Factors associated with COVID-19 severity and mortality among Hispanic patients living on the USA–Mexico border

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ABSTRACT

COVID-19 has ravaged the medical, social, and financial landscape across the world, and the USA–Mexico border is no exception. Although some risk factors for COVID-19 severity and mortality have already been identified in various ethnic cohorts, there remains a paucity of data among Hispanics, particularly those living on borders. Ethnic disparities in COVID-19 outcomes in Hispanic and black populations have been reported. We sought to identify the clinical presentation, treatment, laboratory, and imaging characteristics of 82 Hispanic patients in a county hospital and describe the factors associated with rates of hospitalization, intensive care unit (ICU) admission, and mortality. The most common comorbidities were hypertension (48.8%) and diabetes mellitus (DM) (39%), both found to be associated with hospitalization and mortality, while only DM was associated with increased rate of ICU admission. Multivariable analysis showed that individuals with fever, low oxygen saturation (SpO_2), nasal congestion, shortness of breath, and DM had an increased risk of hospitalization. Individuals with fever, decreased levels of SpO_2, and advanced age were found to be associated with an increased risk of death. The most common cause of death was respiratory failure (28.9%), followed by shock (17.8%) and acute kidney injury (15.6%). Our findings are critical to developing strategies and identifying at-risk individuals in a Hispanic population living on borders. Research aiming to identify key evidence-based prognostic factors in our patient population will help inform our healthcare providers so that best interventions can be implemented to improve the outcomes of patients with COVID-19.

Significance of this study

What is already known about this subject?

- Ethnic disparities in COVID-19 outcomes in Hispanic and black populations have been reported, with higher fatality rates shown in Hispanic and black populations compared with white non-Hispanics.
- There remains a paucity of data with regard to Hispanics, particularly those living on borders.

What are the new findings?

- We evaluated variables that are known to influence the clinical course and severity of COVID-19 hospitalization among Hispanic patients on the USA–Mexico border.
- Using multivariable analysis, we found that individuals with fever, low oxygen saturation (SpO_2), nasal congestion, shortness of breath, and diabetes mellitus had an increased risk of hospitalization.
- Individuals with fever, decreased levels of SpO_2, and advanced age were found to be associated with an increased risk of death.
- The most common cause of death was respiratory failure (28.9%), followed by shock (17.8%) and acute kidney injury (15.6%).

How might these results change the focus of research or clinical practice?

- Our findings are critical to developing strategies and identifying at-risk individuals in a Hispanic population living on borders.
- Research aiming to identify key evidence-based prognostic factors in our patient population will help inform our healthcare providers so that best interventions can be implemented to improve the outcomes of patients with COVID-19.

INTRODUCTION

In late December 2019, reports from China brought to the attention of the world a newly discovered coronavirus named SARS-CoV-2. Due to its highly contagious human-to-human transmission, SARS-CoV-2 infection rapidly spread worldwide, and the WHO declared COVID-19 a pandemic on March 13, 2020.[1] Although majority of patients with COVID-19 recovered without the need for a specific medical intervention, approximately 20% of patients required inpatient hospital care. About 5% of patients necessitated admission to the

intensive care unit (ICU) and often required mechanical ventilator support.[2 3] With an estimated overall mortality of between 1% and 5% to date,[3–6] there is still a significant number of unknown epidemiological, clinical, and prognostic factors about this disease.

Most of the data reported related to COVID-19 management and outcomes in the USA have come from the country's northeastern region. Recent studies showed racial/ethnic differences in clinical presentation and outcomes in patients with COVID-19, with Hispanics affected by higher fatality rates.[7 8] Most of these studies did not include Hispanics of Mexican origin, who are considered even more vulnerable to the infection and its adverse outcomes due to lack of resources and accessibility and due to cultural beliefs. The USA–Mexico border has a unique ethnic distribution compared with other regions in the USA, with approximately 80% of our patient population comprising Hispanics. Since it is known that genetic patterns are associated with a higher risk of certain infectious diseases, it will be useful to understand the clinical features and associated comorbidities of COVID-19 in our Hispanic population. Therefore, it is relevant to improve our knowledge on the behavior of this disease in the southwest region of the country, particularly on the USA–Mexico border. Identifying specific characteristics associated with COVID-19 severity and mortality will help healthcare professionals screen at-risk patients with COVID-19 early and provide better management.

We sought to describe the clinical presentation, treatment profile, and COVID-19 outcomes of Hispanic patients admitted to a county hospital on the USA–Mexico border and to evaluate the factors associated with COVID-19 severity as determined by ICU admission, hospitalization, and mortality.

MATERIALS AND METHODS

Subjects and data

The study used inpatient and outpatient electronic medical record data from the University Medical Center of El Paso, Texas, and its various satellite clinics from March 1 to May 28, 2020. Outpatients included patients seen in clinics who tested positive for SARS-CoV-2, in addition to patients who were seen in the emergency department (ED) who tested positive but were not admitted to the hospital. We did not include any patients who tested positive but were not seen in a clinical setting (ie, clinic, ED). General demographics, comorbidities, symptoms, laboratory findings, imaging findings, and treatment received including ICU admission information from 89 inpatients and 22 outpatients with confirmed COVID-19 were reviewed. Only diagnoses of COVID-19 confirmed by a positive SARS-CoV-2 test with presence of symptomatology were included in this study. Non-Hispanic patients were excluded.

The primary outcomes considered in this study were severity of COVID-19 as measured by hospitalization, ICU admission, and in-hospital mortality. The secondary outcomes included complications such as septic shock, acute respiratory distress syndrome, acute kidney injury, disseminated intravascular coagulation, deep venous thrombosis, rhabdomyolysis, hepatitis, cerebrovascular accident, secondary bacterial or fungal infection, pancreatitis, and acute coronary syndrome.

A large number of demographic and clinical variables were also collected (online supplemental tables 1 and 2).

Statistical analysis

Quantitative variables were described using mean, SD, median, and IQR depending on the distribution of variables. Categorical variables were described using frequency and proportions. All covariates, including demographic, clinical, laboratory, imaging, and treatment profiles, were compared according to hospitalization, ICU admission, and mortality status using either Student's t-test or χ^2 test as per the type of cofactors. For non-normal variables, the Wilcoxon rank-sum test instead of a t-test was used. Generalized linear models with a family Poisson and log link were used to determine factors associated with hospitalization, ICU admission, and mortality separately. Only significant variables with limited missing data from the unadjusted analysis were included in the final multivariable model with a backward stepwise elimination approach to determine variables associated with each primary outcome. The results were summarized with relative risk along with 95% CI and p value. Skewed laboratory values were transformed and included in the model. Spearman rank correlations were used to assess the association between number of days in ICU and quantitative variables. P values less than 5% were considered statistically significant. All analyses were carried out using STATA V.15.1.

RESULTS

General demographics and outcomes

Of the 111 subjects, 82 were included in the final analysis. Thirty-five were women (43%), with an average age of 55 years old and an average body mass index (BMI) of 30 (SD: 5.7) kg/m^2 (table 1). A total of 15 in-hospital deaths (18.3%; 95% CI) were observed, with 74.4% hospitalizations (n=61) and 24.4% ICU admissions (n=20). The most common cause of death was respiratory failure (28.9%), followed by shock (17.8%) and acute kidney injury (15.6%). The average number of days in the ICU was 1.94 (SD: 4.7) (table 2). None of the considered demographic characteristics was associated with any outcomes except age.

Comorbidities

Majority of patients had at least two chronic conditions (47.6%), followed by one chronic condition (16, 19.5%).

Table 1 Demographic characteristics of 82 Hispanic patients with COVID-19

Factors	
N=82	**Entire cohort**
Demographics	
Age, mean (SD)	54.98 (17.43)
Body mass index, mean (SD)	29.87 (5.65)
Sex: female, n (%)	35 (42.7)
Pregnant women, n (%)	2 (2.4)
Current smokers, n (%)	4 (4.9)
Any history of drug use, n (%)	3 (3.7)
Intravenous drug user, n (%)	1 (1.2)
Alcoholic, n (%)	3 (3.7)

Table 2 Outcomes and complications of 82 Hispanic patients with COVID-19

Factors	Value	
N=82	n (%)	Median (IQR)
Outcomes		
Number of days in ICU, mean (SD)	1.94 (4.70)	0.00 (0.00–1.00)
Death	15 (18.3)	
Hospitalization	61 (74.4)	
ICU admission	20 (24.4)	
Complications		
Number of complications, mean (SD)	1.01 (1.36)	
Number of complications		
0	45 (54.9)	
1	10 (12.2)	
2	16 (19.5)	
3	5 (6.1)	
4	4 (4.9)	
5	2 (2.4)	
Septic shock	9 (11.4)	
Acute respiratory distress syndrome	19 (24.1)	
Acute kidney injury	21 (25.9)	
No disseminated intravascular coagulation	78 (95.1)	
Deep venous thrombosis	1 (1.3)	
Rhabdomyolysis	1 (1.2)	
Hepatitis	14 (17.3)	
Cerebrovascular accident	4 (4.9)	
Secondary bacterial or fungal infection	9 (11.3)	
Pancreatitis	1 (1.2)	
Acute coronary syndrome	4 (4.9)	

ICU, intensive care unit.

Table 3 Associated comorbidities

Chronic conditions	Entire cohort, n (%)
Number of chronic diseases, mean (SD)	1.41 (1.30)
Number of chronic diseases	
0	27 (32.9)
1	16 (19.5)
2	25 (30.5)
3	8 (9.8)
4	4 (4.9)
5	2 (2.4)
Chronic obstructive pulmonary disease	2 (2.4)
Diabetes mellitus	32 (39.0)
Hypertension	40 (48.8)
Coronary artery disease	8 (9.8)
Cerebrovascular disease	6 (7.3)
Cancer	1 (1.2)
Chronic kidney disease	7 (8.5)
Cirrhosis	1 (1.2)
Asthma	4 (4.9)
Rheumatological disease	1 (1.2)
Inflammatory bowel disease	1 (1.2)
HIV	1 (1.2)
Hepatitis	2 (2.4)
Hypothyroidism	10 (12.3)
Missing	1 (1.2)

Among individual comorbidities, the most common were hypertension (HTN) (48.8%) and diabetes mellitus (DM) (39%). Both DM and HTN were found to be associated with hospitalization and mortality, while only DM was associated with increased rate of ICU admission. Patients with two or more conditions were strongly associated with COVID-19 severity (hospitalization and mortality), but not with in-hospital mortality (table 3). Other medical conditions included coronary artery disease, cerebrovascular disease, cancer, chronic kidney disease, asthma, cirrhosis, hepatitis, hypothyroidism, HIV, and inflammatory bowel disease.

Factors associated with hospitalization

In unadjusted analyses, numerous variables, including age, signs and symptoms, presence of any signs, laboratory and radiological abnormalities, as well as chronic conditions such as DM and HTN, were found to be associated with hospitalization (shown in online supplemental table 1). However, in multivariable analysis, individuals with increased levels of body temperature, nasal congestion, low oxygen saturation (SpO_2), shortness of breath, and DM had an increased risk of hospitalization (table 4).

Factors associated with ICU admission and length of stay

The multivariable models also assessed the adjusted association between independent variables and outcomes of admission to ICU and length of stay in ICU. Here again, DM and increased respiratory rate were significantly associated with ICU admission (table 5). Spearman correlation analysis was used to assess the association between number of days in ICU and laboratory values (table 5). Numerous variables positively correlated with the extension of stay in ICU, which included advanced age, increased BMI, fever, tachypnea, leukocytosis, procalcitonin and lactic acid levels, elevated aspartate aminotransferase (AST) and alanine aminotransferase (ALT), extended partial thromboplastin time (PTT), hypokalemia, and D-dimer and troponin elevation (online supplemental table 3). On the other hand, blood pressure, SpO_2, hemoglobin, lymphocyte count, and sodium and pH levels were negatively correlated with number of days in ICU (table 6).

Factors associated with mortality

In unadjusted analysis, a large number of variables were found to be associated with in-hospital mortality (online supplemental table 2). In multivariable analysis, individuals with increased levels of body temperature, decreased levels of SpO_2, and increased age were found to be associated with an increased risk of mortality (table 7).

DISCUSSION

Data on COVID-19 in the Hispanic population have been scarce, and data on Hispanics living on the USA–Mexico border are still absent. We decided to evaluate variables that are known to influence the clinical course and severity of COVID-19 hospitalization, given the ethnic disparities in COVID-19 outcomes that translate into higher fatality rates for Hispanic and black populations compared with white

Table 4 Factors associated with hospitalization

	RR	95% CI	P value
Model 1			
Number of chronic conditions	1.065	0.992 to 1.143	0.084
Body temperature	1.165	1.053 to 1.288	0.003
Nasal congestion presence	0.548	0.306 to 0.980	0.043
SpO_2	0.996	0.992 to 1.001	0.089
Model 2			
Nasal congestion presence	0.592	0.355 to 0.985	0.043
Body temperature	1.116	1.018 to 1.224	0.02
Shortness of breath	1.212	0.965 to 1.524	0.099
SpO_2	0.996	0.992 to 1.000	0.044
Diabetes mellitus	1.182	0.989 to 1.413	0.067

Model 2 includes individual chronic conditions instead of number of chronic conditions.
RR, relative risk; SpO_2, oxygen saturation.

non-Hispanics.[7 8] Our study focused on a timeframe that represented the first surge of COVID-19 in the region, at a time when reports from the USA were mainly coming from New York and during which protocols for the use of certain interventions such as steroids, anticoagulation, or antivirals were not yet implemented.

Patients older than 50 years were more likely to present with fever, without any difference in other symptoms.[9] It has been shown that the Hispanic/Latino population has a disease presentation with lower rates of fever, but higher rates of nasal symptoms, myalgia, headache, sore throat, and vomiting/diarrhea, compared with studies from China,[10 11] but similar to European patients.[12] Rhinorrhea has been, in fact, a factor associated with hospitalization.[9]

Initial reports from China showed that more than half of patients had an underlying medical condition, with HTN being the most common, followed by DM and coronary heart disease.[11] We found that DM was a major factor associated with not only hospitalization but with admission to ICU. This is in line with recent meta-analyses on the role of comorbidity in increasing the risk of COVID-19 exacerbation.[13 14] DM alone is associated with a twofold increase in mortality as well as severity of COVID-19.[2]

Several factors were also associated with severity, indicated by length of stay in the ICU. Age, fever, tachypnea, low SpO_2, decreased hemoglobin, leukocytosis, and lymphopenia had been described in more severe patients since the beginning of the pandemic.[3] Lymphopenia, which has been present in more than 83% of patients with COVID-19 on admission,[3 15] is a cardinal laboratory finding with promising prognostic potential.[16 17] Procalcitonin, lactic acid levels, elevated AST and ALT, and D-dimer elevation have

Table 5 Factors associated with ICU admission

	RR	95% CI	P value
Model 1			
Respiratory rate	1.050	1.039 to 1.061	<0.001
Number of chronic conditions	1.220	1.016 to 1.464	0.033
Model 2			
Diabetes mellitus	2.014	0.993 to 4.086	0.052
Respiratory rate	1.048	1.037 to 1.060	<0.001

Model 2 includes individual chronic conditions instead of number of chronic conditions.
ICU, intensive care unit; RR, relative risk.

Table 6 Correlation between length of stay in ICU and disease-state metrics

Days in ICU				
	Untransformed values		Log-transformed laboratory values	
Factor	r	P value	r	P value
Age	0.270	0.014		
BMI	0.067	0.56		
Maximum body temperature recorded	0.486	<0.001		
Respiratory rate (highest)	0.764	<0.001		
Systolic	−0.619	<0.001		
Diastolic	−0.615	<0.001		
Lowest SpO_2 recorded	−0.647	<0.001		
Hemoglobin	−0.420	<0.001		
White cell count	0.481	<0.001	0.481	0.000
Lymphocyte count	−0.329	0.004	−0.329	0.004
Platelet count	0.076	0.52	0.076	0.52
LDH	0.310	0.055	0.310	0.055
CRP	0.216	0.13	0.216	0.13
Procalcitonin	0.587	<0.001	0.587	<0.001
Lactic acid	0.416	0.009	0.491	<0.001
HCO_3	−0.170	0.15		
AST	0.491	<0.001	0.323	0.005
ALT	0.323	0.005	0.318	0.062
INR	0.318	0.062	0.403	0.041
PTT	0.403	0.041	0.222	0.060
Total bilirubin	0.222	0.060	0.339	0.17
CK	0.339	0.17	0.333	0.003
Na	−0.046	0.69		
K	0.333	0.003	0.060	0.61
Cl	0.060	0.61	0.600	<0.001
D-Dimer	0.600	<0.001	0.216	0.40
Pro-BNP	0.216	0.40	0.524	<0.001
Lipase	0.142	0.70	0.416	0.009
Troponin	0.524	<0.001	−0.258	0.74
pH	−0.459	0.014	1.000	1.000
PO_2	0.040	0.84	1.000	1.000
PCO_2	0.258	0.18	0.142	0.70

ALT, alanine aminotransferase; AST, aspartate aminotransferase; BMI, body mass index; BNP, beta natriuretic peptide; CK, creatine kinase; Cl, chloride; CRP, C reactive protein; HCO_3, bicarbonate; ICU, intensive care unit; INR, international normalized ration; K, potassium; LDH, lactate dehydrogenase; Na, sodium; PCO_2, partial pressure of carbon dioxide; PO_2, partial pressure of oxygen; PTT, partial thromboplastin time; SpO_2, oxygen saturation.

Table 7 Adjusted association between mortality and selected cofactors

	RR	95% CI	P value
Age	1.071	1.039 to 1.105	<0.001
Body temperature	1.922	1.475 to 2.505	<0.001
SpO_2	0.964	0.949 to 0.980	<0.001

RR, relative risk; SpO_2, oxygen saturation.

also been described in the initial reports of COVID-19 severity in China.[3] A hypercoagulable state has been observed in a subset of young adult patients with COVID-19, where elevated D-Dimer levels are associated with disease worsening.[16]

Our regression model yielded a list of factors associated with mortality, including advanced age, fever, and low SpO_2. Epidemiological studies have shown increased mortality in men and elderly patients.[4 18] The average age of patients in our studied population was 55 years, concordant with recent literature from China, where in-hospital deaths were associated with older age, precisely 55.5 years old.[11] Lower SpO_2 has also been shown to be a predictor of mortality in COVID-19.[19 20] However, we did not observe mortality association with variables such as male gender,[3 15 18] HTN, DM, use of hydroxychloroquine,[19 21] ground-glass opacity as a radiological finding,[15 18 22] D-dimer elevation,[11] higher white cell count, elevated C reactive protein,[21] and lymphopenia,[17] which have appeared to be robust and consistent predictors of mortality in COVID-19.

Although the number of patients in this report is relatively small and there was not an established medical management, diagnostic and therapeutic protocol in El Paso, our findings are significant as they assess variables in a Hispanic population alone. The repeated appearance of risk factors such as DM in the analysis should prompt a red flag for allocation of expected public health measures such as vaccines. Research aiming to identify key evidence-based prognostic factors in our patient population will help guide our healthcare providers so that best interventions can be implemented to improve the outcomes of patients with COVID-19. Further larger cohort studies, across the nation and across border states, should provide broader insights into how COVID-19 presents and behaves in the Hispanic population.

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Patient consent for publication Not required.

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