


Strict or Sick?

**The Effects of Government
Stringency On Excess Mortality
during the COVID-19 Pandemic**

by Logan Grote



The Problem

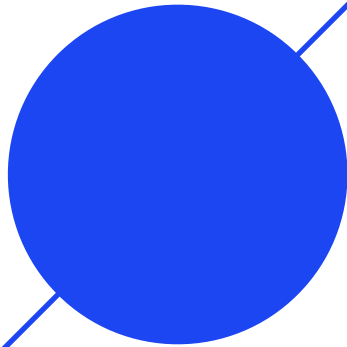


Over the course of the last two years, COVID-19 has caused monumental disruptions to almost every aspect of life around the globe. Chief among them is an huge increase in the burden of disease, public health, and mortality. As governments around the world sprung into action to combat the rising case and death numbers, they took a wide variety of approaches. Politicians and citizens have hotly contested the pros and cons of these various approaches, and whether any individual intervention was worth the cost paid in a reduction in personal freedom, individuals social lives, mental health and well being, or potential economic impact.

In this project, I take a first look at whether government stringency (the level of restrictiveness displayed across policy responses) had an effect on the mortality outcomes for that given country.

Step 1

Data



Finding the right sources

Beginning January 1st 2020, Oxford began collecting systematic information on policy measures different governments have taken to combat COVID-19. These indicators - which include travel restrictions, school closures, and health system policies among others - have been aggregated into a single number representing the degree of stringency with which a given government responded to the pandemic. The original data set can be found here:

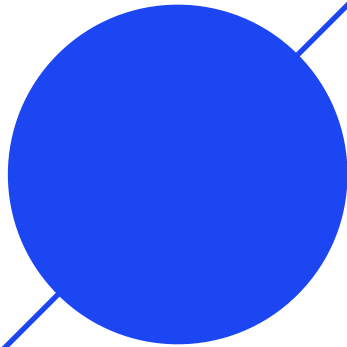
[Oxford COVID-19 Government Response Tracker](#)

COVID-19 death numbers have been difficult to accurately track for a wide variety of reasons (improper accounting, lack of resources, differences in accounting methods, etc). A more reliable method for estimating the total toll COVID-19 has taken in terms of lives lost is excess mortality - the number of deaths from all causes measured during a crisis, above what could be observed under 'normal' conditions. However a relatively small number of countries officially track and report excess mortality. Fortunately the Economist Intelligence Unit has created a country by country estimate, which can be found here:

[Economist Excess Mortality Tracker](#)

Step 2

Data Cleaning



Putting it together

Problem 1: Data sets use a different name and date scheme to represent countries and entries.

Solution: Convert the iso3c used by the Economist data set into the plain name country format of the Oxford data. Then, apply a standardized date and time format across both datasets.

Problem 2: The two data sets cover slightly different dates and countries.

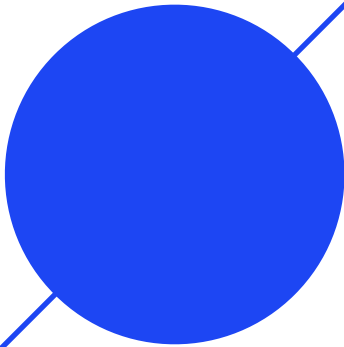
Solution: Limit the period of time in question to the smaller range of the two, and remove countries not covered in both sources.

Problem 3: The merged data set was sorted date rather than country.

Solution: Sort the data set by country first and then by date.

Step 3

Exploratory Data Analysis



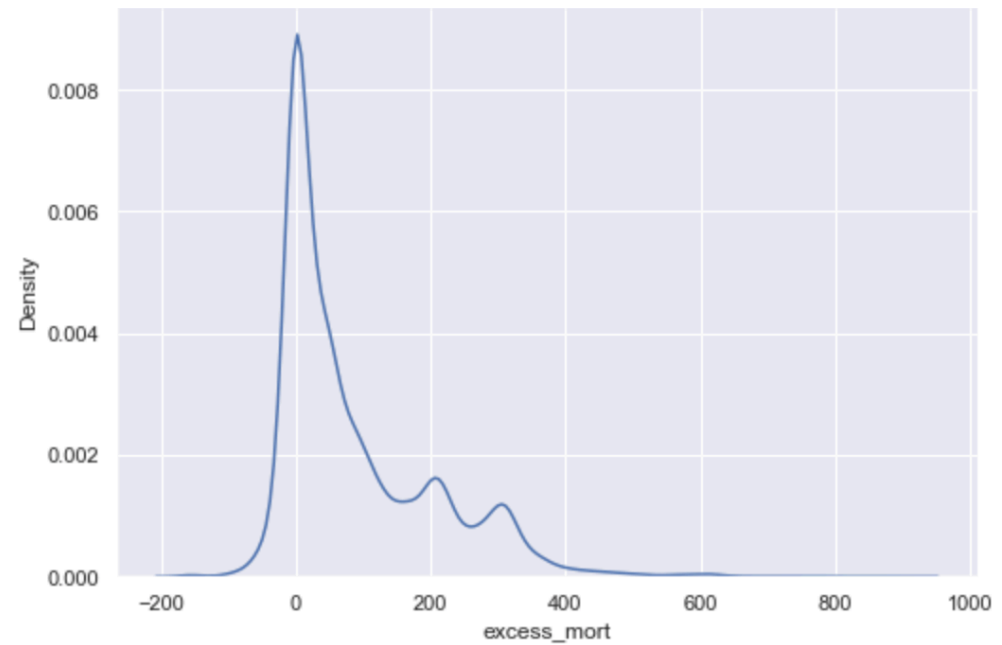
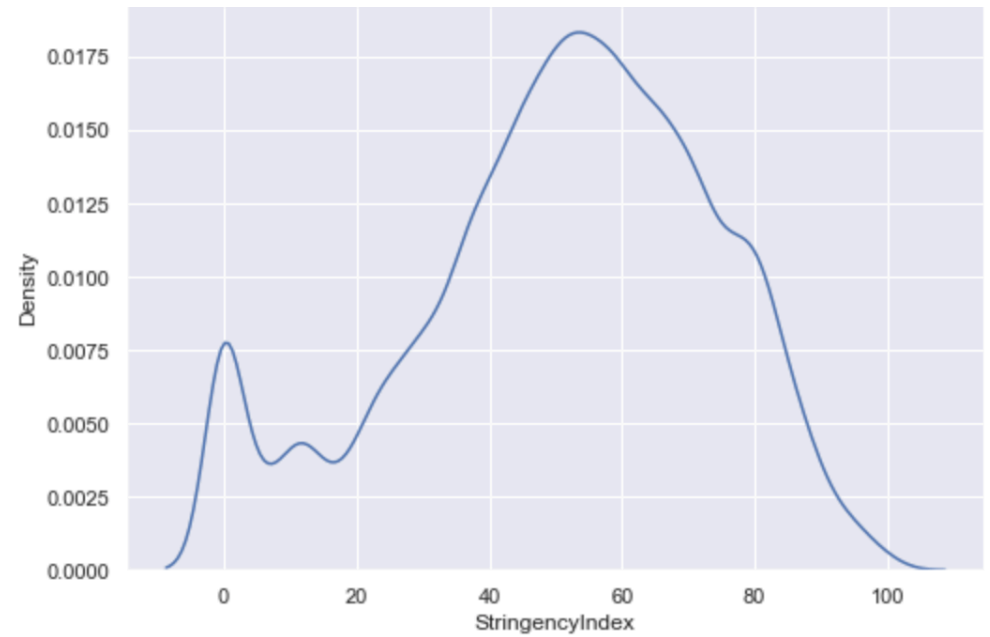
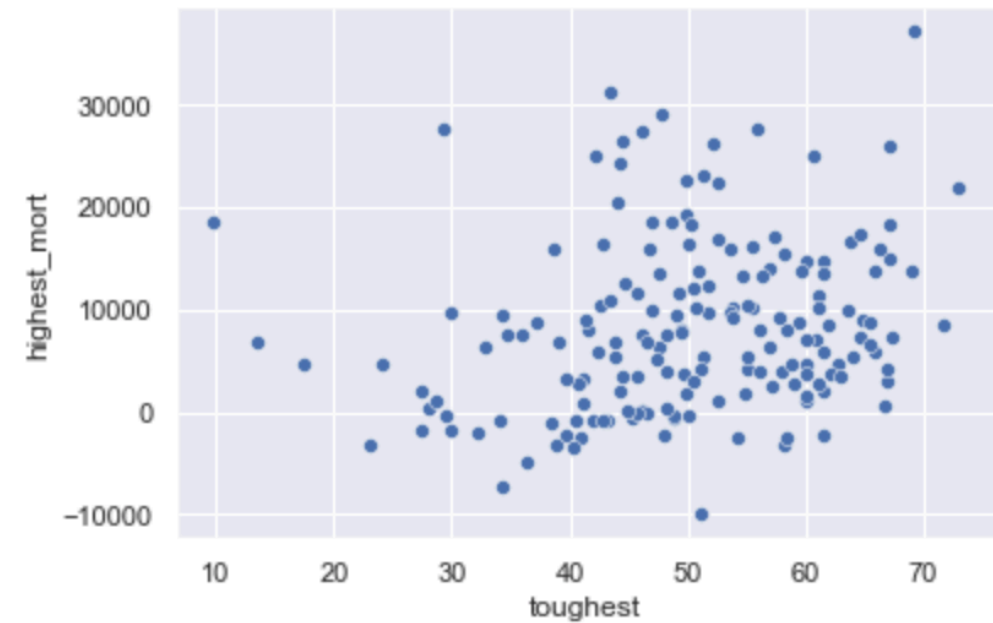
Diving into the data

The distribution of the Stringency looked nearly normal, but with a sharp increase in concentration at the lower bound (0 in this case). The excess mortality displayed very little normality, and there appeared to be a several relatively extreme outliers. Plotting various countries excess mortality against their stringency yielded some interesting results. There was a very clear pattern in mortality, which tended to increase relatively linearly over time (which is what you would expect). Stringency, however, had no such clear pattern with a wide variety of ranges and scores between countries. If you squinted, you may have been able to see a few commonalities (a sharp increase in stringency near the beginning of 2020, some upward movement in response to the different waves of COVID-19, and a typically narrow range of stringency overall) but these were not consistent enough to establish a clear pattern.

Ranking countries on stringency and excess mortality provided an overview of how countries fared relative to one another (who was strictest/most lenient, who have the highest excess mortality/lowest). Plotting these rankings did not display a clear pattern at first glance but revealed that there were indeed outliers, which I ultimately removed from the study.

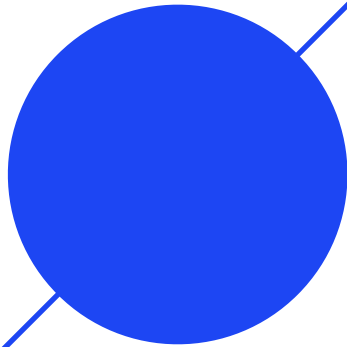
EDA

First Look



Step 4

Preprocessing

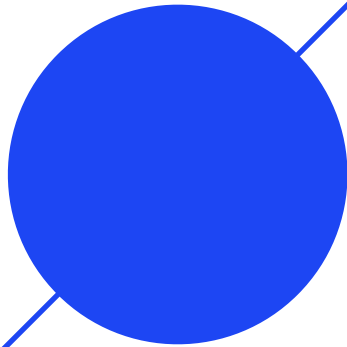


Getting things into shape

After looking into various methods to determine causation, and after consultation with my mentor, I decided that a diff-in-diff method would be appropriate. Accordingly, I developed aggregate scores for each country on the two metrics being considered (stringency and excess mortality). I decided to create two distinct diff-in-diff models. One comparing the average against the most stringent countries and one comparing the average against the least stringent. I split the countries and their scores into 3 quantiles based on stringency (high, middle, and low).

Step 5

Modeling



Doing the math

Using the diff-in-diff with an OLS model, I compared my two treatment groups (high and low stringency) against my control (average).

The first model, comparing high stringency countries against average stringency stringency countries, showed a decrease in expected excess mortality in the treatment group. However, this result fails (by a fair margin) to be statistically significant.

The second model, comparing a low stringency treatment group of countries and an average stringency control group, fared somewhat better. It too showed an expected decrease in excess mortality in the treatment group, with a coefficient of around -3917. This result also fails to reach statistical significance but comes much closer.

High Stringency Treatment

OLS Regression Results

Dep. Variable:	ExcessMortality	R-squared:	0.417			
Model:	OLS	Adj. R-squared:	0.410			
Method:	Least Squares	F-statistic:	54.87			
Date:	Tue, 01 Feb 2022	Prob (F-statistic):	8.67e-27			
Time:	13:58:09	Log-Likelihood:	-2352.8			
No. Observations:	234	AIC:	4714.			
Df Residuals:	230	BIC:	4727.			
Df Model:	3					
Covariance Type:	nonrobust					
=====						
	coef	std err	t	P> t	[0.025	0.975]
const	7.336e-14	745.526	9.84e-17	1.000	-1468.934	1468.934
Treated	-1.626e-12	1049.856	-1.55e-15	1.000	-2068.565	2068.565
Time	9906.9846	1054.333	9.396	0.000	7829.599	1.2e+04
did	-792.6603	1484.721	-0.534	0.594	-3718.052	2132.732
=====						
Omnibus:	58.478	Durbin-Watson:	0.081			
Prob(Omnibus):	0.000	Jarque-Bera (JB):	222.586			
Skew:	0.963	Prob(JB):	4.63e-49			
Kurtosis:	7.373	Cond. No.	6.88			
=====						

Low Stringency Treatment

OLS Regression Results

Dep. Variable:	ExcessMortality	R-squared:	0.324			
Model:	OLS	Adj. R-squared:	0.316			
Method:	Least Squares	F-statistic:	36.81			
Date:	Tue, 01 Feb 2022	Prob (F-statistic):	1.82e-19			
Time:	13:58:09	Log-Likelihood:	-2370.2			
No. Observations:	234	AIC:	4748.			
Df Residuals:	230	BIC:	4762.			
Df Model:	3					
Covariance Type:	nonrobust					
=====						
	coef	std err	t	P> t	[0.025	0.975]
const	-1.399e-12	802.962	-1.74e-15	1.000	-1582.101	1582.101
Treated	-4.006e-12	1130.738	-3.54e-15	1.000	-2227.928	2227.928
Time	9906.9846	1135.559	8.724	0.000	7669.556	1.21e+04
did	-3916.8236	1599.104	-2.449	0.015	-7067.590	-766.057
=====						
Omnibus:	58.627	Durbin-Watson:	0.154			
Prob(Omnibus):	0.000	Jarque-Bera (JB):	166.082			
Skew:	1.077	Prob(JB):	8.62e-37			
Kurtosis:	6.520	Cond. No.	6.88			
=====						



Analysis



01

Short of significant

With neither of the results reaching statistical significance, it is important not to put too much weight of the effect sizes found in the models.



02

Model 2

In the lower stringency group we're given a somewhat clearer picture. At both ends of our confidence interval we observe and overall decrease in excess mortality. While the result was not statistically significant, only slightly larger n would be required to reach significance.



03

Things to consider

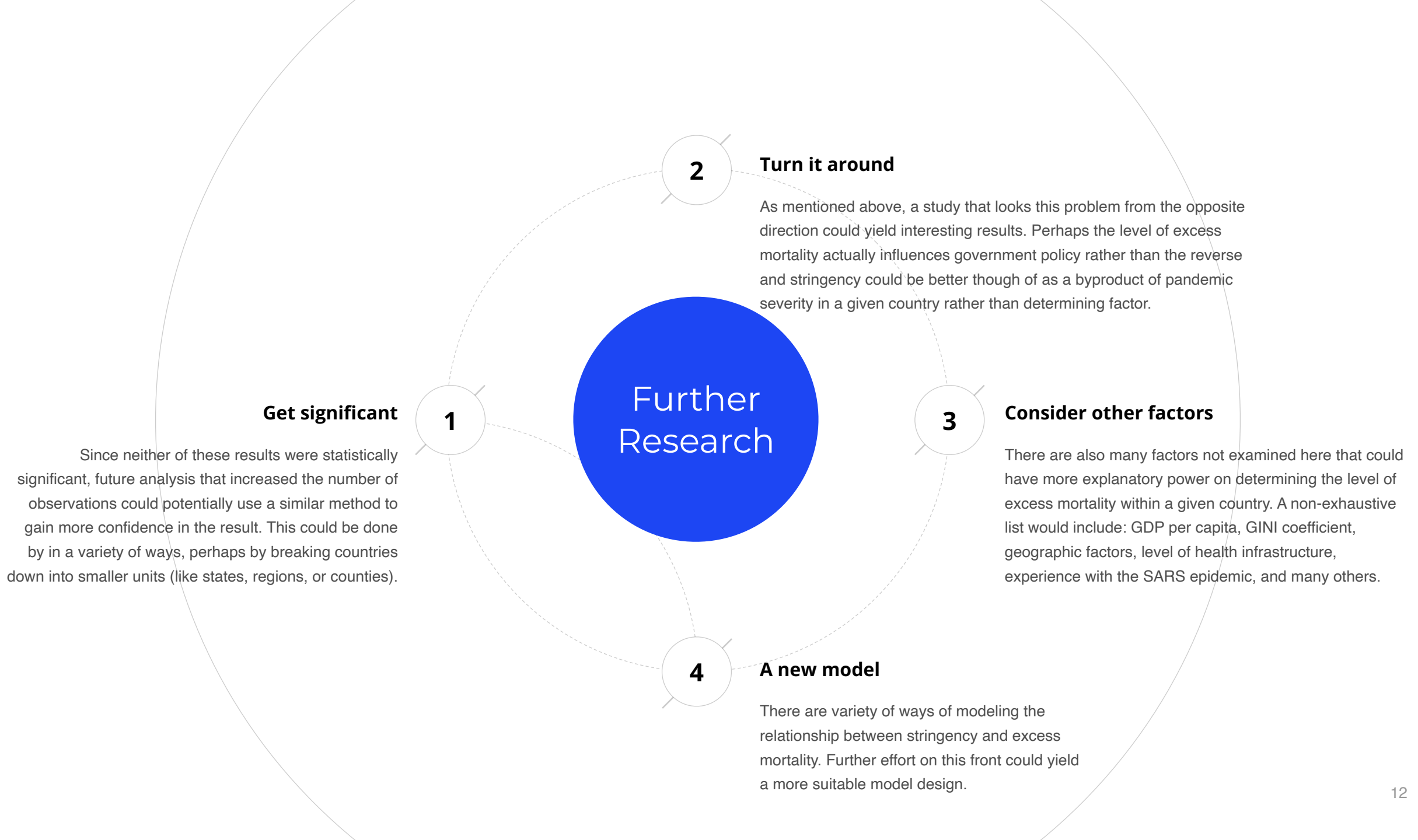
It's also important that many features of the pandemic that were not explored here could have had large effects on this overall picture.



04

Takeaway

Based on these results I'm deeply uncertain whether high levels of stringency made positive or negative impacts on excess mortality during the course of the pandemic. I am lead to believe, however, that countries with a lower stringency than the average saw lower excess mortality rates than their peers.





In Closing

Citations and Credits

Covid-19 government response tracker. Blavatnik School of Government. (n.d.). Retrieved January 27, 2022, from <https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker>

The Economist Newspaper. (n.d.). *Tracking covid-19 excess deaths across countries*. The Economist. Retrieved January 27, 2022, from <https://www.economist.com/graphic-detail/coronavirus-excess-deaths-tracker>

Thanks to Oxford University and the Economist Intelligence Unit for making this data publicly available for researchers, and to Kevin Ding for being an amazing sounding board and mentor.