

Measuring the impact of COVID-19 surveillance variables over the international oil market



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ABSTRACT

Coronavirus (COVID-19) has turned to be an alarm for the whole world both in terms of health and economics. It is striking the global economy and increasing the unpredictability of the financial market in several ways. Significantly, the pandemic spread stimulated the social distancing which led to the lockdown of the countries' businesses, financial markets, and daily life events. International oil markets have accommodated the crude oil prices during the early COVID-19 period. However, after the first 50 days, Saudi Arabia has surged the market with oil, which caused a certain decrease in crude oil prices, internationally. Saudi Arabia is one of the biggest oil reserves in the world. International trade is based on oil reservoirs which in turn, have been significantly dislodged by the pandemic. Therefore, it is crucial to study the impact of COVID-19 on the international oil market. The purpose of this study is to investigate the short-term and long-term impact of COVID-19 on the international oil market. The daily crude oil price data is used to analyze the impact of daily price fluctuation over COVID-19 surveillance variables. The correlation between surveillance variables and international crude oil prices is calculated and analyzed. Consequently, the project will help in stabilizing the expected world economic crises and particularly will provide the implications for the policymakers in the oil market.

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1. Introduction

Influenza is one of the main so far epidemics known to the world. Due to its swift mutation and transmission rate, not only controlling its spread is difficult, but it also has a strong influence on the daily routine operations of society making it a challenge for health and development (Gong et al., 2020). In the 21st century, the world has seen two major outbreaks in the human population. One in the form of Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) in 2003, and the other in the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) in 2012. Over 8000 cases of SARS from

26 countries and 2200 cases of MERS from 27 countries were reported to the WHO (Nesteruk, 2020). Till the end of December 2020, several cases of unknown pneumonia were reported in Wuhan, Hubei, a Province of China. The novel COVID-19 was identified to be the cause of these cases by the Chinese government and WHO, which belongs to the same family of coronaviruses. By the end of January 2020, 7000 infectious cases of COVID-19 were reported from mainland China. When the countries including Thailand, Japan, the United States of America, and South Korea also reported the infectious cases, WHO declares the COVID-19 outbreak as a Public Health Emergency of International Concern (PHEIC).

Currently, two hundred and ten countries across the globe are affected by the disease with almost 2,252,370 reported cases. To prevent the disease spread, the governments of the affected regions have taken serious measures to ensure social distancing. Intending to understand the disease spread, several researchers analyzed the COVID-19 surveillance

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variables and made predictions based on features like the reported cases, recovered cases, and fatalities. Moreover, they recommended ensuring strong social distancing measures for disease prevention.

The COVID-19 influenced a strong impact on almost every field of life including education, business, traveling, and economy. The international oil market is one of the foremost economic factors of society over the globe. The budget revenue of Saudi Arabia depends upon petroleum up to 87%. A major portion of the country's exports belongs to the same sector which makes more than 40% of its GDP. Also, Saudi Arabia has an important role in stabilizing international crude oil prices. COVID-19 has brought many economic crises, worldwide. To stabilize and revive the economic crises, this project will help the economic policymakers of the country to foresee the short-term and long-term impact of COVID-19 on the international oil market.

The daily changing figures of COVID-19 are important for the authorities to take the righteous steps as per the varying situation. These phenomena have motivated us to bring the two important external variables under consideration. In this study, we analyze the data that is curated from multiple sources. However, the study focuses on the correlation of age and gender with the novel COVID-19 surveillance variables for Belgium, in particular. Along with the visualization, COVID-19 surveillance variable frequencies and Pearson's correlation, polyserial correlations, and Cramer's V are used for the analysis of variables. Finally, we note that the extensive experimentation results signify the greater mortality trend in males. However, more reported cases belong to females. In terms of age, people who are more than 45 years old are more susceptible to the novel COVID-19. To sum up, the current analysis provides efficient insights for better health implications for Belgium. In all, the contributions made in this paper are as follows:

- To make efficient and valuable use of the international crude oil price data
- To predict the future oil prices using the prediction methods
- To model the relationship between crude oil prices and COVID-19
- To highlight the short-term and long-term COVID-19 impact on Saudi Arabia

The remaining paper is arranged as: Section 2 provides a review of the related literature, Section 3 gives the details of methods and dataset, section 4 demonstrates the results and detailed discussions on the findings of the study, and section 5 finally concludes the study with some important future directions and recommendations.

2. Literature review

COVID-19 and oil price have a volatile relationship. It is because of the increasing and

decreasing demand for oil during the pandemic, globally. There are quite a few studies that exist in the literature that exhibit correlation between COVID-19 and oil prices. Some recent comprehensive surveys discussed the economy, health, and social media on surveillance variables (Nicola et al., 2020). Also, there have been quite a few recent studies (Dey and Das, 2021; Jiang et al., 2021; Oyewola et al., 2021; Algamdi et al., 2021) However, the significant findings from the oil price point of view are presented next.

Authors tried (Albulescu, 2020a) to categorize the COVID-19 and oil study into two categories – the correlation of oil price and the financial volatility, and oil price and the economic policy uncertainty. They mentioned that financial stress can aid to forecast oil prices. Regarding Saudi Arabia, the authors mentioned that financial markets are under immense stress and fear of COVID-19, however, one can see a continuous increase in the price volatility. Saudi Arabia well-anticipated the powerful decline in global oil demand, the reason, they flooded the market with oil by starting an oil price war on the 9th of March 2020. The crude oil price dropped by 20% and even more in just one day. Ultimately, the financial markets collapsed on the same day due to this shock.

In another study, the authors argued that exports fall due to the COVID-19 and prices fall further due to Saudi Arabia and Russia price war, capital will likely flow out of the economy, the currency will depreciate and prices for basic food products will rise. In addition to falling oil sales, repatriating incomes from oil sales will likely reduce the macroeconomic impact of this trend. Moreover, they concluded that the lack of agreement between Russia and Saudi Arabia, it can further cause a decrease in oil prices. The challenge of oil price and COVID-19 uncertainty is also discussed in Ajami (2020). According to the authors, government budgets of the Arab oil-producing states within OPEC were being anticipated that oil prices would not go beyond 50 US dollars per barrel. On the other hand, along with Russia, Saudi Arabia also failed to produce an impact by reducing OPEC members' oil production. Consequently, the Saudis, being traditional oil producers, determined that they need to increase the oil production by at least beyond 10mbd. Furthermore, for oil export, they agreed to decrease the price. Importantly, the average production cost of Saudi Arabia for a single crude oil barrel is anticipated to be less than 5 US dollars.

In an economy-focused study on the COVID-19 global impact (Yamin, 2020), the authors argued that the recent pandemic has stumbled the oil producers. Lockdowns and movement and transportation restrictions have drastically diminished the oil demand. Despite the decline in production of oil, the crude oil price has touched under 20 US dollars per barrel. This will strictly impact the economies of countries that export oil such as Saudi Arabia. Also, other countries like Arabian Peninsula, Africa,

Russia, Brazil, Venezuela, Mexico, and Kazakhstan are under the impact of the pandemic.

Scientific methods are also being used to understand the oil stock/price nexus. Salisu et al. (2020) used a panel Vector Autoregressive (pVAR) model to analyze the oil response and stocks to COVID-19 shocks. The authors reported that the oil and stock markets will suffer even a greater impact during and after the pandemic as compared to the period before the pandemic. The major reason associated with this impact is the uncertainty in the markets. Bildirici et al. (2020) also have used a deep learning-based model to analyze the volatility of oil prices.

In summary, COVID-19 has squeezed the oil demand resulting in the decline in oil prices, internationally. Authors also made an effort (Ahani and Nilashi, 2020) to study the effect of COVID-19 and prices of crude oil on the US Economic Policy Uncertainty (EPU). It is observed that the global number of reported cases and the death rate has no significant effect on the United States EPU. However, the decrease in crude oil demand is causing higher uncertainty. The US has a business relation with China, the reason, the cases outside China have a positive impact on US EPU as well as the crude oil prices. Regarding the surveillance impact of COVID-19 in Arab countries, Qatar is at the top followed by Bahrain, Saudi Arabia, Egypt, and Iraq (Albulescu, 2020b). It is predicted that the infection rate in the Arab region is likely to increase in the near future.

3. Analysis of surveillance variables over the international oil market

3.1. Dataset

In this study, the data is curated from multiple sources. The current study is primarily focused on correlation analysis of surveillance variables and the international daily crude oil prices. For the COVID-19 surveillance variables, the data is curated from a widely referred COVID-19 API (<https://covid19api.com/>) which is sourced from John Hopkins CSSE. The data contains daily confirmed cases, active cases, deaths, and recovered cases. However, for the daily crude oil prices data, investing.com is used as the data source which provides the data in the form of multiple variables as described in Table 1. It includes the daily price in USD/barrel, open, high, low prices, and the daily volume consumption. In this study, Brent crude oil prices are used which are usually followed in the middle east.

Table 1: Data summary

Variables	Source	Time Period
Oil	INVESTING	Sep 01, 2020 – Feb 29, 2020
Daily price, Open, High, Low, Volume, Change		Mar 01, 2020 – Aug 31, 2020
Surveillance	apicovid19.com	Mar 01, 2020 – Aug 31, 2020
Confirmed, Active, Deaths, Recover		

3.2. Hypothesis

The null hypothesis H_0 is: there is no statistically significant relationship between surveillance variables and oil prices. Considering the continuous nature of the variables, the Pearson correlation analysis is used to test the hypothesis. In all, the following are the null sub-hypothesis:

1. Daily confirmed cases are not statistically related to the daily oil prices
2. Daily recovered cases are not statistically related to the daily oil prices
3. Daily deaths are not statistically related to the daily oil prices
4. Daily confirmed cases are not statistically related to the daily volume contracts
5. Daily recovered cases are not statistically related to the daily volume contracts
6. Daily deaths are not statistically related to the daily volume contracts

3.3. Correlations

In the underline crude oil price data, daily price and number of volume contracts are considered as the dependent variables. The oil price has a relationship with demand. The pandemic has significantly affected both oil prices and demand. Therefore, we divided our analysis into the following four categories:

1. Global Pre-COVID Impact (Sep 2019–Nov 2019)
2. Global Initial-COVID Impact (Dec 2019–Feb 2020)
3. Local Initial-COVID Impact (Mar 2020–May 2020)
4. Local Post-COVID Impact (Jun 2020–Aug 2020)

Regarding the concerned surveillance variables, for each category, the following correlations are calculated:

- Daily confirmed cases and daily price
- Daily recovered cases and daily price
- Daily deaths and daily price
- Daily confirmed cases and daily volume contracts
- Daily recovered cases and daily volume contracts
- Daily deaths and daily volume contracts

We use mainly two widely used statistical methods to analyze the dataset presented in the dataset section, first frequency, and second correlation. Frequencies are obtained from the dataset available from various sources.

3.4. Correlations among numeric variables

For correlations among numeric variables (Admitted, ICU, Respiratory, Recovery, Tests Performed, Deaths), Pearson's correlation is used as formulated in Eq. 1. The variables are represented by x and y and \bar{x} and \bar{y} represent the means of the variables. The correlation value is between -1 and 1.

The strong negative correlation between two variables is represented by -1, strong correlation by 1, and no correlation by 0.

$$r_{xy} = \frac{\sum_i(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\sum_i(x_i-\bar{x})^2}\sqrt{\sum_i(y_i-\bar{y})^2}} \quad (1)$$

3.5. Results and discussion

3.5.1. Global pre-COVID impact (Sep 2019–Nov 2019)

The oil prices before the start of the pandemic are shown in Fig. 1 and the volume of futures contracts in Fig. 2. During the start of Sep 2019, the prices are between USD 58 to 62 per barrel. The price graph shows a spike during mid of Sep 2019 and the prices are declined at the end of the month. However, the price graph started moving upwards at the start of Oct 2019 and it continues towards Nov 2019 which shows a gradual increase in prices. However, the volume graph also shows the spike at the same time as of price graph. Following the pattern of the graph, the volume figures remain almost the same during the month, though, the number of futures contracts decreases at the end of each month. Therefore, for the pre-COVID interval, it is observed that the decreasing oil demand during the end of months caused a gradual increase in prices.

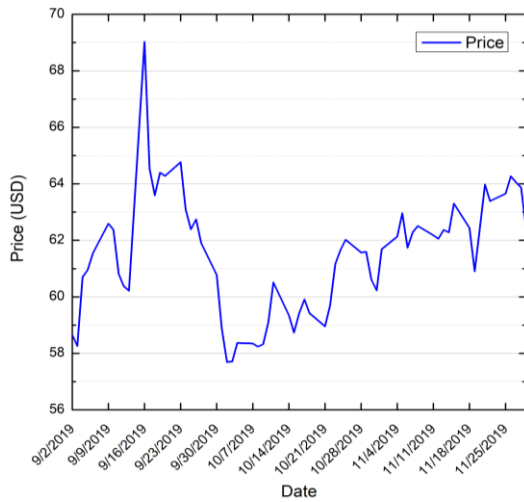


Fig. 1: Global pre-COVID impact on the price

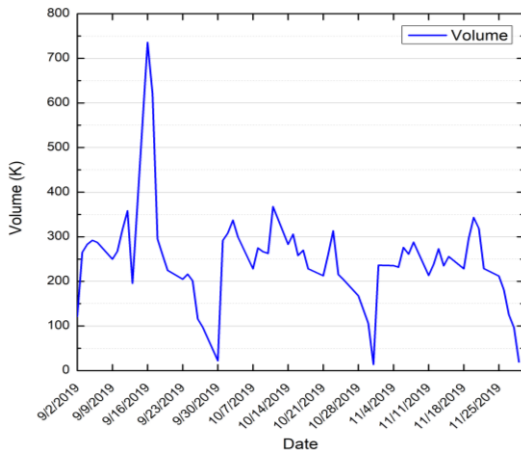


Fig. 2: Global Pre-COVID Impact on the volume

3.5.2. Global initial-COVID impact (Dec 2019–Feb 2020)

The first COVID-19 case was officially registered in Wuhan, China in late Dec 31, 2019, by declaring the COVID-19 as a global pandemic. During the pre-COVID quarter, the oil prices were gradually rising and in Fig. 3, it is obvious that the prices were still rising during Dec 2019 as well. This is because the first case registration and the global pandemic declaration were made in the later part of Dec 2019. However, the moment when the world community observed a new pandemic, the price graph started declining from USD 65-70 per barrel to USD 45-50 per barrel. This was the major decline in price after the pandemic started. In Fig. 4, it can be observed that the number of futures contracts started gradually rising.

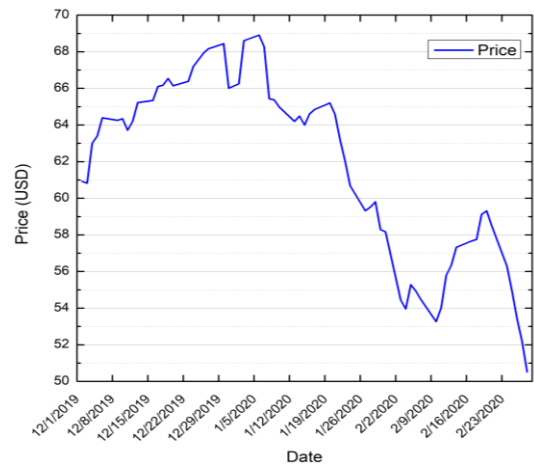


Fig. 3: Global initial-COVID impact on the price

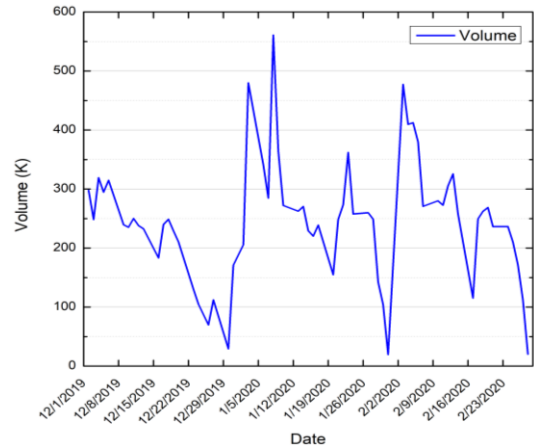


Fig. 4: Global initial-COVID impact on the volume

During the initial COVID period, the Kingdom of Saudi Arabia (KSA) flooded the oil market with low prices, and a lot of futures contracted, globally—due to which, the number of futures contracts increased during Jan-Feb 2020 (Albulescu, 2020a). The overall prices were declined due to the lower demand for oil in the international market. Significantly, 25 countries registered their first COVID case in Jan 2020, and 38 countries registered their first COVID case in Feb 2020. Due to the initial low COVID numbers, no high fluctuation is seen in the oil prices,

however, the prices dropped by 20% (Albulescu, 2020b; Ajami, 2020).

3.5.3. Local initial-COVID impact (Mar 2020–May 2020)

The KSA registered its very first COVID case on March 2, 2020. After mid of Mar 2020, the government started imposing the lockdowns and curfews at administrative levels with the suspension of all domestic and travel. During the initial wave of COVID in KSA, the cases were increasing, and the recovery rate was not satisfactory.

However, the oil prices were continuously declining due to the business and transportation closures as shown in Fig. 5. On the other hand, Fig. 6

shows the rise in the number of futures contracts as compared to the previous months. Due to the higher supply and less demand and consumption of oil, globally, the higher number of futures contracts caused a price decline in the international oil market. Notably, the lockdowns and curfews caused a rise in the recovery rate and containment of the daily new cases as shown in Fig. 7. Initially, the recovery rate was lesser than the daily new cases, however, at the end of the first COVID quarter, the recovery rate provided slight support to the price curve towards the end of the first COVID quarter in KSA. According to Fig. 8, the increasing deaths caused the downfall in the prices. Consequently, the initial COVID significantly impacted the international oil market.

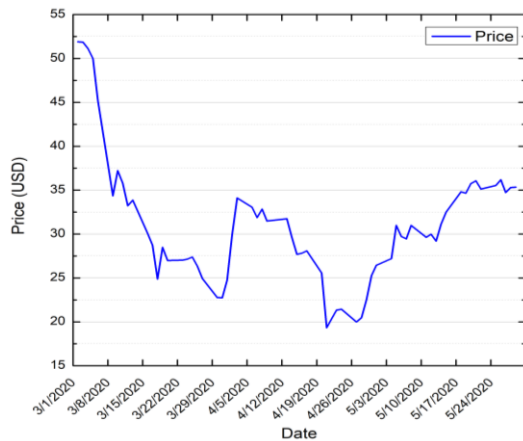


Fig. 5: Local initial-COVID impact on the price

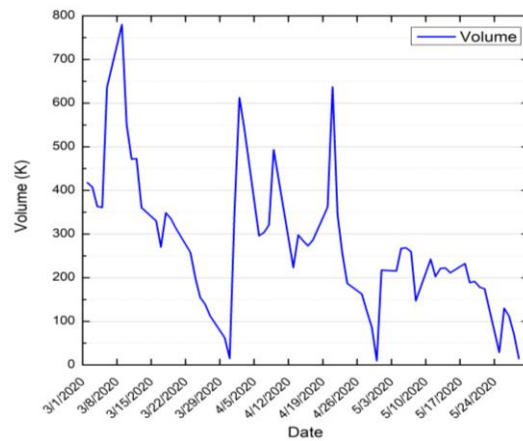


Fig. 6: Local initial-COVID impact on the volume

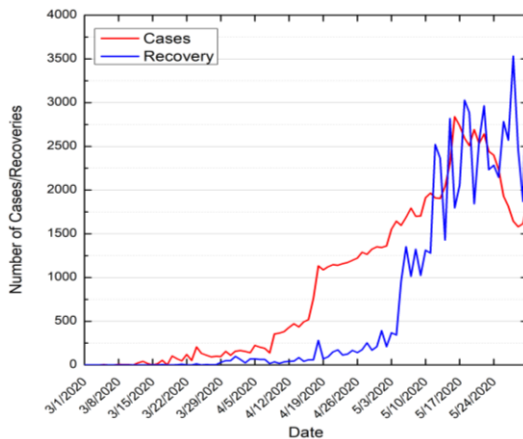


Fig. 7: Local initial-COVID cases vs. recovery

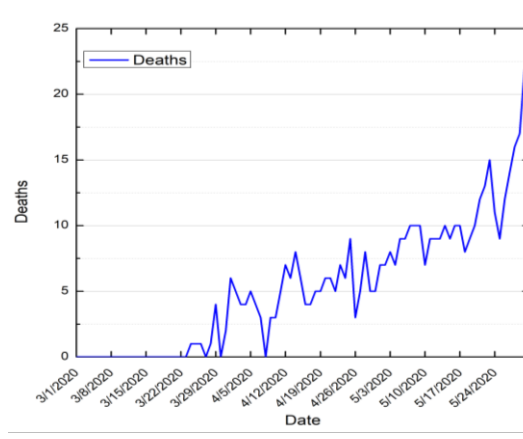


Fig. 8: Local initial-COVID death

3.5.4. Local COVID impact (Jun 2020–Aug 2020)

The initial quarter of the COVID-19 has a noteworthy impact on the international oil market with the price of oil as low as less than USD 20 per barrel during Apr 2020. During the second COVID quarter in KSA, the cases were still increasing, however, the recovery rate was slightly higher than the rate of daily new cases as shown in Fig. 11. That is why the oil price curve started to lift upwards from Jun to Aug 2020 as shown in Fig. 9. As per Fig. 8, the future volume contracts remained stable mostly ranging between 150 K to 250 K. The higher recovery rate caused this stability, however, during

the first COVID quarter, the contracts were increased due to the lower prices with a range of 400 K to 700 K.

After the end of July 2020, the daily new cases were continuously declining, and the recovery rate was increasing day by day. As compared to the first COVID quarter, the death rate was still increasing, however, after Jun 2020, the death rate started declining. The decrease in death and increase in the recovery rate also positively impacted the oil prices. Fig. 10 shows local COVID impact on volume and Fig. 12 shows local COVID deaths.

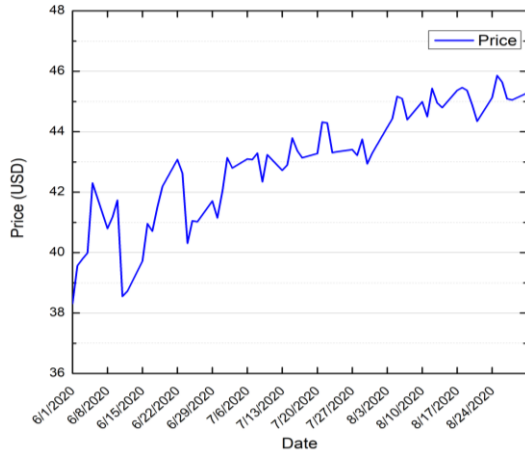


Fig. 9: Local COVID impact on the price

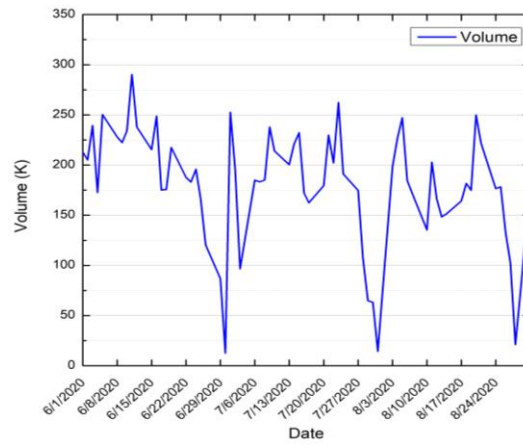


Fig. 10: Local COVID impact on the volume

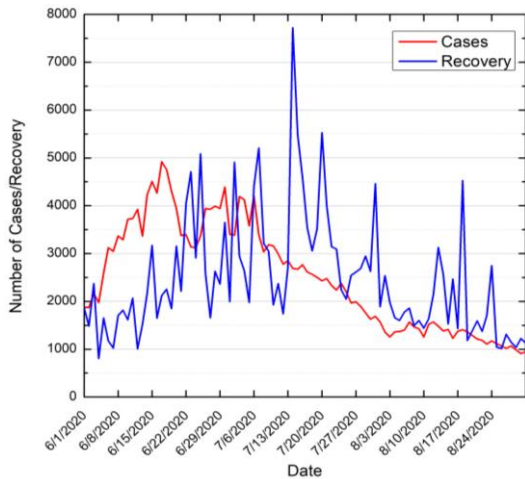


Fig. 11: Local COVID cases vs. recovery

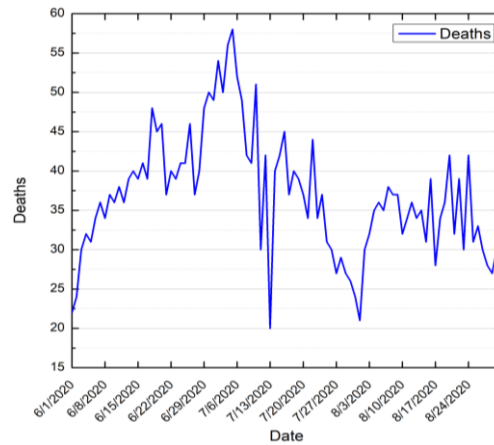


Fig. 12: Local COVID deaths

3.5.5. Correlational analysis

The surveillance variables including daily cases, deaths, and recovery are used for correlational analysis with the daily oil prices and daily volume of contracts. Table 2 shows the correlational matrix for the concerned variables.

Table 2: Correlational matrix for the concerned variables

	Cases	Deaths	Recovery
Price	0.372	0.683	0.523
Volume	-0.400	-0.406	-0.422

4. Conclusion

The analysis of oil prices is quite correlated with the COVID-19 surveillance variables mainly in terms of daily cases, and deaths. The analysis depicts that the international oil market is significantly impacted due to the pandemic. During the initial COVID phase in the KSA, the oil prices faced a negative impact and came to as low as USD 19 per barrel. However, when the recovery rate started getting better and decline in the death rate, the overall oil prices started getting stable with a positive impact. Using the COVID-Oil analysis, the higher authorities both in the economic and health sector can develop better policies during the global pandemic period. The correlation between daily oil prices and daily cases is statistically

significant but is a weak positive relation and it can be used for the prediction of oil prices. However, the correlation between volume and surveillance variables is negative. To better understand the COVID-19 impact over the globe, the same analysis can be extended and compared with the other countries which are major reservoirs of oil like the KSA.

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Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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