ORIGINAL ARTICLE

CLINICAL CHARACTERISTICS, MORTALITY AND ASSOCIATED RISK FACTORS IN COVID-19 PATIENTS REPORTED IN TEN MAJOR HOSPITALS OF KHYBER PAKHTUNKHWA, PAKISTAN

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Background: COVID-19 is an ongoing public health issue across the world. Several risk factors associated with mortality in COVID-19 have been reported. The present study aims to describe clinical and epidemiological characteristics and predictors of mortality in hospitalized patients from Khyber Pakhtunkhwa, a province in Pakistan with highest COVID-19 associated case fatality rate. **Methods:** This multicentre, retrospective study was conducted in hospitalized COVID-19 patients who died or discharged alive until 1st May 2020. Data about sociodemographic characteristics, clinical and laboratory findings, treatment and outcome were obtained from hospital records and compared between survivors and non-survivors. Statistical tests were applied to determine the risk factors associated with mortality in hospitalized patients. **Results:** Of the total 179 patients from the 10 designated hospitals, 127 (70.9%) were discharged alive while 52 (29.1%) died in the hospital. Overall, 109 (60.9%) patients had an underlying comorbidity with hypertension being the commonest. Multivariate logistics regression analysis showed significantly higher odds of in-hospital death from COVID-19 in patients with multiple morbidities (OR 3.2, 95% CI 1.1, 9.1, *p*-value=0.03), length of hospital stay (OR 0.8, 95% CI 0.7, 0.9, *p*-value <0.001), those presenting with dyspnoea (OR 4.0, 95% CI 1.1, 14.0, *p*-value=0.03) and oxygen saturation below 90 (OR 9.6, 95% CI: 3.1, 29.2, *p*-value <0.001). **Conclusion:** Comorbidity, oxygen saturation and dyspnoea on arrival and length of stay in hospital (late admission) are associated with COVID-19 mortality. The demographic, clinical and lab characteristics could potentially help clinician and policy makers before potential second wave in the country.

Keywords: COVID-19; Clinical Characteristics; Mortality; Khyber Pakhtunkhwa; Pakistan

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INTRODUCTION

COVID-19 is a global pandemic and the most challenging threat to public health in the recent history, after world war II.[1] The causative organism is Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-COV-2) from *Coronaviridae* family of viruses.[2] An outbreak with two other members of the same family; SARS-COV and Middle East Respiratory Syndrome (MERS) have been reported China in 2002-03 and Middle East in 2012.[3] The current outbreak is believed to be originated from a zoonotic transmission event in Wuhan, the capital city in Hubei province of China in December 2019. However, rapid spread of the disease soon led the scientist to conclude human-to-human transmission via aerosol droplets as main route of virus spread in the population. The disease spread so rapidly that within a span of only few weeks, almost all the countries around the world have reported COVID-19 cases.[4,5] The COVID-19 pandemic was confirmed to have reached Pakistan on 26th February 2020, and by 18th March, cases had been registered in all four provinces, capital territory Islamabad and the two autonomous regions of Gilgit Baltistan and Azad Jammu and Kashmir.[6]

Considerable variations have been observed in clinical manifestation among COVID-19 patients. A vast majority of these patients are either asymptomatic or present with very mild upper respiratory tract illness. A number of published case series and reports from different countries have reported fever, fatigue, dry cough and myalgia as the most commonly reported symptoms in COVID-19 patients.[3,7] Gastrointestinal symptoms such as diarrhoea, vomiting and abdominal pain has also been reported.[8] In approximately 10% of the confirmed cases, the disease course is severe leading to critical illness

requiring hospitalization and acute care.[9] Age and underlying comorbidities are the most common risk factors associated with mortality in COVID-19 patients in different countries. Mortality risk is high in elderly and people with underlying comorbidities.[10,11] However, till date, no such study on clinical characteristics and risk factors associated with increase mortality in COVID-19 patients have been reported from Khyber Pakhtunkhwa; the province with highest case fatality rate in Pakistan. The incidence of COVID-19 is on decline in Pakistan and with the ease in lock down restrictions, public health professionals fear the potential second wave that might come in the winter. In the present study, we report for the first time, the baseline clinical characteristics, clinical and laboratory pattern, risk factors and management of the COVID-19 confirmed patient admitted to all major hospitals of KP and associate it with the clinical outcome which will contribute towards informed planning and decision making for the clinicians and policy makers.

MATERIAL AND METHODS

The study was conducted by the Institute of Public Health & Social Sciences, Khyber Medical University. The data was collected until 1st May 2020 from designated public sector hospitals of KP, Pakistan that provided in-patient care services for COVID-19 patients. These designated hospitals received a major burden of the COVID-19 patients from all parts of the province. Ethical approval of the study was obtained from Khyber Medical University, no: Dir/Ethics/KMU/2020/22. The requirement of written informed consent was waived off by the ethics board.

This retrospective cohort study was conducted on COVID-19 patients admitted in these hospitals. Diagnosis of COVID-19 was made on the basis of real time reverse transcriptase polymerase chain reaction (RT qPCR) assay of nasal and pharyngeal swabs.[12] In some cases, the diagnosis was confirmed on RT qPCR assay of aspirates obtained from lower respiratory tract of the patients. We have included all the adult (≥18 years old) in-patients with a definite clinical outcome (death or discharge alive) into our study. Asymptomatic patients, those having only mild symptoms and those with incomplete clinical data were excluded from the study. Data were collected from the following 10 designated major hospitals; Hayatabad Medical Complex, Khyber Teaching Hospital, Police Hospital Peshawar, DHQ Teaching Hospital Kohat and Lakki Marwat, MTI-Dera Ismail Khan, Saidu Group of Teaching Hospital, MTI-Mardan, MTI-Abbottabad and MTI-Nowshera**.** Details about sociodemographic characteristics, clinical signs and symptoms, laboratory findings, treatment regimens and outcome data were extracted from the electronic record of the hospitals using a predesigned data collection tool. The following variables were recorded. Data about sociodemographic characteristics (age, gender, occupation, monthly income, travel history), underlying condition (hypertension, coronary heart disease, diabetes, asthma, Chronic Obstructive Pulmonary Disease (COPD), stroke, cancer, kidney disease, dialysis, immunosuppressive drugs use, obesity and multi-morbidity), likely source of infection, presenting symptoms (asymptomatic, fever, sore throat, shortness of breath, fatigue, malaise, myalgia, diarrhoea, nausea, vomiting, loss of smell or taste) were recorded. Vital signs (temperature, blood pressure, pulse rate, breathing rate, oxygen saturation), radiologic (chest X-ray, CT scan) and laboratory tests (complete blood count, urea, creatinine, serum albumin, prothrombin time, C reactive protein, ferritin, D-dimer, Fibrinogen, Cardiac enzymes, lactate dehydrogenase) were performed at the time of admission. Routine care, provision of care according to case management guidelines and clinical outcome (dead or discharged alive) was also recorded. All the collected data was entered into a predesigned data base. As per ethics requirements, hard data for each participant was stored in a locked cabinet and soft data in a password protected computers. In addition, each participant was assigned a unique identifier to maintain confidentiality and privacy of the study participants.

Age was categorized in to four groups, i.e., below <=40 years, 41–50 years, 51–60 years and above 60 years. Employment status was categorized as Employed, Self Employed, Retired and Unemployed. Systolic & diastolic blood pressure, Pulse (>125), Respiratory rate (>24), Oxygen saturation was measured using a standard procedure and reported as Mean ±SD. Temperature was measured using a standard mercury thermometer and is categorized as normal (<=98.6 °F) and having temperature (>98.6 °F) at admission. Comorbidities were labelled as Yes=1 and No=0. Laboratory finding were further categorized into groups.

Categorical and continuous variables were presented as n (%) and Mean (SD). Chi square test was used for categorical variables and independent sample t-test for continuous variables to explore the differences between the survivors and non-survivors COVID-19 patients. To identify the risk factors associated with death in these patients, we used multivariate logistic regression analysis using STATA-15 for which, the data was complete, authentic and fitting the model taking outcome variable (0 discharged alive, 1 dead). *P*-value of <0.05 was considered statistically significant.

RESULTS

A total of 179 admitted patients fulfilling the selection criteria till 1st May 2020 were included in the study. Table-1 gives details of sociodemographic characteristics, clinical symptoms and underlying conditions of patients at the time of admission into the hospital. Mean age of the patients was 48.7 (±17.74 SD) years and 150 (83.8%) were male. The average length of stay in the hospital was 8.2±6.4 days.

Table-1: Characteristics of the study participants and its association with outcome (n=179)

Age (in Years)	Alive n=127 (70.95)	Dead n=52 (29.05)	Total n=179	p-value
40 or below	56 (44.44)	4 (7.84)	60 (33.90)	<0.001
41-50	20 (15.87)	10 (19.61)	30 (16.95)	
51-60	27 (21.43)	11 (21.57)	38 (21.47)	
>60	23 (18.25)	26 (50.98)	49 (27.68)	
Age (Mean ± SD)	44.1 (17.24)	60.3 (13.22)	48.7 (17.74)	<0.001
LOS* (5 missing)	9.8 (6.65)	4.5 (4.24)	8.2 (6.4)	<0.001
Gender				
Male	112 (88.19)	38 (73.08)	150 (83.8)	0.01
Female	15 (11.81)	14 (26.92)	29 (16.2)	
Employment				
Employed	42 (33.07)	13 (25)	55 (30.73)	0.01
Self-employ	36 (28.35)	6 (11.54)	42 (23.46)	
Retired	8 (6.3)	6 (11.54)	14 (7.82)	
unemployed	41 (32.28)	27 (51.92)	68 (37.99)	
Clinical Presentation				
Cough	80 (62.99)	42 (80.77)	122 (68.16)	0.02
Fever	85 (66.93)	43 (82.69)	128 (71.51)	0.03
SOB*	59 (46.46)	47 (90.38)	106 (59.22)	<0.001
Fatigue	31 (24.41)	25 (48.08)	56 (31.28)	0.002
Malaise	19 (14.96)	16 (30.77)	35 (19.55)	0.01
Pneumonia	9 (7.09)	16 (30.77)	25 (13.97)	<0.001
ARDS*	1 (0.79)	9 (17.31)	10 (5.59)	<0.001
Vomiting	5 (3.94)	4 (7.69)	9 (5.03)	0.29
Nausea	5 (3.94)	3 (5.77)	8 (4.47)	0.59
Diarrhoea	6 (4.72)	3 (5.77)	9 (5.03)	0.77
Headache	23 (18.11)	13 (25)	36 (20.11)	0.29
Arthralgia	10 (7.87)	8 (15.38)	18 (10.06)	0.13
Myalgia	20 (15.75)	15 (28.85)	35 (19.55)	0.04
Chills or rigors	20 (15.75)	13 (25)	33 (18.44)	0.15
Rhinorrhoea	5 (3.94)	1 (1.92)	6 (3.35)	0.49
Sore-throat	45 (35.43)	17 (32.69)	62 (34.64)	0.73
Underlying conditions				
Multi-morbid	19 (14.96)	29 (55.77)	48 (26.82)	<0.001
Hypertension	31 (24.41)	31 (59.62)	62 (34.64)	<0.001
Coronary heart disease	10 (7.87)	19 (36.54)	29 (16.2)	<0.001
Diabetes Mellitus	24 (18.9)	24 (46.15)	48 (26.82)	<0.001
Br Asthma	8 (6.3)	4 (7.69)	12 (6.7)	0.73
COPD	6 (4.72)	9 (17.31)	15 (8.38)	0.006
Stroke	0	2 (3.85)	2 (1.12)	0.02
Chronic Kidney disease	1 (0.79)	2 (3.85)	3 (1.68)	0.15
Smoking history	29 (22.83)	18 (34.62)	47 (26.26)	0.104
BCG Mark present	53 (41.73)	16 (30.77)	69 (38.55)	0.17
Temperature				
100 ^{0}F or below	67 (52.76)	16 (30.77)	83 (46.37)	0.007
Above 100 ^{0}F	60 (47.24)	36 (69.23)	96 (53.63)	
Systolic BP (Mean ± SD)	125.3 (18.17)	125 (26.55)	125.2 (20.6)	0.93
Diastolic BP (Mean ± SD)	80.5 (10.14)	79.8 (16.54)	80.3 (12.08)	0.75
Pulse (Mean ± SD)	84.7 (12.65)	97.2 (19.63)	88.1 (15.85)	<0.001
Respiratory rate (Mean ± SD)	20.6 (5.24)	27.4 (10.22)	22.7 (7.84)	<0.001
Oxygen saturation (Mean ± SD)	92.1 (8.75)	76.6 (13.76)	86.8 (12.93)	<0.001
Bilateral infiltrates	39 (30.71)	32 (61.54)	71 (39.66)	<0.001
Pleural Effusion	0	4 (7.69)	4 (2.23)	0.002
CT Scan Chest	5 (3.94)	5 (9.62)	10 (5.59)	0.13
Ischemic changes on ECG	10 (7.87)	23 (44.23)	33 (18.44)	<0.001

LOS: Length of stay in hospital, SOB: Shortness of breath, ARDS: Acute respiratory distress syndrome, COPD: Chronic obstructive pulmonary disease

Clinically, most of the patients presented with fever 71.51% (n=128), cough 68.16% (n=122) and shortness of breath 59.22% (n=106). Loss of smell and taste were the least common clinical presentation at admission reported by 2 (1.1%) and 1 (0.6%) patient respectively. Of all the patients, 109 (60.9%) have reported one or more underlying conditions at the time of admission; the commonest being hypertension (34.64%) followed by diabetes (26.82%) and coronary heart diseases (16.2%). Presence of multi-morbid conditions, i.e., having more than one co-morbidity at the time of admission was also common (26.8%). Vital signs, chest radiographs and oxygen saturation were performed for all the patients at the time of admission. Mean pulse and respiratory rate were 88.1±15.85 and 22.7±7.84 respectively. Mean oxygen saturation was 86.8±12.93 and approximately 40% of the patients have bilateral lung infiltrate evident on the chest radiographs. Ischemic changes on ECG was obvious only in 33 (18.4%) patients. Azithromycin and hydroxychloroquine were the most commonly prescribed medication received by 129 (72.8%) and 45 (48.02%) patients respectively.

Out of the total 179 patients, 52 died resulting an in-hospital mortality rate of around 29.05%. A comparison of the characteristics between the two groups of patients (survivors and non survivors) is also given in Table-1. Almost half of the patients who died were above 60 years of age and mainly male (83.8%). However, the mortality rate was high in female (48.8%) than male (25.3%). Hypertension, diabetes, coronary heart diseases, chronic obstructive pulmonary disease (COPD), stroke and multi morbid conditions were significantly more common in non survivors. Clinically, shortness of breath (SOB), pneumonia and acute respiratory distress syndrome (ARDS) were significantly (p<0.001) more common in non-survivors. The vital clinical signs were also significantly different between the two groups. Compared to survivors, non survivors had significantly high pulse and respiratory rate (p<0.001) and low oxygen saturation (p<0.001). Bilateral infiltrate and ischemic changes were also more frequently reported in non-survivors (p<0.001). Pleural effusion was present only in four patients and none of them survived. Baseline laboratory investigations at admission revealed significant (p<0.05) differences between survivors and non-survivors in terms of white blood cell count, platelets count, random blood sugar and creatinine level (Table-2). Furthermore, except oxygen therapy, there was no statistically significant difference between the treatments provided on admission to the patients between the two groups.

We further perform multivariate logistic regression analysis (Table-3) of the data for all variables and patients (n=179). We found that at the time of admission, the patients presented with shortness of breath (OR 4.0, 95% CI: 1.1, 1.4, p-value 0.03), length of hospital stay (OR 0.8, 95% CI 0.7, 0.9, p-value <0.001) having multi-morbid condition (OR 3.2 95% CI 1.1 and 9.1 p-value 0.03) and oxygen saturation below 90 (OR 9.6, 95% CI 3.1, 9.1, p-value <0.001) had significantly higher risk of death from COVID-19.

Table 2: Clinical investigations and treatment regimen of the study participants and its association with outcome (n=179)

Clinical investigation on admission				
	Alive n=127 (70.95)	**Dead n=52 (29.05)**	**Total n=179**	**p-value**
Hemoglobin (g/dL) (Mean ± SD)	13.2 (1.56)	12.6 (2.67)	13.0 (1.97)	0.16
Anemic (<13.5 g/dL)	50 (55.56)	27 (67.50)	77 (59.23)	0.2
Normal (≥ 13.5 g/dL)	40 (44.44)	13 (32.50)	53 (40.77)	
WBC *10^3/L (Mean ± SD)	9 (0.52)	124 (3)	10 (46)	0.002
Low (<4 10^3/L)	3 (4.48)	0	3 (3.06)	0.001
Normal (4-10 10^3/L)	40 (59.70)	7 (22.58)	47 (47.96)	
High (≥10 10^3/L)	24 (35.82)	24 (77.42)	24 (48.98)	
Platelets *10^3/L (Mean ± SD)	238 (258)	370 (328)	282 (288)	0.08
Low (<150 10^3/L)	6 (14.29)	3 (14.29)	9 (14.29)	0.002
Normal (150-400 10^3/L)	35 (83.33)	11 (52.38)	46 (73.02)	
High (≥400 10^3/L)	1 (2.38)	7 (33.33)	8 (12.70)	
RBS (64) (Mean ± SD)	141.03 (86.65)	179.8 (129.62)	154.4 (104.07)	0.15
Normal (<140 mg/dL)	27 (62.49)	8 (36.36)	35 (54.69)	0.02
Pre-diabetic (140-200 mg/dL)	10 (23.81)	5 (22.73)	15 (23.44)	
Diabetic (≥200 mg/dL)	5 (11.90)	9 (40.91)	14 (21.88)	
Urea (67) (Mean ± SD)	42.43 (58.68)	53.8 (23.67)	46.2 (50.04)	0.34
Low (<12 mg/dL)	2 (4.00)	0	2 (2.99)	0.53
Normal (12-20 mg/dL)	3 (6.00)	2 (11.76)	5 (7.46)	
High (≥20 mg/dL)	45 (90.00)	15 (88.24)	60 (89.55)	
Creatinine (84) (Mean ± SD)	1.08 (0.43)	1.87 (1.17)	1.34 (0.84)	<0.001
Low (<0.9 mg/dL)	18 (32.14)	3 (10.71)	21 (25)	<0.001
Normal (0.9-1.3 mg/dL)	29 (51.79)	9 (32.14)	38 (45.24)	
High (≥1.3 mg/dL)	9 (16.07)	16 (57.14)	25 (29.76)	
CRP (10) mg/L (Mean ± SD)	82.4 (55.32)	94.7 (156.61)	88.58 (110.92)	0.87
D-Dimer (14) ng/mL (Mean ± SD)	536.6 (102.43)	2865 (3301.79)	2366.1 (598.61)	0.25
LDH (9) U/L (Mean ± SD)	495.3 (165.08)	734.1 (444.49)	654.5 (380.21)	0.41
Treatment Regimen/Adherence				
Hydroxy-chloroquine	62 (49.21)	23 (45.1)	85 (48.02)	0.62
Azithromycin	89 (70.63)	40 (78.43)	129 72.88	0.29
Steroid	48 (38.1)	28 (54.9)	76 (42.94)	0.04
Salbutamol	37 (29.6)	17 (33.33)	54 (30.68)	0.62
Oxygen	36 (28.57)	38 (74.51)	74 (41.81)	<0.001
Blood transfusion	3 (2.38)	4 (7.84)	7 (3.95)	0.09
Other antibiotics	54 (42.86)	19 (37.25)	73 (41.24)	0.49

RBS: Random blood sugar, CRP: C reactive protein, LDH: Lactate dehydrogenase

Table-3: Multivariate Logistic regression between outcome (0 survivor, 1 non-survivor) and characteristics of the Patients (n=179)

	Adjusted Odds Ratio	95% CI	*p*-value
Age (in years)			
41–50	1.5	0.3, 8.3	0.64
51–60	3.3	0.7, 16.7	0.14
>60	2.7	0.5, 14.0	0.23
Gender			
Female	1.2	0.3, 4.3	0.77
Length of Stay	0.8	0.7, 0.9	<0.001
Having Fever	0.9	0.2, 3.2	0.83
Having Productive cough	1.6	0.5, 5.2	0.44
Having SOB	4.0	1.1, 14.0	0.03
Having Multi-morbid condition	3.2	1.1, 9.1	0.03
Oxygen saturation	9.6	3.1, 29.2	<0.001

DISCUSSION

This study has identified several risk factors associated with death in hospitalized patients; most notably, old age, comorbidity, oxygen saturation and dyspnoea on arrival and length of stay in hospital (late admission). Old age has consistently been recognized as an independent predictor for mortality in COVID-19 patients in different countries of the world[2,13–16] including Pakistan[17]. A recent meta-analysis of thirteen studies encompassing 3027 COVID-19 patients has also concluded higher risk of critical disease and mortal outcome in older patients especially those aged 65 or above.[10] Similar odds of mortality has also been reported in SARS and MERS patients[19,20] The exact underlying mechanism is not known. However, age associated defects in T-cell and B-cell immunity and increase release of type 2 cytokine may lead to prolonged pro-inflammatory status and failure of immune system to eradicate viruses resulting in poor outcome.[21]

The current study has reported significantly higher comorbid conditions including hypertension, diabetes, cardiovascular diseases and multi morbidities in non-survivors. These finding are in concordance with the previously reports from elsewhere.[7,22–26] Cardiac complications are a common occurrence in COVID-19 patients. The current study as well as many other published reports have linked pre-existing cardiovascular diseases as risk factor for mortality in COVID-19 patients.[2,27] However, the relationship between COVID-19 and cardiovascular complications is not unidirectional. Recently, several clinical studies have reported that COVID-19 may promote cardiovascular disorders (myocardial injury, arrhythmias, thromboembolism, cardiac arrest) in patients with no history of the disease[28] and even children[29]. Our study has also reported high prevalence of diabetes in patients who died of COVID-19. This along with several other studies[10,25] points toward syndromic nature of the disease in which poor glycaemic control along with other risk factors such as age, ethnicity, comorbidities especially cardiovascular diseases and hypertension leads to subacute, chronic inflammatory and pro-coagulative status. All these factors potentially contribute towards COVID-19 associated worse outcomes.[26] The comorbid conditions described above rarely occur alone especially in the older segment of the population. In the current study, presence of multi-morbid conditions have been identified as an independent risk predictor for mortality in convid-19 patients. Recently, several other studies have also reported similar finding.[23,30] However, it should be noted that age associated frailty and multi-morbidities is potentially not a risk factor for contracting COVID-19 per se, but hospitalization and adverse outcome.[23]

Clinical characteristics of the patients in our study followed that same general pattern as reported elsewhere.[7,17,10] Dyspnoea or shortness of breath was the most common symptoms in non-survivor group. Dyspnoea is one of the most easily assessed symptom requiring special attention as it is one of the independent risk factors for death in COVID-19 patients.[31] Another closely related and easily monitored clinical measure is oxygen saturation. We have found that decrease oxygen saturation at the time of admission was related to death in COVID-19, independent of age and sex. Recent evidence suggests that saturation ≤90 significantly increases chances of death in COVID-19 patients. Therefore, oxygen supplementation is one of the most critical aspect of COVID-19 clinical management. According to an estimate, with every one-unit increase in oxygen supplementation results in an overall 8% decrease in mortality.[31] This is an important consideration for developing countries like Pakistan where critical care provision exists only in tertiary care hospitals. Recently, in Pakistan, we

have observed that COVID-19 patients who were transported to hospital in a vehicle with oxygen availability survived more in hospital than those, with no oxygen support (unpublished data). It is therefore absolutely critical for Pakistan and other developing countries to make sure availability of oxygen supplementation at the level of primary care hospitals and BHUs (Basic Health Units) in order to save precious lives.

Although, our study is the first study on the clinical characteristics and definite outcome of COVID-19 patients from an area with highest national case fatality rate in Pakistan, it has some limitations. First the sample size is not reasonable large as reported in studies from other countries such as China. Second, due to retrospective design, laboratory data was not available for all patients and hence, the role of some clinical parameters and laboratory findings may be underestimated. Third, COVID-19 was at peak in Pakistan during the month of June and July and we have not included those patients in our analysis. Therefore, the mortality rate in our study cannot be predict the true mortality rate of COVID-19 in Pakistan. However, by including all the patients hospitalized in tertiary care hospitals, we believe that our study is representative of in-hospital COVID-19 patients of KP, Pakistan. Moreover, these cases received in the initial months to the major public sector hospitals of the KP province are informative for health care professionals caring for suspected and confirmed cases in the province, Pakistan and elsewhere.

CONCLUSION

The present study concluded that age, presence of underlying comorbidities and clinical parameters such as dyspnoea and oxygen saturation on arrival are independent risk predictors in COVID-19 mortality in KP, Pakistan. Stringent evaluation of the mortality associated risk factors and clinical follow of the COVID-19 patients is recommended. Furthermore, the epidemic curve of COVID-19 in Pakistan is on decline. However, according to public health professionals, a second wave might be expected and these findings will be helpful for evidence-based directions to inform the clinicians, public health workers and policy makers.

Conflict of interest: The authors declare no conflict of interest.

AUTHORS' CONTRIBUTION

ZUH had the original idea. All authors contributed in design, tool making, data collection and supervision of their respective hospitals. ZUH, SF, MIK did data analysis and prepared first draft. All authors significantly contributed to the final version of the manuscript.

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