How did Countries Respond to the COVID-19 pandemic?

Research Project

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Introduction

The research will involve analyzing the quantitative data to obtain the required information in the research process's analysis and conclusion. The research's objectives were to understand the underlying conditions of how the COVID-19 virus spread and different countries' tactics in controlling it with their Medicare systems. It aimed at uncovering the best ways that healthcare can offer support and mitigate the pandemic's growth. This research report includes information from reliable resources that uphold accuracy such as the World Factbook, European Centre for Disease Prevention and Control, and more. We have used statistical software such as SPSS and Excel to calculate and analyze our results on each topic proposed, and used 5 statistical techniques including t-test, ANOVA, regression, correlation, and scatter plots. This research sought to understand the political and environmental landscapes of countries that affect their ability to control the virus and assist with proper medical attention.

Research Hypotheses

The purpose of our research hypotheses was to allow us to predict the research outcomes to the questions regarding the impact of COVID-19. By creating these hypotheses, we can further understand how COVID-19 has impacted our global communities and understand the steps taken to reduce death and contagion rates. Through gathering data from 61 counties randomly selected around the globe, the hypotheses we predict are as shown with a 0.10 significance level.

H_{01}: Developed countries' mass purchasing of crucial medical supplies increased the spread of COVID-19 in third-world countries

t-Test: Paired Two Sample for Means

Health Spending as a percentage of GDP	*Country's COVID-19 cases per 100,000*	
Mean	7.189230769	132.9147778
Variance	10.67840769	67996.15765
Observations	13	13
Pearson Correlation	0.140299323	
Hypothesized Mean Difference	0	
df	12	
t Stat	-1.741340593	
P(T<=t) one-tail	0.053586997	
t Critical one-tail	1.356217334	
P(T<=t) two-tail	0.107173995	
t Critical two-tail	1.782287556	

The significance value used in this study is 0.10. To determine if we accept the null hypothesis, we will compare the significant value and the p-value on the two tails. The value is 0.107173995, which shows a positive relationship and is equal to the significance value of 0.10; hence we accept the null hypothesis that Developed countries' mass purchasing of crucial medical supplies increased the spread of COVID-19 in third-world countries. We can also determine the strength of the relationship of the variables above using the regression analysis.

Regression analysis

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.140299
R Square	0.019684
Adjusted R Square	-0.06944
Standard Error	3.37933
Observations	13

	Coefficients	*Standard Error*	*t Stat*	*P value*	*Lower 95%*	*Upper 95%*	*Lower 90.0%*	*Upper 90.0%*
Intercept	6.955541	1.060992	6.5556	934.1E05	4.620312	9.290769	5.0501	218.860961

Country's COVID-19 cases per 100,000	0.001758	0.003741	0.469969	0.647557	-0.00648	0.009992	-0.00496	0.008477

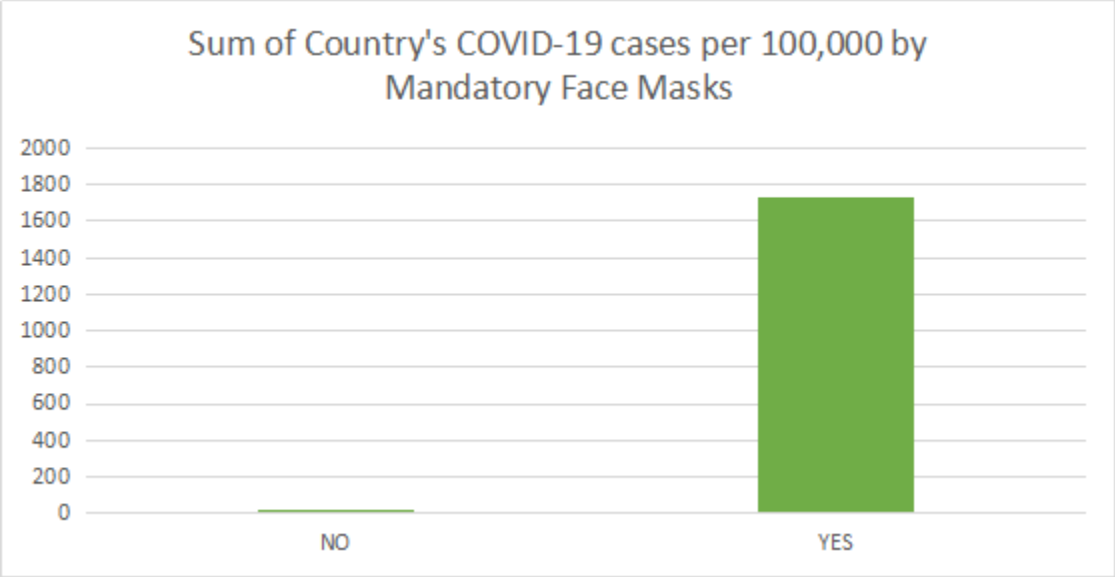
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2.522313	2.522313	0.220877	0.647557
Residual	11	125.6186	11.41987		
Total	12	128.1409			

To determine the strength existing between the two variables, we examine the value of Multiple R. in this case, the value of Multiple R is 0.140299. The relationship between the Developed countries' mass purchasing of crucial medical supplies and the spread of COVID-19 in third-world countries is weak and cannot provide enough evidence to accept the relationship.

H_{02}: Countries encouraging house quarantine and strict distancing precautions can control the virus more effectively than those with lenient regulations

In this case, we will find the relationship basing on the government's strictness on controlling the spread of the virus.



The clustered column graph above indicates that most of the countries who did impose mandatory cases of masks had the highest number of virus cases infections while those who did not have a mandatory face mask had the least cases of the virus. To determine if there was a difference in the number of the data used, we will perform the descriptive analysis to determine the factor that causes a huge difference.

Descriptive statistics

Country's COVID-19 Cases

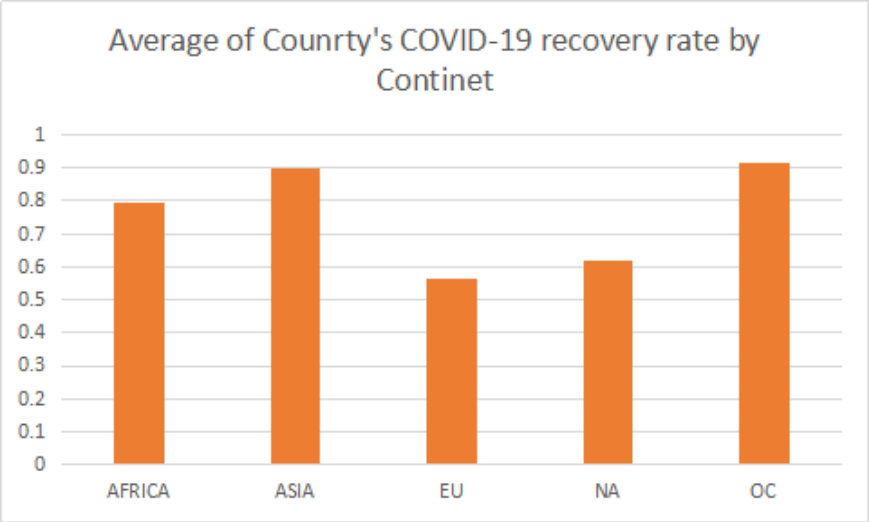
Mandatory Face Masks		*cases per 100,000*
Mean	1.153846154	132.9147778
Standard Error	0.104154339	72.3220137
Median	1	26.129377
Mode	1	#N/A
Standard Deviation	0.375533808	260.7607287
Sample Variance	0.141025641	67996.15765
Kurtosis	3.223140496	8.571959785
Skewness	2.178716804	2.828502762
Range	1	936.0601433
Minimum	1	0.01813384

Maximum	2	936.0782771
Sum	15	1727.892112
Count	13	13
Confidence Level (90.0%)	0.185632981	128.898625

The sample variance is the measure of dispersion in a data set. In other words, it measures how spread out a data set is. It is calculated by first finding each element's deviation in the data set from the mean and then squaring it. Judging the above results, 13 samples were used in both the data categories. The sample variance for mandatory face is very small, while the sample variance for the Country's COVID-19 cases per 100,000 caused the big difference in the clustered column.

H_{03}: Countries that have dealt with major epidemics in the past were able to effectively handle the quarantine and lower their cases compared with inexperienced countries.

Most of the countries that have been in the record in dealing with the pandemic in the past are the developed countries, while most developing countries have lacked in dealing with pandemics. The test will involve an analysis of the rate of recovery in different countries around the world.



The graph shows that Asia slightly above the 90% mark and Australia had the highest recovery rate then followed by Africa. Africa has developing countries, which means that there was no proof that countries that have dealt with major epidemics in the past could effectively handle the quarantine and lower their cases compared with inexperienced countries. The European continent and North America recorded low recovery cases, meaning they could not handle the pandemic and protect their citizens from the pandemic and most of the patients died.

H_{04}: The COVID-19 virus promoted increased attention and funding in hospitals and medical professions greater in wealthy countries versus developing countries

ANOVA test

ANOVA: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Health Spending as a percentage of GDP	13	93.46	7.189231	10.67841
Country's COVID-19 cases per 100,000	13	1727.892	132.9148	67996.16

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	102744.9	1	102744.9	3.021606	0.094978	2.927117
Within Groups	816082	24	34003.42			
Total	918827	25				

The significance value used in this analysis is 0.10 the p-value from the ANOVA test is 0.09. This is less than the significance value when we generalize the test. However, we can perform a

test to compare the developing countries and wealthy countries.

ANOVA: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Poor Countries	3	11.87	3.956667	12.73143
wealth countries	3	20.42	6.806667	4.539033

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	12.18375	1	12.18375	1.410935	0.300612	4.544771
Within Groups	34.54093	4	8.635233			
Total	46.72468	5				

The p-value, in this case, is 0.30, which is greater than the significance value of 0.10. Hence, we do not reject the null hypothesis that the COVID-19 virus promoted increased attention and funding in hospitals and medical professions greater in wealthy countries versus developing countries.

Research Questions

Questions were presented in this research project that asks about certain elements affecting the COVID-19 impacts on each country and the degree to which each country was stricken. This included analyzing a country's government structure and leadership, as well as its spending, literacy rates, poverty rates, and whether the choice to lock down the country was given. There are a total of 6 questions that use a significance level of 0.10 using various statistical techniques depending on the question.

Question #1 - In countries where a female was in a position of leadership did the countries' ability to control the pandemic spread seen as better, worse, or indifferent?

For this question, we will be using the 2-Sample T-Test method to determine whether a female in a position of leadership affected the countries ability to control its spread using a 0.1 significance level.

H0: $\mu = 0$

HA: $\mu \neq 0$

Group Statistics

	Leader Gender	N	Mean	Std. Deviation	Std. Error Mean
Cases/ 100,000	1	57	785.19	1103.313	146.137
	2	2	2464.00	1076.217	761.000

Notes:

1 = Male

2 = Female

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									90% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Cases/ 100,000	Equal variances assumed	.000	.989	-2.116	57	.039	-1678.807	793.392	-3005.381	-352.233
	Equal variances not assumed			-2.166	1.075	.261	-1678.807	774.905	-6030.634	2673.020

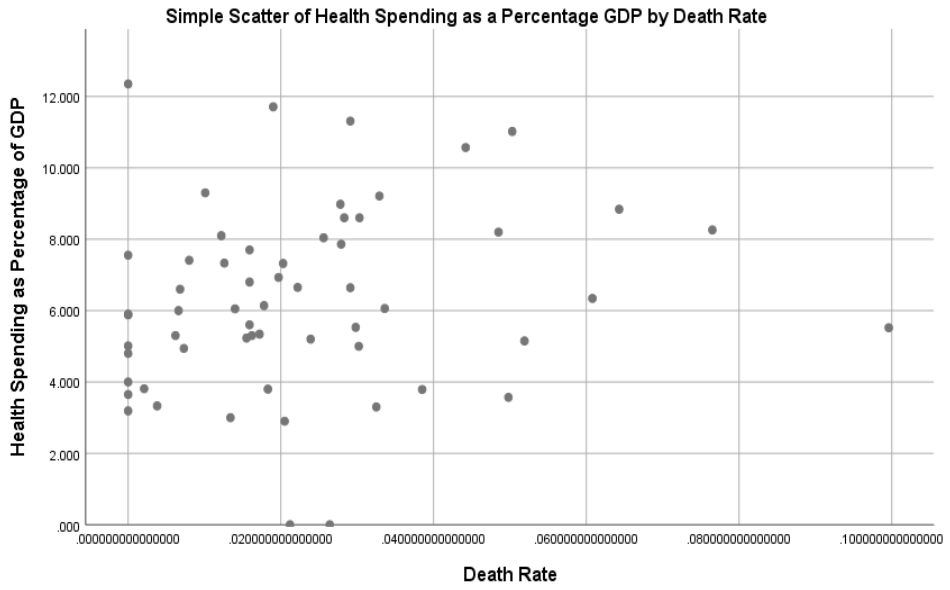
Since the p-value (.039) is less than the significance level (.1), we reject H0. At the .1 significance level, we can conclude that the countries with a female leader had a worse ability to control the pandemic than those countries with a male leader. Countries with a male leader had significantly greater control regarding the COVID-19 virus, as is evident when comparing the means as well with males having 785.19 per 100,000 COVID-19 cases against the females' 2,464 per 100,000 cases. However, there is a much higher number of male leaders with an amount of 57 against the number of female leaders of 2 in this random sample of countries that heavily increase the mean among countries with female leadership.

Question #2 - Did the countries with higher health spending as a percentage of GDP see lower death rates?

For this question, we will be using the Correlation method to determine whether countries with higher health spending as a percentage of GDP see lower death rates because they are both quantitative variables. Firstly, we will use a scatterplot to get a graphical representation of the results with health spending as a percentage of GDP against the death rates.

H0: $\mu \geq 0$

HA: $\mu < 0$



As seen in the scatterplot, it is evident that there is seemingly no relationship between the health spending as percentage of GDP and the death rate.

Descriptive Statistics

	Mean	Std. Deviation	N
HS-%GDP	6.27986	2.563958	59
Death Rate	.0228898305	.0203078607	59

Correlations

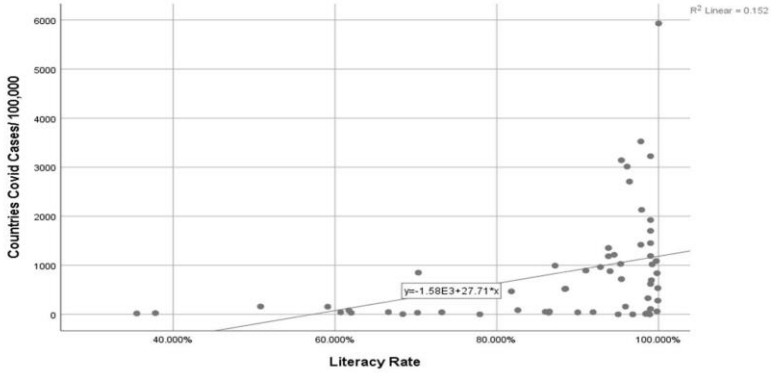
		HS-%GDP	Death Rate
HS-%GDP	Pearson Correlation	1	.177
	Sig. (2-tailed)		.179
	N	59	59
Death Rate	Pearson Correlation	.177	1
	Sig. (2-tailed)	.179	
	N	59	59

Since the p-value (.179) is greater than the significance level (.1), we do not reject H0. At the 10% significance level, there is not sufficient evidence to suggest that having a higher percentage of health spending in GDP results in lower death rates in a country. Although there is a slight positive correlation in the graph with a .177 Pearson correlation, the data suggests that the death rate is affected by means other than the amount allocated toward health spending by a country.

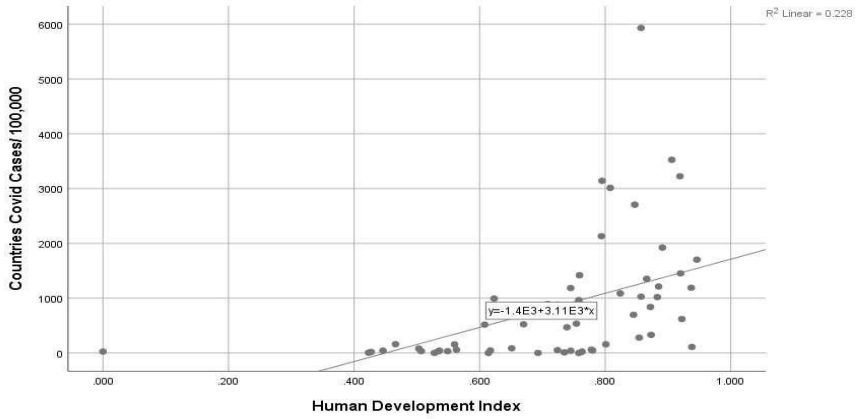
Question #3 - In countries where illiteracy rates and poverty rates are high having a worse time off during the pandemic comparatively to countries with high literacy rates and low poverty rates?

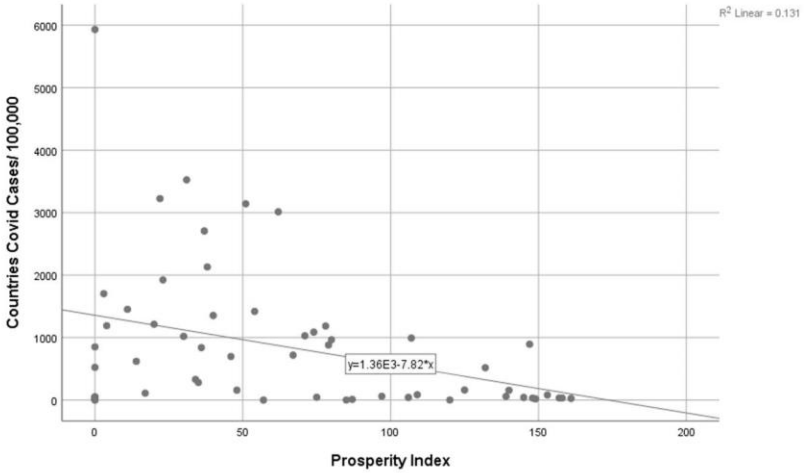
For this question, we will be using the multiple linear regression analysis to determine the effects a countries' poverty and literacy rate has on the number of cases reported per 100,000.

Step. #1 Creating Scatter Plots



These Scatterplot displays a positive linear relationship between the country's literacy rates + Human Development Index and COVID-19 Case per 100,000.





As opposed to when comparing the relationship between the country's prosperity index and the amount of cases, which displays a negative relationship.

Step. #2 Compute the relative data for linear regression.

Regression Statistics	
Multiple R	0.482335408
R Square	0.232647446
Adjusted R Square	0.190791852
Standard Error	1021.381323
Observations	59

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	17395698.03	5798566.012	5.558335813	0.002098732
Residual	55	57377089.36	1043219.806		
Total	58	74772787.39			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-876.0586538	1044.990604	-0.838341178	0.405467824	-2970.266623	1218.149
Poverty Index	-1.779537636	3.4051663	-0.522599333	0.603351949	-8.603643395	5.044568
Human Development Index	3145.212259	1641.162856	1.916453476	0.060509533	-143.7515999	6434.176
Literacy Rates	-491.9858667	1625.196377	-0.30272395	0.763242237	-3748.952188	2764.98

Step. #3 Analyze the above data and explain

$\alpha = 0.05$

$H = \beta = \beta = \beta = \beta = 0$

H = At least one β does not equal 0

Critical Value = 2.76 approx.

By using our F-Test Statistic we can evaluate if the model is significant, and test to ensure that this model is appropriate to test the correlation between the number of Covid-19 cases and the independent variables (Red Circle)

F-STAT = 5.5583 > 2.76

This tells us that the model is indeed significant, the next step is to move to test whether there is individual variable significance in the independent variables, we shall use a 0.05 confidence interval for this. (Blue Circle)

Ho: B = 0

Ha: B is not equal 0 Critical Value = 2.0040

Poverty Index
-0.5226 < -2.0040 Reject Human Development Index
1.9164 < 2.0040 Do not Reject Literacy Rates
-0.3027 < -2.0040 Reject

This displays that the Human Development Index Independent variable does influence the number of cases in the selected country. The final point to check to confirm that at least one of the independent variables influences how many cases have been reported that of the R-Squared.

R-Squared = 0.2326 (Green circle) which means overall the model has a 23.26% of the total variation is explained.

Step. #4 Conclusion

In conclusion after analyzing and comparing if the Human Development Index, Poverty Rate, or Literacy Rate correlate with the number of cases reported by countries the answer is very little if no significance. We see this since the F-test and T-test show that there is a significance that

the Human development index does affect the number of reported cases, but the overall model shows it affects this depended by a mere 23.26% which makes it mostly negligible.

Question #4 - Did the country's government models affect said country's ability to control the spread of the pandemic?

For this question, we will be using the One-way ANOVA method to determine whether a country's government model affected said country's ability to control the spread of the pandemic across 9 different types of government because it is suitable to determine if the population means are equal.

H0: $\mu_1 = \mu_2 = \ldots \mu_k$ Where k = number

HA: Not all μ_j are the same Where j = group

Descriptives

Cases/ 100,000

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Democracy	2	4728.00	1701.299	1203.000	-10557.56	20013.56	3525	5931
Democracy/Commonwealth	6	516.33	571.249	233.212	-83.16	1115.82	25	1452
Presidential Rebublic	28	643.57	899.160	169.925	294.91	992.23	0	3142
Democracy/Monarchy	1	3225.00	.	.	.	.	3225	3225
Constitutional Monarchy	4	1285.50	1249.506	624.753	-702.74	3273.74	46	3013
Communist Party Led	3	20.33	34.356	19.835	-65.01	105.68	0	60
Monarchy	3	966.33	420.902	243.008	-79.24	2011.91	518	1353
Parlamentry Republic	11	608.73	473.330	142.714	290.74	926.71	26	1419
Other	1	1087.00	.	.	.	.	1087	1087
Total	59	842.10	1135.423	147.820	546.21	1137.99	0	5931

ANOVA

Cases/ 100,000

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	41136658.68	8	5142082.336	7.644	.000
Within Groups	33636128.71	50	672722.574		
Total	74772787.39	58			

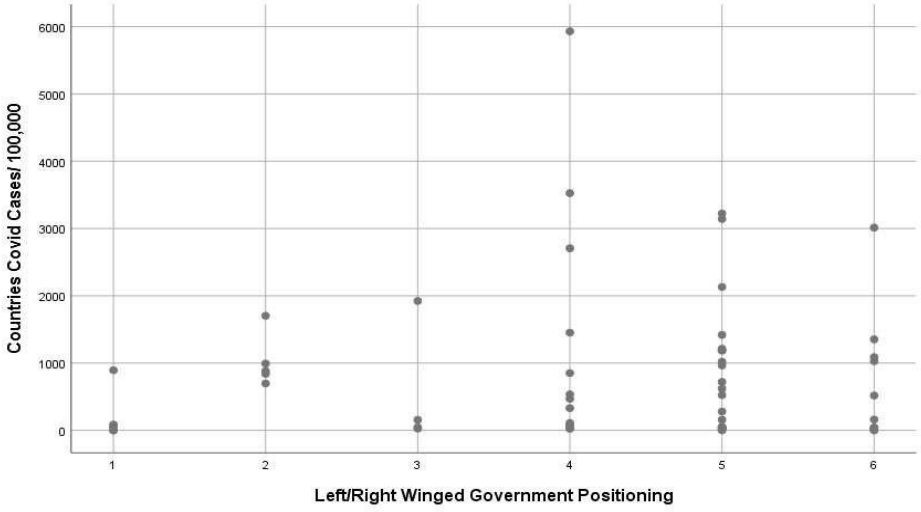
Since the p-value (.000) is less than the significance level (.1), we reject H0. At the 10% significance level, there is sufficient evidence to suggest that the country's government model

has a significant effect on their ability to control the COVID-19 pandemic. For instance, there is evidence that the democratic type of government has the highest amount of cases per 100,000 people with a mean of 4,728, while communism is on the opposite extreme with a very low number at 20.33. This shows that the leadership and order of a country are huge factors in the spread and actions of COVID-19 in each country.

Question #5 - Did countries who have a left-winged government party in power fair better than that country whose leaders were right-winged?

To analyze the effects of the governing party's position on the political spectrum in the relation to how many cases of Covid-19 case are present in the country, we will use One-way ANOVA to properly understand the relationship.

Step #1 - Building a scatter plot to visually see the correlation.



Notes:
1 = Left
2 = Right
3 = Center
4 = Center-Right
5 = Center-Left
6 = Other

Step #2 Compute the Anova One-Way test and analyze

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Left	6	1097	182.8333333	122214.1667
Right	5	5114	1022.8	155807.2
Center	4	2150	537.5	856447
Center Right	12	16056	1338	3355980.364
Center Left	21	17994	856.8571429	947949.6286
Other	11	7273	661.1818182	863656.7636

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	6457802.549	5	1291560.51	1.002015988	0.425692192	2.38944376
Within Groups	68314984.84	53	1288961.978			
Total	74772787.39	58				

F-Stat = 1.0020

$\alpha = 0.05$

Df = Numerator (5) Denominator (53)

$Ho = \mu1 = \mu2 = \mu3 = \mu4 = \mu5 = \mu6$

Ha = Not all means are equal

Critical Value = Fa (2.37)

$\boldsymbol{\alpha = 0.4256}$

Step #3 Conclusion

Since F-stat 1.0020 < 2.37, we do not reject the Null Hypothesis. P-value 0.4256 >0.05 which reaffirms that at least one of the means is equal to another mean. This tells us that the leading governments' political spectrum positioning, has not had any effect on the number of cases present in their corresponding countries. Thus, rejecting our initial hypothesis.

Question #6 - Did countries who implemented a country lockdown fare better than those who did not?

For this question, we will be using the Independent T-test with multiple samples method to determine whether countries who participated in a lockdown fared better than those who did not in consideration of the cases per 100,000 people and the death rate.

H0: $u \leq 0$

HA: $u > 0$

Group Statistics

	Lock DW	N	Mean	Std. Deviation	Std. Error Mean
Cases/ 100,000	1	29	1059.00	1044.910	194.035
	2	30	632.43	1196.521	218.454
Death Rate	1	29	.0247172414	.0224619213	.0041710741
	2	30	.0211233333	.0181964506	.0033222022

Notes:

1 = Lockdown

2 = No Lockdown

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									90% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Cases/ 100,000	Equal variances assumed	.032	.858	1.457	57	.151	426.567	292.864	-63.110	916.243
	Equal variances not assumed			1.460	56.431	.150	426.567	292.184	-62.055	915.189
Death Rate	Equal variances assumed	.004	.952	.676	57	.502	.0035939080	.0053133838	-.005290223	.0124780392
	Equal variances not assumed			.674	53.864	.503	.0035939080	.0053324372	-.005330664	.0125184803

Since the p-value in both the cases per 100,000 (.151) and the death rate (.502) is greater than the significance level (.1), we do not reject H0. There is sufficient evidence to conclude that countries who went on lockdown had fared worse than those who did not participate in a lockdown strategy regarding the cases per 100,000 people and the death rate. This may be because the countries were already in a desperate situation from COVID-19 that forced them into resorting to a lockdown of their citizens.

Conclusion

The virus affected the entire world with different kinds of magnitudes and factors affecting each individual country and person. All nations strived to prevent the spread and to curb the underlying problems that were causing the spread of a deadly and fast-moving virus. Most of the countries that were initially capable of handling the pandemics did not succeed earlier as compared to countries in Africa that did not experience high cases and death rates. Developed countries recorded the highest number of death and cases around the world, with some resorting to desperate measures such as lockdown and mandatory masks. It is worth noting that the most developed countries strived to increase the financial attention and education of the virus, unlike the developing countries which maintained the same funding and attention they were offering to their hospitals. However, if they increased, it cannot overdo the attention of the developed countries.

Data Sheet Link:
https://drive.google.com/file/d/1dp3Hou5EVExkcLCZz9Bz7ITOjE7GNbg9/view?usp=sharing

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