COVID-19-Related Mortality across the Gulf Cooperation Council Countries: Based on Countries' Available Data Up to November, 2020

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Authors' contributions

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ABSTRACT

Background: The world has endured a high burden of mortality and morbidity due to Covid-19 over the last year. There may be factors that account for differences in mortality rates. The Gulf Corporation Council (GCC) countries share similar cultural identities, socioeconomic conditions, population structure and display similar health-status composition of their population. There is a

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demand for data on the differentials of the COVID-19 pandemic across all countries. This statistical analysis primarily compared the crude mortality rates, and estimates the relative risk of COVID-19 death rates across the GCC countries using longitudinal study design.

Methods: This statistical analysis used downloaded data from Our World in Data, which was last updated on November 19, 2020. We computed COVID-19 crude mortality rates for the GCC countries individually. We estimated COVID-19 death rates for the GCC countries and compared them to the reference largest country Saudi Arabia. To adjust for most relevant confounding factors for COVID-19 deaths, a Poisson mixed effect regression model was fitted with COVID-19 new cases and the number test per case as fixed effect predictors of COVID-19 deaths.

Results: The estimated relative risk of COVID-19 deaths rates for UAE and Qatar was 0.352 (95% CI: 0.220-0.564, p-value <0.001) and 0.467 (95% CI: 0.287-0.762, p-value = 0.002), respectively, showing 64.8% and 53.3% fewer COVID-19 death rates compared to Saudi Arabia, individually. No statistically significant difference was found between Bahrain, Kuwait and Oman as compared with Saudi Arabia.

Conclusion: The UAE has the lowest COVID-19 death rate among any other GCC countries, followed by Qatar. In addition, the number of tests per case were negatively associated with the number of Covid-19 deaths. Besides, the number of new COCID-19 infections relative to the number of patients correlates with the number of patient deaths.

Keywords: COVID-19; crude mortality rates; COVID-19 mortality; relative risk; gulf cooperation council countries.

1. INTRODUCTION

The COVID-19 pandemic caused significant morbidity and mortality, around the world, making it a global and grave public health concern [1]. The burden created from the pandemic has generated an exceptional need for information. Each country, with its unique healthcare system, fights the pandemic with different mitigation strategies, leading to quite different reported death rates [2]. Differences in COVID-19 mortality rates between countries is an important proxy indicator of relative risk of death that might help to understand the severity of a disease, identify at-risk populations, evaluate the quality of healthcare and dedicate scarce medical resource allocations [3].

Mortality is a leading determinate of measuring the burden of COVID-19 amongst the most important ways to measure the burden of COVID-19 [4]. The crude mortality rate, which is the measure of the number of deaths in a given population divided by the size of that population, can be used to describe the number of deaths per 100,000 person - time period [5]. Mortality rates vary regionally, and the WHO estimates a global mortality of about 3% of confirmed cases [6]. Compared to other parts of the world, the total number of cases and the death rates of COVID-19 in the Gulf Corporation Council (GCC) nations are considered low [7], with deaths per million population ranging from the lowest of 0.61 in Bahrain, to the highest of 6.03 deaths per million in Oman [8].

There may be some confounding factors that account for differences in mortality rates such as differences in the number of people tested, varying population demographics and age structure, characteristics of the healthcare system and its readiness, economic support, government responses to the crisis and other less clearly identified confounding factors [9].

The GCC countries share similar political, cultural identities, socioeconomic conditions, population structure and relatively similar health-status composition of their population [10]. The healthcare sector has been a high-priority area for the governments of GCC. Additionally, the GCC countries have made considerable advances in their efforts to upgrade and align appropriate access to the healthcare system during the past decade through continuous investment in the healthcare sector [11]. Among other countries in the world, the GCC government responses and the effectiveness of the public health measures during the pandemic were tracked and reported [12]. However, no data is available on the different predictors of COVID-19 deaths and the differences between the expected and observed Covid-19 deaths (mortality ratios) within the GCC countries.

Accordingly, this study aimed to compare COVID-19 death rates between the GCC countries using longitudinal data and investigate the differentials of COVID-19 mortality risk across the GGC countries considering the existing similarities.

2. METHODS

2.1 Study Design

Coronavirus (COVID-19) pandemic data for the Gulf Cooperation Council (GCC) countries was downloaded from Our World in Data COVID-19 dataset, an online interactive dashboard, hosted by the Johns Hopkins University, USA, to track reported cases of coronavirus disease 2019 (COVID-19) in real time [13]. Data from March 21st. to the last updated November 13th, 2020 (makes 238 days) was included in the statistical analysis, retrospectively. Last observation carried forward was used to impute a missing value over time, whenever data were not available [14].

2.2 Statistical Analysis

COVID-19 Crude Morality Rates (CMRs) were calculated by dividing the number of observed total COVID-19 deaths at each day, divided by the population at risk and multiplied by 100,000). The CRDs were computed for each country over 238 days [15].

The coronavirus data were then aggregated by 14 days into 17-time periods to decrease data variance [16]. To adjust for most relevant confounding factors for COVID-19 deaths, a Poisson mixed effect regression model [17] was fitted with COVID-19 new cases and the number tests per case as fixed-effect predictors. Time period (17-time periods where 14 days data were aggregated into a single measurement) and country were used as random effects variables. The outcome was COVID-19 new cases. The population variable was added as an offset in the model. The predicted COVID-19 deaths were estimated as the model's fitted values.

Predicted COVID-19 deaths were computed from the fitted Poisson regression model and used as a random effect variable in a Poisson mixed effect model; with COVID-19 new deaths as an outcome and GCC country as fixed effect predictor with Saudi Arabia as a reference group. The populations variable was added as an offset in the model. The country Saudi Arabia was used as the reference group as has the largest population. Time-periods and predicted COVID-19 deaths were used as random effect variables. The Wald statistic and its corresponding p-value, as well as the relative risk (RR) with 95% confidence intervals (CI) were estimated and reported. All applied statistical tests were two-sided, p-value < 0.05 were considered statistically significant. Statistical analyses were performed in R version 4.0.2 [18,19].

3. RESULTS

Table 1 shows the median and interquartile range (IQR) for the number of tests per case over 17-time periods. The UAE has the highest number of tests per case with a median of 103.988 (IQR = 79.002), followed by Saudi Arabia with a median of 35.213 (IQR = 65.719). While the country Oman has the lowest number of tests per case with a median of 2.944 (IQR = 0.964).

The estimated COVID-19 CMRs over 238 days are shown in Fig. 1. One can see that the UAE had the highest crude mortality rates until May 16th, where Kuwait's COVID-19 CMR started to increase exponentially. The UAE's COVID-19 CMRs curve remains relatively flat and the UAE achieved the lowest COVID-19 CMR since June 29, 2020. The COVID-19 CMRs for Bahrain, Oman, and Qatar have exponentially risen since June 2020. However, COVID-19 CMRs for Qatar remains lower than the crude mortality rates for Bahrain, Kuwait, Oman, and Saudi Arabia since July 2020, but higher than the crude mortality rates for UAE. Moreover, Fig. 1. shows that Oman has the highest COVID-19 CMRs since August 2020.

Table 2 presents the results of the performed Poisson mixed effect model. The number of new COVID-19 cases was positively associated with COVID-19 deaths with a RR = 1.299 (95% CI: 1.211 - 1.393, z-value = 7.354 and p-value < 0.001). Furthermore, the number of tests per case was negatively associated with the number of the COVID-19 deaths with RR = 0.890 (95% CI: 0.834 - 0.949; z-value = -3.553 and p-value < 0.001). The median age was not statistically significant (p-vale = 0.206).

Fig. 2. shows that the estimated RRs for the UAE and Qatar were 0.352 (95% CI: 0.220 - 0.564, p-value < 0.001) and 0.467 (95% CI: 0.287 - 0.762, p-value = 0.002), respectively. These reveal 64.8% and 53.3% less estimated COVID-19 mortality rates, compared with Saudi Arabia (reference country).

Furthermore, there were higher COVID-19 death rates for Oman, Kuwait and Bahrain as compared with of the reference country (Saudi Arabia), with an estimated RR of 1.309 (95% CI: 0.818 - 2.095, p-value = 0.262), 1.185 (95% CI:

0.740 - 1.898, p-value = 0.479); and 1.126 (95% CI: 0.695 - 1.825, p-value = 0.629), respectively. However, these estimated differences in COVID-19 deaths rates were not statistically significant as all corresponding 95% CIs do include the value of 1 (dashed grey line in Fig. 2).

There was also total separation of the 95% CI of the estimated RR for UAE as compared with Bahrain, Kuwait and Oman - which suggests statistically significant differences between UAE and each of these countries, respectively.

Table 1. Estimated median values over 17-time periods (IQR) of the number of test per case variable and the median age for the GCC countries

	Statistic	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE
Test per case	Median (IQR)	24.553 (15.458)	5.531 (1.869)	2.944 (0.964)	12.683 (18.968)	35.213 (65.719)	103.988 (79.002)
Median Age (years)	32.4	33.7	30.7	31.9	31.9	34.0	32.4

Table 2. Results of the fitted Poisson regression model. Estimated RR wit 95% CI and corresponding Wald's test p-value for new cases and test per cases

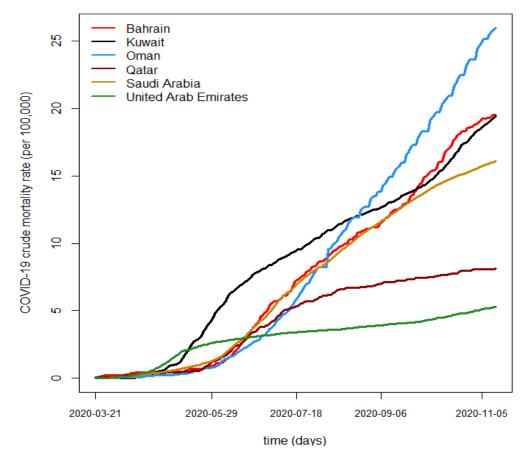|	RR (95% CI)	z-value	p-value
Median age	0.822 (0.606, 1.114)	-1.265	0.206
log(New cases)	1.299 (1.211, 1.393)	7.354	< 0.001
log(Tests per case)	0.890 (0.834, 0.949)	-3.553	< 0.001

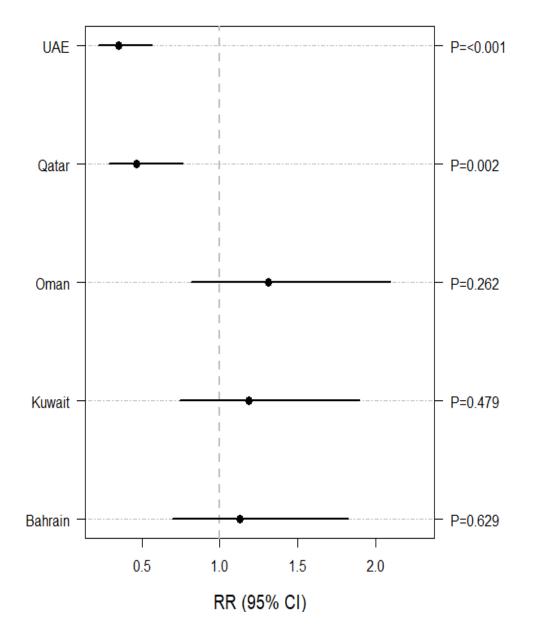**Fig. 1. COVID-19 crude mortality rates for the GCC countries**

Fig. 2. Estimated RR wit 95% CI and corresponding Wald's test p-value for Bahrain, Kuwait, Oman, Qatar and United Arab Emirates compared with the reference group Saudi Arabia (grey dashed line)

4. DISCUSSION

In this study, we compare COVID-19 mortality rates between the GCC countries using longitudinal data over 238 days. The UAE's crude mortality rates appear very modest compared to other GCC countries' COVID-19 mortality rates. However, one should be cautious when comparing the crude mortality rates, as they do not consider potential confounding factors - such as COVID-19 new cases and

number of tests per case. These are clearly not uniformly distributed amongst the GCC countries and can have different impacts on COVID-19 mortality rates. However, homogeneity between the GCC countries was assumed in terms of having similar healthcare systems, socio-demographics and display similar population structure.

To adjust for important confounding factors, we fitted a Poisson mixed effect model with new

COVID-19 cases and the number of tests per case as fixed effect predictors and country and time periods as random effect. Predicted COVID-19 deaths were computed and used as random effect variable in a Poisson mixed effect model, where the GCC countries variable was used as a single fixed effect predictor with Saudi Arabia as reference group. Random effect variables were time periods and COVID-19 predicted deaths. In addition, the estimated RR for UAE and Qatar shows 64.8% and 53.3% statistically significant less COVID-19 death rates compared with Saudi Arabia respectively. While COVID-19 death rates for Oman, Kuwait and Bahrain were higher than the COVID-19 death rate for Saudi Arabia, however, it was not statistically significant.

In this study, we show that through two statistical analysis methods that the UAE has the lowest COVID-19 mortality rates, followed by Qatar, among other GCC countries by means of the crude mortality rates and the relative risks. Therefore, our research findings could be of public health importance and should be used to enhance step up off the GCC countries' efforts to fight against COVID-19 pandemic.

The UAE and Bahrain were among the world's first countries with over a million population to test for more than half of their population [20]. Both countries lead the rest of the world in testing for COVID-19 as they are ranked the 5th and the 7th respectively, for testing per million of the population globally. Moreover, since the pandemic began Qatar ranks ninth on testing per population rankings globally [21]. This means that those GCC countries are having greater access to COVID-19 data per capita than many other parts of the world. October saw the announcement by the UAE that it had become the first country in the world where the number of COVID-19, tests exceeded the country's population [22]. Moreover, all residents in the UAE have access to free or subsidized testing, treatment facilities, and quarantine, which might have a role in lowering death rates within the country [21].

Generally, during the peak of the pandemic, all the gulf countries, like others, released a series of protective measures in order to control the spread of the COVID-19 pandemic. These included restrictions on travel, limiting religious activities that gathered individuals, launching mobile drive-through test centers, and dedicated hospitals for coronavirus patients alone [7]. All the above measures seem to have flattened the peak of the infection curve within the Gulf countries [23].

In this statistical analysis, we show that having more test per cases is negatively correlating with COVID-19 death rates. Though some other confounding factors can be attributed to the number of COVID-19 deaths. Possible confounding factors are social determinants, poverty, insurance rates, population, age, and density [24].

It should be mentioned that, studies to generate estimates applicable to the general population, representativeness is difficult to ensure, even for the most rigorous studies and despite adjustments made [25].

As the purpose of this statistical analysis was to investigate the death rates in the GCC countries, only six countries were included in the statistical analysis, which may be considered as a limitation of the analysis. Furthermore, as there were no accurate COVID-19 mortality data available for all countries by five-year age groups, the age standardized mortality rates could not be calculated.

5. CONCLUSION

The UAE has the lowest COVID-19 death rate among any other GCC countries, followed by Qatar. In addition, the number of tests per case were negatively associated with the number of Covid-19 deaths. On the contrary, the number of new infections relative to the number of patients correlates with the number of patient deaths.

Nevertheless, the results of this analysis would enhance public health measures and improve resource planning for both commissioners and health care providers in the GCC countries. While the results of this analysis are specific to the GCC populations, the methodology could be applied to other similar population groups to further assist countries in their fight against the ongoing pandemic. Further research is needed to assess the statistical analysis on adjusted death rates from COVID-19, on risk factors and confounders, and mortality associated with high-risk groups compared to non-high-risk groups.

AVAILABILITY OF DATA AND MATERIALS

This study used downloaded data from Our World in Data, which was last updated on November 19, 2020.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Ethical standards were adhered to throughout this study, and the study was defined as non-human subject research as it consists of secondary published data usage.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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