Demographic and Clinical Features Association With Mortality in Patients With COVID-19: A Cross-Sectional Study in the West of Iran

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Abstract- The coronavirus disease 2019 (COVID-19) pandemic as an emergency public health concern has caused hundreds of thousands of deaths in the world. Identifying predictors of death in COVID-19 patients is a key to improving survival and helping patients triage, better management, and assist physicians and health care. The present study was conducted on 512 positive COVID-19 patients confirmed by real-time PCR hospitalized in Sina Hospital, Hamadan, in 2020. The data of demographic characteristics, clinical manifestations, laboratory findings, chest examination, and disease outcome were collected. The logistic regression model was performed to explore the predictors of in-hospital mortality. Among 512 patients, 57 (11.1%) deaths have occurred. The adjusted odds ratios (OR) estimate of death in COVID-19 for patients with age more than 60 years versus those lower than 60 years was 3.15 (95% CI: 1.06, 9.37). The adjusted OR estimate of death in patients with hypertension comorbidity versus those with no comorbidity was 3.84 (95% CI: 1.27, 11.59). In addition, the adjusted OR estimate (95% CI) of death in patients with respiratory rate above 30 per minute, BUN >20 mg/dL, LDH >942 U/L and SGOT >45 U/L against lower than those values was respectively 10.72 (1.99, 57.68), 5.85 (2.19, 15.63), 13.42 (2.17, 83.22) and 2.86 (1.02, 8.05). The risk of death was higher among the patients with multiple comorbidity diseases, systolic BP lower than 90 mmHg, SPO2 lower than 88 and more than ten days hospitalization in comparison with COVID-19 patients with no comorbidity disease (P=0.002), systolic BP higher than 90 mmHg (P=0.002), SPO2 higher than 88 (P<0.001) and hospitalization for lower than ten days (P=0.012). Our findings suggest that older age, pre-existing hypertension and/or multiple co-morbidities, high respiratory rate, elevated BUN, LDH and SGOT, low systolic BP, and hypoxemia were independently associated with in-hospital mortality in COVID-19 patients. These results can be helpful for physicians and health care workers to improve clinical management and appropriate medical care of COVID-19 patients.

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Keywords: Severe acute respiratory syndrome coronavirus 2 (Sars-CoV-2); Infectious disease; Coronavirus; Death; Epidemiology

Introduction

Since the outbreak of coronavirus disease 2019 (COVID-19) in Wuhan, China, in December 2019, the virus has spread rapidly throughout China and many other countries (1). On January 30, 2020, the World Health Organization (WHO) declared COVID-19 as an emergency public health with international concern (2).

COVID-19 is now spread in most countries of the world, and there have been more than 35 milion patients

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with confirmed COVID-19 worldwide by the end of September 2020 (3). Common symptoms at the onset of the disease include fever, cough, muscle pain, and shortness of breath or difficulty breathing, while other symptoms include headache, diarrhea, altered sense of smell or taste, and lymphopenia (4,5).

The results of epidemiological studies indicate that the risk of `death due to COVID-19 is higher in men, the elderly, and patients with a history of chronic diseases such as diabetes, hypertension and renal disease (5-7). In some studies, obesity and cardiovascular disease have been named as factors that aggravate the severity of symptoms (7-9). According the evidence, D-dimer on admission greater than 2.0 µg/mL can be used as a predict for in hospital death in patients with COVID-19 (10).

Many studies have been performed to better understand the factors associated with death in COVID-19 patients. However, most of them had a small sample size, or examined a few variables. On the other hand, we know that the clinical spectrum of the disease is very wide, from asymptomatic carriers to patients with critical condition. Identifying and eliminating factors associated with risk of death in COVID-19 patients are a key to improve survival and help patients triage, better management, and assist physicians and health care.

Materials and Methods

The present retrospective observational study was conducted on 512 confirmed COVID-19 patients hospitalized in Sina Hospital, affiliated to Hamadan University of Medical Sciences from 1 March 2020 to 18 July 2020. In this study, patients with positive real time reverse transcriptase polymerase chain reaction (RT-PCR) on samples from upper respiratory nasopharyngeal swabs were enrolled to the study.

The protocol of the study was approved by the Ethics Committee of Hamadan University of Medical Sciences (Ethic code: IR.UMSHA.REC.1399.440). The data of demographic characteristics, clinical manifestations, laboratory findings, chest examination and disease outcome were collected. Moreover, demographic findings, including gender, age, marriage status, residency, contact with infected cases, comorbidity, heart rate, blood pressure, respiratory rate, breath pattern, chest examination, electrocardiogram (ECG), and also laboratory findings, including the counts of white blood cells (WBC), neutrophils (NUT) and lymphocytes (Lymph); Alkaline Phosphatase (ALP), glutamic-pyruvic transaminase (SGPT), SGOT, Lactate dehydrogenase (LDH), Creatine phosphokinase (CPK), Hematocrit (HCT), Monocytes, K (Potassium), Na (Natrium), Blood sugar (BS), partial thromboplastin time (PTT), platelets count, prothrombin time (PT), Creatinine, blood urea nitrogen (BUN), Oxygen saturation (SPO2), hemoglobin (Hb) (Normal Range: 12-16 g/dl for women and 14-18 g/dl for men), HCT (Normal Range: 37-47 percent for women and 42-52 percent for men), Erythrocyte Sedimentation Rate (ESR), and C-reactive protein (CRP) were collected for each patient.

Descriptive statistics were reported as number (%) for categorical variables and mean (SD) for continuous variables across the patient's background. Univariable logistic regression was performed to explore the association of demographic, laboratory, and clinical characteristics of patients with the risk of in-hospital mortality. Those with $P<0.2$ were considered as potential significant determinants of death and were included in multivariable logistic regression. Statistical analyses were done using Stata version 14 software (Stata Corp LP, College Station, TX, USA). A significant level was considered as P of less than 0.05.

Results

During the study period, 57 (11.1%) deaths were occurred due to COVID-19 diseases. The mean (SD) age of death and recovered patients was 68.32 (14.72) and 55.09 (16.34) years, respectively.

The distribution of the characteristics of patients according to disease outcome and the effect of various potential risk factors on the death due to COVID-19 using an unadjusted odds ratio are shown in Table 1. Approximately 76.8% of dead patients and 39.7% of recovered patients were more than 60 years old ($P<0.001$). In addition, approximately a quarter (26.3%) of the dead and one-sixth (14.1%) of the recovered patients had hypertension. Also, 26.3% of the dead and 14.3% of the recovered patients had multiple comorbidity diseases. Table 1 shows the percentage of patients with systolic blood pressure less than 90 mm Hg, CT findings with Crackling/Rales, a respiratory rate higher than 30 per minute, SPO2 lower than 88 percent, abnormal ECG, BUN higher than 20 mg/dL, Creatinine higher than 1.3 mg/dL, WBC more than 11 (×1000 µL), Lymph lower than 20 percent, Mono lower than 2 percent, Nut higher than 60 percent, high HCT (more than 47 percent for women and more than 52 percent for men), abnormal Hb (out of 12-16 g/dl for women and out of 14-18 g/dl for men), LDH higher than 942 U/L (>2ULN), SGOT higher than 45 U/L, K higher than 5.1 mEq/L, patients with ICU admission and hospitalization more than 10 days in died

patients was significantly higher than recovered patients. Moreover, status of tachypnea breath pattern, platelets, WBC, HCT and NA was normal in most of patients. Although, dyspnea and distress breath pattern, platelets lower than 130 (×1000 µL), WBC lower than 4.5 (×1000 µL), abnormal HCT and Natrium lower than 130 mEq/L in dead patients were higher than recovered patients; but the differences were not statistically significant (*P*=0.069, *P*=0.090, *P*=0.066, *P*=0.052 and *P*=0.080, respectively). The distributions of gender, marriage status, residence, heart rate, CRP, ESR, PT, PTT, CPK, SGPT, Alp, and BS were almost the same with no statistically significant difference.

Table 1. Association between the death of COVID-19 and potential risk factors using unadjusted odds ratio

Characteristics	Treatment outcome		Total (N=512)	Unadjusted odds ratio (95% CI)	*P*
	Alive (N=455)	Dead (N=57)			
Gender (n=512)					
Male	235 (51.7)	31 (54.4)	266 (52)	1.00	---
Female	220 (48.4)	26 (45.6)	246 (48.1)	0.9 (0.52, 1.55)	0.697
Age (n=510)					
≤60 year	274 (60.4)	13 (23.2)	287 (56.3)	1.00	---
>60 year	180 (39.7)	43 (76.8)	223 (43.7)	5.04 (2.63, 9.63)	<0.001
Marriage Status (n=510)					
Married	384 (84.6)	46 (82.1)	430 (84.3)	1.00	---
Single	26 (5.7)	2 (3.6)	28 (5.5)	0.64 (0.15, 2.79)	0.555
Divorced & Dead	44 (9.7)	8 (14.3)	52 (10.2)	1.52 (0.67, 3.42)	0.314
Residence (n=512)					
City	380 (83.5)	48 (84.2)	428 (83.6)	1.00	---
Village	75 (16.5)	9 (15.8)	84 (16.4)	0.95 (0.45, 2.02)	0.894
Contact with COVID patient (n=512)					
No	340 (74.7)	38 (66.7)	378 (73.8)	1.00	---
Yes	115 (25.3)	19 (33.3)	134 (26.2)	1.48 (0.82, 2.67)	0.194
Comorbidity (n=512)					
No	269 (59.1)	20 (35.1)	289 (56.5)	1.00	---
Diabetes	33 (7.3)	4 (7)	37 (7.2)	1.63 (0.53, 5.06)	0.398
Heart disease	24 (5.3)	3 (5.3)	27 (5.3)	1.68 (0.47, 6.07)	0.428
Hypertension	64 (14.1)	15 (26.3)	79 (15.4)	3.15 (1.53, 6.49)	0.002
Multiple	65 (14.3)	15 (26.3)	80 (15.6)	3.1 (1.51, 6.39)	0.002
Systolic BP (mm Hg, n=510)					
≥90	448 (98.9)	53 (93)	501 (98.2)	1.00	---
<90	5 (1.1)	4 (7)	9 (1.8)	6.76 (1.76, 25.96)	0.005
Breath pattern (n=512)					
Normal	81 (17.8)	10 (17.5)	91 (17.8)	1.00	---
Tachypnea	361 (79.3)	42 (73.7)	403 (78.7)	0.94 (0.45, 1.96)	0.873
Dyspnea & Distress	13 (2.9)	5 (8.8)	18 (3.5)	3.12 (0.92, 10.58)	0.069
Chest examination (n=512)					
Normal	345 (75.8)	35 (61.4)	380 (74.2)	1.00	---
Crackling (Rales)	104 (22.9)	21 (36.8)	125 (24.4)	1.99 (1.11, 3.57)	0.021
Wheezing	6 (1.3)	1 (1.8)	7 (1.4)	1.64 (0.19, 14.04)	0.65

Cont. table 1

Respiratory rate (per minute, n=511)					
≤30	442 (97.4)	50 (87.7)	492 (96.3)		
>30	12 (2.6)	7 (12.3)	19 (3.7)	5.16 (1.94, 13.7)	0.001
Heart rate (per minute, n=509)					
≤125	440 (97.4)	56 (98.3)	496 (97.5)	1.00	---
>125	12 (2.7)	1 (1.8)	13 (2.6)	0.65 (0.08, 5.13)	0.687
SPO2 (percent, n=512)					
>88	278 (61.1)	16 (28.1)	294 (57.4)	1.00	---
≤88	177 (38.9)	41 (71.9)	218 (42.6)	4.02 (2.19, 7.39)	<0.001
ECG (n=512)					
Normal	374 (82.2)	37 (64.9)	411 (80.3)	1.00	---
Abnormal	81 (17.8)	20 (35.1)	101 (19.7)	2.5 (1.38, 4.52)	0.003
CRP (n=476)					
Negative	156 (37.1)	16 (28.6)	172 (36.1)	1.00	---
Positive	264 (62.9)	40 (71.4)	304 (63.9)	1.48 (0.8, 2.73)	0.212
ESR (n=474)					
Normal	49 (11.6)	7 (13.5)	56 (11.8)	1.00	---
Abnormal	373 (88.4)	45 (86.5)	418 (88.2)	0.84 (0.36, 1.98)	0.697
BUN (mg/dL, n=507)					
<20	394 (87.6)	25 (43.9)	419 (82.6)	1.00	---
≥20	56 (12.4)	32 (56.1)	88 (17.4)	9.01 (4.98, 16.3)	<0.001
Cr (mg/dL, n=506)					
0.8-1.3	336 (74.8)	33 (57.9)	369 (72.9)	1.00	---
<0.8	58 (12.9)	4 (7)	62 (12.3)	0.7 (0.24, 2.06)	0.519
>1.3	55 (12.3)	20 (35.1)	75 (14.8)	3.7 (1.98, 6.91)	<0.001
PT (Sec, n=419)					
11-13	205 (56)	26 (49.1)	231 (55.1)	1.00	---
>13	161 (44)	27 (50.9)	188 (44.9)	1.32 (0.74, 2.35)	0.342
PTT (Sec, n=414)					
30-35	218 (60.4)	29 (54.7)	247 (59.7)	1.00	---
>35	143 (39.6)	24 (45.3)	167 (40.3)	1.26 (0.71, 2.25)	0.433
Platelets (×1000µL, n=503)					
130-400	370 (83)	42 (73.7)	412 (81.9)	1.00	---
<130	76 (17)	15 (26.3)	91 (18.1)	1.74 (0.92, 3.29)	0.090
WBC ((×1000µL, n=504)					
4.5-11	287 (64.2)	33 (57.9)	320 (63.5)	1.00	---
< 4.5	147 (32.9)	8 (14)	155 (30.8)	0.47 (0.21, 1.05)	0.066
>11	13 (2.9)	16 (28.1)	29 (5.8)	10.70 (4.73, 24.20)	<0.001
Lymph (Percent, n=501)					
20-40	260 (58.4)	14 (25)	274 (54.7)	1.00	---
<20	134 (30.1)	41 (73.2)	175 (34.9)	5.68 (2.99, 10.79)	<0.001
>40	51 (11.5)	1 (1.8)	52 (10.4)	0.36 (0.05, 2.83)	0.334
Mono (Percent, n=427)					
2-8	335 (87.9)	33 (71.7)	368 (86.2)	1.00	---
<2	46 (12.1)	13 (28.3)	59 (13.8)	2.87 (1.41, 5.84)	0.004

Cont. table 1

Nut (Percent, n=501)					
40-60	110 (24.7)	3 (5.4)	113 (22.6)	1.00	---
<40	11 (2.5)	1 (1.8)	12 (2.4)	3.33 (0.32, 34.83)	0.315
>60	324 (72.8)	52 (92.9)	376 (75.1)	5.88 (1.8, 19.22)	0.003
HCT (n=500)					
Normal	333 (75.2)	32 (56.1)	365 (73)	1.00	---
Low	88 (19.9)	16 (28.1)	104 (20.8)	1.89 (0.99, 3.6)	0.052
High	22 (5)	9 (15.8)	31 (6.2)	4.26 (1.81, 10.02)	0.001
Hb (n=505)					
Normal	350 (78.1)	32 (56.1)	382 (75.6)	1.00	---
Low	86 (19.2)	21 (36.8)	107 (21.2)	2.67 (1.47, 4.86)	0.001
High	12 (2.7)	4 (7)	16 (3.2)	3.65 (1.11, 11.96)	0.033
LDH (U/L, n=441)					
≤942	389 (98.5)	38 (82.6)	427 (96.8)	1.00	---
>942	6 (1.5)	8 (17.4)	14 (3.2)	13.65 (4.5, 41.4)	<0.001
CPK (n=371)					
≤342	297 (88.9)	31 (83.8)	328 (88.4)	1.00	---
>342	37 (11.1)	6 (16.2)	43 (11.6)	1.55 (0.61, 3.97)	0.358
SGOT (U/L, n=446)					
≤45	291 (74.1)	25 (47.2)	316 (70.9)	1.00	---
>45	102 (26)	28 (52.8)	130 (29.2)	3.2 (1.78, 5.73)	<0.001
SGPT (U/L, n=437)					
≤37	327 (84.5)	42 (84)	369 (84.4)	1.00	---
>37	60 (15.5)	8 (16)	68 (15.6)	1.04 (0.46, 2.32)	0.927
Alp (U/L, n=416)					
≤270	326 (89.3)	43 (84.3)	369 (88.7)	1.00	---
>270	39 (10.7)	8 (15.7)	47 (11.3)	1.56 (0.68, 3.55)	0.294
K (mEq/L, n=493)					
3.5-5.1	414 (94.3)	46 (85.2)	460 (93.3)	1.00	---
<3.5	21 (4.8)	2 (3.7)	23 (4.7)	0.86 (0.19, 3.77)	0.838
>5.1	4 (0.9)	6 (11.1)	10 (2)	13.5 (3.67, 49.6)	0.000
NA (mEq/L, n=497)					
136-145	340 (77.3)	38 (66.7)	378 (76.1)	1.00	---
<136	100 (22.7)	19 (33.3)	119 (23.9)	1.7 (0.94, 3.08)	0.080
BS (mg/dl, n=354)					
70-105	131 (42.12)	14 (32.56)	145 (40.96)	1.00	---
>105	180 (57.88)	29 (67.44)	209 (59.04)	1.51 (0.77, 2.96)	0.234
ICU (n=511)					
No	385 (84.8)	1 (1.8)	386 (75.5)	1.00	---
Yes	69 (15.2)	56 (98.3)	125 (24.5)	312.46 (42.55, 2294.81)	<0.001
Hospitalization (n=511)					
≤10 days	393 (86.56)	42 (73.68)	435 (85.13)	1.00	---
>10 days	61 (13.44)	15 (26.32)	76 (14.87)	2.31 (1.21, 4.41)	0.012

The effect of various potential risk factors on the death of COVID-19 is given in Table 2 using an adjusted

odds ratio. Based on these results, the adjusted odds ratios (OR) estimate of death in COVID-19 for patients with age more than 60 years versus those lower than 60 years was 3.15 (95% CI: 1.06, 9.37). The adjusted OR estimate of death in patients with hypertension comorbidity versus those with no comorbidity was 3.84 (95% CI: 1.27, 11.59). In addition, the adjusted OR estimate (95% CI) of death in patients with respiratory rate above 30 per minute, BUN >20 mg/dL, LDH >942 U/L and SGOT >45 U/L against lower than those values was respectively 10.72 (1.99, 57.68), 5.85 (2.19, 15.63), 13.42 (2.17, 83.22) and 2.86 (1.02, 8.05).

Table 2. Association between the death of COVID-19 and potential risk factors using adjusted odds ratio for all other variables in the table

Characteristics		Treatment outcome		Total (N=512)	Adjusted odds ratio (95% CI)	*P*
		Alive (N=455)	Dead (N=57)			
Gender	**Male**	235 (51.7)	31 (54.4)	266 (52)	1.00	---
	Female	220 (48.4)	26 (45.6)	246 (48.1)	1.87 (0.76, 4.57)	0.172
Age	**≤60 year**	274 (60.4)	13 (23.2)	287 (56.3)	1.00	---
	>60 year	180 (39.7)	43 (76.8)	223 (43.7)	3.15 (1.06, 9.37)	0.039
Chronic Disease	**Healthy**	269 (59.1)	20 (35.1)	289 (56.5)	1.00	---
	Diabetes	33 (7.3)	4 (7)	37 (7.2)	1.28 (0.27, 6.07)	0.753
	Heart disease	24 (5.3)	3 (5.3)	27 (5.3)	2.40 (0.38, 15.07)	0.350
	Hypertension	64 (14.1)	15 (26.3)	79 (15.4)	3.84 (1.27, 11.59)	0.017
	Multiple	65 (14.3)	15 (26.3)	80 (15.6)	0.69 (0.18, 2.63)	0.588
Respiratory rate (per minute, n=511)	**≤30**	442 (97.4)	50 (87.7)	492 (96.3)		
	>30	12 (2.6)	7 (12.3)	19 (3.7)	10.72 (1.99, 57.68)	0.006
SPO2 (percent)	**>88**	278 (61.1)	16 (28.1)	294 (57.4)	1.00	---
	≤88	177 (38.9)	41 (71.9)	218 (42.6)	1.71 (0.67, 4.33)	0.262
ECG	**Normal**	374 (82.2)	37 (64.9)	411 (80.3)	1.00	---
	Abnormal	81 (17.8)	20 (35.1)	101 (19.7)	2.08 (0.78, 5.57)	0.143
CRP (n=476)	**Negative**	156 (37.1)	16 (28.6)	172 (36.1)	1.00	---
	Positive	264 (62.9)	40 (71.4)	304 (63.9)	1.50 (0.59, 3.80)	0.397
BUN (mg/dL, n=507)	**<20**	394 (87.6)	25 (43.9)	419 (82.6)	1.00	---
	≥20	56 (12.4)	32 (56.1)	88 (17.4)	5.85 (2.19, 15.63)	<0.001
Hb	**Normal**	362 (80.8)	36 (63.2)	398 (78.8)	1.00	---
	Low	86 (19.2)	21 (36.8)	107 (21.2)	2.16 (0.90, 5.15)	0.084
LDH (U/L, n=441)	**≤942**	389 (98.5)	38 (82.6)	427 (96.8)	1.00	---
	>942	6 (1.5)	8 (17.4)	14 (3.2)	13.42 (2.17, 83.22)	0.005
SGOT (U/L, n=446)	**≤45**	291 (74.1)	25 (47.2)	316 (70.9)	1.00	---
	>45	102 (26)	28 (52.8)	130 (29.2)	2.86 (1.02, 8.05)	0.047
SGPT (U/L, n=437)	**≤37**	327 (84.5)	42 (84)	369 (84.4)	1.00	---
	>37	60 (15.5)	8 (16)	68 (15.6)	0.39 (0.09, 1.67)	0.204

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The risk of death was higher among the patients with multiple comorbidity diseases, systolic BP lower than 90 mmHg, SPO2 lower than 88 and more than ten days hospitalization in comparison with COVID-19 patients with no comorbidity disease (*P*=0.002), systolic BP higher than 90 mmHg (*P*=0.002), SPO2 higher than 88 (*P*<0.001) and hospitalization for lower than ten days (*P*=0.012) (Table 2), although adjusted analysis of these covariates was not statistically significant. There was no significant association between the death of COVID-19

and gender, marriage status, residence, heart rate, CRP, ESR, PT, PTT, CPK, SGPT, Alp, and BS.

Discussion

Our study describes the presenting characteristics and predictors of death in 512 hospitalized COVID-19 patients in Hamadan, West of Iran. In the final adjusted analysis, we found that nine factors independently associated with an increased odds of death in these patients including: older age, pre-existing hypertension, high respiratory rate, high level of BUN, LDH and SGOT, having multiple comorbidity diseases, low systolic BP and SPO_2 lower than 88.

Results of this study showed that older age is associated with increase odds of death in COVID-19 patients. The results of other studies were in line with the results of the present studies (11,12). The worse outcome regarding SARS and MERS in old age has been shown previously (13,14). It seems that, the defects in T-cell and B-cell function and the excess production of type 2 cytokines due to advanced age can lead to a insufficiency control of viral replication and more prolonged pro-inflammatory responses, which can be associated with poor outcomes in patients (15).

In this study, pre-existing hypertension was another predictor of death in COVID-19 patients. Lippi *et al*., in their meta-analysis showed that hypertension was associated with 2.5-fold increased risk mortality in these patients (16). One hypothesis is that given that COVID-19 bind to target cells through angiotensin-converting enzyme 2 (ACE2) and in a case that hypertension treated with ACE inhibitors, pathogenicity promoted. Therefore, hypertension directly through pre-existing clinical predictor of disease severity, or by contributing to deterioration late in disease course, characterized by acute respiratory distress syndrome (ARDS) and systemic inflammatory response syndrome (SIRS), is associated with increased severity of COVID-19 (17).

We found that patients with elevated baseline BUN were more prone to in-hospital death. The effect of indicators of kidney involvement at admission in association with increased risk of in-hospital death has been shown previously (6).

In line with a previous report by Xie *et al*., (18), we found that hypoxemia is a strong risk factor of death in COVID-19 patients. Severe hypoxemia is associated with elevation of inflammatory markers and consequently acute inflammation of the respiratory system; therefore, it may be mechanistically responsible for the significant pulmonary injury and subsequently an increased risk of death (19).

This study has some limitations, first due to the retrospective study design, not all clinical and laboratory data, such as d-dimer, were assessed for all patients. The second limitation is that our data were obtained from hospitalized patients for the first months of the epidemic, and they may not be representative of later cases of COVID-19. Third, in this study, we assessed only hospitalized patients with relatively severe symptoms, and patients with mild or moderate symptoms were not admitted to the hospital. Finally, the data obtained from hospitalized patients in a single hospital may not be generalizable to all hospitalized patients in the province.

We found that older age, pre-existing hypertension and/or multiple comorbidities, high respiratory rate, elevated BUN, LDH and SGOT, low systolic BP, and hypoxemia were independently associated with in-hospital mortality in COVID-19 patients. These results can be helpful for physicians and health care workers to improve clinical management and appropriate medical care of COVID-19 patients.

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