing wasn't very important to Sweden because they are naturally socially distant. Once implemented, public events with more than 50 people were banned and employees were advised to work from home if possible (Vogel 2020). The social distancing restrictions in Iceland were 2 meters (with associated fines if violated). (Harvard Law 2020).

Curfew Regulations

Curfew regulations attempt to maintain control of private events that may occur at night and where most people are geared towards having fun with no regard for caution. Curfews seem to be the least popular lockdown method, and in the countries discussed in this paper, curfews were not enforced. Chancellor Merkel observed Germany's major cities with a curfew in mind but did not enforce it (Stelzenmüller and Denney 2020). The United Kingdom did not enforce a curfew (Cabinet Office 2020), and nor did Italy, Sweden, or Iceland. Although there was no curfew in any of the countries presented, as with many other countries, store hours of operation were one form of imposed curfew and having public event spaces closed made being out and about late less likely. Iceland, unlike the other countries, has not seen a threat to curfew enforcement and they may not, due to the fines associated with breaking any of the safety regulations (Harvard Law 2020). It is very possible that a curfew could be needed in the future in some of these countries, especially those who initially took no caution with regard to the pandemic.

Border Lockdowns

One of the best ways to keep a pandemic from spreading is to keep it out and to keep travel limited. All of the countries discussed enforced some form of a travel ban, safety regulations for travel, or encouraged only necessary travel. Germany barred any non-EU citizen from entering the European Union for 30 days on March 18, 2020, and immediately after this enforcement period ended. On April 10, 2020, all travelers arriving in Germany, regardless of their origin, were required to quarantine for 14 days (Robert Koch Institute 2020). In the United Kingdom, the Commonwealth & Development Office advised British nationals against all but essential international travel but travel to some countries and territories were exempted (Gov.UK). Italy's border lockdown was much like that of Germany and the United Kingdom. The travel advice of the Public Health Agency of Sweden was heeded because when the agency advised against non-essential domestic travel at the end of March, travel in the Stockholm region decreased by over 40 percent. While Iceland did not completely lockdown the borders, they did participate in temporary restrictions on non-essential travel to the Schengen Area, and enacted internal border control including a 14-day quarantine upon arrival, all with the tentative plan to re-open borders in June 2020 (Harvard Law 2020).

Explanation of the Variables

Smoking Rate Review

World Health Organizations wrote the review that brought evidence supporting the theory that there is a dependency between smoking habits and the severity of COVID-19 outcomes amongst patients (World Health Organization Study 2020). The study suggests that smoking is associated with increased severity of the disease and death in hospitalized COVID-19 patients (World Health Organization Study 2020). The variable indicates the hypothesis that the smoking rate affects the country's mortality rate and gives the information for future studies about outcomes for those countries with a higher smoking rate. The data was gathered from the world population review website, which has the main numbers from World Health Organization about smoking rates globally (World Population Review 2021). The indicators are in percentage measurements, and the lowest percentage means the lower smoking rate in the country. For data collections, WBO uses age-standardized and non-age standardized estimates of tobacco and cigarette smoking (World Health Care Organization 2000-2025). Average prevalence rates for countries are calculated in percentage by population-weighting the age-specific prevalence rates in countries, then age-standardizing the region's age-specific average rates. The smoking rate was included as a factor that might affect mortality levels in the country (World Health Care Organization 2000-2025).

IQ Air Level Pollution

Another study suggests that increasing long-term exposure to PM2.5 has many negative consequences concerning the patients. The hypothesis is that the country's mortality numbers from COVID-19 may rise from the higher level of pollution. (Nethery,., Sabath,., Braun, Dominici, , 2020.)

Assessing the percentage of Air Pollution is one factor that needs attention in analyzing existing mortality data from COVID-among countries. Besides the lockdown policies and other factors, this paper will testify whether long-term exposure to air pollution increases the severity of COVID-19 health outcomes, including death. Data was gathered from the IQ Air website and was collected by this organization from different governmental resources that monitor information (IQ AIR report 2018, 3-7). At the same time, quantifications were made public in real-time (generally every other hour). Furthermore, data was sorted by validated outdoor IQAir

AirVisual air quality monitors controlled by private individuals and organizations' information from which they have been embedded. (IQ AIR report 2018, 3-7).

The data analysis report shows that the main focus is PM2.5 as the leading indicator that calculates the level of air pollution. PM2.5 refers to the particulate issue (ambient airborne particles), which measures up to 2.5 microns in size, and has various chemical makeups and sources. PM2.5 is broadly considered the pollutant with the highest level health impact of all frequently measured air chemical pollutants (IQ AIR report 2018, 3-7).

Picked-out data was assumed by the average PM2.5 concentration (µg/m3), which means that a lower concentration for the country is better and less dangerous. For a variable in our table, we used an air pollutant (e.g., ozone) was presented in micrograms (one-millionth of a gram) per cubic meter of air or µg/m3 (European Environmental Agency, n.d.).

Forms of Greetings and Cultural Preferences

Today, the greeting habits and etiquette have been changed significantly among the world, according to the latest study and published articles (Bomey 2020). This paper suggests that cultural preferences can be one indicator that substantially affects the spread of COVID-19 and the mortality rate. The hypothesis is that countries with kissing, hugging, and other forms of greeting customs will more likely have a higher death rate than those who, in general, are more socially distant. We decided to evaluate by numbers the type of preferred greeting type that country had. We used three numbers as 3,4,5, which gave the ability to compare different types of greetings. Number 3 indicated handshake preferences as to this greeting. Number 4 represented the hug and handshake, while 5 was the highest number and was measured those countries, that kiss each other and prefer close contact. The information was gathered through different websites, such as Cultural Diplomat, E - diplomat, and various articles about countries' greeting preferences and traditions, and was measured by scale from 0-5.

DeathRates

A central question as to the COVID-pandemic, is why the Covid-19 mortality rate varies so much across countries. A mortality number is an important variable that helps quantify and compare mortality cases from country to country. There are discussions that simple regression analyses show that the negative association of COVID-19 mortality with test numbers varied with country characteristics, including demographics, features, and cultural preferences (Liang, , Tseng, , Ho, et al. 2020). The death rate number is an essential variable in the formula that can help show and measure results from the influence of factors such as (cultural preferences, air pollution, etc.). It can help explain and explore why some countries had higher infection rates but lower mortality rates. What are the factors that shaped that number?

Data was gathered from the website, Our World in Data. In contrast, that website was used as the source, Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University. Updates are presented daily and include data on confirmed cases, deaths, hospitalizations, and testing. For measurement purposes, we use percentages percentages that represent the death number per million people.

Infection Rate per Million People

According to the previous research, significant differences show up between countries when combining deaths against confirmed COVID-19 cases. This is important in order to present data for comparison since it will explore the mortality number versus the infection rate. Data existence and excellence play an essential part in these highly variable statistics. Still, it is hard to be 100 % sure that countries are reporting reliable and accurate numbers. Simultaneously, there might be some number of unreported cases that are believed to be quite considerable in some Asian and African countries (Our World in Data 2021). Another issue that might affect the number, numbe, is that the number of confirmed cases present a lower number than actual cases; the main problem is that some countries have limited testing opportunities (World Mapper 2021). The data presented by Our World in Data is gathered from the Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University. The measurements are presented in the numbers that show how much was fixed, and how it happened per million people. (John Hopkins University 2021).

GHS Index

With the rise of different pandemics, different sources started to raise questions about countries' ability to respond and handle pandemics.

The GHS index evaluation is based on countries' health security and capabilities across six categories, 34 indicators, and 85 sub-indicators. The findings are developed using results from open-source information that answered 140 questions across the categories (GHS 2019, 10-15).

The 140 GHS index questions are organized around indicators such as prevention, detection, reporting, and rapid response. The other three are a health system, compliance with international norms, and risk environment (GHS 2019, 10-15).

The GHS project's foundation lies in estimating the health security and abilities of 195 countries worldwide that make up the States Parties to the International Health Regulations (IHR 2005, 10-11). The idea of the project is developed by the Nuclear Threat Initiative (NTI) and the Johns Hopkins Center for Health Security (JHU) with the assistance of The Economist Intelligence Unit (EIU).

The researchers believe that those countries with a higher GHS index will show more successful responses to the COVID-19 pandemic. We are looking at the numbers, and the United Kingdom, that has an index of 77. 9, one of the highest indexes among all countries, has one of the highest death rates, while Ukraine, with the Health index twice smaller - 38, has twice a lower death rate, which is 1.9. The question is how necessary GHS in the success response is according to other factors that we have presented and testified, and what can negatively influence GHS on these measurements. In other words, why Denmark with an index of around 70, which is very high and a little lower than the United Kingdom, has a low death rate as well, and it is about 1.5.

Population Density and Mean Age

Population density usually counts as population divided by total land area. The data was gathered through the website, Statistic Times, while that website took information and data from United Nations (Department of Economics and Social Affairs 2020). It is presented in the excel sheet by United Nations with the information of both sexes' population. We hypothesize that countries with a higher population density involve more cases and higher mortality rates since such people live closer to one another, and more comfortably and easily spread the virus. This paper suggests that analyzing the population density number of Iceland, 36.5, gives lower chances to produce more cases. At the same time, there were many suggestions about Italy's population density, and it did negatively affect the mortality rate of that country since it was ten times higher. Population density reflects the number of people per square mile (World Population Prospects 2019).

There was a well-published study recently and presented by David W. S. Wong and Yun Li, who suggested that population density might be an essential factor for the early stage of outbreaks, but it is influential in later stages (Wong, Li, 2020). Our paper will testify toward this hypothesis and will discuss how this factor affects mortality and the infection rate number.

The mean age is another crucial factor that might affect the number of mortality cases and, more challenging, COVID-19 cases in the nations with a higher median age. Statistics show that the higher mortality rates favor groups of people within the older population, so this paper hypothesized that older populations and age groups within countries would be more adversely affected than the younger counterparts. The variable analyzes and counts by ages within the population and presents the mean age among women and men in all countries (World Population Review 2021).

School/Workplace Closures/Cancellations

The closures pertaining to the cancellations and the closings of schools and businesses occurred extensively during the pandemic. The closures and event cancellations ranged from no measures enacted by certain nations, such as Sweden and Iceland, to the more severe implementations of closure by the majority of nations as indicated in the table and the paper. The numerical variables attest to the degree and the severity of the measures implemented. A numerical variable of 0 indicates lack of closure since the onset of the pandemic, 1 indicates recommended forms of measures, though such measures are not mandated, 2 suggests the adherence to guidelines and restrictions determined by academic grade level, capacity, phases, and percentage of infection, etc., and 3 indicates a complete closure of schools and businesses across all academic levels, while allowing some essential workers to remain employed during this time and this phase of restrictions. The numerical evidence appears to establish that the nations that engaged in the longest durations of closures and cancellations pertaining to the workplace and schools failed to establish much decline in the rates of infection. (Our World in Data 2020).

The same methodology holds true for the cancellations of events, such as entertainment, and performance venues ranging from lack of cancellation, recommended cancellations, and mandatory cancellations regardless of capacity limitations, etc. This is also characterized by the numerical variables ranging from 0-3 as evidenced by the table. (Our World in Data 2020).

Restrictions on Gatherings/Public Transportation

Restrictions placed upon gatherings can be observed across all nations indicated by the table. The numerical variables range from 0-4 in this observation. 0 indicates lack of restrictions regardless of capacity, or maximum occupancy, 1 indicates the imposition of limitations that restrict gatherings if the maximum capacity would exceed 1,000 occupants, 2 restricts the maximum occupancy to a maximum of 100-1000 people, 3 places a limitation of 10-100 people per gathering, and a 4 would suggest a gathering not to exceed 10 people per gathering. As per the closing and restrictions placed upon public modes of transportation, a numerical range of 0-2 can be used as measurement of the degree of severity. 0 indicates lack of closures, 1 indicates recommendations for closure, though not mandatory. 1 also indicates limitations and restrictions places upon modes of transportation dependent upon volume of passengers. A value of 3 indicates a complete restriction or prohibition of the use of public transportation. The data suggests that restricting the capacity regarding event attendance and public gatherings failed to show much decline in the rate of infection across nations studied. (Our World in Data 2020).

Public Information Campaign

There are limitations and restriction imposed upon those engaging in the efforts of campaign purposes and the implications that the pandemic could place upon these campaigns. 0 would indicate virtually no restrictions placed upon campaign efforts and purposes, 1 indicates an urgency of caution recommended, and a level of 2 suggest a limitation that would call for coordination of the efforts in order to adhere to COVID-19 regulations and guidelines. (Our World in Data 2020).

Stay at Home Restrictions

These restrictions pertain to the lockdown measures that are imposed nationwide across the vast majority of nations observed in the research presented, though most restrictions of this nature are imposed as a result of a national stay at home order, there are instances where it varies by region, city, locality, etc. For instance, Sweden and Iceland did not issue a stay-at-home order or national lockdown, and a value of 0 would be used to indicate no restrictions enacted regardless of percentage rate of infection or hospitalization. 1 indicates a recommended, though not mandatory lockdown order, 2 mandates a lockdown order with the exception of essential travel or essential conduction of business or transaction. 3 indicates a mandatory order, though limited to certain exceptions. It can be inferred from the data collected that the nations that have imposed the strictest and the longest durations of these orders failed to see a significant decline, or lack of a decline regarding the rates of infection. (Our World in Data 2020).

International Travel Controls/Restrictions on Internal Movement

These restrictions that pertain to international travel restrictions as well as internal movement, are subject to guidelines and restrictions from merely recommendations to the more severe restrictions and limitations imposed upon travel in the international and internal scope. Internally, travel restrictions range from the numerical variable of indicating no restrictions, 1 indicating mere recommendations that fall short of mandatory policies restricting movement, and a level of 2 which suggests full restrictions upon movement. Internationally, a 0 would indicate lack of restrictions imposed upon travel, 1 meaning that prior screening would be mandated before international travel could take place, 2 is indicative of a mandatory quarantine policy upon traveling to and upon arrival to certain regions or nations, 3 calls for more complete bans and restrictions to certain countries and regions in which foreigners are not permitted within the boundaries of the respective nations and regions, and 4 indicates a complete shutdown shutdown of the borders of nations with this high level restriction implemented, no foreign travelers are permitted within the borders of the respective nations adhering to this level of restriction. (Our World in Data 2020).

Testing Policy/Contact Tracing

With regards to national mandates of testing, Sweden and Iceland as an example did not mandate testing under any circumstances, while others made this mandatory in many instances, such as with international travel, etc. 0 indicates no mandatory testing policies enacted, 1 may require testing of certain populations and groups of individuals, such as essential workers and more vulnerable populations, etc., as well as those that may exhibit symptoms of the virus. Level 2 indicates testing mandated or required for symptomatic individuals, and level 3 calls for open, accessible testing for all that may request it, regardless of age or individual group, essential workers, or certain portions of the population. This would also include that that do not exhibit symptoms of the virus, would allow for asymptomatic testing. Policies that mandate the tracing of the contacts of those that exhibit symptoms of the virus, or those that yield a positive test result, are implemented in a large number of countries and regions within. (Our World in Data 2020).

Sweden and Iceland did not implement contact tracing policies as an example. For the majority of other nations, such as those observed in the research, mandate such policies for those that may have come into contact, close contact, indirect or direct contact with those that are positive or presumptive positive for the virus. Those that are identified as among the contacts of those that may be tested positive for the virus may be subject to a 14-day quarantine from the point of last contact. Numerically, 0 indicates lack of tracing mandates, 1 indicates tracing of contacts on a limited basis depending upon the region or nation, and in certain cases. 2 indicates an exhaustive and comprehensive contact tracing program of all those that may have been exposed to the virus, both indirectly and directly. (Our World in Data 2020).

Face coverings

The majority of nations observed, implemented a mandatory policy for face coverings to be utilized when outside the home, to buy or sell goods and services, or to enter or conduct business, as well as to travel internationally, as well as internally. Strict measures for face coverings have been implemented worldwide and the severity is dependent upon the locality, city, region, or nation. Sweden and Iceland would serve as the example of the complete refraining from implementing such a mandate nationally. A variable of 0 indicates a lack of a mandate, 1 indicates a mere recommendation of the use of face coverings, falling short of a mandate, 2 requires masks to be used in certain public spaces and settings, 3 indicates usage in all public spaces and for modes of transportation, and a level 4 would require exhaustive measures that would mandate the use of face coverings in all spaces and contexts apart from the home, which may include this use in outdoor settings in addition to all public spaces. It can be concluded from the data collected that the policies mandating face coverings were deficient in the curbing of the virus, its spread, and rate of infection as can be inferred from the nations that have implemented such policies and those that implemented the mandate for the longest durations of time. (Our World in Data 2020).

Government Stringency Index

The government stringency index indicates a range from 0 to 100 as numerical variables that would indicate and describe the stringency of policies enacted. This is also considered to be a composite of all measures undertaken internationally in response to the virus. This is all inclusive of measures pertaining to closures, restrictions imposed upon travel, as well as the varying policies enacted at the sub national levels. At the sub regional levels, the index would be reflective and indicative of the highest levels of the region in such a case, indicates a response level that indicates a stringent, or a strict adherence to these restrictions. (Our World in Data 2020).

The table will show the data and numerical variables to reflect the time durations of the respective national lockdown measures and durations. Levels of 0 indicate lack of a lockdown implemented, 1 would equate to a duration of 15 days or less, 2 translates to a span of 15 days to 30 days, 3 indicates more than 30 days to 45 days, and a numerical value of 4 reflects a duration of more than 45 days to an indefinite measure of time. The data gathered may suggest that the implementation of lockdowns have had little to no effect on the infection rates or the spread of the virus. This can be viewed as the nations that imposed the strictest and lengthiest lockdown durations failed to see much decline in the infection rates. (Our World in Data 2020).

Research Questions

1) Which of the factors presented in the table affect the mortality rate the most in the country?
2) Are lockdown duration and lockdown policies reducing mortality number and spread of Covid 19?
3) Which is the main factor that affects the mortality level in the country?

4) Do the nations that have enacted lockdown measures and restrictions on movement demonstrate a sizeable contrast compared to the nations that enacted little to no measures or restrictions?
5) Are the measures and restrictions enacted efficient and demonstrate long term solutions to counter the effects of the pandemic?

Hypothesis

H1: When comparing data across countries, Government stringency as the predictor variable has a direct relationship with increased mortality as the outcome variable.

H1 (null): There is no relationship between government stringency and mortality

H2:When comparing data across countries, Government stringency will be associated with an increased viral spread.

H2(null): There is no relationship between government stringency and increased viral spread.

H3 Countries with closer personal interaction with greetings as a predictor variable will have a direct relationship on increased mortality and viral spread as the outcome variables

H3 (null): There is no relationship between

Stringency Tracker

Since the lockdown measures were different from country to country, there were variations in outcomes which may be tied to the severity of the response to COVID-19. We determined that the "stringency index" was a good tool which quantified the level of severity of a country's restrictions across a historical timeline. The stringency index was developed at Oxford University and was implemented in the Oxford COVID-19 Government Response Tracker. The tracker takes gathered data which produces a score based on the severity of the restrictions imposed. Data is gathered and totaled for countries around the world. The scores are based on the following:
School closures: 0 - No measures, 1 - recommend closing, 2 - Require closing (only some levels or categories, eg just high school, or just public schools), 3 - Require closing all levels.
Workplace closures: 0 - No measures, 1 - recommend closing (or work from home), 2 - require closing (or work from home) for some, sectors or categories of workers, 3 - require closing (or work from home) all but essential workplaces (eg grocery stores, doctors).
Cancel public events: 0- No measures, 1 - Recommend cancelling, 2 - Require cancelling.
Restrictions on gatherings: 0 - No restrictions, 1 - Restrictions on very large gatherings (the limit is above 1000 people), 2 - Restrictions on gatherings between 100-1000 people, 3 - Restrictions on gatherings between 10-100 people, 4 - Restrictions on gatherings of less than 10 people.
Close public transport: 0 - No measures, 1 - Recommend closing (or significantly reduce volume/route/means of transport available), 2 - Require closing (or prohibit most citizens from using it).

Public information campaigns: 0 -No COVID-19 public information campaign, 1 - public officials urging caution about COVID-19, 2 - coordinated public information campaign (e.g. across traditional and social media).
Stay at home: 0 - No measures, 1 - recommend not leaving house, 2 - require not leaving house with exceptions for daily exercise, grocery shopping, and 'essential' trips, 3 - Require not leaving house with minimal exceptions (e.g. allowed to leave only once every few days, or only one person can leave at a time, etc.).
Restrictions on internal movement: 0 – No measures, 1 - Recommend movement restriction, 2 - Restrict movement
International travel controls: 0 - No measures, 1 – Screening, 2 - Quarantine arrivals from high-risk regions, 3 - Ban on high-risk regions, 4 - Total border closure.
Testing policy: 0 – No testing policy, 1 – Only those who both (a) have symptoms AND (b) meet specific criteria (eg key workers, admitted to hospital, came into contact with a known case, returned from overseas), 2 – testing of anyone showing COVID-19 symptoms, 3 – open public testing (eg "drive through" testing available to asymptomatic people).
Contract tracing: 0 - No contact tracing, 1 - Limited contact tracing - not done for all cases, 2 - Comprehensive contact tracing - done for all cases.
The above categories are scored for each nation and then added up to an overall "stringency level. This provides a numerical data value that can be used to easily compare countries. The data has been continuously gathered and implemented in a database to provide reference points and enable comparison of the lockdown phenomenon that has enveloped the world since COVID.

Predictor and Non-predictor Variables

The main predictor variable for this study will be the government stringency index. The non-predictor and other outcome variables include infection rates, hospitalization, death rates, smoking rate, population density, health index, cultural preferences, and air pollution measurements. The predictor variables, as well as the outcome variables in the study, are quantitative. Statistical analysis shows that the predictor variable of the data collected is largely inconclusive (Salkind 2010). This suggests that better data sources or some unknown variable that was not gathered may be needed to formulate more accurate and reliable findings. The findings may be large time dependent because many of them varied over time, while the data presented is simply a snapshot in time. (Our World in Data 2020).

The use and the observation of the predictor and non-predictor variables should indicate the effectiveness of measures to curb the viral spread. In the statistical analysis, the rates of infection, hospitalization, and death rates among nations observed were largely ineffective in mitigating the viral spread or aiding in the decline of death rates among nations (Frost, n.d.). The government stringency index fails to indicate a decline in the correlation among the enacted measures among nations or a demonstrable decline in death rates among nations observed. This predictor variable also fails to demonstrate a decline in the viral spread rate among nations observed (Our World in Data 2020). This could illustrate the inverse of the null hypothesis. If the data indicates a correlation among the variables that observed a decline in the death rates among nations, this could be viewed as the null hypothesis (Mackenzie and Adams 2020).

The predictor variables indicate that the non-predictor variables, such as the enacted lockdown measures, also failed to demonstrate a correlation between the predictor variables observed and the non-predictor variables, such as the death rate comparison among nations. (Our World in Data 2020).

It can be concluded from our statistical analysis that the predictor variables do not contribute to the decline of the rates of death among the other various rates observed. This indicates a lack of effectiveness of the enacted measures and lockdown measures to curb the viral spread. It could also be concluded that the null hypothesis, a lack of a correlation among the predictor variables, shows no success of measures meant to curb the viral spread. Therefore, it could be concluded that the lockdown measures are largely ineffective considering the lack of significant declines in the death rates among nations. (Our World in Data 2020).

Methodology

We used log transformations methodology because it is often recommended for skewed data since much of our data consists of demographic measures or gathered data from different sources (Htoon 2020). For example, Table A (Descriptive statistics) median and IQR are used instead of mean and standard deviation because a lot of the data is highly skewed. Log transforming data usually affects spreading out clumps of data and bringing together spread-out data (Galili 2013). Log transformed linear multiple regressions are needed because we have multiple quantitative predictor variables, and we have quantitative outcome variables. As well, it will help us to form nonlinear quantitative variables to create a linear relationship. The log transformation is necessary because rates are bounded by 0 and 1, making their relationships with predictor variables nonlinear. The log transform removes the bounds on the rates and makes the relationship appear more linear (Robert and Casella 2004). The method also included multiple regression because we tried to estimate a rate since our outcome variables are rates. The "multiple" part comes from multiple predictors (i.e., the predictor of interest = stringency, and the confounders). The outcome variable is not involved in the difference between "simple" regression and "multiple" regression (Feng and Wang 2012, 230-239). We have multiple confounders: smoking rate, cultural preferences, population density, health index, and air pollution, so there is more than one predictor. The used formula for the model and this methodology was is log (death. rate) = b0 + b1*(govt stringency) + b2*(mean.age) + b3*(population density) + b4*(health index) + b5*(air pollution) + b6*(smoke rate).

Consideration of the Factors: Lockdown

Findings

Table A shows the data set for our project using median intervals instead of averages in order to circumvent the potential skewing of the numerical values due to outliers.

		IQR	
N=48 countries	MEDIAN	Low	High
Death Rate	2.25	1.5	2.9
Gov't Stringency Index	58.33	42.83	67.83
Median Age	40.55	33.2	42.5
Population Density	212.95	87.38	319.05
Health Index	55.1	46.4	63.45
Infections per million	11.97	7.05	19.94
Air Pollution	15.19	10.19	22.03
Smoking Rate	24.9	19.05	31.02
Greeting Pref 3	18	37.50%	
Greeting Pref 4	17	35.40%	
Greeting Pref 5	13	27%	
Table A			

The death rates and the government stringency indexes include the interquartile range to demonstrate the distribution range. The variables were used to determine the correlation of the variables with death rate and infection rate. The intercept, b0, was uninterpretable for all questions since it would reflect the data measurements of the variables measured altogether. (Our World in Data 2020).

Three questions were examined statistically as follows: 1. Does the stringency index have a relationship with the death rate? 2. Does the stringency index have a relationship with infection rate? 3. Do cultural greeting preferences have a relationship with infection rate? These questions will be examined below.

Question 1: do government stringency indexes affect the death rate? The equation for this question is: log (death. rate) = b1*(govt stringency) + b2*(mean. Age) + b3*(population density) + b4*(health index) + b5*(air pollution) + b6*(smoke rate) + b7*(Greeting Pref 4) + b8*(Greeting Pref 5).   When comparing two countries using this formula, we expect a 1-unit stringency increase to have a 1% higher death in the country with a higher government stringency, assuming the two countries have the same median ages, population densities, health indices, air pollution, smoking rates, and greeting preference. Unfortunately, the confidence interval runs from 87% on the lower end to 672% on the higher end. Even though there is a slight correlation, we cannot conclude that having a higher government stringency score is associated with having a higher death rate because the confidence interval includes "1.0." When a confidence interval covers 1, there is no difference, nor is there enough data to see a difference.

Additionally, the data shows the number, and the increase may be an artifact of small sample size and some uncollected confounders. Also, this is a chicken-egg problem. Did the strict laws come before or after the deaths? Other potential confounders include variation within the stringency index. Were there factors within stringency calculations that were more effective: for example, did curfew restrictions or school closures have competing effects on the overall effectiveness of the stringency/mortality interaction?

	Exponentiated Coefficients	95% Confidence Interval	P-Value
Intercept	0.9473	(0.1334, 6.7273)	0.9558
Gov't Stringency	1.0107	(0.9969, 1.0248)	0.1242
Mean Age	0.993	(0.9505, 1.0373)	0.746
Population Density	0.9998	(0.999, 1.0006)	0.6448
Health Index	1.0128	(0.9871, 1.0392)	0.3242
Air Pollution	1.0068	(0.9888, 1.0252)	0.4507
Smoking Rate	0.9833	(0.9575, 1.0097)	0.2061
Greeting Pref 4	1.0825	(0.6817, 1.7189)	0.7308
Greeting Pref 5	1.3358	(0.8131, 2.1946)	0.2452

Question 2: does the stringency index affect infection rate? The formula used to answer this question was: log (infections per million) = b1*(govt stringency) +b2*(mean. Age) + b3*(population density) + b4*(health index) + b5*(air pollution) + b6*(smoke rate) +

b7*(Greeting Pref 4) + b8*(Greeting Pref 5). Under this equation, when comparing two countries with a difference in government stringency of 1-unit, we expect the infection rate (per million people) to be 4% higher in the country with a higher government stringency, assuming the two countries have the same median ages, population densities, health indices, air pollution, smoking rates, and greeting preference. The confidence interval runs from .8% lower to 7.8% higher. Thus, the conclusion can be made that having a higher government stringency score is associated with having a higher infection rate. This, however, does not mean that the stringency measures caused the higher infection rate, and brings up the chicken-egg question from before, did the higher infection rates prompt government to enact higher stringency measures? Additionally, since the confidence interval does not cover 1, it barely excludes the number. Therefore, there are probably important factors that would make it more significant or non-significant that were not explored.

	Exponentiated Coefficients	95% Confidence Interval	P-Value
Intercept	1.9306	(0.0144, 258.3092)	0.7873
Gov't Stringency	1.0433	(1.008, 1.0797)	0.0171
Mean Age	0.9054	(0.8118, 1.0098)	0.0731
Population Density	0.9999	(0.9979, 1.0019)	0.907
Health Index	1.0316	(0.9674, 1.1)	0.3338
Air Pollution	1.0009	(0.9567, 1.0471)	0.969
Smoking Rate	1.0788	(1.0095, 1.1528)	0.0262
Greeting Pref 4	0.6786	(0.2138, 2.1543)	0.5013
Greeting Pref 5	0.5272	(0.1525, 1.8217)	0.3028

Question: 3: Do cultural greeting preferences have a relationship with infection rate? When exploring the statistical data, we expect countries with greeting pref 5 (more naturally social distant) to have a 47% lower infection rate than countries with greeting pref 3 (less socially distant), assuming the two countries have the same gov't stringency scores, median ages, population densities, health indices, air pollution, and smoking rates. Even with this data, the confidence interval contains 1, so we do not have evidence that the two groups of countries are different in death rates based on social preferences.

Another source of confounding numbers can come from the data set, which appears to have some extreme variance. Iceland, Jordan, Egypt, Argentina, and India are all were very influential in different parts of our analysis. They seem to have some extreme values in almost all of their categories. For example, Jordan has a very high government stringency, infection rate, and smoking rate. It also has a shallow death rate, health index, and mean age.

Another example is seen in Egypt, having a high death rate but low infection rate. This highlights the importance of ensuring the data is collected from good sources and that the data collected is valid. Different countries have distinct methods for reporting illnesses in their countries, as well as additional capabilities. For example, the USA tests everyone for COVID-19 in the hospitals, so the US has good testing numbers; a country with different resources may not test people for COVID-19 at the same rate, and deaths may not be attributed to COVID-19, changing the reported infection and death rates.

Discussion and Recommendations

The consequences and impacts of the lockdown and the virus itself were quite profound. When examining the countries in this study that imposed the highest levels of lockdown, the pandemic seemed to have a larger curve. In comparison with Sweden's relatively level epidemic curve, Italy recorded hundreds of deaths per day and saw its health systems on the verge of collapse. Italy has population-adjusted fatality rates above that of Sweden. Instead, Sweden allowed people to live relatively normal lives, but urged people to socially distance, and banned elderly care home visitors. The hope, states epidemiologist Anders Tegnell said, was that people might develop a widespread "herd immunity" as this happened (Baker 2020).

There were other consequences of the lockdown measures. In the United Kingdom, the Royal College of Psychiatrists reported a sixfold increase in suicide attempts by the elderly because of depression and anxiety caused by social isolation during the lockdown. There was also a surge in 18-25 year-old men that were "badly affected by first-time mental health issues." (Thakur 2020).

According to the news in the U.K., over 2 million planned and elective activities have been canceled. An internal memo that circulated for Cabinet discussion predicted “up to 150,000” could suffer non-COVID-19 immature deaths due to the lockdown, including almost 18,000 cancer patients. Karol Sikora, a consultant oncologist with the National Health Service, measureds up to 50,000 more U.K. deaths from cancer if the lockdown lasts six months, owing to the lockdown-induced delay in health screenings (Thakur 2020).

Up to 20 percent of hospital patients in England contracted got coronavirus while there for another illness,” said a recent Guardian headline. The U.K. has documented one of the highest numbers of people in Europe of people dying at home, including from cardiac arrests, because people are reluctant to call for an ambulance. They fear that beds may not be accessible, or that they might contract the virus in hospitals (Thakur 2020). Lockdowns also blocked people from some healthy open-air lifestyle options in parks, gardens gardens, and on beaches, instead cooping them up in high-risk environments like blocked living complexes. In New York, two-thirds of new hospital admissions were infected at home while sheltering-in-place. Prolonged exposure in contained environments is high risk; in outdoor settings, the risk is under 5 percent. The Guardian announced on May 9, 6,546 more non-COVID-19 deaths at homes across Great Britain correlated with the seasonal five-year average (Thakur 2020).

Therefore, in light of these staggering challenges, we were interested in seeing if any of the data was significant in the lethality or spread of the virus. The data we gathered pointed to the fact that data collection needed to be improved. The problem is that the collected information is cross-sectional on the time-dependent outcome and predictors of interest. To address this problem, there is a need for more valid and accurate data. Applying to the same system countries with more valid data might help to prove or disprove the hypothesis. Another reasonable investigation would include making a timeline with numbers of infection rate, death rate before lockdown, and after lockdown month by month. This information may provide more information on how lockdowns affect the death rate throughout the world.

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