Clinical characteristics and in-hospital mortality of COVID-19 adult patients in Saudi Arabia

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ABSTRACT

الأهداف: تقديم دراسة مفصلة عن ديموغرافية مرضى (COVID-19)، والأمراض المصاحبة لهم، والخصائص السريرية لهم، وكذلك النتيجة.

المنهجية: أجريت دراسة مقطعية مستقبلية في مدينة الملك سعود الطبية في الفترة من 23 مارس إلى 15 يونيو. تم جمع البيانات الديموغرافية، والأعراض السريري، والفحوصات المخبرية، والمضاعفات، والنتيجة في المستشفى لمرضى COVID-19 مع تحليل الخصائص السريرية للناجين والمتوفين.

النتائج: تضمنت الدراسة 768 مريضاً. كان متوسط أعمارهم (46.36±13.7) سنة ومعظمهم ذكور (76.7%) . 96.3% من المرضى أفادوا وجود أكثر من واحد مرض مصاحب، وكان مرض السكري هو الأكثر شيوعا (46.4%) . كانت في مقدمة الأعراض الرئيسية للمرضى: الحمى (84.5%) ، السعال (82.3%) وضيق في التنفس (79.8%) . وخلال المتابعة، تم تقري حالات الالتهاب الرئوي بنسبة 68.6% و متلازمة ضيق التنفس الحادة بنسبة 32.7% والصدمات الإنتانية في 20.7%، والفشل التنفسي بنسبة 20.3%، وإصابة الكلى الحادة (AKI) بنسبة 19.3% . 45.8% من المرضى تطلبوا دخول وحدة العناية المركزة. وقد كانت أمراض الرئة نسبة الأرجحية= 3.862 فترة الثقة (6.074–2.455)، والسمنة نسبة الأرجحية= 3.732 فترة الثقة (5.546–2.511)، والتدخين نسبة الأرجحية= 2.991 فترة الثقة (4.317–2.072)، وأمراض الكلى المزمنة نسبة الأرجحية= 2.296 فترة الثقة (3.521–1.497)، ومرض السكري نسبة الأرجحية= 2.291 فترة الثقة (3.063–1.714) هي تنبؤات مسببة لدخول وحدة العناية المركزة. كانت نسبة الوفيات (4.27%)، وكان الرجال أكثر انتشاراً في مجموعة الوفيات .

الخلاصة: أن COVID-19 يضع عبئًا كبيرًا على مرافق الرعاية الصحية، لا سيما في المرضى الذين يعانون من أمراض مصاحبة. مرضى COVID-19 الذين يعانون من السمنة المفرطة والمدخنين والذين لديهم تاريخ مرض السكري على خطر كبير من الموت .

Objectives: To provide a detailed study of demographic, baseline comorbidities, clinical features, and outcome for Coronavirus disease 2019 (COVID-19) patients.

Methods: A record-based case-series study conducted from March 23 to June 15, 2020 in King Saud Medical City, Riyadh, Saudi Arabia. Demographic data, clinical presentation, laboratory investigations, complications, and in-hospital outcome of COVID-19 patients collected with analysis of the clinical characteristics for survivors and deceased.

Results: A total of 768 patients were included. The mean age was 46.36±13.7 years and 76.7% were men. Approximately 96.3% reported more than one comorbidity; diabetes mellitus was the most frequent (46.4%). Fever (84.5%), cough (82.3%), and shortness of breath (79.8%) were the main presenting symptoms. During the follow-up, pneumonia reported in 68.6%, acute respiratory distress syndrome in 32.7%, septic shock in 20.7%, respiratory failure in 20.3%, and acute kidney injury in 19.3%. Approximately 45.8% of enrolled patients required intensive care unit admission. Lung disease (odd ratio [OR]=3.862 with 95% confident interval [CI] (2.455-6.074), obesity (OR=3.732, CI=2.511-5.546), smoking (OR=2.991, CI=2.072-4.317), chronic kidney disease (OR=2.296. CI=1.497-3.521), and diabetes mellitus (OR=2.291, CI=1.714-3.063) are predictors of ICU admission. Fatality ratio was 89/2084 (4.27%). Men were more prevalent in dead group.

Conclusion: Coronavirus disease 2019 places a huge burden on healthcare facilities, particularly in patients with comorbidity. Coronavirus disease 2019 patients who are obese and smokers with history of diabetes mellitus have a high risk of death.

Keywords: COVID-19, in-hospital, clinical characteristics, mortality, Saudi Arabia

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Coronavirus disease 2019 (COVID-19) outbreaks emerged in December 2019 in Wuhan, China. From there it spread rapidly and threaten many different countries in the world, and was soon declared to be a global pandemic.[1-4] Coronavirus disease 2019 is a highly contagious disease that is caused by the 2019 novel coronavirus (SARS-COV-2) from the *Orthocoronavirinae* family. The virus contains an enveloped, single-stranded RNA, and distinctive "crown-like" spikes on its surface.[5] The COVID-19 virus belongs to the same family as the Severe Acute Respiratory Syndrome (SARS-COV) virus, and the Middle East Respiratory Syndrome (MERS-COV) virus. Although it has been reported to be more contagious, its pathogenesis is not fully understood.[6,7] The most vital encoded structural protein of COVID-19 is the spike glycoprotein (S) that consists of 3 S1-S2 heterodimers that bind to the angiotensin-converting enzyme 2 (ACE2) receptor on type II pneumocytes.[2,8]

In the Kingdom of Saudi Arabia, the first COVID-19 case was declared on March 2, 2020, and most of the confirmed cases were due to returning travelers and their immediate contacts. The total number of COVID-19 confirmed cases, by July 14, 2020, increased to approximately 235,000, with a fatality rate of approximately 1%.[9,10]

The manifestations of COVID-19 are broad, usually starting with non-specific symptoms including fever, a dry cough, and fatigue. The disease can also involve a variety of systems, including the respiratory, neurological, musculoskeletal, and the gastrointestinal systems. The disease also can progress rapidly to acute respiratory distress syndrome (ARDS) in highly risk patients such as the elderly,[5] and individuals with other medical comorbidities such as heart, lung, kidney, or liver diseases. Importantly, patients with immunosuppressive disorders may have worse prognoses and higher mortalities due to the earlier development of septic shock, heart failure, arrhythmias, and multi-organ failure.[11-13]

Information on the clinical characteristics of COVID-19 and its course is rapidly evolving; data are beginning to emerge from retrospective clinical studies conducted worldwide which have focused primarily on epidemiological and clinical characteristics.[14,15]

However, there have been few reports conducted in the Middle East region.

The aim of this research is to provide a comprehensive analysis of worst-outcome predictors in addition to demographic, baseline comorbidity, and clinical characteristics of hospitalized COVID-19-positive patients in Saudi Arabia.

Methods. A descriptive, record-based case-series single-center study that included all adult patients confirmed with COVID-19 who were hospitalized in King Saud Medical City, Riyadh, Saudi Arabia between March 23 and June 15, 2020. Exclusion criteria were COVID-19 patients with unavailable or incomplete data.

The process of suspicion-to-confirmation of COVID-19 was guided by the Saudi Centers for Disease Control and Prevention guidelines (updated in June 2020) based on the best available data and evidence.[16] According to the latest of these guidelines, all patients visiting the emergency department were scored using the Visual Triage Checklist (V1:3, Appendix-I).[16] Patients with relevant triage scores were directed to a designated respiratory clinic for full assessment for COVID-19/MERS-CoV based on a surveillance case definition (V1:3, Appendix-II).[16] A nasopharyngeal swab sample was collected for COVID-19 laboratory screening using a polymerase chain reaction (PCR) test. Confirmation of a COVID-19 infection was then reported based on a positive PCR result. Patients with confirmed COVID-19 infections and complete clinical and laboratory data were included in our study.

All demographic data, clinical presentation data (including clinical symptoms and signs), comorbidities, laboratory findings, and outcomes were collected from electronic medical records. The laboratory investigations included the PCR results for SARS-CoV-2 infection, complete blood count, cardiac enzymes (troponin I, creatinine kinase [CK], CK-MB), D-dimer, C-reactive protein, prothrombin time, lactate dehydrogenase, glycated hemoglobin (Hb A1C), and liver- and renal-function tests. Clinical outcomes were classified into 3 categories: home-isolation, hospitalization, and death.

In the early stages of this pandemic in Saudi Arabia, hospital admission was mandatory for all suspected cases, and confirmed cases were referred to designated facilities for further follow-up. As the situation evolved, home isolation of suspected and confirmed COVID-19 cases that were clinically stable was allowed if they met certain criteria defined by the Saudi Ministry of Health (Appendix-III).[16]

This work was performed in compliance with the ethical approval of the Ethical Committee of the King Saud Medical City and the Helsinki Declaration and its amendments by World Medical Association (WMA).

Statistical analyses. The data were analyzed using Microsoft Excel 2016 and Statistical Package for Social Sciences for Windows, version 26 (IBM Corp., Armonk, NY, USA). Continuous (normally distributed) variables were represented as means ± SDs with 95% confidence intervals (CI), and percentiles, frequencies, and percentages were used for categorical variables. Non-normally distributed variables were represented as medians with 25% and 75% values. Student's t-tests were used to compare means of normally distributed variables between groups, and the Mann-Whitney U test was used for non-normally distributed variables. The χ2 test, or Fisher's exact test, was used to compare categorical variables between groups. Effect modifications were evaluated by stratification, statistical interaction was assessed by including main predictor variables and their product terms in the binary logistic regression analysis in addition to mutinominal logistic regression analysis. A *p*-value <0.05 was considered statistically significant.

Results. *Baseline characteristics.* During the period of our study, 2084 patients were diagnosed with COVID-19. A total of 768 patients with full clinical data sets were included in this study (**Figure 1**).

The mean age was 46.36 ± 13.7 years and 76.7% were male. The dominant nationality among the patients was non-Saudi (75.5%). Many of the patients (96.3%) had more than one comorbidity. Diabetes mellitus was the most common (46.4%) in patients, followed by hypertension (34.6%), smoking (20.8%), obesity (8.6%), lung disease (14.1%) chronic kidney disease (CKD) (13.5%), history of ischemic heart disease (IHD) (10.7%), and cerebrovascular accident (CVA) (5.9%). Other clinical characteristics are presented in **Table 1**.

Clinical presentation. Patient clinical presentations were variable. The following symptoms were reported: fever (84.5%), cough (82.3%), shortness of breath (79.8%), and diarrhea (21.9%). In addition, 39 patients (5.1%) were diagnosed with acute coronary syndrome (ACS), 32 (4.2%) presented with decompensated heart failure, 7 (0.9%) presented with arrhythmia, and 2 (0.3%) presented with myocarditis. During follow-up, pneumonia was reported in 527 patients (68.6%), ARDS in 251 (32.7%), septic shock in 159 (20.7%), respiratory failure (RF) in 156 (20.3%), and acute kidney injury (AKI) in 148 patients (19.3%) (**Table 1**).

Management plan and complications. In total, 590 patients (76.8%) were hospitalized due to severe
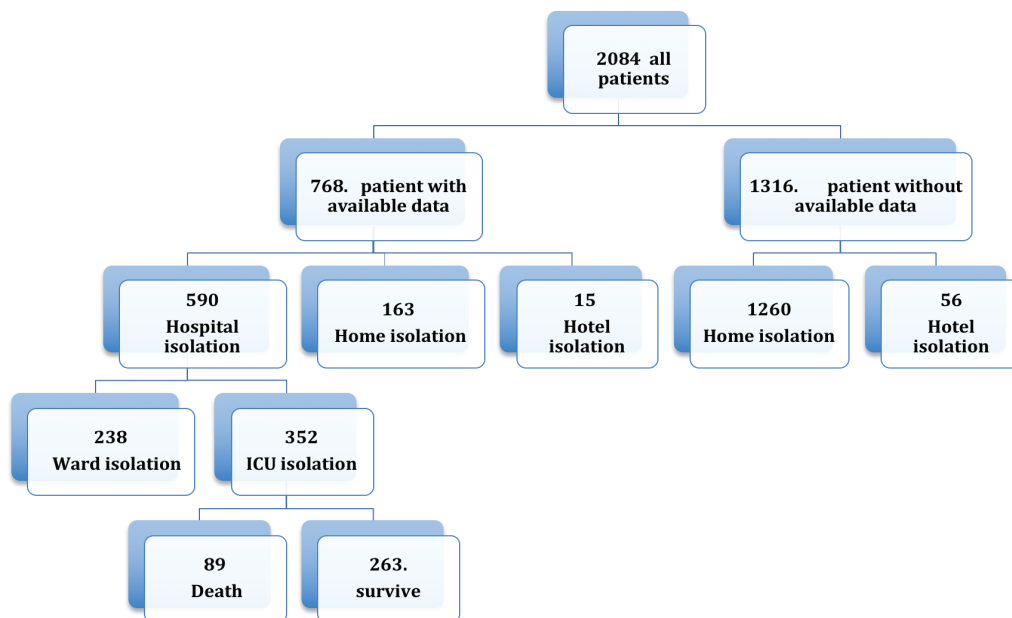
Figure 1 - The flowchart of analysis procedure.

Table 1 - Demographics and clinical characteristics of patient (N=768).

Demographic data	n (%)
Age (years)	
Mean±SD	46.36 ± 13.7
Min-Max	21.0 - 75.0
Gender	
Male	589 (76.7)
Female	179 (23.3)
Nationality	
Saudi	188 (24.5)
Non-Saudi	580 (75.5)
History of comorbidities:	
Smoker	160 (20.8)
Obesity	143 (18.6)
Hypertension	266 (34.6)
Chronic kidney disease	104 (13.5)
Diabetes Mellitus	356 (46.4)
Cerebro vascular accidents	45 (5.9)
Ischemic heart disease	82 (10.7)
Lung disease	108 (14.1)
Clinical presentation, n (%):	
Fever	649 (84.5)
Shortness of breath	613 (79.8)
Cough	632 (82.3)
Diarrhea	168 (21.9)
Heart Failure	32 (4.2)
Acute coronary syndrome	39 (5.1)
Myocarditis	2 (0.3)
Arrhythmia	7 (0.9)
Complications, n (%):	
Pneumonia	527 (68.6)
Acute respiratory distress syndrome	251 (32.7)
Septic shock	159 (20.7)
Respiratory failure	156 (20.3)
Acute kidney injury	148 (19.3)
Death	89 (11.6)

Values are presented as numbers and percentages (%).

Table 1 - Demographics and clinical characteristics of patient (N=768) (continuation).

Demographic data	n (%)
Laboratory investigations	
Hemoglobin (g/dl) (mean±SD)	12.3±2.36
White blood cells, (10ˆ9/L) (Min-Max)	9.0 (6.1-12.6)
Leucopenia, (%)	261 (34.0)
Platelets, (10ˆ9/L) (mean±SD)	265.84±111.1
International normalized ratio (mean±SD)	1.11±0.18
Creatine kinase (U/L)	245.0 (104.3-517.5)
Lactate dehydrogenase (U/L) (Min-Max)	495.0 (333.2-760.0)
Creatine kinase-MB (ng/ml)	1.9 (0.6-12.0)
Cardiac troponin I (ng/mL) (Min-Max)	0.001 (0.001-0.006)
D-dimer (mg/L) (Min-Max)	1.1 (0.9-2.3)
Creatinine (mmol/L) (Min-Max)	87.0 (67.0-124.0)
Urea (mmol/L) (Min-Max)	5.7 (4.0-9.0)
Blood sugar (mmol/L) (Min-Max)	8.7 (6.0-15.0)
Aspartate aminotransferase (U/L) (Min-Max)	43.0 (27.0-79.0)
Alanine aminotransferase (U/L) (Min-Max)	31.0 (23.0-50.3)
Total bilirubin (umol/L) (Min-Max)	10.6 9 (7.0-17.0)
Sodium (mmol/L) (mean±SD)	138.5±4.43
Isolation status after confirmation	
Home isolation	163 (21.2)
Hotel isolation	15 (2.0)
Hospital isolation	590 (76.8)
Ward isolation	238 (31.3)
Intensive care unit isolation	352 (45.8)

Values are presented as numbers and percentages (%)

symptoms either in the intensive care unit (ICU; 352; 45.8%) or on a general ward (240; 31.3%). In contrast, 163 patients (21.2%) with mild symptoms were isolated at home and 15 (2.0%) were isolated in hotels (Table 1). We found that patients admitted to the ICU were significantly older than non-ICU admissions (mean 47.4 ± 13.8 years vs 45.5 ± 13.5 years, p=0.05). Males were admitted to the ICU more often than women (284; 80.7% versus 69; 19.3%, p=0.01].

For other comorbidities, we found that ICU admission was significantly associated with smokers compared to non-smokers (p=0.001), obesity (p=0.001), hypertension (p=0.01), CKD (p=0.001), diabetes mellitus (p=0.001), IHD (p=0.03), and lung

disease (p=0.001). Reported complications were also significantly higher among ICU admissions when compared to non-ICU admissions for pneumonia (p=0.01), ARDS (p=0.001), septic shock (p=0.001), RF (p=0.001), AKI (p=0.001), and death (p=0.01). Five patients (1.4%) with ARDS admitted to the ICU required treatment with extracorporeal membrane oxygenation (Table 2).

Laboratory results. Patients who were admitted to the ICU had significantly lower hemoglobin levels (p=0.001) and platelet counts (p=0.04), but international normalized ratio (INR), creatinine, and D-dimer values were significantly higher in ICU patients. Other laboratory results are presented in Table 2.

Predictors for ICU admission. Using a univariate regression we found that lung disease, obesity, smoking, CKD, and diabetes mellitus were predictors for ICU admission (Table 3).

Predictors for death. During follow-up, 89 patients (4.27%) died, with males being more prevalent. Demographic and clinical characteristics of deceased patients compared to survived patients are shown in Table 4.

A univariate regression analysis in Table 5 showed that clinical predictors of death were: obesity (p=0.001), history of smoking (p=0.001), and diabetes mellitus (p=0.001).

Discussion. The present study analyzed the demographics of patients with confirmed COVID-19 infections and found that 76.8% were hospitalized (45.8% requiring ICU admission). The mortality rate was approximately 4.3%. Male gender, ARDS, acute renal failure, and septic shock were major predictors for death.

The COVID-19 outbreak in Saudi Arabia is one of the biggest challenges in the last few decades. Although older patients are more vulnerable for infection, younger patients were predominantly affected here with a mean age of 46.4 years; close to that (47 years) reported previously for the young adults representing the majority of COVID-19-positive patients.[15,17,18] Male-gender predominance in our study was also similar to that reported by Huang et al[14] and Chen et al.[19] A recent report (published May 10, 2020) confirmed that men have higher ACE2 levels than women, and

Table 2 - Demographics and clinical characteristics of patients regarding Non-intensive care unit (ICU) and ICU admission.

Demographic data	Non-ICU n=416	ICU n=352	*P*-value
Age (years) (mean±SD)	45.5±13.5	47.4±13.8	0.049*
Gender			
Female	111 (26.7)	68 (19.3)	0.008*
Male	305 (73.3)	284 (80.7)	
Nationality			
Non-Saudi	308 (74.0)	272 (77.3)	0.134
Saudi	108 (26.0)	80 (22.7)	
History of comorbidities			
Smoker	53 (12.7)	107 (30.4)	0.001*
Obesity	41 (9.9)	102 (29.0)	0.001*
Diarrhea	103 (24.8)	65 (18.5)	0.018*
Hypertension	125 (30.0)	141 (40.1)	0.008*
Chronic kidney disease	38 (9.1)	66 (18.8)	0.001*
Diabetes mellitus	154 (37.0)	202 (57.4)	0.001*
Cerebro vascular accidents	26 (6.3)	19 (5.4)	0.612
Ischemic heart disease	35 (8.4)	47 (13.4)	0.028*
Lung disease	29 (7.0)	79 (22.4)	0.001*
Clinical presentation			
Fever	353 (84.9)	296 (84.1)	0.701
Shortness of breath	329 (79.1)	284 (80.7)	0.587
Cough	346 (83.2)	286 (81.3)	0.479
Heart failure	16 (3.8)	16 (4.5)	0.602
Acute coronary syndrome	14 (3.4)	25 (7.1)	0.019*
Myocarditis	1 (0.2)	1 (0.3)	0.879
Arrhythmia	3 (0.7)	4 (1.1)	0.489
Complications			
Pneumonia	270 (64.9)	257 (73.0)	0.008*
Acute respiratory distress syndrome	34 (8.2)	217 (61.6)	0.001*
Septic shock	11 (2.6)	148 (42.0)	0.001*
Respiratory failure	25 (6.0)	131 (37.2)	0.001*
Acute kidney injury	28 (6.7)	120 (34.1)	0.001*
Death rate	0 (0.0)	89 (25.3)	0.001*

Values are presented as number and percentages (%).
*p-value <0.05 is significant.

Table 2 - Demographics and clinical characteristics of patients regarding Non-intensive care unit (ICU) and ICU admission (continuation).

Demographic data	Non-ICU n=416	ICU n=352	P-value
Laboratory investigations			
Hemoglobin, (g/dl) (mean±SD)	12.6 ± 2.2	11.9 ± 2.5	0.001*
White blood cells, (10^9/L)	8.0 (6.0 - 11.7)	9.8 (6.5 - 13.0)	0.001*
Leucopenia	133 (32.0)	128 (36.4)	0.211
Platelets, (10^9/L) (mean±SD)	273.2±108.5	257.1 ± 113.6	0.038*
International normalized ratio	1.1±0.1	1.3 ± 0.2	0.001*
Creatine kinase (U/L)	194.3 (95.3 - 388.7)	298.5 (146.5 - 666.8)	0.001*
Lactate dehydrogenase (U/L)	422.5 (244.3 - 659.3)	654.5 (429.0 - 963.0)	0.001*
Creatine kinase-MB (ng/ml)	1.3 (0.4 - 9.0)	3.2 (1.0 - 15.0)	0.001*
Cardiac troponin I (ng/mL)	0.001 (0.001 - 0.001)	0.001 (0.001 - 0.1)	0.008*
D-dimer (mg/L)	1.0 (0.7 - 1.6)	1.5 (1.0 - 3.6)	0.001*
Creatinine (mmol/L)	80.0 (62.0 - 100.0)	101.5 (78.0 - 50.3)	0.001*
Urea (mmol/L)	5.0 (3.7 - 7.3)	6.7 (4.6 - 12.0)	0.001*
Blood sugar (mmol/L)	8.0 (5.7 - 13.0)	10.0 (7.0 - 16.2)	0.001*
Aspartate aminotransferase (AST) (U/L)	36.0 (24.7 - 58.0)	55.0 (32.0 - 98.7)	0.001*
Alanine aminotransferase (ALT) (U/L)	28.9 (22.5 - 45.0)	32.0 (23.0 - 60.3)	0.009*
Total bilirubin (umol/L)	9.4 (6.3 - 15.0)	12.0 (8.0 - 19.0)	0.001*
Sodium (mmol/L)	138.5 ± 3.9	138.4 ± 5.0	0.794
Extracorporeal membrane oxygenation	0 (0.0)	5 (1.4)	0.008*

Values are presented as number and percentages (%). *p-value <0.05 is significant.

Table 3 - Predictors of risk of intensive care unit admission among COVID-19 patients.

Predictors	OR	95% CI Lower - Upper	P-value
History of comorbidities			
Lung disease	3.862	2.455-6.074	0.001*
Obesity	3.732	2.511-5.546	0.001*
Smoker	2.991	2.072-4.317	0.001*
Chronic kidney disease	2.296	1.497-3.521	0.001*
Diabetes mellitus	2.291	1.714-3.063	0.001*
Complications			
Septic shock	26.711	14.152-50.415	0.001*
ARDS	18.06	11.969-27.249	0.001*
Respiratory failure	9.271	5.861-14.663	0.001*
Acute kidney injury	7.167	4.605-11.155	0.001*

P-value calculated depend on logistic regression analysis.
**p*-value <0.05 is significant. OR: odd ratio, CI: confidence interval, ARDS: acute respiratory distress syndrome

as a consequence of ACE2 helping the virus to infect healthy cells, this may explain why men are more susceptible than women to COVID-19.[20] Importantly, multiple comorbidities such as hypertension, diabetes, and cardiovascular disease can predispose patients to a severe form of the disease and various complications.[21] Hypertension and diabetes were the most frequently reported comorbidities among COVID-19 patients by Richardson et al[22] and likewise, most of our study population had multiple comorbidities. These risk factors can also affect immune-system responses to this infection; a good example is the influence diabetes can have on viral cell-entry and the body's inflammatory response to the infection.[23,24]

We have reported that fever, cough, and shortness of breath were the most prevalent clinical presentations in approximately 80-85% of patients; findings that are consistent with previous reports.[14,17,19,25,26] Less commonly, gastrointestinal symptoms such as diarrhea were noted in one fifth of our study patients, similar to that reported in a multi-center Chinese study.[27]

Table 4 - Demographics and clinical characteristics of survived COVID-19 patients compared to deceased patients.

Demographic data	Live n=679	Death n=89	*P*-value
Age (years) (mean ± SD)	45.9±14.0	47.6±15.6	0.298
Gender (%)			
Female	167 (24.6)	12 (13.5)	0.019*
Male	512 (75.4)	77 (86.5)	
Nationality (%)			
Non-Saudi	504 (74.2)	76 (85.4)	0.018*
Saudi	175 (25.8)	13 (14.6)	
History of comorbidities (%)			
Smoker	109 (16.1)	51 (57.3)	0.001*
Obesity	80 (11.8)	63 (70.8)	0.001*
Diarrhea	157 (23.1)	11 (12.4)	0.021*
Hypertension	232 (34.2)	34 (38.2)	0.501
Chronic kidney disease	89 (13.1)	15 (16.9)	0.287
Diabetes mellitus	294 (43.3)	62 (69.7)	0.001*
Cerebro vascular accidents	42 (6.2)	3 (3.4)	0.297
Ischemic heart disease	74 (10.9)	8 (9.0)	0.601
Lung disease	43 (6.3)	3 (3.4)	0.297
Clinical presentation (%)			
Fever	576 (84.8)	73 (82.0)	0.511
Shortness of breath	542 (79.8)	71 (79.8)	0.897
Cough	563 (82.9)	69 (77.5)	0.198
Heart failure	28 (4.1)	4 (4.5)	0.789
Acute coronary syndrome	31 (4.6)	8 (9.0)	0.069
Myocarditis	2 (0.3)	0 (0.0)	0.598
Arrhythmia	6 (0.9)	1 (1.1)	0.786
Complication (%)			
Pneumonia	477 (70.3)	50 (56.2)	0.009*
Acute respiratory distress syndrome	176 (25.9)	75 (84.3)	0.001*
Septic shock	83 (12.2)	76 (85.4)	0.001*
Respiratory failure	74 (10.9)	82 (92.1)	0.001*
Acute kidney injury	72 (10.6)	76 (85.4)	0.001*
Laboratory investigations			
Hemoglobin, (g/dl)	12.4 ± 2.3	11.3 ± 2.6	0.001*
White Blood Cells, (10^9/L)	8.8 (6.1-12.3)	10.0 (6.4 - 13.0)	0.01*
Leucopenia	238 (35.1%)	23 (25.8%)	0.412
Platelets, (10^9/L)	270.1 ± 112.2	233.4 ± 96.8	0.001*
INR	1.1 ± 0.1	1.2 ± 0.3	0.123
Creatine kinase (U/L)	231.4 (102.8 - 477.5)	350.0(147.0 - 1034.0)	0.001*
Lactate dehydrogenase (U/L)	473.0 (321.0 - 740.0)	666.0(453.0 - 1065.5)	0.001*
Creatine kinase-MB (ng/ml)	1.7 (0.5 - 12.0)	5.5(1.0 - 22.2)	0.001*
Cardiac troponin I (ng/mL)	0.001 (0.001 - 0.001)	0.02(0.001 - 0.345)	0.001*
D-dimer (mg/L)	1.0 (0.8 - 2.0)	2.9(1.1 - 7.2)	0.001*
Creatinine (mmol/L)	85.0(65.0 - 112.8)	124.0(86.0 - 181.5)	0.001*
Urea (mmol/L)	5.3 (4.0 - 8.4)	9.0(5.6 - 18.9)	0.001*
Blood sugar (mmol/L)	8.4 (6.0 - 15.0)	10.0(7.0 - 15.0)	0.070
Aspartate aminotransferase (U/L)	40.9 (26.0 - 74.0)	64.0(33.3 - 99.0)	0.001*
Alanine aminotransferase (U/L)	30.0 (22.5 - 49.4)	35.0(25.0 - 60.0)	0.038*
Total bilirubin (umol/L)	10.0 (6.8 - 16.0)	12.6(8.6 - 23.5)	0.001*
Sodium (mmol/L) (mean ± SD)	138.4 ± 4.4	139.0 ± 4.6	0.201

Table 4 - Demographics and clinical characteristics of survived COVID-19 patients compared to deceased patients (continuation).

State of isolation (%)			
Isolation status after confirmation			
Hotel	15 (2.2)	0 (0.0)	0.001*
Home	163 (24.0)	0 (0.0)	
Hospital	501 (73.8)	89 (100.0)	
Hospital isolation			
Ward	238 (47.5)	0 (0.0)	0.001*
Intensive care unit	263 (52.5)	89 (100.0)	
Extracorporeal membrane oxygenation (%)	4 (0.6)	1 (1.1)	0.487

Table 5 - Predictors of mortality in COVID-19 patients.

Predictors	OR	95% CI Lower - Upper	*P*-value
History of comorbidities			
Obesity	18.143	10.862-30.303	0.001*
Smoker	7.018	4.398-11.199	0.001*
Diabetes mellitus	3.007	1.867-4.844	0.001*
Complications			
Respiratory failure	95.772	42.663 - 214.993	0.001*
Acute kidney injury	49.286	26.067 - 93.187	0.001*
Septic shock	41.980	22.325 - 78.938	0.001*
Acute respiratory distress syndrome	15.310	8.437 - 27.783	0.001*

P-value calculated depend on logistic regression analysis.
*p-value <0.05 is significant.
OR: odd ratio, CI: confidence interval

Cardiovascular disease (ACS, decompensated heart failure, dysrhythmias, and myocarditis) was reported in 10% of our patients and may have had a negative impact on prognoses and outcomes due to resultant myocardial injuries.[28,29] Differentiation between cardiac versus respiratory etiologies may be difficult for COVID-19 patients presenting with dyspnea or chest pain; however, recognizing the combined cardiovascular and pulmonary pathologies for this disease is critical for its management and prognosis.[30]

Although previous studies have illustrated the importance of clinical characteristics and the presence of risk factors in ICU-admitted patients,[31,32] our study provides more comprehensive data regarding predictors for ICU admission and death in severely ill patients. The major predictors were advanced age, male gender, and the co-existence of multiple comorbidities. The latter has been shown to be linked to rapid progression of the disease and a higher risk for developing multi-organ failure and ARDS, which might require prolonged hospitalization and extensive support with ECMO. [33,34]

Laboratory investigations are also vitally important for the assessment of disease severity, and to guide disease management. Low hemoglobin levels, low platelet counts, prolonged INR levels, elevated cardiac enzymes, D-dimer levels, renal-function tests, and liver-function tests have all been reported as indicators for poor outcomes.[35,36]

Approximately 4.3% of the patients evaluated in this study died. Most deaths were due to ARDS and respiratory failure, and a previous study showed that ARDS was responsible for 53% of total COVID-19 deaths.[37] The clinical implication for this study is that it provides insight for the major death and ICU admission predictors among COVID-19 patients in Saudi Arabia. This may help treating physicians to better triage patients and subsequently prioritize ICU admissions by identifying high-risk medical and clinical indicators.

Study limitations. First, although we obtained data from 768 patients in Saudi Arabia with laboratory-confirmed COVID-19, the analysis is based on a single center. More patients will be needed from other centers to provide more generalizable data. Second, we have reported baseline results from patients upon hospital admission; data from patients in home isolation or at hotels were not easily obtained.

In conclusion, despite these constraints, our data provides evidence that COVID-19 affects a wide variety of people, fever was consistently the most common early symptom, and both diabetes and hypertension were the most associated comorbidities. Certain patients with COVID-19, particularly smokers, obese or those who have history of lung disease, were in a critical risk of ICU admission. In high-risk populations, infection with SARS-Cov-2 can induce both systemic and pulmonary inflammation, leading to multiple organ dysfunction. Added to respiratory failure and acute respiratory distress syndrome, acute kidney injury and septic shock

may also contribute to the critical illness state associated with high mortality. Fatality rate was 4.3%. Obesity, smoking, and diabetes mellitus were predictors of death in COVID-19 positive patients.

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