Original Article

Clinical characteristics of COVID-19 in Saudi Arabia: A national retrospective study

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ABSTRACT

Background: The global battle to contain the novel coronavirus disease 2019 (COVID-19) pandemic rages on. Previous studies described the clinical characteristics of COVID-19, but knowledge gaps remain in the Middle East region. Identifying these features will help in mapping the disease and guiding pandemic management. A multi-center, retrospective cross-sectional study was initiated to describe the demographic data, clinical characteristics, and outcomes of COVID-19 cases across all the regions of Saudi Arabia.

Methods: The analysis included all laboratory-confirmed positive COVID-19 patients from the 1st of March 2020 to 31st of March 2020 across all regions of Saudi Arabia. Demographic data, clinical characteristics, incubation periods, laboratory findings, and patient outcomes data were retrieved from 1519 cases in the Health Electronic Surveillance Network Database.

Results: The median age was 36 years and 54.3% (n = 825) of the patients were men. Patients working in health care facilities represented 12.5% of the cases (n = 190) and 9.3% of cases were asymptomatic. The median incubation period was 6 days. The most common symptoms were cough (89.4%), fever (85.6%), and sore throat (81.6%); 20.1% of the patients had underlying comorbidities. Hypertension was seen in 8.8% and diabetes in 7.6% of all the cases. The percentage of cases with temperatures >38 °C was 20.3% (n = 129), and 1.6% of patients had heart rates >125 beats/min and 4.7% of them had respiratory rates >24 breaths/min. Lymphocytopenia occurred in 37.5% of cases. Overall, 71.6% of patients were admitted to hospitals and 4.7% required ICU treatment. We could not completely assess the clinical courses or final outcomes of COVID-19 patients.

Conclusion: In this multi-center retrospective study, fever and cough were common symptoms. Special attention should be addressed toward asymptomatic carriers and workers in health care facilities as they play a key role in disease transmission.

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Introduction

An emerging novel coronavirus first reported in 2019 in Wuhan, China caused a rapid spread of the coronavirus disease known as (COVID-19) and was soon after declared a pandemic [1]. On the 2nd of March, a Saudi citizen coming from Iran through Bahrain tested positive for COVID-19 and was immediately isolated and reported by the Ministry of Health as the first case in the Kingdom of Saudi Arabia [2]. Although the virus originates from the same coronavirus family as the Middle East Respiratory Syndrome (MERS-COV) and Severe Acute Respiratory Syndrome (SARS-COV), its virologic course and pathogenesis are not fully understood. Known for their animal-to-human transmission of viruses, bats are potential reservoirs of the COVID-19 virus with higher rates of infectivity [3,4].

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Case definition and clinical judgment are two key factors to determine if a patient’s signs and symptoms are compatible with COVID-19 and therefore if the patient should be isolated or tested. The reported initial manifestation included fever, fatigue, cough, myalgia anorexia, and sore throat [5,6]. The incubation period is thought to be within 14 days, but most cases reported symptoms four to five days after exposure [5,7].

The severity of the disease seems variable due to distinct demographic features, comorbidities, and immune system responses among different populations. Pneumonia might be the most frequent manifestation that can progress to Acute Respiratory Distress Syndrome (ARDS) [8]. Other serious complications have been reported, including arrhythmias, septic shock, and multi-organ failure [9,10].

The reported white blood cell count varies as leukopenia, leukocytosis, and lymphopenia, which can predict the outcomes of COVID-19 patients [11–13]. There is no conclusive clinical evidence that prior exposure to similar strains of the virus will lead to cross-immunity [14]. In the Middle East, a few studies revealed that antibodies against MERS-CoV were detected in a significant fraction of asymptomatic individuals exposed to camels and dromedaries. This population’s semi-immunity might explain the geographical discrepancies in the reported severity of COVID-19 [15,16].

Understanding the clinical characteristics of COVID-19 helps in mapping the disease, identifying high-risk patients, and guiding future management. In this study, we describe the demographic data, clinical characteristics, co-morbidities, incubation periods, and outcomes of COVID-19-positive patients in Saudi Arabia and explore the deviations from other countries’ presentations.

Materials and methods

We conducted a multi-center, retrospective cross-sectional study among all patients presenting to health care facilities who were positive for COVID-19 between the 1st of March, 2020 and the 31st of March, 2020 across all regions of Saudi Arabia. All patients were included in this study and there were no exclusion criteria.

Data were extracted from the Health Electronic Surveillance Network (HESN) Database. This system contains demographic, clinical, laboratory, and raw outcome data of COVID-19-positive patients from all regions of Saudi Arabia.

Demographic, clinical, laboratory, and outcome data of COVID-19-positive patients were obtained. Fever was defined as an oral temperature of 38°C or higher [17]. Lymphocytopenia was defined as a lymphocyte count of less than 1,500 per cubic millimeter. Thrombocytopenia was defined as a platelet count of less than 150,000 per cubic millimeter [5]. COVID-19 was diagnosed based on the results of quantitative RT-PCR testing, done at the National Health Laboratory, of nasopharyngeal samples in accordance with the protocol established by the World Health Organization [18].

Data were independently entered into electronic sheets by two data collectors and any discrepancies were resolved by the investigator based on the verification report on the records.

All measures were taken to preserve the integrity and privacy of data. All subjects were assigned a study identification number. The electronic database was secured with passwords and access was limited to selected investigators after those investigators signed confidentiality agreement forms. This study was approved by the Central Ministry of Health Institutional Review Board Committee (Approval number 20–75M).

The Statistical Package for Social Sciences program, version 24 (SPSS-24), was used for data analysis. Descriptive statistics were used to describe the baseline demographic data and clinical characteristics. Categorical variables are presented as counts and percentages, whereas continuous variables are presented as means and standard deviations when data were normal or as medians (MDs) and interquartile ranges (IQRs) otherwise. The t-test was used for continuous variables and chi-squared test was used for categorical variables. A p-value of <0.05 was considered statistically significant. We used CDC Epi InfoTM Version 7.2.3.1 to plot the distribution of COVID-19 cases across Saudi Arabia.

Results

During the period from the 1st to the 31st of March 2020, 65,000 patients were screened for COVID-19 based on their concerning clinical symptoms, exposure to positive cases, or recent travel history. We extracted data from 1519 positive cases across all regions in Saudi Arabia (Fig. 1).

Regarding demographics, the MD age for all patients (n = 1519) was 36 years and the age distribution was as follows: 4.8% (n = 74) were age 14 and less, 12.2% (n = 186) between 15–25, 30.5% (n = 464) between 26–35, 19.4% (n = 295) between 36–45, 15.9% (n = 241) between 46–55, 11.1% (n = 169) between 56–65, and 5.9% (n = 90) were 66 and above. The cases were close in their sex ratio; males constituted 54.3% (n = 825) and females 45.7% (n = 694) of the cases. The dominant nationality among the cases was Saudi (n = 811, 53.4%). The distribution of COVID-19 cases across Saudi Arabia is shown in Fig. 2.

Comorbidities were reported among 1,095 cases, and 20.1% (n = 220) of those cases reported one or more comorbidity. Diabetes mellitus (DM) occurred in 7.6% and hypertension (HTN) in 8.8% of the cases. Asthma was present in 4.9% and chronic lung disease in 5.2% of the cases. Chronic kidney disease (CKD) occurred in 1.2% and cardiac diseases in 2.3% of the cases. Cancer and immunodeficiency occurred in 1.1% of the cases.

Regarding the cases’ occupations, 12.5% (n = 190) worked in healthcare facilities, 2.0% (n = 31) worked in the military, and the remaining 85.5% (n = 1,298) worked in other jobs. Of the 1,095 cases, 159 (14.5%) said they were smokers.

Admission to ward or intensive care units (ICUs) was explored with 767 cases; 66.9% (n = 513) were admitted to ward and 4.7% (n = 36) to the ICU, yielding a total hospitalization rate of 71.6%. Concerning outcomes measured during the study period, out of 1,519 cases, only 10 (0.65%) deaths were reported (Table 1).

Patients were classified as being symptomatic or asymptomatic based on their reporting of their clinical symptoms; around 9.3% (n = 142) were categorized as asymptomatic. The MD and IQR values of age for both the symptomatic and asymptomatic groups were close: 37 years (IQR 22) and 36 years (IQR 22), respectively. The gender distributions were also similar in the two groups: males were 54.2% and 54.9% of the symptomatic and asymptomatic groups, respectively.

The occupation was significantly different between the groups (p value = 0.000), which mainly reflected the difference in the percentages of workers in health care facilities between the symptomatic and asymptomatic groups, i.e., 11.4% and 23.2%, respectively (Table 2).

Symptom, sign incubation period, and laboratory finding data were collected for COVID-19-positive cases. The most common symptoms were cough in 89.4% of cases (429 out of 480), fever in 85.6% (333 out of 389), sore throat in 81.6% (257 out of 315), and runny nose in 72% (139 out of 193). Less common symptoms were myalgia (202 out of 707, 28.6%), headache (193 out of 707, 27.3%), and gastrointestinal (GI) symptoms (101 out of 707, 14.3%) (Fig. 3).

The vital signs that were recorded were temperature 38°C (n = 637) with a MD (IQR) of 37°C (0.95). The percentage of cases with temperatures higher than 38°C was 20.3% (n = 129). The MD (IQR) heart rate (n = 257) was 86 beats/min (10.8) and 1.6% (n = 4) of cases had heart rates equal to or higher than 125 beats/min.
The MD respiratory Rate (n = 236) was 20 breaths/min with an IQR of 2.3 and 4.7% (n = 11) of cases had respiratory rates higher than 24 breaths/min. The MD (IQR) of Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) were 120 mmHg (20) and 72.5 mmHg (12), respectively, and only 1.2% (n = 3) of the cases had SBP values below 90 mmHg. The MD (IQR) oxygen saturation (n = 618) was 98% (3) with 11.7% (n = 72) of cases showing values below 94%. Three hundred and nine cases provided dates for exposure and onset of symptoms. The incubation period of COVID-19 had a total MD of 6 days and IQR of 7.5 days, but this differed across age groups, with higher scores in the elderly (MD 7 days and IQR 9.5) between 56–65 years and those above 65 years of age (MD 13 days and IQR 16.3). The incubation period showed similar occurrences across regions with a MD that ranged between five and seven days.

Laboratory testing was retrieved for some cases. WBC per mm$^3$ (n = 85) had a MD (IQR) value of 6,000 (2300) with 85.9% (n = 73) of the cases showing normal counts between 4,000 and 12,000, 10.6% (n = 9) below 4,000, and 3.5% (n = 3) above 12,000. Neutrophil % (n = 75) had a MD (IQR) value of 60.2 (32.7) and 41.3% (n = 31) of the cases had values of less than 55%, 33.3% (n = 25) between 55 and 70%, and 25.3% (n = 19) of greater than 70%. Lymphocyte % (n = 64) had a MD (IQR) value of 24.5 (15.9) and 37.5% (n = 24) of the cases had values less than 20%, 50% (n = 32) between 20 and 40%, and 12.5% (n = 8) greater than 40%. Finally, the platelet counts per mm$^3$ (n = 86) had a MD (IQR) value of 225,500 (890,000) and 6.9% (n = 6) of the cases had values less than 150,000, 88.4% (n = 76) between 150,000 and 400,000, and 4.7% (n = 4) greater than 400,000 (Table 3).

**Discussion**

To our knowledge, this is the first multi-center study to describe the demographic data and clinical characteristics of COVID-19 patients in the Middle East. We retrieved all the laboratory-confirmed COVID-19 cases from all regions of Saudi Arabia, ranging from asymptomatic cases in quarantines to critical patients in ICUs.

The median age group was 36 years, compared to the international average age of 47–62 years [5,19,20]. This might be attributed to differences in the inclusion criteria and the population age groups. Nevertheless, all the age groups might have been infected,
Table 1
Demographic variables and clinical characteristics of COVID-19 cases in Saudi Arabia.

| Characteristic                        | Count | Percent |
|---------------------------------------|-------|---------|
| Age in years                          |       |         |
| <14                                   | 1519  | 100     |
| 15–25                                 | 74    | 4.8     |
| 26–35                                 | 186   | 12.2    |
| 36–45                                 | 464   | 30.5    |
| 46–55                                 | 295   | 19.4    |
| 56–65                                 | 241   | 15.9    |
| ≥66                                   | 169   | 11.1    |
| Gender                                |       |         |
| Male                                  | 1519  | 100     |
| Female                                | 825   | 54.3    |
| Nationality                           | 694   | 45.7    |
| Saudi                                 | 811   | 53.4    |
| Non-Saudi                             | 708   | 46.6    |
| Region                                | 1519  | 100     |
| Riyadh                                | 568   | 37.4    |
| Makkah                                | 296   | 19.5    |
| Eastern Region                        | 252   | 16.6    |
| Jeddah                                | 213   | 14.0    |
| Madinah                               | 77    | 5.1     |
| Asir                                  | 23    | 1.5     |
| Taif                                  | 21    | 1.4     |
| Najran                                | 17    | 1.1     |
| Bahah                                 | 16    | 1.1     |
| Bisha                                 | 12    | 0.8     |
| Jazan                                 | 11    | 0.7     |
| Qassim                                | 5     | 0.3     |
| Tabouk                                | 5     | 0.3     |
| Northern Region                       | 2     | 0.1     |
| Hafar Al Batin                        | 1     | 0.1     |
| Comorbidities                         | 1095  | 100     |
| Reported comorbiditiesa               | 220   | 20.1    |
| DM                                    | 83    | 7.6     |
| HTN                                   | 97    | 8.8     |
| Asthma                                | 54    | 4.9     |
| Chronic lung diseaseb                 | 57    | 5.2     |
| CKD                                   | 13    | 1.2     |
| Cardiac disease                       | 25    | 2.3     |
| Cancer / Immunodeficiency             | 12    | 1.1     |
| Occupation                            |       |         |
| Working in health care facilitiesd    | 190   | 12.5    |
| Military                              | 31    | 2.0     |
| Others                                | 1298  | 85.5    |
| Workers in health care facilities     | 190   | 100     |
| Nurse                                 | 36    | 18.9    |
| Physician                             | 25    | 13.2    |
| Medical waste cleaner                 | 5     | 2.6     |
| Pharmacist                            | 4     | 2.1     |
| Others                                | 120   | 63.2    |
| Smoking status                        | 1095  | 100     |
| Yes                                   | 159   | 14.5    |
| No                                    | 936   | 85.5    |
| History of recent travel outside KSA  | 357   | 100     |
| Yes                                   | 162   | 45.4    |
| Destinations of outside travel        |       |         |
| Iraq                                  | 154   | 100     |
| United Kingdom                        | 30    | 19.5    |
| Egypt                                 | 28    | 18.2    |
| India                                 | 13    | 8.4     |
| Iran                                  | 9     | 5.8     |
| Other Countries                       | 66    | 42.9    |
| Clinical outcomes                     | 767   | 100     |
| Ward                                  | 513   | 66.9    |
| ICU                                   | 36    | 4.7     |
| Others                               | 218   | 28.4    |
| Death                                 | 10    | 0.65    |

a Reported one or more comorbidity.
b Includes chronic lung diseases other than asthma: COPD, interstitial lung disease, bronchiectasis, lung cancer, and others.
c Involves physicians, nurses, pharmacists, lab technicians, cleaners, and other workers in health care facilities.
d Includes patients who recovered and were discharged, or in quarantines.

Table 2
Demographic variables of COVID-19 cases in Saudi Arabia according to presence of clinical symptoms.

| Characteristic                        | Symptomatic N = 1377 (90.7%) | Asymptomatic N = 142 (9.3%) | P-value |
|---------------------------------------|-------------------------------|----------------------------|---------|
| Age in years (Median, IQR)            | 37.0 (22)                     | 36.0 (22)                  | 0.874   |
| Age categories                        |                               |                            |         |
| <14                                   | 65 (4.7%)                     | 9 (6.3%)                   | 0.968   |
| 15–25                                 | 171 (12.4%)                   | 15 (10.6%)                 |         |
| 26–35                                 | 419 (30.4%)                   | 45 (31.7%)                 |         |
| 36–45                                 | 269 (19.5%)                   | 26 (18.3%)                 |         |
| 46–55                                 | 219 (15.9%)                   | 22 (15.5%)                 |         |
| 56–65                                 | 152 (11.0%)                   | 17 (12.0%)                 |         |
| ≥66                                   | 82 (6.0%)                     | 8 (5.6%)                   |         |
| Gender                                |                               |                            |         |
| Male                                  | 747 (54.2%)                   | 78 (54.9%)                 | 0.877   |
| Female                                | 630 (45.8%)                   | 64 (45.1%)                 |         |
| Occupation                            |                               |                            |         |
| Working in healthcare facilities      | 157 (11.4%)                   | 33 (23.2%)                 | <0.05a  |
| Military                              | 29 (2.1%)                     | 2 (1.4%)                   |         |
| Others                                | 1191 (86.5%)                  | 107 (73.5%)                |         |

a Significant result at α = 0.05.

including those younger than 14 and older than 65. Males were affected slightly more often than females (males were 54.3% of the cases), in accordance with previous studies [5,19,20]. The estimated median incubation period was 6 days, which is not far from the initial reported incubation periods of this pandemic. Furthermore, 71.6% of our patients were admitted and 4.7% received ICU care, which was close to the international estimate percentages [5].

Consistent with previous reports [19,21], the two most common symptoms in our patients were cough (89.4%) and fever (85%); however, GI symptoms were uncommon [22]. High temperatures were only seen in 20.3% of cases as objective readings were taken initial when visiting health care facilities. This could be explained by the early presentation or wide range of inclusion criteria. Our study did not report any other major vital sign abnormalities that matched those of a recent retrospective study from Wuhan, China [20]. Furthermore, 37.5% of our patients showed lymphopenia, similar to a recently-reported story [13].

Of note, asymptomatic patients are at high risk for disease transmission. Unlike the outbreak on the Diamond Princess Cruise, where half of the patients were asymptomatic [23], only 9.3% of our cases had no symptoms, mainly in the 26–35 age group. This could be attributed to cultural differences in clinical practice as swabs are mainly taken, in some centers, from asymptomatic patients, regardless of their epidemiological links in the early phases of the pandemic. Moreover, comorbidities were reported in 20.1% of patients with hypertension 8.8% and DM 7.6%, matching the rates reported by a study from Nanjing, China [24].

We noticed a clear burden of COVID-19 infection on people working in healthcare facilities. Along with a recent report [25], we share the importance of early screening for those workers to prevent disease transmission and avoid unnecessary staff deple-
tion. This was evident in 29% of patients in a single retrospective study in Wuhan, China [11]. In our study, workers in health care facilities represented 12.5% of all patients, and 17.3% of them were asymptomatic.

At this early stage, it is unclear whether the source of the infection was community-acquired or related to hospital outbreaks. Our findings suggested that initial vital signs and laboratory investigations are not reliable screening tools for COVID-19.
Table 3
Symptoms, vital signs, incubation period, and laboratory results.

| Characteristic                        | Count | Statistic |
|--------------------------------------|-------|-----------|
| Symptoms                             |       |           |
| Fever (N = 389)                      | 333   | 85.6%     |
| Cough (N = 480)                      | 429   | 89.4%     |
| Sore throat (N = 315)                | 257   | 81.6%     |
| Runny nose (N = 193)                 | 139   | 72.0%     |
| Headache (N = 707)                   | 193   | 27.3%     |
| GI symptoms (N = 707)                | 101   | 14.3%     |
| Myalgia (N = 707)                    | 202   | 28.6%     |
| Vital Signs                          |       |           |
| Temperatures (median, IQR) - °C      | 637   | 37°(0.95) |
| Cases >38%                           | 129   | 20.3%     |
| Heart rate (median, IQR) - beats/min| 257   | 86(10.8)  |
| Cases >125%                          | 4     | 1.6%      |
| Respiratory rate (median, IQR)       | 236   | 20(2.3)   |
| Cases >24%                           | 11    | 4.7%      |
| SBP (median, IQR) - mmHg              | 253   | 120(20.0) |
| Cases SBP <90                        | 3     | 1.2%      |
| DBP                                  | 253   | 72.5(12.0)|
| Oxygen SAT (median, IQR) %           | 618   | 98(3.0)   |
| Cases with SAT <94%                  | 72    | 11.7%     |
| Incubation period (median, IQR) - days| 309  | 6(7.5)    |
| Median (IQR)                         | N = 309 |          |
| Lab tests                            |       |           |
| WBC (median, IQR) - per mm³          | 85    | 6000(2300) |
| <4000                                | 9     | 10.6%     |
| 4000–12000                           | 73    | 85.9%     |
| >12000                               | 3     | 3.5%      |
| Neutrophils (median, IQR) - %        | 75    | 60(32.7)  |
| <55%                                 | 31    | 41.3%     |
| 55–70%                               | 25    | 33.3%     |
| >70%                                 | 19    | 25.3%     |
| Lymphocytes (median, IQR) - %        | 64    | 245(15.9) |
| <20%                                 | 24    | 37.5%     |
| 20–40%                               | 32    | 50.0%     |
| >40%                                 | 8     | 12.5%     |
| Platelet count (median, IQR) - pm³   | 86    | 225,500(890,000) |
| <150,000                             | 6     | 6.9%      |
| 150,000–400,000                      | 76    | 88.4%     |
| >400,000                             | 4     | 4.7%      |

* Involves abdominal pain, vomiting, or diarrhea.

patients. On the other hand, improving the clinical assessment of symptoms is of utmost importance. Along with the young asymptomatic patients, workers in health care facilities with no symptoms remain a threat for disease transmission. Immediate actions should be taken by local and international health organizations as these facilities are considered high-risk areas and compliance with standard precautions should be effective at all times. Maintaining a high index of suspicion, applying strict infection control protocols and active surveillance measures, and attending mandatory educational courses for all workers are essential strategies to combat COVID-19[3].

Further studies of COVID-19 in the region are advised to focus elaborately on severity predicators, thorough laboratory findings, distinctive radiological features, and related risk factors for deterioration.

This study collected data from different regions in Saudi Arabia, but it was not without any limitations. First, the study design was retrospective and cross-sectional. Hence, clinical courses and outcomes could not be fully assessed. Although we reported mortality in less than 1% of the cases, this does not reflect the final outcomes of the entire study population. Second, incomplete data regarding symptoms and certain laboratory findings could change the narrative. Third, not all patients reported accurate dates of their source exposure or symptoms onset, and thus affected the incubation period results and exposed our study to recall bias. Fourth, previous studies reported that patients with COVID-19 could manifest with different imaging abnormalities [21,26]; unfortunately, we were unable to access any radiological findings in this study.

Conclusion

After the first month of COVID-19 infections in Saudi Arabia, it continues to spread. Fever and cough were common clinical symptoms, but not many COVID-19 patients developed vital sign abnormalities. Special attention should be addressed to asymptomatic carriers and workers in health care facilities as they play a key role in disease transmission.

Conflict of interests

None declared.

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