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Analysis of COVID-19 infections in GCC countries to identify the indicators correlating the number of cases and deaths

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Abstract

Purpose – The world has faced various epidemic situations caused by different viruses such as SARS-Cov, MERS-Cov, Ebola and many more during the past few decades, SARS-Cov-2 (COVID-19) is the genetic variant of newly the discovered Coronavirus, which has been believed to spread from China during December 2019, which has created a catastrophic effect for the whole world. In the first quarter of 2020, the virus started to spread to different countries, in addition, the severity of cases, the mortality rate and the recovery rate varied between countries. In the Sultanate of Oman and different parts of the world, the COVID started to spike during the end of March 2020. In this research paper, COVID data for Gulf Cooperation Council (GCC) countries are extracted and analysis has been made based on different parameters. The analysis has been divided into two categories – the first part focuses on the total number of cases, the total number of recoveries and the total number of deaths and comparison has been made for different GCC countries, from these analyses, it gives a clear picture of the days of a particular month, which contributes to the increase of COVID cases. The second part focuses on finding out the indicators that are correlating with the COIVD-19 cases and deaths; it has been found that there is a very strong correlation between the total population and labour force of every GCC country with the corresponding COVID cases and deaths.

Design/methodology/approach – The entire research steps involved starts with data collection, data pre-processing and data analysis. The analysis has been divided into two categories – the first part focuses on the total number of cases, the total number of recoveries and the total number of deaths and comparisons has been made for different GCC countries. The second part focuses on finding out the indicators that are correlating with COIVD-19 cases and deaths.

Findings – It has been found that there is a very strong correlation between the total population and labour force of every GCC country with the corresponding COVID cases and deaths.

Research limitations/implications – The data set considered is limited and can be extended further.

Social implications – This research paper definitely provides a road map for practice, as this research provides details about the total number of active cases, death based on the days in different GCC countries. It

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has been observed that during the end of each month and during weekends, the total number of cases increases drastically, so by taking into consideration the governing bodies can impose a lockdown during these spike durations. In addition to it, the citizens and residents should make a practice to avoid or limit their movement during the spike durations, which was analysed by this research work.

Originality/value – The idea is the own idea and not copied from any other source.

Keywords Gulf cooperation council countries, Data analytics, COVID-19, Data visualization, Death rate, Infection rate

Paper type Research paper

1. Introduction

Six Coronavirus species are known to cause human diseases, four viruses (229E, OC43, NL63 and HKU1) cause common cold symptoms, which are immuno-competent by individuals based on their body immunity level (Su *et al.*, 2016).

The other two SARS-CoV and MERS-CoV are respiratory syndrome, which are linked to fatal illness, which emerged in 2003 and 2012, respectively (Cui *et al.*, 2018). The first case of COVID-19 was reported in the last quarter of 2019, when a cluster of patients were reported by officials in Wuhan city, China (Who.int, 2019). According to the World Health Organization (WHO), the Coronavirus that evolved naturally infected human beings from an animal species, most likely to be a bat. COVID-19 started to spread in the beginning of 2020, which turned to be an epidemic, causing an unexpected critical situation for the complete human society. The precautionary measures and community restrictions have been triggered by all the countries around the world to stop the spreading of this terrific disease. For this research, the data used is about the Gulf Cooperation Council (GCC) countries, which form the major portion of Arab states of the Persian Gulf. GCC was established in 1981, which constitutes the following countries, namely, Sultanate of Oman, United Arab Emirates, Kingdom of Saudi Arabia, State of Kuwait, Kingdom of Bahrain and State of Qatar (Gcc-sg.org, 2019). The overall goal of GCC is to promote peace, unity across members of nations based on the common objective, as well as similar political and cultural views based on the beliefs of Islam. Total area covered by GCC countries are over 1 million square miles with a total population of 54 million people and its gross domestic product (GDP) around $3.464tn (worldpopulationreview.com, 2020).

Different parameters have been used to analyse the extracted data. As one of the important parameters the total population of each GCC countries has been extracted and which part of the population either rural or urban that causes the increase in COVID cases. The GDP and the health parameters of each GCC country has been collected to be used as one of the parameters to examine the correlation and another important parameter used is the Google search volume for the keywords COVID and coronavirus. By taking all the necessary data along with the needed parameters, analysis has been made with the confirmed cases and the deaths to extract useful information.

2. Literature review

Al Amri and Marey-Pérez (2020) in their research found that around 670 real estate owners in Oman are facing bankruptcy situation due to this pandemic situation. Many expatriates have left the country by losing their job or by resigning their jobs in this situation. According to data from the National Centre for Statistics and Information, there has been a decrease of about 79,000 expatriates between the months of March and June 2020. To control this pandemic, Oman Government had implemented complete and partial lockdown in many phases and areas. Due to the globalized recession in this pandemic Oman industries are not getting supplies and also facing contractual problems. The researchers have claimed that 2.7 billion works have got affected due to this pandemic. The working time has also been reduced by 6.7% on an average. Overall, all existing projects will be delayed and the new projects may not start in the recent future in Oman. This situation is also applicable for all GCC countries (Badahdah *et al.*, 2020).

McKibbin and Fernando (2020), have studied Global Macroeconomic impacts by COVID-19 using seven parameters. In conclusion, they have specified the impact may change due to a few parameters but there will be definitely a strong impact due to this virus globally. They have suggested short-term and long-term policies to manage this COVID-19 virus effect on the global macroeconomics. Government and financial institutions support to the people will reduce the impact to some extent but mainly Hygiene system should be improved globally. The impact will be less where the good health system is in place and accessible to the common public. Otherwise, the impact will be adverse. The economy will also get affected accordingly.

In total, 1.6 billion learners are affected by the closure of schools and colleges throughout the world. In GCC, the number of people test positive everyday has reached its peak during April, May and June. The number is getting low during July and August. The economy is still declining and need more time to get recovered, as many industries such as tourism and construction are not yet opened. GCC countries, which are having a better health system and hygiene system is better compared to Africa and the least developed countries (unstats.un.org, 2020). In total, 86.9% of the Children in the age group of 1–14 years experienced violent discipline by caregivers in the past month. In total, 40 to 60 million people forcibly pushed into extreme poverty.

In GCC and North Africa, as per a report from Organization for Economic Co-operation and Development (OCED) on the COVID-19 effect, the public health consequences are pretty less than the expected or the forecast. The economic and social effects are worse due to this pandemic. MENA country governments have implemented the lockdown to restrict the movement of people to reduce the COVID-19 contagion. Early steps taken by the governments showed its positive impact on the spread of the COVID-19 virus. Since the impact is less after July 2020, governments are making policies to ease the restrictions and to recover the economy. The United Nations Economic and Social Commission for West Asia estimates that the economic slowdown caused by the pandemic will cause an additional 8.3 million people to fall into poverty (OECD, 2020).

All GCC countries reacted to the pandemic situation even when it was in the infant stage. Even though the first death of COVID-19 happened in Iran, still they took it lightly and went on with many public events. They realized the impact very late and took action against it and still they are in the top list of COVID-19 most affected country. Even though the COVID-19 virus impact is controlled by the GCC countries, they could not stop the economy crash due to the worldwide recession (ReliefWeb, 2020). The social and the economic impacts will be there until an effective vaccine against the pandemic is made available. Economy of most of the GCC and Arab countries have got affected due to no tourism in this pandemic, as well as low petrol price globally (copyright Fundación Real Instituto Elcano, 2002–2016, 2020).

A psychological study conducted in Malaysia for the university students revealed that a considerable percentage of students are having anxiety during this pandemic (Sundarasen *et al.*, 2020). The study also suggests people not to see the news about the pandemic from the unreliable sources but maintain a healthy life study to improve the immunity power they have also suggested that “it helps to feel that everyone is in this together” (Fransen *et al.*, 2015). At the same time, the authors also have mentioned that:

> From a broader perspective, ministries and related agencies in coordination with the WHO, UNESCO, and CDC need to intensify community mindfulness, specifically for the students, by using artificial intelligence to obtain evidenced-based and scientific measures for pandemics (Sundarasen *et al.*, 2020).

Another study has explained how this pandemic made the social media to boost m-commerce (Hossain *et al.*, 2020). Also, the number of hours the users are using the mobile phone is also increased.

> It can be inferred from the results that a high percentage of time is spent by users on various SNSs – 35.2% of respondents reported an average of more than 4 hr on average [15].

In another recent research paper, the authors have confirmed that the COVID-19 impact is under the control of the government bodies as on May 2020. They have also mentioned that the continuous monitoring and appropriate precautionary measures are required to evaluate the actual impact and keep the impact under control (Alandijany *et al.*, 2020). Khamis, F., Al Rashidi has also mentioned that "vigorous strategies should be implemented to protect and reduce transmission and symptom progression of COVID-19 in vulnerable populations, including both elderly people and foreign-born individuals living in crowded housing" (Khamis *et al.*, 2020).

The research reports about the pandemic (Oman, 2020; ReliefWeb, 2020) have confirmed that the numbers of death and the affected people are till date (September 2020) is increasing steadily. The governments in the GCC countries have reduced the restrictions, as the pandemic is under control and the impact is rising very gradually. This is still acceptable, as there are no vaccines available for this virus.

3. Research methodology

The entire research steps involved starts with data collection, data pre-processing and data analysis. The entire processing and analysis works are done using Python programming language.

3.1 Data collection

The data for this entire work was collected from multiple sources. The COVID-19 daily statistics data was extracted from the Github repository (GitHub, 2020). The COVID-19 data considered for this research paper is from 22nd January 2020 to 26th July 2020. The COVID-19 data of GCC countries is analysed with the country's GDP, population etc. These data were extracted from the World Bank data (Worldbank.org, 2019) and GCCStat organization (dp.gccstat.org, 2020). The data for the year 2019 was used for the comparative analysis. The Google search data for the terms related to COVID-19 was extracted from the Google Trends website (Google Trends, 2015).

3.2 Data preprocessing

The COVID-19 data collected from the data source consist of three separate files that contain the details about the number of daily cases, daily deaths and daily recoveries. These three data sets were joined together to form a single data set. Some of the main operations carried out are removing duplicates, removing null values, data formatting, finding the cumulative counts, extracting the required countries, etc.

3.3 Data analysis

The data analysis starts with visualizing the various fine details from the data set including the daily cases, progression, deaths, recoveries, active cases and day-based analysis. The visual representation of the analysis can give a very clear insight to the users about the covid-19 infections. The second part of the data analysis is about identifying the indicators that influence the number of covid-19 cases and deaths in GCC countries. The main indicators considered are the population, economy, health and the search terms.

4. COVID-19 data analysis for Gulf cooperation council countries

This section focuses on the COVID-19 analysis for all the GCC countries, which includes the total number of cases, deaths, active cases and recoveries. The analysis also provides insights about the daily progression, day and date wise analysis of the number of cases and deaths.

4.1 Number of cases

The map given below in Figure 1 highlights the total number of COVID-19 cases reported in the GCC countries. Saudi Arabia reported 266,941 cases, which tops the GCC countries followed by Qatar with 109,305 cases, Oman with 76,005 cases. The list is followed by Kuwait with 63,773 cases, UAE with 58,913 cases and Bahrain with 39,131 cases. The colour scale shows the intensity of the number of cases in each country.

4.2 Daily progression of new cases

Figure 2 shows the daily progression of the new cases for all GCC countries. The size of the circle indicates the daily case reported by each country. From this graph, it is obvious that Qatar has exceptionally reduced the daily cases over the period of time. It is also observed

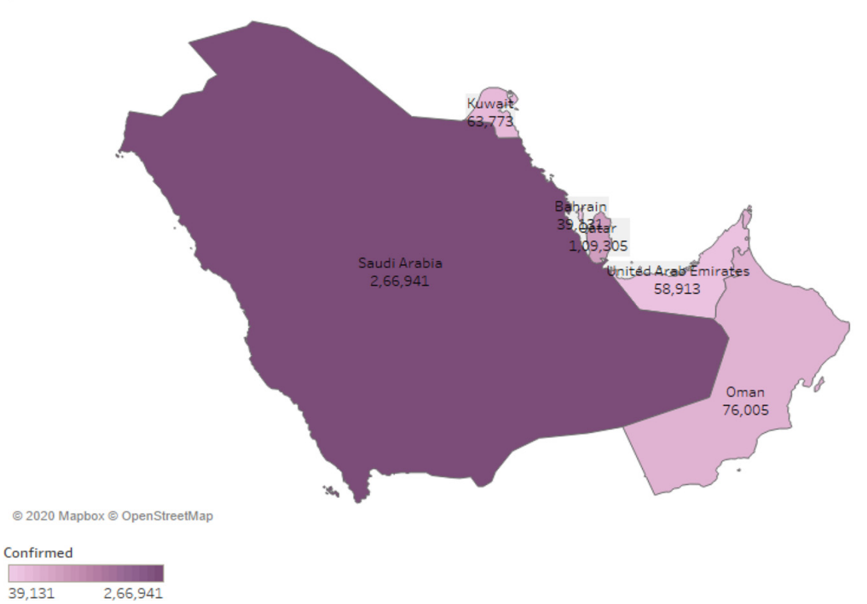

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Figure 1.
Map representing the number of cases

that more number of cases are reported in the months of May and June in most of the countries. The graph also shows a high variation of daily reported cases in most of the countries. The good news is that the number of cases in all GCC countries started reducing from July.

4.3 Active cases

The bubble chart Figure 3 shows the number of active COVID-19 cases in the GCC countries. The chart shows that Saudi Arabia with 43,885 cases (16.44% of total cases) leads among other countries with more number of active cases followed by Oman (26.74% of total cases), Kuwait (14.06% of total cases), UAE (10.84% of total cases), Bahrain (8.44% of total cases) and Qatar (2.85% of total cases). The data also shows Qatar is having a very less percentage of active cases and Oman is having a high percentage of active cases when compared to the total number reported in the respective countries. The size of the bubble in the chart represents the number of active cases.

4.4 Confirmed vs recovered cases

The following graph Figure 4 shows the cumulative number of confirmed and recovered cases over the period in all GCC countries. The area shown in blue colour is the confirmed cases and in green colour shows the recovered cases. The area graph clearly shows the close correlation between the confirmed and recovered numbers in the GCC countries. The difference between the cumulative confirmed cases and the cumulative recoveries remains a constant throughout the period.

4.5 COVID-19 deaths

The following tree graph Figure 5 shows the total deaths occurred and death percentage in all GCC countries. The size parameter in the graph shows the volume of deaths that occurred and the colour parameter indicates the death percentage. The implication is that the country is having more deaths, if the size of the box is big and darker the color shade indicates more death percentage. From this graph, it is observed Saudi Arabia has more number of deaths (2,733) among all the GCC countries followed by Kuwait with 433 deaths, Oman (384 deaths), UAE (344 deaths), Qatar (165 deaths) and Bahrain (140 deaths). Saudi Arabia is having the highest death percentage of 1.02%, followed by Kuwait (0.68%), UAE (0.58%), Oman (0.51%), Bahrain (0.36%) and Qatar is having the lowest death rate with 0.15%.

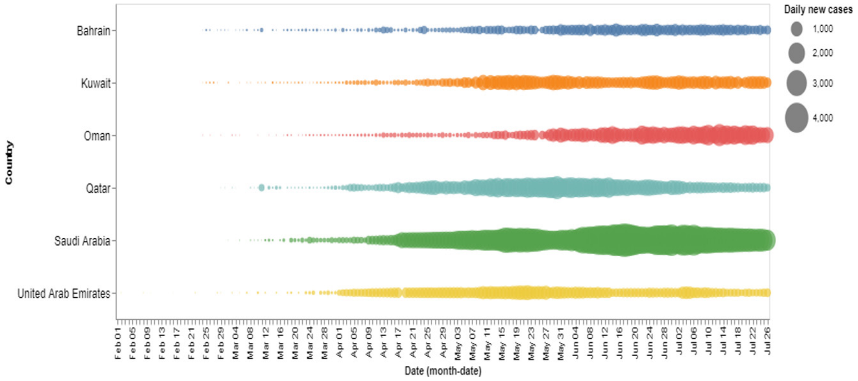

Figure 2.
Daily progression of
new cases

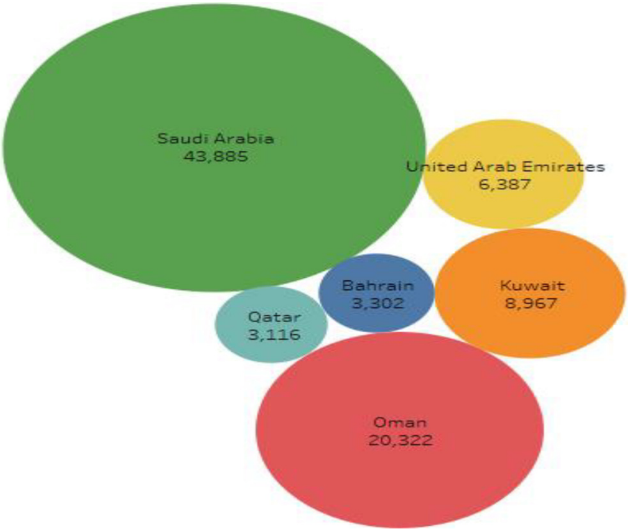

Figure 3.
Active cases

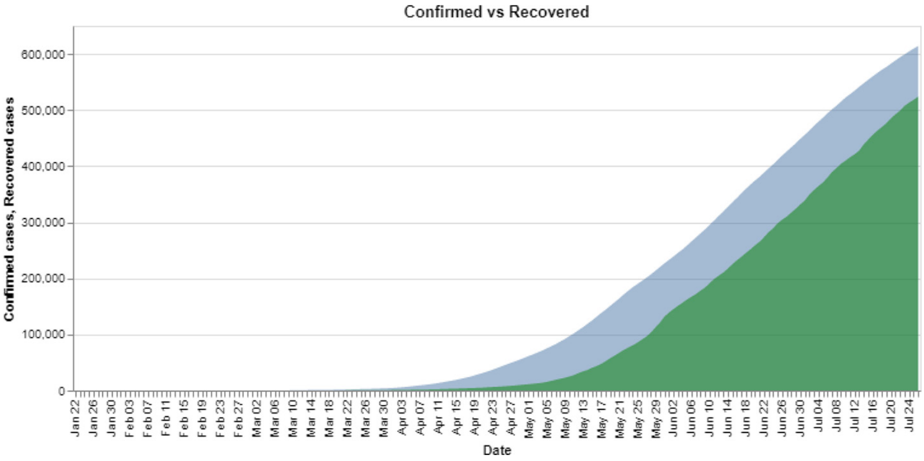

Figure 4.
Confirmed vs
recovered cases

4.6 COVID-19 recoveries

The following tree graph in Figure 6 shows the COVID-19 recovery and recovery rate among the GCC countries. The size parameter in the graph shows the volume of recovered cases and the colour parameter indicate the recovery percentage. Saudi Arabia has the highest number (220,323) of recoveries, followed by Qatar (106,024), Oman (55,299), Kuwait (54,373), UAE (52,182) and Bahrain (35,689). Qatar is having the highest recovery rate (96.99%) followed by Bahrain (91.20%), UAE (88.57%), Kuwait (85.26%), Saudi Arabia (82.54%) and Oman is having the lowest recovery rate of 72.76%.

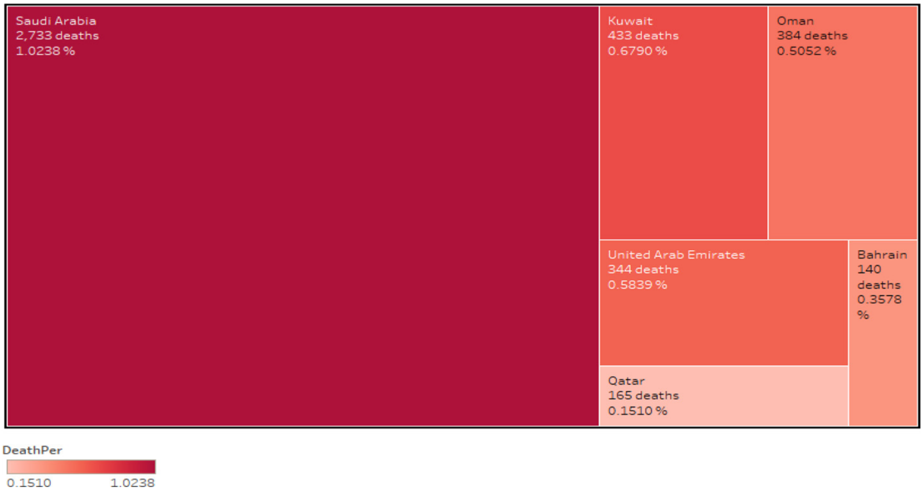

Figure 5.
Deaths and death rate

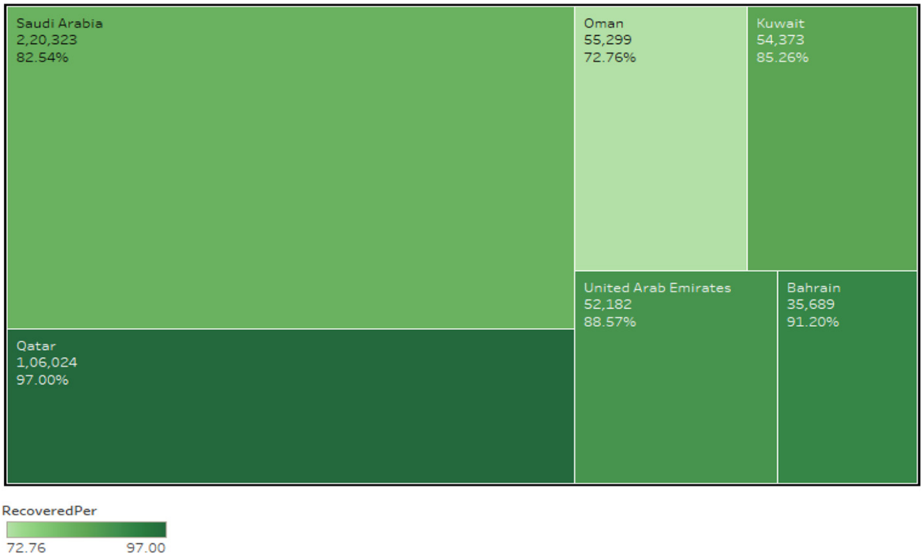

Figure 6.
Recovery and recovery rate

4.7 Number of cases and deaths based on dates of the month

The main objective of this analysis is to find any interesting insights behind the number of cases and deaths to a specific date. The following heat maps Figures 7 and 8 show the faceted view of the total number of cases and deaths in all GCC countries based on the dates. From Figure 7, it can be observed that more new cases were added during the dates between 12 and 26 of every month and very less cases during the month end and beginning of the month. Figure 8 also shows the same kind of pattern for the deaths happened in all countries. More deaths occurred between 14 to 26 of every month. From both the charts, it can be observed that more number of cases and deaths happened on 22nd day of the month.

4.8 Number of cases and deaths based on weekday of the month

The main objective of the heat maps shown in Figures 9 and 10 is to find out, which day of the week more number of cases and more deaths happened. Figure 9 clearly indicates that Friday counts to the more number of cases identified with a count of 92,152 cases and on Tuesday, less number of cases identified with a value of 85,334 cases.

Figure 10 shows a clear picture that more deaths due to COVID-19 happened in GCC countries is on Sunday with 650 deaths and the lowest death reported on Mondays with 550 deaths.

5. Analysis of indicators

The main idea of this paper is to find out the factors that influence the COVID-19 cases and the deaths occurred. The analysis is grouped into three categories, the first category is to compare the number of cases and deaths with the population parameter of each country. The second category is to compare the number of cases and deaths in each country with the economy and health parameters of the corresponding country. The third category is comparing the number of cases and deaths with the volume of Google searches made by the corresponding country people related to the COVID-19 disease.

Figure 11 shows the correlation between the population parameters with the number of cases and deaths of each country. The population parameters considered for this analysis are total population, rural population percentage, urban population percentage and the total labour force in each country. The parameters are represented as a separate scatter plot by

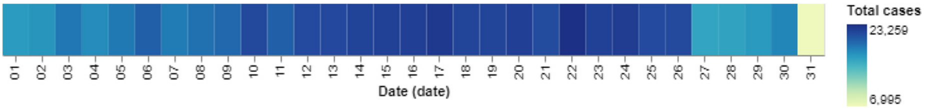

Figure 7.
Number of cases based on dates

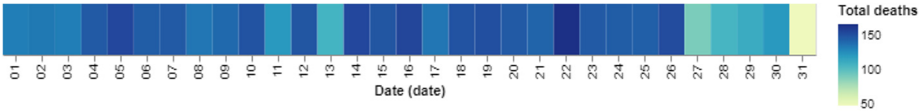

Figure 8.
Number of deaths based on days

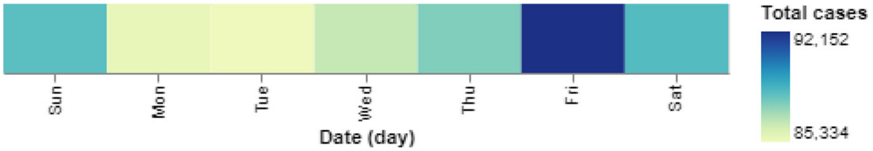

Figure 9.
Number of cases based on weekday

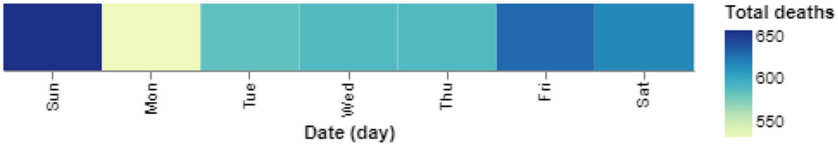

Figure 10.
Number of deaths based on weekday

marking the regression line to show the correlation between them. Among the four parameters considered, only two parameters the total population and the labour force of each country have a high degree of correlation. This shows the population and the labour force of the country are the factors among other factors that are highly related to the number of COVID-19 cases and deaths.

Figure 12 shows the comparison between the economy and health indicators with the COVID-19 cases and deaths. The parameters considered for this comparison are GDP per capita value ($) of each GCC country, percentage of people with diabetes, current health expenditure per capita, PPP ($) and the domestic general government health expenditure (per cent of GDP). The scatter plot and the corresponding regression line shows the relationship between the selected indicators to the number of COVID-19 cases and deaths. The plot clearly indicates that there is no correlation or relationship between the indicators and number of cases and deaths.

The third analysis is to find out the relationship between the number of cases and deaths to the volume of Google searches related to COVID-19 made by the people of the corresponding country. The Google search data for the GCC countries for two search terms "Coronavirus" and "COVID" are compared with the actual number of cases and deaths as given in Figure 13. The scatter plot reveals that there is a medium correlation between the search terms and the number of cases and deaths. The search term "Coronavirus" shows a medium positive correlation and the search term "COVID" shows a medium negative correlation between the number of cases and deaths.

The most commonly used measure to find the correlation between two variables is the Pearson's correlation coefficient. The Pearson's correlation coefficient (*R*-value) is calculated for all the indicators to the dependent variable and shown in Table 1. If the *R*-value is greater than 0.7, indicates that there is a high correlation between two variables. From the table, it

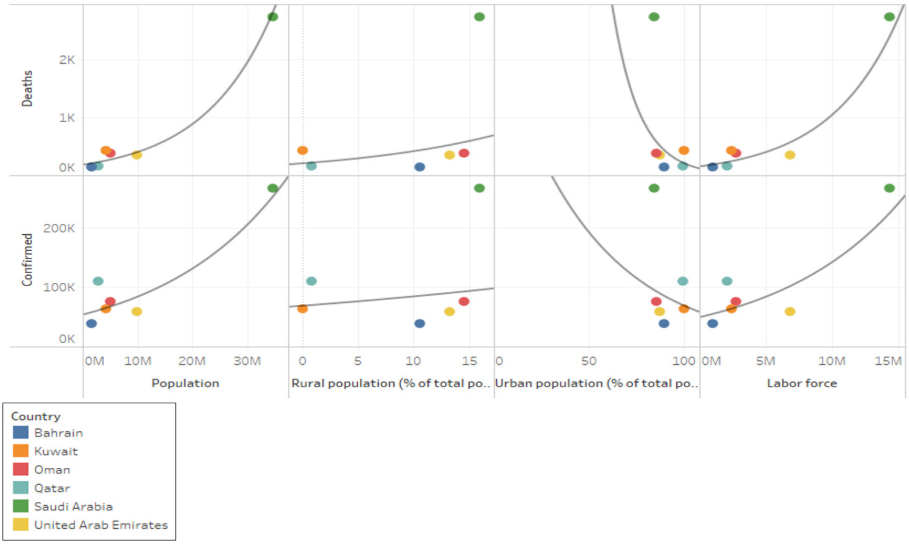

Figure 11.
Confirmed cases and deaths vs population

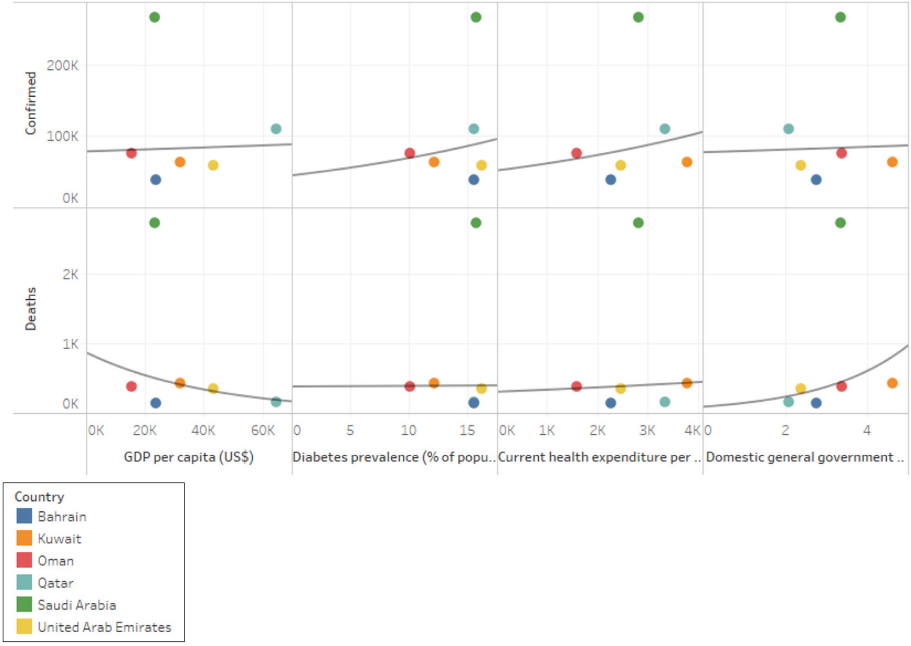

Figure 12.
Confirmed cases and deaths vs GDP and health

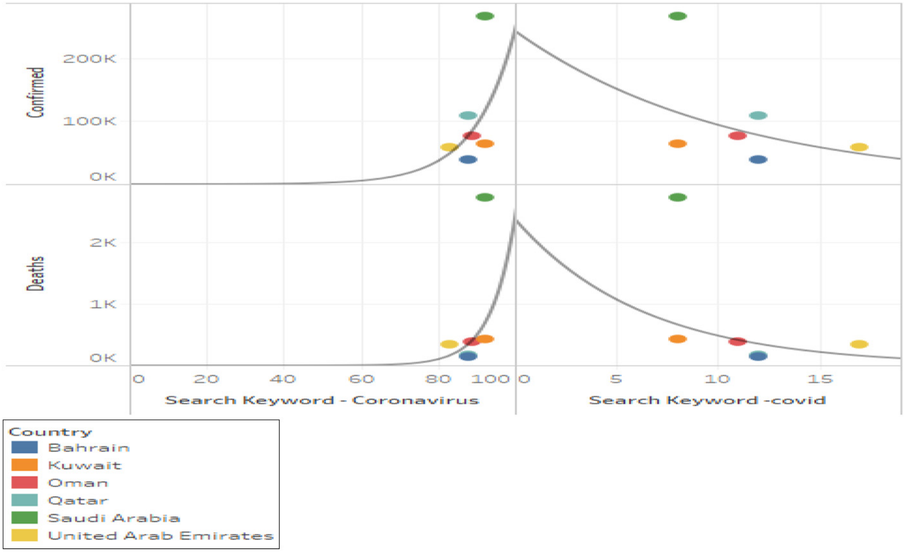

Figure 13.
Confirmed cases and deaths vs search term frequency

can be observed that two indicators population and labour force are having a high *R*-value influence the number of COVID-19 cases and deaths.

The *R*-value between population and confirmed cases is 0.93 and a highest *R*-value of 0.98 between population and deaths. *R*-value between labour force and confirmed cases is 0.88 and 0.93 between labour force and deaths. Also, the search terms are having a medium influence in the number of cases and deaths.

6. Conclusion

In conclusion, the research team has collected the COVID-19-related data for the GCC countries from 22nd Jan 2020 to 26th July 2020. The main objectives have been covered by the research team. The data is compared with 2019-year data to measure the actual impact of this pandemic. The maximum number of people were affected in Saudi Arabia, but as per the number of affected people per million, Qatar stands first in the list. Pandemic effect in the GCC countries was high during May and June and reduced considerably by July 2020. It is a good sign and progress made by the GCC countries. Oman stood first in the active cases as on July 26th, 2020 followed by Saudi Arabia. There is a consistency in reported and recovered cases in the GCC countries. Saudi Arabia's death toll stands in 1% whereas all other GCC countries death tolls are in decimal points. In every month 12th till 24th also on Friday greater number of cases were identified and causality was high on Sunday. After the analysis, the research team found that the population and the labour force of the country are the factors among other factors that are highly correlated to the number of COVID-19 cases and deaths. Also, there is a medium correlation between the search terms and the number of cases and deaths. The population and labour force indicators of the countries are having the high *R*-value influence the number of COVID-19 cases and deaths. In the coming days, the number of people affected by the COVID-19 virus will be low and recovery will be high in almost all the GCC countries. The research team has found that the graph is in the sliding stage of the adverse effects of the pandemic.

7. Future research

This research paper provides a road map for practice, as this research provides details about the total number of active cases, death based on the days in different GCC countries. It has been observed that during the end of each month and during weekends the total numbers of cases increase drastically, so by taking into consideration the governing bodies can impose a lockdown during these spike durations. In addition to it, the citizens and residents should make a practice to avoid or limit their movement during the spike durations, which was

Indicators	Pearson's correlation coefficient Confirmed	Deaths
Population	0.930756939	0.982647709
Rural population (% of total population)	0.339325595	0.474433257
Urban population (% of total population)	−0.339325595	−0.474433257
Labour force	0.876710112	0.932305419
GDP per capita (US$)	−0.09862072	−0.328644416
Diabetes prevalence (% of population ages 20 to 79)	0.263770376	0.221963864
Current health expenditure per capita, PPP ($)	0.150294181	0.073290846
Domestic government health expenditure (% of GDP)	0.055030962	0.219761534
Search term – Coronavirus	0.497900217	0.511174783
Search term – COVID	−0.497900217	−0.511174783

Table 1. Pearson's correlation coefficient between confirmed cases, deaths to the indicators

analysed by this research work. Future work concerns deeper analysis by using more parameters to impose added steps for practice, in turn, provides a way to control the spread of COVID-19. And also, a complete data set, which represents values of different parameters till date can be used to predict the spike of COVID-19.

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