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Abstract

Background: To prevent the spread of coronavirus disease 2019 (COVID-19), the Saudi Arabian Government introduced a number of measures in different phases (e.g. social distancing, curfew and lockdown).

Aims: This study describes the incidence of COVID-19 in Saudi Arabia during different phases of prevention strategies and assesses their effects on controlling the spread of the disease.

Methods: This cross-sectional study used COVID-19 data for 2 March–5 July 2020 from the Ministry of Health website. The period was divided into five phases based on prevention strategies implemented to control the infection. The incidence, point prevalence, case fatality, overall mortality rate and recovery rates for COVID-19 infection were assessed at the national, regional and city levels.

Results: At the end of phase 5 on 5 July 2020, the nationwide incidence of COVID-19 was 11%, total recovery rate 70%, case fatality rate 0.9% and adjusted case fatality rate 1.4% (adjusted for time lag for mortality). The COVID-19 point prevalence increased from 2.1/100 000 population in phase 1 to 178.2/100 000 population in phase 5. A high recovery rate (68.7%) was observed in phase 4 accompanied with lower overall mortality and incidence in phase 5. The eastern region of Saudi Arabia had the highest point prevalence of COVID-19 infection (450.5 per 100 000 population), while Jeddah and Mecca had the highest overall mortality.

Conclusions: The health system of Saudi Arabia efficiently used lockdown and curfew periods to prepare for management of confirmed cases of COVID-19, reflected by the decreased incidence and mortality rates in phase 5.

Keywords: COVID-19, incidence, prevalence, government measures, Saudi Arabia

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Introduction

In December 2019, some cases of pneumonia-like illness were reported in Wuhan City, Hubei Province of China (1). On 10 January, it was confirmed that this illness was caused by a new coronavirus. Coronavirus disease 2019 (COVID-19) spread rapidly and was declared a pandemic by the World Health Organization (WHO) on 11 March 2020 (2). Thereafter, the global number of cases continued to rise exponentially, and reached almost 16 million confirmed cases and more than 6.4 million deaths worldwide by the end of July 2020 (3). The common symptoms associated with COVID-19 include fever, fatigue, cough, myalgia, anorexia, and sore throat (4,5). The incubation period of the virus is reported to be less than 14 days, but the symptoms become visible after 4–5 days from first exposure to the virus (4,6).

The first confirmed case of COVID-19 in Saudi Arabia was reported on two March 2020, 2 months after the emergence of the disease in China. The disease was reported in the country after a Saudi Arabian citizen returned from the Islamic Republic of Iran through Bahrain (7). Immediately after the confirmation of this case, the Government of Saudi Arabia initiated various prevention measures to control the spread of the disease (8). The first step was suspension of

the Umrah and tourism for the citizens and residents. At the same time, prevention strategies, including quarantine, isolation, physical distancing, wearing of facemasks, gloves and hand hygiene measures, were imposed throughout the country (8–10). Later on, schools were closed and international flights were suspended. All these steps were implemented in the first phase of the response, i.e. 2–24 March 2020 (8–10).

In Saudi Arabia, late afternoon and night-time gatherings are common so the government imposed a curfew from 15:00 to 06:00 to stop public gatherings and control the spread of the disease, fines were imposed on those not adhering to the prevention measures. This phase was for a short duration of eight days (25 March–1 April 2020). In the third phase, a complete lockdown was implemented in the main cities (2–24 April 2020) and fines were increased for non-adherence to prevention measures. In the fourth phase of the response (25 April–20 June 2020), the lockdown was replaced with a night-time curfew (20:00 to 06:00) and fines continued to be imposed for not observing the prevention strategies. On 21 June 2020, the curfew was lifted but the citizens had to follow certain basic prevention measures: physical distancing, wearing facemasks and adhering to hand hygiene. These precautionary measures are still required until date.

The development and rollout of COVID-19 vaccines has emerged as an effective control measure for now and the future through vaccination. According to the Ministry of Health, the first shipment of the COVID-19 vaccine arrived in Saudi Arabia on 16 December 2020. As of 21 February 2021, a total of 541 411 people had been vaccinated and none of the people vaccinated showed any signs of health challenges (11–13).

The aim of our study was to describe the key data on COVID-19 in Saudi Arabia during the different prevention phases and to assess the effect of the prevention strategies on controlling the spread of the disease during the first 18 weeks following the first case report in Saudi Arabia.

Methods

We carried out a cross-sectional study to evaluate the effect of prevention strategies implemented in Saudi Arabia to control the spread of COVID-19 from 2 March to 5 July 2020 (total 18 weeks). Data were collected from the dashboard of the Saudi Arabia Ministry of Health (https://covid19.moh.gov.sa/) (9). The sources of information for this site are the Ministry of Health, COVID-19 Command & Control Center and National Health Emergency Operation Center. The target population was suspected cases of COVID-19, for example, people with: a history of travel, contact with a person confirmed to have COVID-19, and contact with a person with fever and respiratory disease symptoms. Polymerase chain reaction (PCR) tests were

performed in COVID-19 certified laboratories by the Saudi Arabian Centre for Disease Control (9).

We used the following definitions in the study: (i) confirmed COVID-19 case meaning a suspected case with laboratory confirmation of COVID-19 infection; (ii) COVID-19 death meaning death resulting from a clinically compatible illness in a confirmed or suspected COVID-19 case unless a clear alternative cause of death is evident; (iii) recovered case, a) for symptomatic patients – 10 days after onset of symptoms plus at least three days without symptoms (fever and respiratory symptoms), or three days without symptoms and one negative PCR test and b) for asymptomatic patients – remaining asymptomatic for 10 days after testing positive; and (iv) Active case – [confirmed cases – total recovered cases – total deaths] (9).

For the purposes of the study, Saudi Arabia was divided into five regions: eastern, western, northern, southern, and central. Five main cities of Saudi Arabia were included in the analysis: Dammam (Capital of Eastern Province), Jeddah (with the busiest international airport in the country as the entry point for pilgrims), Mecca (Islam's holiest city, main Islamic pilgrimage site and main city of the western region), Medina (Islamic holy city, main Islamic pilgrimage site), and Riyadh (Capital of Saudi Arabia).

The period of 18 weeks was divided into five phases based on the prevention strategies implemented to control the infection (Table 1). We analysed the data by COVID-19 phase at the national and regional levels and for the main cities of Saudi Arabia.

The analytic measures were calculated using the following formulas:

(i) incidence rate = total new cases of COVID-19 in a given time period divided by total tests performed in the same period;

(ii) point prevalence on the last day of each phase = total active cases present on that day divided by the total population;

(iii) case fatality rate (CFR) = total mortality due to COVID-19 in a given period divided by total

confirmed cases;

(iv) adjusted CFR = cumulative mortality divided by the total active cases present on 20 days before the date of calculation;

(v) overall mortality rate = total mortality on the last day of the phase divided by the total population; and

(vi) recovered rate = total recovered cases divided by total active cases. We adjusted the CFR as we observed that the first COVID-19 death was reported 20 days after the first case in Saudi Arabia had been confirmed.

Results

COVID-19 data, 5 July 2020

A total of 1 934 391 COVID-19 tests (polymerase chain reaction tests) had been administered until 5 July 2020. Given that the current population of Saudi Arabia is estimated to be 34.85 million, this represents a testing rate of about 55 500 tests per million inhabitants. The incidence rate of COVID-19 on 5 July 2020 was 11%, CFR 0.9%, adjusted CFR 1.4% and recovery rate 70.0%. The point prevalence of COVID-19 on 5 July was 178.2/100 000 population and overall mortality rate was 5.7/100 000 population. The proportion of confirmed cases of COVID-19 to the population of Saudi Arabia was 612.3/100 000 population.

The point prevalence of COVID-19 on 5 July 2020 was highest in the eastern region (450.5/100 000 population) and lowest in the northern region (86.0/100 000 population) (Table 2). The overall mortality was highest in the western region (11.0/100 000 population) and lowest in the southern region (0.9/100 000 population). The CFR was highest in the western region (1.5%) and lowest in the eastern region (0.3%), while the adjusted CFR was highest in the northern region (11.1%) and lowest in the eastern region (1.7%) The highest recovery rate was in the western region (83.5%) and lowest in the southern region (50.0%) (Table 2).

The point prevalence of COVID-19 on 5 July 2020 was highest in Dammam (484.3/100 000 population) and lowest in Jeddah (70.4/100 000 population) (Table 2). The overall mortality was highest in Mecca (22.2/100 000 population) and lowest in Dammam (5.7/100 000 population). The CFR was highest in Jeddah (2.1%) and lowest in Dammam (0.5%), while the adjusted CFR

was highest in Mecca (9.5%) and lowest in Dammam (2.4%). The highest recovery rate was in Jeddah (87.3%) and lowest in Dammam (55.9%) (Table 2).

COVID data, phases 1–5

In Saudi Arabia overall, the incidence rate, mortality and recovered rate were highest in phase 4 (13.7%, 32.7/100 000 population and 68.7%, respectively) and thereafter they declined in phase 5. CFR and adjusted CFR were highest in phase 2 (1.6% and 35.5%) (Table 3, Figure 1 and Figure 3).

The COVID-19 point prevalence showed increasing trends in the eastern, northern and southern regions from phase 1 to phase 5. In western and central regions, the point prevalence increased until phase 4 and then declined (Table 3 and Figure 1). In phase 5, the CFR was lower in the eastern and southern regions than western, central and northern regions. The highest CFR in the western region was in phase 2 (3.0%), while in central and northern regions the highest CFR was in phase 5 (3.6% and 1.8%, respectively). The highest overall mortality was in the western region in phases 4 (7.8/100 000 population) (Table 3 and Figure 3) . The highest overall mortality in phase 5 was in the central region (3.3/100 000 population). All the regions in Saudi Arabia showed the highest recovery rate in phase 4. The northern and western regions had the highest recovery rate in phase 4 (79.1% and 76.3%, respectively) (Table 3 and Figure 1).

Dammam and Medina had an increasing trend in COVID-19 point prevalence from phase 1 to phase 5 (Table 3 and Figure 2). However, Dammam had a higher point prevalence (484.3/100 000 population) than Medina (130.1/100 000 population) in phase 5. In Jeddah, Mecca and Riyadh the point prevalence increased from phase 1 to phase 4 and then it declined. In phase 1, of the two patients with COVID-19 infection in Medina, one patient died, which was the first COVID-19 death reported in Saudi Arabia. The highest overall mortality was observed in most cities in phase 4 except Riyadh which had the highest overall mortality in phase 5 (4.2/100 000 population) (Table 3 and Figure 3) . The highest overall mortality in phase 4 was in Mecca (15.6/100 000 population).

Medina and Riyadh showed an increasing trend in recovery rate from phase 1 to phase 4 and then it declined in phase 5. In phase 4, the highest recovery rate was in Medina (84.6%) and lowest in Riyadh (56.2%). However, in phase 5, Dammam had the lowest recovery rate (22.4%)

while Mecca had the highest recovery rate (62.4%) (Table 3 and Figure 2).

Discussion

This is the first study describing the geographical distribution, prevalence, CFR, recovery rate and overall mortality rates of COVID-19 from Saudi Arabia. However, three previous studies have discussed COVID-19: one highlighted the demographic and clinical characteristics of COVID-19 cases in the different regions of Saudi Arabia (14); another examined Saudi Arabia's level of preparedness to manage COVID-19 (8); and the third described the status and management practices with regard to COVID-19 in the Gulf Cooperation Council countries (10).

On 5 July 2020, about 55 500 COVID-19 PCR tests had been performed per million inhabitants in Saudi Arabia. This was lower than Italy which reported 93 250 tests per million inhabitants by 5 July 2020 (15). However, in Eastern Mediterranean countries, Saudi Arabia had a high testing rate along with Bahrain, Djibouti, Qatar, and United Arab Emirates (16). In addition, 11% of the tests performed in Saudi Arabia were positive for COVID-19. In contrast, by 5 July, 2020 Italy reported a lower proportion (4%) of confirmed cases from the total tests conducted (15). By the end of phase 5 on 5 July, the proportion of the population in Saudi Arabia affected with COVID-19 was 612.3/100 000 population which was higher than other countries such as the United Kingdom of Great Britain and Northern Ireland (422/100 000 population), Italy (393.3/100 000 population), France (290.1/100 000 population) and Germany (230/100 000 population) (17). The higher number of confirmed cases in Saudi Arabia may be due to the presence of two holy mosques where millions of pilgrims from around the world visit throughout the year to perform religious pilgrimage.

Effect of prevention strategies

The restrictions on public gatherings through lockdown followed by a curfew and rigorously implemented precautionary measures resulted in containment of the infection in the country. This is evidenced by the decreased COVID-19 incidence rates in the phase 5.

Effect of prevention strategies regionally

The lockdown followed by the curfew was effective in controlling the spread of COVID-19 in western and central regions, which were greatly affected by the infection. The high infection rate may be attributable to the presence of the two holy mosques in the western region, given the fact that millions of pilgrims visit the region throughout the year to perform Umrah. The reduction in new cases and mortality in the western region in phase 5, which occurred after the lockdown of the holy cities (Mecca and Medina), as well as Jeddah (the entry point for most pilgrims to Saudi Arabia), demonstrates the effectiveness of the suspension of international flights in the first phase. The COVID-19 point prevalence decreased in phase 5, which suggests that

adhering to basic precautionary measures after lockdown and curfew helped control the spread of the disease as the communicable period of the infection was managed properly during phase 3 and phase 4. However, the northern and southern regions of Saudi Arabia had higher point prevalence rates in phase 5, which may be due to the late introduction of infection to these regions and as a result, the propagation period may have started during or after the curfew period. However, lockdown and curfew were not effective in containing the infection in the eastern region as it remained the most highly affected region of Saudi Arabia in phase 5.

Effect of prevention strategies in major cities

Out of the five main cities, three, in which curfew and lockdown measures were implemented, reported decreases in the number of new cases and mortality in phase 5. The only city in which lockdown followed by curfew did not lower the number of new cases was Dammam in the eastern region. This may be due to the presence of many industries in this region as employees travelled frequently for their work during phase 4 (curfew) of the intervention. This may have resulted in propagation of the disease. However, the political decision to unlock towns and cities should be based on a combination of scientific evidence of outbreak control and safeguard of political economic continuity (18).

Effect of prevention strategies on management of COVID-19 cases

The health care system of Saudi Arabia made efficient use of the lockdown and curfew periods to enhance capacity to provide the best patient care for confirmed cases of COVID-19. This is reflected by high recovery rate (68.7%) in phase 4 accompanied with lower overall mortality in phase 5.

Similar to our findings, a number of studies have reported an enhanced effectiveness of quarantine, isolation, contact tracing, and travel bans when implemented along with lockdown to control COVID-19 (19–23). Other studies have reported that the addition of physical distancing with quarantine and isolation leads to a reduction in deaths and effectively reduces the ability of the infection to spread by half. Therefore, physical distancing can lead to remarkable reduction in incidence rate and epidemic period, and can enhance the effectiveness of prevention strategies to control the spread of COVID-19 (24,25).

To measure the effectiveness of national health systems, it is important to examine the recovery rate, as well as the CFR. In our study, the recovery rate was 70%, which was higher than the global recovery rate (65%) as of 5 July 2020 (26). Similarly, the CFR was 0.9%, which was lower than the global mortality rate (4.9%) on 5 July 2020 (26). In Italy, 45 days after COVID-19 infection was first detected in the country, 1809 deaths had been recorded, while in Saudi Arabia there were 1968 deaths 120–126 days after COVID-19 infection was first detected in the

country (18th week). However, the deaths in Saudi Arabia was 65 by 35-42, which was lower than Italy (15). The CFR in Saudi Arabia in the 5th week (2–35 days) was 1.1%, which was lower than other countries – Italy (12.6% on the 68th day) and China (4.03% on the 77th day) (15). Similar to the Saudi Arabia, Hungary identified the first case in the first week of March when an Iranian student returned from Tehran on 4 March 2020 (25). By 10 May 2020 (after 67 days), the cumulative number of confirmed COVID-19 cases was 3284 (33.1/100 000 population), and there were 421 deaths (crude CFR 12.8%). In the 10th week in Saudi Arabia, 6836 new cases (117.7/100 000 population) were reported with 255 deaths (CFR 0.6%) (27). The lower mortality rate in Saudi Arabia than Hungary may be due to the early detection of COVID-19 cases and proper medical management of confirmed cases.

Our study has some limitations. The sources of data used for key events were from sites other than the Ministry of Health website, which may have led to a slight discrepancy in the duration of each phase of intervention. The recovery rates and CFRs were calculated using the data available on the website of the Ministry of Health of Saudi Arabia, but as the disease was so widespread, it is possible that some cases may not have been reported to the authorities; therefore these numbers may not reflect the true values for Saudi Arabia . Finally, we used only confirmed cases of COVID-19 reported by the Ministry of Health for calculating the mortality rate, some deaths occurred in people who had not been tested for COVID-19.

Conclusion

Our study shows that the eastern region of Saudi Arabia was most affected by COVID-19 infection. The spread of COVID-19 was higher in Saudi Arabia than other developed countries. Our study indicates that curfews and lockdowns are effective in preventing the spread of infectious diseases. The incidence rate, recovery rate and CFRs are essential elements to monitor during an outbreak response as they can provide an accurate picture of infection situation in the country. This analysis of COVID-19 and the effect of preventive measures on its spread will help inform planning of preventive strategies in the future.

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Cas et décès liés à la COVID-19 après la mise en œuvre de stratégies de prévention en Arabie saoudite

Résumé

WHO EMRO | COVID-19 cases and deaths after implementation of prevention strategies, Saudi Arabia

Contexte : Pour empêcher la propagation de la maladie à coronavirus 2019 (COVID-19), le gouvernement saoudien a mis en place un certain nombre de mesures en plusieurs phases (par exemple, la distanciation sociale, le couvre-feu et le confinement).

Objectifs : L'étude décrit l'incidence des cas de COVID-19 en Arabie saoudite au cours des différentes phases des stratégies de prévention et évalue leur effet sur la maîtrise de la propagation de la maladie.

Méthodes : La présente étude transversale a été réalisée à partir des données sur la COVID-19 recueillies du 2 mars au 5 juillet 2020 sur le site Web du ministère de la Santé. La période a été divisée en cinq phases en fonction des stratégies de prévention mises en œuvre pour lutter contre l'infection. Le taux d'incidence, la prévalence ponctuelle, le taux de létalité, le taux global de mortalité et le taux de guérison de l'infection par la COVID-19 ont été évalués aux niveaux national, régional et municipal.

Résultats : À la fin de la phase 5, le 5 juillet 2020, l'incidence nationale de la COVID-19 était de 11 %, le taux de guérison total de 70 %, le taux de létalité de 0,9 % et le taux de létalité ajusté de 1,4 % (ajusté en fonction du décalage temporel par rapport à la mortalité). La prévalence ponctuelle de la COVID-19 a augmenté entre la phase 1 (2,1/100 000 habitants) et la phase 5 (178,2/100 000 habitants). Un taux de guérison élevé (68,7 %) a été observé en phase 4, avec une mortalité globale et une incidence plus faibles en phase 5. C'est dans la région orientale de l'Arabie saoudite que la prévalence ponctuelle de la COVID-19 était la plus élevée (450,5 cas pour 100 000 habitants), tandis que Djeddah et La Mecque affichaient la mortalité globale la plus forte.

Conclusions : Le système de santé saoudien a mis à profit de manière efficace les périodes de confinement et de couvre-feu pour se préparer à la prise en charge des cas confirmés de COVID-19, comme en témoigne la diminution des taux d'incidence et de mortalité lors de la phase 5.

حالات الإصابة والوفيات الناجمة عن مرض كوفيد **-19** بعد تنفيذ استراتيجيات الوقاية، المملكة العربية السعودية

نرجس جوفيد، محمد الزبير، صبا أمين، بسمة بوقس، محمد المحيذيف

الخلاصة

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