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Research Paper

Characteristics, risk factors and outcomes among the first consecutive 1096 patients diagnosed with COVID-19 in Kuwait

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ABSTRACT

Background: In Kuwait, prior to the first case of COVID-19 being reported in the country, mass screening of incoming travelers from countries with known outbreaks was performed and resulted in the first identified cases in the country. All COVID-19 cases at the time and subsequently after, were transferred to a single center, Jaber Al-Ahmad Al-Sabah Hospital, where the patients received standardized investigations and treatments. The objective of this study was to characterize the demographics, clinical manifestations, and outcomes in this unique patient population.

Methods: This retrospective cohort study was conducted between 24th February 2020 and 20th April 2020. All consecutive patients in the entire State of Kuwait diagnosed with COVID-19 according to WHO guidelines and admitted to Jaber Al-Ahmad Al-Sabah Hospital were included. Patients received standardized investigations and treatments. Multivariable analysis was used to determine the associations between risk factors and outcomes (admission to intensive care and/or mortality).

Findings: Of 1096 patients, the median age was 41 years and 81% of patients were male. Most patients were asymptomatic on admission (46.3%), of whom 35 later developed symptoms, and 59.7% had no signs of infection. Only 3.6% of patients required an ICU admission and 1.7% were dead at the study's cutoff date. On multivariable analysis, the risk factors found to be significantly associated with admission to intensive care were age above 50 years old, a qSOFA score above 0, smoking, elevated CRP and elevated procalcitonin levels. Asthma, smoking and elevated procalcitonin levels correlated significantly with mortality in our cohort.

Introduction

Defining the clinical characteristics and associated outcomes of patients diagnosed with coronavirus disease (COVID-19) is integral to improving our understanding and management of this disease. Several articles have recently been published, describing the clinical features and outcomes of retrospective cohorts of patients with COVID-19 [1–3]. Most of the patients included in those studies were deemed sufficiently ill to merit being hospitalized. As a result, the clinical features and outcomes that have been described are representative of those symptomatic patients.

The COVID-19 patient cohort in the State of Kuwait is unique for several reasons. As soon as reports emerged of an outbreak in certain regions in Iran, all citizens were immediately repatriated, and mass screening of all travelers for COVID-19 was implemented. With the subsequent rise of locally transmitted cases, screening was also extended to people who had come in contact with COVID-19 patients as well as those living in high-risk residential areas. All the cases, irrespective of symptoms, that tested positive for SARS-COV-2 were hospitalized and remained hospitalized until two negative polymerase chain reaction (PCR) results were obtained from nasopharyngeal swabs. As the disease became more widespread, the same protocol was implemented for COVID-19 cases from non-travelers. Consequently, all patients diagnosed with COVID-19, early on Kuwait, received standardized investigations and treatments in the same treating facility. This presents an opportunity to obtain a more holistic understanding

Interpretation: To our knowledge, this is the first large retrospective cohort study observing the characteristics of the initial consecutive COVID-19 patients of an entire country. Further, large proportion of asymptomatic patients provides novel insights into the clinical features of patients with milder disease.

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Research in context

Evidence before this study

A search was conducted using the Medline and Embase databases from January 1, 2020 to May 1, 2020. Inclusion criteria for the search were studies with the terms COVID-19, SARS-CoV-2, Novel Coronavirus, Epidemiology and Outcomes.

Added value of this study

The evidence provided in this study gives new insight on the overall behavior of COVID-19 across all severities of the disease. This contrasts with most publications observing only severe cases requiring hospital admissions.

Implications of all the available evidence

The results presented in this study not only show the overall mild course of disease in the vast majority of patients with COVID-19, but also helps medical personnel in stratifying, in cases of severe disease, which risk factors will lead to worse outcome.

of the clinical features and outcomes of patients diagnosed with COVID-19, including patients who present with no symptoms. The objective of this study is to summarize the clinical characteristics, laboratory and radiologic findings and outcomes of the first consecutive 1096 patients who tested positive for SARS-COV-2 and were hospitalized at Jaber Al-Ahmad Al-Sabah in Kuwait.

Methods

Participant recruitment and study design

Jaber Al-Ahmad Al-Sabah hospital is a 1240 bed tertiary hospital based in South Surra, Kuwait. All patients admitted to Jaber Al-Ahmad Al-Sabah hospital in Kuwait, with a diagnosis of COVID-19, based on the World Health Organization (WHO) interim guidance [4] and have been confirmed by laboratory testing using PCR testing, between February 24th 2020 and the study's cutoff date of April 20th 2020 were included in the study. Patients who had equivocal PCR test results or were suspected cases were excluded from the study. Equivocal PCR test results were those with cycle threshold (CT) values below what is accepted for accurate diagnosis (values depending on which sequence primers were used). These patients, in our center, were regarded as more likely to be negative and were therefore not included to avoid confounding the results with false positives. Ethical approval for this study was obtained from the Kuwait Ministry of Health Ethical Review Board.

Data collection

Data regarding patients' demographics and initial clinical presentation (signs, symptoms, laboratory and radiographic findings) was collected for the study from Jaber Al-Ahmad Al-Sabah hospital's electronic medical record system. This clinical data was obtained as part of the routine clinical practice of the hospital and not specifically for this study. For patients with previous medical illnesses, the electronic medical records also provided a direct data link to the patients' medical history, including electronic files from general practice and hospital records. Radiologic findings were extracted from the radiologists' reports on the electronic medical record system. A custom data collection form was created using the SurveyCTO (Dobility, Inc) platform. To minimize data entry errors, appropriate constraints were placed on most of the data entry fields. All data then underwent a secondary quality check and was reviewed by a physician and a statistician. Any discrepancies were resolved by a third physician to ensure accuracy of the data that was entered.

Definitions

Study participants' signs, symptoms, vital signs, laboratory investigations and radiologic findings were all recorded on admission. Patients who were asymptomatic on first admission, were re-reviewed to check if they developed symptoms later during their hospital stay. Since all patients were admitted directly at the time of PCR diagnosis, the terms 'on admission' and 'at the time of diagnosis' are used interchangeably to describe the variables that were collected initially for patients on the first day they were admitted to hospital. All the chest x-rays that were ordered on admission for patients were reviewed by a consultant radiologist and formally reported. The normal reference ranges for vital signs are provided in (Appendix 1). Fever was defined as an oral temperature of 37.3 °C and above. The disease severity of COVID-19 on admission was quantified using the quick sequential organ failure assessment score (qSOFA) score for sepsis [5]. Patients' BMIs [6] were categorized according the WHO criteria. The diagnostic criteria that were used for the adverse events that were collected are listed in (Appendix 2). The treatment protocols of patients with COVID-19 pneumonia at our center followed the official Kuwait Ministry of Health COVID-19 management guidelines, the latest version of which can be found in (Appendix 4). All patients diagnosed with COVID-19 stayed in the hospital until they had resolution of symptoms; defined as being afebrile for more than 72 h and having oxygen saturations equal to or above 94%, Discharge occurred after two consecutive negative PCR tests for COVID-19, more than 24 h apart.

Laboratory investigations

All diagnostic tests were performed in Jaber Al-Ahmad Al-Sabah hospital in Kuwait. COVID-19 testing was performed via real-time reverse-transcriptase-polymerase chain-reaction (RT-PCR) assay of specimens obtained via nasopharyngeal swabs.

Outcome measures

The main outcomes measured in this study were admission to the intensive care unit (ICU) and in-hospital mortality. Only patients with positive COVID-19 RT-PCR results were admitted and subsequently included in this paper; therefore the mortalities of the patients were all attributed to COVID-19 infection.

Statistical analysis

Entered data were checked for accuracy, then for normality, using Kolmogorov–Smirnov and Shapiro–Wilk tests, and proved to be not normally distributed. Qualitative variables were expressed as numbers and percentages while quantitative variables were expressed as means and standard deviations and/or medians and interquartile ranges (IQR). The bivariate relationship between the explanatory variables and the outcome variables (ICU admission and death), were assessed using Mann–Whitney U test, X^2 test or Fisher's Exact test. Clinical outcomes were subcategorized by age: below 18, between 18 and 64 and above 65 years old. For the possible confounding effects of the variables, multiple logistic regression were used for the final analysis to predict factors which may be associated with COVID-19 outcomes: mortality and admission to ICU. Ten variables were purposely chosen for inclusion in the multivariable analysis, based on our bivariate analysis, previous findings, and current literature [7]. All the explanatory variables included in the logistic models were categorized into two levels (0 for no and 1 for yes). In multivariable analysis, the associations between exposure and outcomes were

expressed in terms of odds ratio (OR), together with 95% confidence intervals (95% CI). A 5% level is chosen as a level of significance in all statistical significance tests used. All statistical analysis was performed using IBM SPSS® version 22 for Windows.

Role of funding

A research grant was awarded by the Kuwait Foundation for the Advancement of Science to aid in data collection and purchasing statistical software and database packages for the paper.

Results

Demographics and baseline characteristics

A total of 1096 patients were included in the study. Table 1 summarizes our study sample's demographics, recent travel history and source of COVID-19 transmission tabulated according to disease severity. The median age of our sample was 41 years (inter-quartile range, 25–57 years old). Of those patients, 888 (81%) were male. Most patients were of Indian origin (48.1%), followed by Kuwaitis (27.1%) and Egyptians (6.6%). Of note, 506/527 (96.0%) of the Indian nationals were male. The mean BMI of our sample was 26.6 (SD, 4•6), after excluding children below the age of 12. 41.5% of those were classed as overweight, with a BMI between 25 and 29.9. Most of the patients were non-smokers 1052/1096 (96.0%). Many patients had a history of recent travel (within the past 30 days), 287/1096 (26.2%); mainly from the United Kingdom (8.7%) and Iran (7.4%). The most common mode of COVID-19 transmission in our patient population was contact with a known positive case of COVID-19 (48.3%).

Clinical characteristics on initial hospital admission

Almost half of the patients were asymptomatic at the time of diagnosis, and around 60% had no signs of infection. Thirty-five patients who were initially asymptomatic, went on to develop symptoms later (median=3 days). For the patients who presented with symptoms, the vast majority had either cough (29%), chills (26.8%) or sore throat (11.7%). Table 2 provides a summary of the symptoms present at the time of diagnosis. The mean vital sign measurements taken on admission were within normal limits for most patients, with a mean temperature of 36.9 ± 0.5 °C (Table 2). Although most patients did not have any co-morbidities (69.4%), hypertension and diabetes mellitus were present in 177/1096 (16.1%) and 155/1096 (14.1%) of the patients respectively (Table 2). Of note there were 3 (0.3%) patients who were pregnant. Most patients had a qSOFA score of 0 on admission (63%) and only a small number of patients required vasopressors or intubation on admission (0.6% and 0.9% respectively) (Table 2).

Laboratory findings on admission

Table 3 summarizes the laboratory findings on admission, with most patients having results within the normal laboratory reference range (normal reference ranges listed in Appendix 3). Of note, 975/1088 (89.0%) of the patients had a normal white blood count with a mean value of 6.3 ± 2.4 × 10^9/L. Most patients had normal lymphocyte levels (mean 31 ± 13%) but levels were below normal in patients admitted to ICU (mean 18.5 ± 10%) and those who died (mean 15 ± 11%). With regards to the inflammatory markers overall elevations above normal were observed in C-reactive protein (CRP), D-dimer and procalcitonin (PCT) levels (mean values 26 ± 59 mg/L, 637 ± 1511 mg/mL, and 0.98 ± 10.0 ng/mL, respectively). One third of the patients were hyperglycemic on admission, and the predominant electrolyte imbalances were hyponatremia (28.7%) and hypocalcemia (20.6%). In terms of liver enzymes, only the aspartate aminotransferase (AST) levels were found to be above the normal reference range value, with a mean of 43 ± 371 IU/L. Finally, more than half (53.4%) of the patients had low prothrombin time (PT) and most patients had a normal coagulation profile.

Initial radiographic findings

As depicted in Table 4, only one third of patients had a chest x-ray that was reported as being 'normal' by the radiologist on admission (33%). The most reported findings by the radiologists were prominent broncho-vascular markings (43.3%), unilateral local patchy shadowing or opacification (16.6%) or diffuse opacification (8.2%) (Table 4). Only 71 patients had a computed tomography (CT) of the chest, of which 54 (76.1%) were reported as normal by the radiologist. The most reported finding on CT chest was ground glass opacity (15.4%)

Treatments and adverse events during hospital admission

Based on the previously described treatment protocols at our center, a total of 27.9% of patients did not receive any medications or treatments and were admitted to hospital for institutional quarantine purposes. Most patients (68.2%) were labeled as having received 'other treatments', and this mostly included supportive medications such as paracetamol and vitamin supplements (Table 5). The most common non-supportive medications that were prescribed, were antibiotics (13.8%), followed by antivirals (7.1%) and hydroxychloroquine (4.1%). For therapeutic interventions, admission to the intensive care unit (3.6%), oxygen therapy (3.2%) and mechanical ventilation (2.8%) were the most frequently administered. Most patients (90.1%) had no adverse events during hospital admission. Pneumonia was the most common complication associated with COVID-19 (7.1%), followed by acute respiratory distress syndrome (2.8%) (Table 5).

Clinical outcomes

At the study's cutoff date, most of the patients in our cohort were eventually discharged from the hospital (88.2%), and only 19 (1.7%) patients succumbed to the disease. The median length of stay (LOS) for the patients was 18 days (interquartile range, 13–24 days), with patients aged above 65 years having the longest median LOS of 24 days (interquartile range, 18–31 days). A breakdown by age of the most frequent adverse events and clinical outcomes is outlined in Table 6.

On multivariable analysis, the risk factors significantly associated with an admission to the intensive care unit were found to be age above 50 years old (OR: 2.88 [95% CI, 1.05–7.95], $p = 0.041$), a qSOFA score above 0 (OR: 2.80 [95% CI, 1.25–6.26], $p = 0.012$), smoking (OR: 5.86 [95% CI, 1.40–24.47], $p = 0.015$), elevated CRP levels (OR: 9.08 [95% CI, 1.97–41.95], $p = 0.005$) and elevated PCT (OR: 7.00 [95% CI, 2.79–17.59], $p = 0.00003$). As for mortality risk, the factors that were found to have a significant associations were asthma (OR: 4.92 [95% CI, 1.03–23.44], $p = 0.046$), smoking (OR: 10.09 [95% CI, 1.22–83.40], $p = 0.032$ and elevated PCT (OR: 8.24 [95% CI, 1.95–43.74], $p = 0.004$) (Table 7).

Discussion

To our knowledge, this is one of the first large retrospective cohort studies to summarize demographic, clinical characteristics and outcomes of consecutive COVID-19 patients in a single country. Our study sample had several distinguishing features, such as; a large proportion of asymptomatic hospitalized COVID-19 patients (46.3%), the majority of patients had definitive outcomes at the study's cutoff date (90.0%) and all the patients in our sample were admitted at a single center for treatment and/or quarantine purposes where they all received standardized investigations and treatment protocols,

Table 1
Demographic information.

Demographics N	Total 1096	Not admitted to ICU 1054 (96.2%)	Admitted to ICU 42 (3.8%)	*p*-Value	Alive 1077 (98.3%)	Dead 19 (1.7%)	*p*-value
Age (years), median (IQR) [range]	41 (25–75) [0–93]	37.1 ± 16	54.8 ± 11	***p*<0.000**	38.7 ± 15.1	55.0 ± 10.1	***p*<0.000**
0–14 years	33 (3.0%)						
15–49 years	752 (68.6%)						
50–64 years	231 (21.1%)						
≥ 65 years	80 (7.3%)						
Gender				0.422			1.000
Female	208 (19.0%)	198 (95.2%)	10 (4.8%)		205 (98.6%)	3 (1.4%)	
Male	888 (81.0%)	856 (96.4%)	32 (3.6%)		872 (98.2%)	16 (1.8%)	
Body Mass Index	26.6 ± 4.6	26.8 ± 7.7	29.0 ± 5.1	***p*<0.000**	26.8 ± 5.9	33.0 ± 4.7	***p*<0.000**
WHO criteria BMI, above age 12 years old (%)	11 (1.6%)						
Underweight (<18.5)	236 (35.0%)						
Normal (18.5 –24.9)	280 (41.5%)						
Overweight (25–29.9)	147 (21.8%)						
Obese (≥ 30)							
Smoker	44 (4.0%)	39 (88.6%)	5 (11.4%)	***p*<0.023**	42 (95.5%)	2 (4.5%)	0.175
Nationality				***p*<0.001**			0.060
Bangladesh	70 (6.4%)	66 (94.3%)	4 (5.7%)		68 (97.1%)	2 (2.9%)	
Egypt	72 (6.6%)		3 (4.2%)		72 (100.0%)	0 (0.0%)	
India	527	69 (95.8%)	6 (1.1%)			4 (0.8%)	
Iran	(48.1%)		2 (8.7%)		523 (99.2%)	2 (8.7%)	
Kuwait	23 (2.1%)	521	22 (7.4%)			9 (3.0%)	
Philippines	297	(98.9%)	0 (0.0%)		21 (91.3%)	0 (0%)	
European	(27.1%)	21 (91.3%)	0(0.0%)		288 (97.0%)	0 (0.0%)	
Other	20 (1.8%)		5 (6.3%)			2 (2.5%)	
	4 (0.4%)	275			20 (100.0%)		
	80 (7.3%)	(92.6%)					
		20 (100.0%)			4 (100%)		
		4 (100.0%)			78 (97.5%)		
		75 (93.8%)					
Travel History				***p*<0.001**			***p*<0.000**
Iran	79 (7.2%)	72 (91.1%)	7 (8.9%)		79 (100.0%)	0 (0.0%)	0.214
United Kingdom	84 (7.7%)		2 (2.4%)	***p*<0.019**		2 (2.4%)	0.771
Other (Europe)	19 (1.7%)	82 (97.6%)	0 (0.0%)		82 (97.6%)	0 (0.0%)	0.427
France	13 (1.2%)		1 (7.7%)	0.359	19 (100.0%)	1 (7.7%)	0.210
Other (Asia)	24 (2.2%)	19	1 (4.2%)	0.294		0 (0.0%)	0.496
Other (Africa)	11 (1.0%)	(100.0%)	1 (9.1%)	0.701	12 (92.3%)	0 (0.0%)	0.658
United States of America	6 (0.5%)	12 (92.3%)	(0.0%)	0.412	24 (100.0%)	0 (0.0%)	***
Other (S. America)	2 (0.2%)		0 (0.0%)	0.361		0 (0.0%)	***
Saudi Arabia	4 (0.4%)	23 (95.8%)	1 (25.0%)	***	11 (100.0%)	0 (0.0%)	***
Italy	1 (0.1%)		0 (0.0%)	***		0 (0.0%)	***
Spain	3 (0.3%)	10 (90.9%)					
China	2 (0.2%)	6 (100.0%)					
Multiple	18 (1.6%)	2 (100.0%)					
None	830 (75.7%)	3 (75.0%)					
		1 (100.0%)					
		3 (100.0%)					
		1 (50.0%)					
		17 (94.4%)					
		803 (96.7%)					
			0 (0.0%)	***	6 (100.0%)	0 (0.0%)	***
			1 (50.5%)	***	2 (100.0%)	1 (50.0%)	***
			1 (5.6%)	***	4 (100.0%)	1 (5.6%)	***
			27 (3.3%)	***	1 (100.0%)	14 (1.7%)	0.834
				0.078	3 (100.0%)		
					1 (50.0%)		
					17 (94.4%)		
					816 (98.3%)		
Transmission source				***p* < 0.033**			***p* < 0.028**
Unknown	313	297 (94.9%)	16 (5.1%)		302 (96.5%)	11 (3.5%)	
Contact	518	518 (97.9%)	11 (2.1%)			4 (0.8%)	
Travel	238	224 (94.1%)	14 (5.9%)		525 (99.2%)	4 (1.7%)	
Healthcare worker	16	15 (93.8%)	1 (6.3%)			0 (0.0%)	
					234 (98.3%)		
					16 (100.0%)		

*** Reduced power due to small sample size (<10).

irrespective of disease severity (Appendix 4). In this study sample, we found an association between several risk factors and admission to the intensive care unit: namely, age above 50 years old, smoking, elevated qSOFA score, elevated CRP and PCT levels. Also, the following risk factors were identified as having a correlation with mortality in our sample: asthma, smoking and elevated PCT levels.

The median age for our sample was lower (41 years old), compared to the two other large retrospective cohort studies from China [11] (47 years old) and New York City [2] (63 years old). This is likely a result of our sample encompassing a large cohort of patients who were asymptomatic and were only identified as being COVID-19 positive due to the mass screening efforts of the Kuwaiti government for

Table 2
Clinical characteristics on initial hospital presentation.

Clinical characteristics *N*	Total 1096	Not admitted to ICU 1054 (96.2%)	Admitted to ICU 42 (3.8%)	*p*-Value	Alive 1077 (98.3%)	Dead 19 (1.7%)	*p*-value
Symptoms							
None	508 (46.3%)	508 (100%)	0 (0.0%)	***p*<0.000**	508 (100%)	0 (0.0%)	***p*<0.000**
Cough	314 (28.6%)	291 (92.7%)	23 (7.2%)	***p*<0.001**	301 (95.9%)	13 (4.1%)	***p*<0.000**
Chills	308 (28.1%)	286 (93.0%)	22 (7.1%)	***p*<0.000**	297 (96.4%)	11 (3.6%)	***p*<0.002**
Sore throat	129 (11.8%)	125 (96.9%)	4 (3.1%)	0.657	127 (98.4%)	2 (1.6%)	0.875
Myalgias/arthralgias	75 (6.8%)	71 (94.7%)	4 (5.3%)	0.483	73 (97.3%)	2 (2.7%)	0.521
Headache	70 (6.4%)	69 (98.6%)	1 (1.4%)	0.279	69 (98.2%)	1 (1.4%)	0.840
Fatigue	38 (3.5%)	35 (92.1%)	3 (7.9%)	0.184	36 (94.7%)	2 (5.3%)	0.090
Shortness of breath	30 (2.7%)	18 (60.0%)	12 (40.0%)	***p*<0.000**	22 (73.3%)	8 (26.7%)	***p*<0.000**
Nasal congestion	27 (2.5%)	27 (100.0%)	0 (0.0%)	0.294	27 (100.0%)	0 (0.0%)	0.485
Sputum production	24 (2.2%)	18 (75.0%)	6 (25.0%)	***p*<0.000**	22 (91.7%)	2 (8.3%)	0.120
Nausea and/or vomiting	18 (1.6%)	16 (88.9%)	2 (11.1%)	0.105	18 (100.0%)	0 (0.0%)	0.570
Diarrhea	16 (1.5%)	15 (93.8%)	1 (6.3%)	0.612	16 (100.0%)	0(0.0%)	0.521
Conjunctival congestion	1 (0.1%)	0 (0.0%)	1 (0.0%)	***	1 (100.0%)	0 (0.0%)	***
Hemoptysis	1 (0.1%)	1 (0.0%)	0 (0.0%)	***	1 (100.0%)	0 (0.0%)	***
Anosmia	1 (0.1%)	1 (100.0%)	0 (0.0%)	***	1 (100.0%)	1 (100.0%)	***
Other	44 (4.0%)	36 (81.8%)	8 (18.2%)	***p*<0.000**	40 (90.9%)	4 (9.1%)	***p*<0.000**
Duration of symptoms prior to initial presentation (days), median (IQR) [range]	3 (0–6) [0–21]	-	-	-	-	-	**-**
Signs of Infection							
None	654 (59.7%)	644 (98.5%)	10 (1.5%)	***p*<0.000**	652 (99.7%)	2 (0.3%)	***p*<0.000**
Throat congestion	27 (2.5%)	26 (96.3%)	1 (3.7%)	0.972	27 (100.0%)	0 (0.0%)	0.485
Lymphadenopathy	0 (0.0%)	0 (0.0%)	0 (0.0%)	***	***	***	***
Tonsillar swelling	0(0.0%)	0 (0.0%)	0 (0.0%)	***	***	***	***
Other	39 (3.6%)	31 (79.5%)	8 (20.5%)	***p*<0.000**	33 (84.6%)	6 (15.4%)	***p*<0.000**
Comorbidities							
None	761 (69.4%)	750 (98.6%)	11 (1.4%)	***p*<0.000**	757 (99.5%)	4 (0.5%)	***p*<0.000**
Hypertension	177 (16.1%)	160 (90.4%)	17 (9.6%)	***p*<0.000**	169 (95.5%)	8 (4.5%)	***p*<0.002**
Diabetes mellitus	155 (14.1%)	137 (88.4%)	18 (11.6%)	***p*<0.000**	149 (96.1%)	6 (3.9%)	***p*<0.028**
Dyslipidemia	65 (5.9%)	58 (89.2%)	7 (10.8%)	***p*<0.003**	62 (95.4%)	3 (4.6%)	0.066
Asthma	43 (3.9%)	37 (86.0%)	6 (14.0%)	***p*<0.000**	39 (90.7%)	4 (9.3%)	***p*<0.000**
Coronary artery disease/ischemic heart disease	41 (3.7%)	33 (80.5%)	8 (19.5%)	***p*<0.000**	36 (87.8%)	5 (12.2%)	***p*<0.000**
Hypothyroidism	25 (2.3%)	22 (88.0%)	3 (12.0%)	***p*<0.031**	24 (96.0%)	1 (4.0%)	**0.380**
Cancer	14 (1.3%)	13 (92.9%)	1 (7.1%)	0.516	14 (100.0%)	0 (0.0%)	**0.617**
Chronic renal disease	11 (1.0%)	8 (72.7%)	3 (27.3%)	***p*<0.000**	8 (72.7%)	3 (27.3%)	***p*<0.000**
Cerebrovascular disease	7 (0.6%)	6 (85.7%)	1 (14.3%)	***	7 (100.0%)	0 (0.0%)	***
Hepatitis	6 (0.5%)	5 (83.3%)	1 (16.7%)	***	5 (83.3%)	1 (16.7%)	***
Chronic obstructive pulmonary disease	5 (0.5%)	3 (60.0%)	2 (40.0)	***	4 (80.0%)	1 (20.0%)	***
Recent surgery (30 days prior to initial presentation)	4 (0.4%)	4 (100.0%)	0 (0.0%)	***	4 (100.0%)	0 (0.0%)	***
Immunodeficiency	1 (0.1%)	1(0.0%)	0 (0.0%)	***	1 (100.0%)	0 (0.0%)	***
Other	32 (2.9%)	27 (84.4%)	5 (15.6)	***	29 (90.6%)	3 (9.4%)	***
Pregnancy	3 (0.3%)	3 (100.0%)	0 (0.0%)	***	3 (100.0%)	0 (0.0%)	***
Vital signs on admission							
Heart Rate (beats per minute)	87.0 ± 12.5	87.0 ± 13	91.3 ± 15	***p*<0.001**	86.2 ± 13	93.2 ± 18	***p*<0.000**
Systolic Blood Pressure (mmHg)	127.9 ± 16.5	124.3 ± 21	128.1 ± 19	***p*<0.000**	125.4 ± 20	126.2 ± 22	***p*<0.000**
Diastolic Blood Pressure (mmHg)	79.1 ± 9.8	77.2 ± 13	72.6 ± 14	***p*<0.000**	77.9 ± 13	71.0 ± 16	***p*<0.000**
Respiratory Rate (breaths per minute)	20.8 ± 1.8	20.9 ± 2.1	23.4 ± 6.1	***p*<0.000**	20.9 ± 1.9	23.4 ± 8.6	***p*<0.000**
Temperature (°C)	36.9 ± 0.5	36.9 ± 1.1	37.1 ± 0.8	***p*<0.000**	36.9 ± 0.4	37.2 ± 0.8	***p*<0.000**
Glasgow Coma Scale	15±1.9	15±0.6	11±5.5	***p*<0.000**	15±0.0	10±6	***p*<0.000**
qSOFA score	691 (63.0%)	677 (98.0%)	14 (2.0%)	***p*<0.000**	685 (99.1%)	6 (0.9%)	***p*<0.000**
0	372 (33.9%)	351 (94.4%)	21 (5.6%)	***p*<0.000**	375 (98.1%)	7 (1.9%)	***p*<0.000**
1	33 (3.0%)	26 (78.8%)	7 (21.2%)	***p*<0.000**	27 (81.8%)	6 (18.2%)	***p*<0.000**
2	7 (0.6%)	1 (14.3%)	6 (85.7%)		2 (28.6%)	5 (71.4%)	
Required vasopressors on admission	9 (0.8%)	0 (0.0%)	9 (100.0%)		2 (22.2%)	7 (77.8%)	
Intubated on admission							

*** Reduced power due to small sample size (<10).

incoming travelers. This may also account for the large proportion of patients with a history of recent travel in our cohort (21.7%). Only 19% of our study's patients were female, which is lower but in keeping with findings by Guan et al. [1] and Richardson et al. [2], who also reported a lower admission rate for women compared to men (41.9% and 39.7%, respectively). A contributing factor to the lower proportion of women in our study sample, may be the high rates of COVID-19 detected in manual laborer of Indian ethnicity, who tend to be both male and younger. An outbreak in two main epicenters, *Al-Jileeb* and *Mahboula* areas in Kuwait, both of which house high concentrations of Indian male manual laborers may also account for the large proportion of young, male, Indian patients in our study sample (48.1%) [8]. Also, South Asian ethnicity and lower socio-economic state have been hypothesized to be associated with higher rates of COVID-19 and poorer outcomes, based on epidemiological observations [9]. The mean BMI for our sample was 26.6 kg/m^2, with 41.5% of patients in the overweight category, which is reflective of the normal weight demographics in Kuwait [10].

As reported by other studies [11], hypertension (16.1%) and diabetes mellitus (14.1%) were the most common co-morbidities in our cohort. For symptomatic patients, the most common symptom was cough (57.5%), which is in keeping with several other retrospective cohort studies [1–3,12,13]. Interestingly, almost half of our sample were asymptomatic on admission (46•3%) and had no signs of infection on clinical examination (59.7%). This rate is consistent with findings from a recent narrative review which approximated that 40–45% of those infected with SARS-CoV-2 are asymptomatic [14]. This may explain why most of our patient population had a

Table 3
Laboratory findings on initial hospital presentation.

Laboratory findings N	Total 1096	Not admitted to ICU 1054 (96.2%)	Admitted to ICU 42 (3.8%)	*p*-Value	Alive 1077 (98.3%)	Dead 19 (1.7%)	*p*-value
Full blood count							
White blood count (10^9/L)	6.3 ± 2.4	6.1 ± 2.1	6.61±2.7	0.263	6.1 ± 2.1	8.4 ± 3.1	***p*<0.000**
Neutrophils (%)	56.4 ± 14	55.7 ± 13	72.5 ± 13	***p*<0.000**	56±13	76±15	***p*<0.000**
Lymphocytes (%)	31±13	32.3 ± 12	18.5 ± 10	***p*<0.000**	32±12	15±11	***p*<0.000**
Monocytes (%)	9.3 ± 4.0	9.7 ± 3.9	8.13±6.0	***p*<0.011**	9.7 ± 3.9	8.4 ± 8.3	0.152
Eosinophils (%)	1.6 ± 2.4	1.6 ± 2.2	0.7 ± 1.2	***p*<0.006**	1.6 ± 2.2	0.7 ± 1.4	0.083
Hemoglobin (g/L)	140±19	143±17	128±20	***p*<0.000**	143±17	127±25	***p*<0.000**
Red Cell Distribution Width (%)	14.1 ± 76	14.4 ± 19	13.9 ± 2	0.883	14.4 ± 19	14.2 ± 3.0	0.962
Platelets	241±76	239±75	201±79	***p*<0.001**	238±75	214±98	0.162
Coagulation Profile							
Prothrombin time (seconds)	13±2.1	24±2.3	13±2.1	***p*<0.007**	13±2.1	15±3.1	***p*<0.003**
Activated Partial Thromboplastin Time (seconds)	32±6.5	31±3.2	36±6.5	***p*<0.000**	32±3.3	36±8.3	***p*<0.000**
International Normalized Ratio	0.99±0.2	0.98±0.2	1.06±0.2	***p*<0.007**	0.98±0.2	1.11±0.2	***p*<0.003**
Biochemical Profile							
C-Reactive Protein (mg/L)	26±59	17±31	121±120	***p*<0.000**	18±34	162±151	***p*<0.000**
Procalcitonin (ng/mL)	0.98±10.0	0.41±5.2	0.79±1.9	0.639	162±151	0.4 ± 5.1	0.405
Glucose (mmol/L)	6.5 ± 2.9	6.4 ± 2.8	8.3 ± 3.5	***p*<0.000**	1.41±2.7	6.4 ± 2.8	***p*<0.021**
Urea (mmol/L)	4.0 ± 2.4	3.7 ± 1.7	7.0 ± 5.5	***p*<0.000**	8.0 ± 3.5	3.8 ± 1.8	***p*<0.000**
Creatinine (μmol/L)	83.6 ± 170	76.8 ± 36	98.7 ± 45	***p*<0.000**	8.5 ± 6.5	77.1 ± 36	***p*<0.000**
Estimated Glomerular Filtration Rate (mL/mins/1.73m^2)	100.0 ± 27	103±19	79±28	***p*<0.000**	103±19	54±19	***p*<0.000**
Magnesium (mmol/L)	1.0 ± 4.0	1.1 ± 4.8	0.8 ± 0.1	0.707	1.1 ± 4.8	0.9 ± 0.1	0.829
Sodium (mmol/L)	137±6.9	137±3.0	136±4.5	0.097	137±3.0	137±4.8	0.525
Potassium (mmol/L)	4.2 ± 3.6	4.3 ± 0.5	4.1 ± 0.5	0.763	4.3 ± 4.2	4.2 ± 0.4	0.927
Total Protein (g/L)	67.6 ± 8.3	68.5 ± 7.2	62.2 ± 6.6	***p*<0.000**	68.3 ± 7.2	60.6 ± 6.3	***p*<0.000**
Albumin (g/L)	39±6.3	39±5.1	30±6.2	***p*<0.000**	39.1 ± 5.2	23.0 ± 7.8	***p*<0.000**
Alkaline Phosphatase (IU/L)	73±41.6	68±31.8	73±36	0.298	67±31.7	88±44	***p*<0.012**
Alanine Aminotransferase (IU/L)	37±138	33±32	52±73	***p*<0.000**	32±32	68±98	***p*<0.000**
Aspartate Aminotransferase (IU/L)	43±371	30±20	65±92	***p*<0.000**	68±98	31±23	***p*<0.000**
Gamma-Glutamyl Transferase (IU/L)	31±32	29±28	75±77	***p*<0.000**	76±107	30±30	***p*<0.000**
Total Bilirubin (μmol/L)	13.1 ± 7.7	13.0 ± 6.2	19.5 ± 21.4	***p*<0.000**	12.8 ± 6.4	21.7 ± 22	***p*<0.000**
Direct Bilirubin (μmol/L)	2.8 ± 3.8	2.4 ± 1.8	7.7 ± 13.7	***p*<0.000**	2.4 ± 1.8	12.4 ± 20	***p*<0.000**
Adjusted Calcium (mmol/L)	2.3 ± 0.2	2.3 ± 0.2	2.3 ± 0.1	0.412	2.3 ± 0.1	2.3 ± 0.1	0.856
HCO_3 (meq/L)	24.9 ± 4.1	25.4 ± 2.3	24.5 ± 2.3	0.117	25.6 ± 33	25.4 ± 2.3	0.133
D-Dimer (mg/mL)	637±1511	259±206	1357±1392	***p*<0.000**	4.7 ± 11	263±207	***p*<0.000**

***Reduced power due to small sample size (<10).

temperature within normal range (Supplementary Table 8), which is in stark contrast to the other retrospective cohort studies in COVID-19 patients which reported much higher rates (Richardson et al. [2], 30.7%, Guan et al. [1], 59.2%, Wu et al. 38.3% [12] above 39 °C, Zhou [3] et al. 94% above 37.3 °C), as almost all their patients were symptomatic. As a result, we believe our study sample provides a more accurate portrayal of the clinical manifestations of COVID-19 in a general population. Our findings also raise the question of whether fever is an effective screening tool for COVID-19.

Most of the laboratory findings were within the normal reference range in our study, probably secondary to the mild disease present in most of the cases (Supplementary Table 9). Interestingly, a large proportion of patients had sodium and calcium levels below the reference range on admission (28.7% and 20.6%, respectively). Hong et al. [15] recently reported similar findings, where 50% of COVID-19 patients they examined had hyponatremia and hypokalemia and they suggested there was a correlation with the degree of renal injury in those patients. Similarly, Sun et al. [16] found high rates of hypocalcemia (74.7%) in their COVID-19 patient population, on admission. Elevated CRP, D-dimer and PCT levels were present in a large percentage of patients, as noted by other studies [17–19]. Further studies are needed to determine whether they can be used as a surrogate for monitoring disease severity and resolution. Additionally, prothrombin levels below the reference range were present in over half our study population (53.4%). The implications of this findings are unclear, but we hypothesize it may be related the procoagulant state that is thought to occur in COVID-19 patients [20]. As almost all our patients had a chest x-ray on admission, we determined that 76.3% patients either had a normal chest-ray or benign findings such as prominent broncho-vascular markings, as reported by a radiologist. Conversely, Wong et al. reported that in a cohort of 64 patients they studied, only 31% of COVID-19 had normal initial chest x-ray [21]. Of our patients with abnormal chest x-ray findings, 16.6% had unilateral local patchy shadowing or opacification, as the most common pathological finding.

Most of our patient cohort did not experience any adverse events (90.1%). As other studies have shown, pneumonia and ARDS were the most common complication of COVID-19[12]. As a result, the most prescribed medications were antibiotics (13.8%). Of note, 27.9% of patients received no medications and 68.2% received 'other' treatments. 'Other treatments' consisted of supportive medications such as paracetamol and ibuprofen and vitamin supplements, such as vitamin C and D, as well as prophylactic anticoagulation, as outlined in Kuwait's Ministry of Health COVID-19 protocols (Appendix 4).

The median length of hospital stay was 18 days (IQR 13–24) for our study sample. This was longer that the median length of stay observed in similar studies [1,2]. In addition, the length of stay was longer in older patients, above 65 years of age in our sample (24 days, IQR 18–31). This may reflect the stringent discharge criteria at our center (2 consecutive nasopharyngeal swabs, 24 h apart after symptom resolution). Despite the prolonged median length of hospital stay for most of our patients, 88.2% were discharged alive at the study cutoff date, 90•1% of patients had no reported adverse events during their admission, 3.6% required an ICU admission and only 1.7% died. This may reflect the young age of our study population and the fact that our cohort included a large portion of asymptomatic patients. Our mortality rates and admission rates are similar to Guan et al. [1] (mortality, 1.4% and ICU admission, 5%), but much lower than the other large retrospective cohort studies (Wu et al. [12], 21.9% mortality, 26.4% ICU admission, Zhou et al. [3], 28.3% mortality,

Table 4
Radiographic findings on initial hospital presentation.

Radiographic findings *N*	Total 1096	Not admitted to ICU 1054 (96.2%)	Admitted to ICU 42 (3.8%)	*p*-Value	Alive 1077 (98.3%)	Dead 19 (1.7%)	*p*-value
Abnormalities on chest radiograph							
None	362 (33%)	361 (99.7%)	1 (0.3%)	***p*<0.000**	361 (99.7%)	1 (0.3%)	***p*<0.005**
Prominent broncho-vascular markings	475 (43.3%)	458 (96.4%)	17 (3.6%)	0.703	471 (99.2%)	4 (0.8%)	***p*<0.048**
Unilateral local patchy shadowing or opacification	182 (16.6%)	167 (91.8%)	15 (8.2%)	***p*<0.001**	178 (97.8)	4 (2.2%)	0.599
Diffuse opacification or bilateral patchy shadowing	90 (8.2%)	68 (75.6%)	22 (24.4%)	***p*<0.000**	78 (86.7%)	12 (13.3%)	***p*<0.000**
Consolidation	17 (1.6%)	9 (52.9%)	8 (47.1%)	***p*<0.000**	13 (76.5%)	4 (23.5%)	***p*<0.000**
Ground glass opacity	3 (0.3%)	2 (66.7%)	1 (33.3%)	***	3 (100.0%)	0 (0.0%)	***
Pleural effusion	2 (0.2%)	1 (50.0%)	1 (50.0%)	***	2 (100.0%)	0 (0.0%)	***
Interstitial abnormalities	1 (0.1%)	1 (100.0%)	0 (0.0%)	***	1 (100.0%)	0 (0.0%)	***
Cardiomegaly	5 (0.5%)	3 (60.0%)	2 (40.0%)	***	16 (94.1%)	1 (5.9%)	***
Other	17 (1.6%)	14 (82.4%)	3 (17.6%)	***	16 (94.1%)	1 (5.9%)	***
Abnormalities on chest CT scan							
None	54 (76.1%)	52 (96.3%)	2 (3.7%)	***p*<0.000**	53 (98.1%)	1 (1.9%)	0.946
Ground glass opacity	11 (15.4%)	4 (36.4%)	7 (63.6%)	***p*<0.000**	10 (90.9%)	1 (9.1%)	0.060
Local patchy shadowing or opacification	2 (2.8%)	1 (50.0%)	1 (50.0%)	***	2 (100%)	0 (0.0%)	***
Other	4 (5.6%)	3 (75.0%)	1 (25.0%)	***	3 (75.0)	1 (25.0%)	***

*** Reduced power due to small sample size (<10).

Table 5
Treatments, adverse events and clinical outcomes during hospital admission.

Treatments, adverse events, outcomes *N*	Total 1096	Not admitted to ICU 1054 (96.2%)	Admitted to ICU 42 (3.8%)	*p*-Value	Alive 1077 (98.3%)	Dead 19 (1.7%)	*p*-value
Treatments							
None	306	306	0	***p*<0.000**	306	0	***p*<0.000**
Antibiotics	(27.9%)	(100%)	(0.0%)	***p*<0.000**	(100.0%)	(0.0%)	***p*<0.000**
Antivirals	151	109	42	***p*<0.000**	134	17	***p*<0.000**
Hydroxychloroquine	(13.8%)	(72.2%)	(27.8%)	***p*<0.000**	(88.7%)	(11.3%)	***p*<0.000**
Admission to intensive care unit	78 (7.1%)	43 (55.1%)	35 (44.9%)	***p*<0.000**	64 (82.1%)	14 (17.9%)	***p*<0.000**
Oxygen therapy	45	31	12	***p*<0.000**	40	5	***p*<0.000**
Mechanical ventilation	(4.1%)	(68.9%)	(26.7%)	***p*<0.000**	(88.9%)	(11.1%)	***p*<0.000**
Systemic glucocorticoids	40	0	40	***p*<0.000**	24	16	0.204
Antifungals	(3.6%)	(0.0%)	(100.0%)	***p*<0.000**	(60.0%)	(40.0%)	***
Extracorporeal membrane oxygenation (ECMO)	35 (3.2%)	8 (22.9%)	27 (77.1%)	***	27 (77.1%)	8 (22.9%)	***
Continuous renal replacement therapy	31	0	31	***	18	13	***
Non-invasive ventilation	(2.8%)	(0.0%)	(100.0%)	***	(58.1%)	(41.9%)	***
Other	13 (1.2%)	6 (46.2%)	7 (53.8%)	***p*<0.021**	12 (92.3%)	1 (7.7%)	0.398
	8 (0.7%)	2 (25.0%)	6 (75.0%)		4 (50.0%)	4 (50.0%)	
	8 (0.7%)	0 (0.0%)	8 (100.0%)		6 (75.0%)	2 (25.0%)	
	5 (0.5%)	1 (20.0%)	4 (80.0%)		3 (60.0%)	2 (40.0%)	
	4 (0.4%)	2 (50.0%)	2 (50.0%)		4 (100.0%)	0 (0.0%)	
	748	726	22		736	12	
	(68.2%)	(97.1%)	(2.9%)		(98.4%)	(1.6%)	
Adverse events – no. (%)							
None	987	985	2	***p*<0.000**	984	3	***p*<0.000**
Physician-diagnosed pneumonia	(90.1%)	(99.8%)	(0.2%)	***p*<0.000**	(99.7%)	(0.3%)	***p*<0.000**
Acute respiratory distress syndrome	78	44	34	***p*<0.000**	67	11	***p*<0.000**
Acute kidney injury	(7.1%)	(56.4%)	(43.6%)	***p*<0.000**	(85.9%)	(14.1%)	***p*<0.000**
Septic shock	31	0	31	***	18	13	***
Disseminated intravascular coagulation	(2.8%)	(0.0%)	(100.0%)	***	(58.1%)	(41.9%)	***
Encephalopathy/encephalitis	14 (1.3%)	3 (21.4%)	11 (78.6%)	***	8 (57.1%)	6 (42.9%)	***
Other	7 (0.6%)	0 (0.0%)	7 (100.0)	***p*<0.015**	2 (28.6%)	5 (71.4%)	***p*<0.001**
	3 (0.3%)	1 (33.3%)	2 (66.7%)		2 (66.7%)	1 (33.3%)	
	1 (0.1%)	0 (0.0%)	1 (100.0%)		0 (0.0%)	1 (100.0%)	
	26 (2.4%)	22 (84.6%)	4 (15.4%)		22 (84.6%)	4 (15.4%)	
Clinical outcomes at study cutoff date				***p*<0.000**			***p*<0.000**
Discharged alive	967	960	6		967	0	
Died	(88.2%)	(99.4%)	(0.6%)		(100.0%)	(0.0%)	
Hospitalized, in ICU	19 (1.7%)	2 (10.5%)	17 (89.5%)		0 (0.0%)	19 (100.0%)	
Hospitalized being actively treated	19 (1.7%)	0 (0.0%)	19 (100.0%)		19 (100.0%)	0 (0.0%)	
Hospitalized not receiving active treatment	26	27	0		26	0	
	(2.4%)	(100.0%)	(0.0%)		(100.0%)	(0.0%)	
	65	65	0		65	0	
	(5.9%)	(100.0%)	(0.0%)		(100.0%)	(0.0%)	
Length of hospital stay – median, (IQR) [range]	18 (13–24) [2–64]	–	–	–	–	–	–
For all patients	17 (13–20) [3–41]						
By age	17 (13–23) [2–64]						
<18 years old	24 (18–31) [8–64]						
18–65 years old							
>65 years old							

*** Reduced power due to small sample size (<10).

Table 6
Clinical outcomes for patients at study cutoff date by age.

	Discharged alive			Died			Still in hospital		
	<18	18–65	>65	<18	18–65	>65	<18	18–65	>65
Admitted to ICU (no./no. total no.) (%)	0/37 (0.0)	4/876 (0.5)	2/54 (3.7)	0/0 (0.0)	13/15 (86.7)	4/4 (100.0)	1/5 (20.0)	14/89 (15.7)	4/16 (25.0)
Required mechanical ventilation (no./total no.) (%)	0/37 (0.0)	2/876 (0.2)	0/54 (0.0)	0/0 (0.0)	9/15 (60.0)	4/4 (100.0)	1/5 (20.0)	11/89 (12.4)	4/16 (25.0)
Extracorporeal membrane oxygenation (ECMO) (no./total no,) (%)	0/37 (0.0)	0/876 (0.0)	0/54 (0.0)	0/0 (0.0)	2/15 (13.3)	0/4 (0.0)	0/5 (0.0)	4/89 (4.5)	2/16 (12.5)
Acute Respiratory Distress Syndrome (ARDS) (no./total no.) (%)	0/37 (0.0)	2/876 (0.2)	1/54 (1.9)	0/0 (0.0)	9/15 (60.0)	4/4 (100.0)	1/5 (20.0)	10/89 (11.2)	4/6 (25.0)
Physician-diagnosed pneumonia (no./total no.) (%)	2/37 (5.4)	30/876 (3.4)	10/54 (18.5)	0/0 (0.0)	8/15 (53.3)	3/4 (75.0)	1/5 (20.0)	20/89 (22.5)	4/6 (25.0)

26% ICU admission and Richardson et al. [2]). This may reflect that the study by Guan et al. [1], was one of the earliest COVID-19 retrospective cohort studies so the included patients may have had milder symptoms, compared to studies that were published later, when health resources became more limited.

Multivariable analysis, demonstrated an association between mortality and being a smoker, having asthma and elevated PCT levels. There was also an association between ICU admission and age above 50 years old, a qSOFA above 0, smoking, elevated CRP levels and elevated PCT levels. Interestingly, being a smoker and raised PCT levels were the only factors found to be correlated with both mortality and ICU admission. Both factors have also been associated with unfavorable outcomes by other recent studies and systematic reviews [22–24]. Controversy exists, however, surrounding the role smoking may play in reducing rate of contracting COVID-19 but increasing the severity of the disease once infected, and is still a subject of major debate [25,26]. In addition, the fact the an elevated PCT correlates with bacterial, and not viral, sepsis suggests that patients with severe disease might additionally have an element of bacterial pneumonia. Similarly, several studies have found a correlation between older age [2,12,27] and elevated CRP levels [15–17] and poor outcomes. High qSOFA and SOFA score was found to be correlated with death by Zhou et al. [3]. Our findings did not find an association between qSOFA score and death, but we did find a correlation with ICU admission. This may be due to the small number of deaths in our sample. Although an association between asthma and poor outcomes has been suggested by some authors [28,29], we did not find any other studies that have reported this.

Table 7
Multivariable analysis of factors associated with mortality or admission to intensive care.

	Multivariable odds ratio			
	(95% CI)	Lower CI	Upper CI	*p*-value
Mortality				
Age >50 years old	3.034	0.582	15.811	0.188
Obesity	0.223	0.033	1.513	0.223
Diabetes Mellitus	0.831	0.166	4.164	0.822
Hypertension	0.837	0.462	4.812	0.841
Asthma	4.92	1.03	23.44	**0.046**
Chronic Renal Disease	2.085	0.270	16.076	0.481
Smoker	10.09	1.22	83.40	**0.032**
qSOFA score > 0	2.968	0.831	10.605	0.094
Elevated procalcitonin	8.24	1.95	34.74	**0.004**
Elevated CRP	6.880	0.615	76.911	0.117
Admission to Intensive Care				
Age >50 years old	2.88	1.05	7.95	**0.041**
Obesity	2.883	0.938	5.954	0.068
Diabetes Mellitus	2.287	0.799	6.550	0.123
Hypertension	0.592	0.198	1.767	0.347
Asthma	1.446	0.383	5.455	0.586
Chronic Renal Disease	0.494	0.062	3.945	0.494
Smoker	5.86	1.40	24.47	**0.015**
qSOFA score > 0	2.798	1.25	6.26	**0.012**
Elevated CRP	9.08	1.97	41.95	**0.005**
Elevated procalcitonin	7.00	2.79	17.59	**0.000**

Most of the limitations in our study are due to its retrospective nature, such as potential loss of data due to omissions. In addition, although we were able to obtain the patients' previous medical data and co-morbidities from the electronic medical records, there were a few cases where this data was based on patient self-reporting and/or diagnosed using laboratory results during their admission. Also, as the number of COVID-19 cases escalated, the guidelines for its treatments and discharge/diagnostic criteria slightly evolved over time, which may have implications on our results. At the end of the study, some patients remained hospitalized (10%) and their clinical course is still unclear. Finally the relatively small number of patients with adverse events (admission to ICU and mortality) in this study limits the statistical power of the analysis.

This study is, to our knowledge, the first comprehensive study to provide data on the initial 1096 consecutive COVID-19 cases of an entire country, all admitted to a single center, undergoing the same investigations and treatment protocols. We believe it gives a different perspective on the nature and clinical course of this novel disease, compared to other large retrospective cohort studies, as it includes patients with a wide spectrum of disease severity. Future studies, directed at further characterizing risk factors for disease severity and outcomes, particularly predictive scoring systems, are needed.

Declaration of Competing Interest

The author Sulaiman Almazeedi declares having no conflicts of interest or financial ties to disclose.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.eclinm.2020.100448.

References

[1] Guan W-J, Ni Z-Y, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020. doi: 10.1056/NEJMoa2002032.
[2] Richardson S, Hirsch JS, Narasimhan M, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. JAMA 2020. doi: 10.1001/jama.2020.6775.
[3] Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet 2020. doi: 10.1016/S0140-6736(20)30566-3.
[4] World Health Organization. Clinical management of severe acute respiratory infection when novel coronavirus (nCoV) infection is suspected. WHO; 2020.
[5] Seymour CW, Liu VX, Iwashyna TJ, et al. Assessment of clinical criteria for sepsis for the third international consensus definitions for sepsis and septic shock (sepsis-3). J Am Med Assoc 2016. doi: 10.1001/jama.2016.0288.
[6] WHO. Mean body mass index (BMI). WHO; 2017.
[7] Jamal MH, Doi S, Al Youha S, et al. Predicting disease progression in COVID19: a score based on lab tests at time of diagnosis. medRxiv 2020. doi: 10.1101/2020.05.05.20088906.
[8] F. Al-Ghimlas. Personal communication: department of public health. 2020.
[9] Khunti K, Singh AK, Pareek M, Hanif W. Is ethnicity linked to incidence or outcomes of covid-19? BMJ 2020. doi: 10.1136/bmj.m1548.
[10] Weiderpass E, Botteri E, Longenecker JC, et al. The prevalence of overweight and obesity in an adult Kuwaiti population in 2014. Front Endocrinol (Lausanne)2019. doi: 10.3389/fendo.2019.00449.
[11] Singh AK, Gupta R, Misra A. Comorbidities in COVID-19: outcomes in hypertensive cohort and controversies with renin angiotensin system blockers. Diabetes Metab Syndr Clin Res Rev 2020. doi: 10.1016/j.dsx.2020.03.016.
[12] Wu C, Chen X, Cai Y, et al. Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 Pneumonia in Wuhan, China. JAMA Intern Med 2020. doi: 10.1001/jamainternmed.2020.0994.
[13] Chen Q, Zheng Z, Zhang C, et al. Clinical characteristics of 145 patients with corona virus disease 2019 (COVID-19) in Taizhou, Zhejiang, China. Infection 2020. doi: 10.1007/s15010-020-01432-5.
[14] Oran DP, Topol EJ. Prevalence of asymptomatic SARS-CoV-2 infection. Ann Intern Med 2020 M20−3012.
[15] Hong X, Chi Z, Liu G, et al. Analysis of early renal injury in COVID-19 and diagnostic value of multi-index combined detection. medRxiv 2020. doi: 10.1101/2020.03.07.20032599.
[16] Sun Jia-Kui, Zhang Wen-Hao, Zou Lei, Liu Ying, Li Jing-Jing, Kan Xiao-Hua, Dai Lian, Shi Qian-Kun, Yuan Shou-Tao, Yu Wen-Kui, Xu Hong-Yang, Wei Gu J-WQ. Serum calcium as a biomarker of clinical severity and prognosis in patients with coronavirus disease 2019: a retrospective cross-sectional study. Crit Care Emerg Med 2020 published online March 18. doi: 10.21203/RS.3.RS-17575/V1.
[17] Wang L. C-reactive protein levels in the early stage of COVID-19. Med Mal Infect 2020. doi: 10.1016/j.medmal.2020.03.007.
[18] quan Li L, Huang T, Wang Y qing, et al. COVID-19 patients' clinical characteristics, discharge rate, and fatality rate of meta-analysis. J Med Virol 2020;92:577–83.
[19] Lagunas-Rangel FA. Neutrophil-to-lymphocyte ratio and lymphocyte-to-C-reactive protein ratio in patients with severe coronavirus disease 2019 (COVID-19): a meta-analysis. J Med Virol 2020. doi: 10.1002/jmv.25819.
[20] Ranucci M, Ballotta A, Di Dedda U, et al. The procoagulant pattern of patients with COVID-19 acute respiratory distress syndrome. J Thromb Haemost 2020. doi: 10.1111/jth.14854.
[21] Wong HYF, Lam HYS, Fong AHT, et al. Frequency and distribution of chest radiographic findings in COVID-19 positive patients. Radiology 2019. doi: 10.1148/radiol.2020201160.
[22] Zhang G, Hu C, Luo L, et al. Clinical features and short-term outcomes of 221 patients with COVID-19 in Wuhan, China. J Clin Virol 2020. doi: 10.1016/j.jcv.2020.104364.
[23] Vardavas CI, Nikitara K. COVID-19 and smoking: a systematic review of the evidence. Tob Induc Dis 2020. doi: 10.18332/tid/119324.
[24] Brake SJ, Barnsley K, Lu W, McAlinden KD, Eapen MS, Sohal SS. Smoking upregulates angiotensin-converting enzyme-2 receptor: a potential adhesion site for novel coronavirus SARS-CoV-2 (Covid-19). J Clin Med 2020. doi: 10.3390/jcm9030841.
[25] Farsalinos K, Barbouni A, Niaura R. Systematic review of the prevalence of current smoking among hospitalized COVID-19 patients in China: could nicotine be a therapeutic option? Intern Emerg Med 2020. doi: 10.1007/s11739-020-02355-7.
[26] Rossato M, Russo L, Mazzocut S, Di Vincenzo A, Fioretto P, Vettor R. Current smoking is not associated with COVID-19. Eur Respir J 2020. doi: 10.1183/13993003.01290-2020.
[27] Grasselli G, Zangrillo A, Zanella A, et al. Baseline Characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the Lombardy Region, Italy. J Am Med Assoc 2020. doi: 10.1001/jama.2020.5394.
[28] Abrams EM, Jong Geert W't, Yang CL. Asthma and COVID-19. Can Med Assoc J 2020 cmaj.200617.
[29] Hegde S. Does asthma make COVID-19 worse? Nat Rev Immunol 2020 1−1.