

Mortality and Risk Factors in Patients With COVID-19 in Ecuador: A Cross-Sectional Analytic Study

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Research Article

Keywords: COVID-19, mortality, Ecuador, chronic diseases, Latin America

Posted Date: March 11th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-261732/v1>

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Abstract

Background: In Ecuador, a high mortality was observed during the maximum peak of COVID-19 cases in spring/summer 2020. Thus, 10000 thousand more deaths were registered in 2020 compared to 2019 in the same period time. A few researchers in Latin America have identified clinical conditions that could be associated with severity and mortality of this disease. The aim of this study was to describe main clinical characteristics and risk factors in patients with COVID-19 in the Ecuadorian context.

Methods: A cross sectional analytic study was conducted from March to July 2020. Adult patients with COVID-19 confirmed by PCR test and admitted in emergency service was included in this study. Descriptive statistical measures were computed, and Chi-squared and logistic regression were performed to analyze associations between categorical variables.

Results: The main results of 157 patients, showed that had a high prevalence of comorbidities (45%), and the case-fatality rate in this group was around 37%. Hypertension (17.83%) and diabetes (14.65%) were the most prevalent chronic diseases with a significant difference between sex groups (*p value* 0.00). Risk factor such as age more than 65 years, presence of comorbidities such as non-communicable diseases, and abnormalities in blood markers like urea, AST, lactate, leucocytes, PO₂ and D-dimer increased risk to die in this population.

Conclusions: The elevated prevalence of non-communicable diseases (hypertension and diabetes) contributed to a high mortality in adult patients with COVID-19. Huge challenges must face health care systems in the Latin America countries due to the high prevalence of these diseases.

Background

The new novel coronavirus SARS-CoV2 that causes COVID-19 disease was first detected in Wuhan province of China on December 2019 and World Health Organization (WHO) declared worldwide emergency pandemic in March 2020. As soon as it could spread around the world, on February the disease reached all Latin American (LA) countries affecting especially those with high socioeconomic inequalities like Brazil, Peru and Ecuador.

Most of the cases in this region have been correlated with social determinants such as poverty, humanitarian crisis, fragile health system and persistent inequalities overtime. Moreover, longstanding increases of obesity and diabetes as non-communicable diseases are probably main contributor to elevated mortality [1].

The setting of this study is Ecuador, a middle-income country situated on South America with high socio-economic inequalities and ethnic diversity [2]. The healthcare system is highly fragmented with several sub-systems in the public and private sector. The public sector includes the Ministry of Health (MoH); and Social Security (in Spanish Instituto Ecuatoriano de Seguridad Social-IESS); while MoH provide coverage to the poorest without access to social insurance, IEISS cover formal workers and public employees. For other hand people placed in upper middle class and the rich segment use private services through health private insurance or out pocket expenses [3].

On February 29th the first case was reported in Ecuador, in August approximately 94,000 cases had been confirmed, with an accumulated incidence of 193,57 per 100000 habitants and 8.31% of lethality placing it as

one of the countries with the highest mortality rate [4]. During this period 10000 thousand deceases more were registered in 2020 compared to 2019 in the same period time probably due to the collapse of health care system. This, high mortality has been reported since the beginning of the pandemic even under estimation of real data could display a worst-case scenario. [5]. Few investigations at the local level have focused on evaluating the main clinical characteristics in patients and the degree of association between risk factors and mortality. [6]. Moreover, during these months COVID-19 pandemic in Ecuador caused saturation and difficulties to access healthcare services, especially intensive care units, which could have contributed to increasing the probability of death as has been reported elsewhere. [7, 8].

The aim of this study was to describe the main clinical characteristics and risk factors associated with mortality in adult patients admitted to the emergency service of the General Teaching Hospital of Calderon in Quito, the capital of Ecuador, which belong to MoH in the public health system and delivery health care services those population without access to health insurance.

Methods

Study design

A cross sectional analytic study was conducted for this research. Participants involved were all adult men and women (older than 18 years) with COVID-19 confirmed by PCR test and admitted to the emergency service room of the General Teaching Hospital Calderon from March to July 2020.

Data source

Main socio demographic characteristics of each patient were obtained from the mandatory notification of Epidemiological Surveillance System (VIEPI) (Sistema de Vigilancia Epidemiológica). Clinical data on the date of symptom onset, symptoms, comorbidities, and vital signs were collected manually from the patient admission forms prepared in the emergency service. The final health outcome was verified from the hospital statistic department death certificates.

Study definitions

Demographic data, clinical features, comorbidities, blood markers were established as risk factors (independent variables); while mortality was established as the dependent variable. According to the WHO guidance, laboratory confirmation of SARS-CoV-2 was performed as a positive result of real time reverse transcriptase–polymerase chain reaction (RT PCR) assay in nasopharyngeal swabs. Results were obtained from a laboratory certified by the Ministry of Health (MoH).

The time of illness was defined as the interval between date of symptom onset (i.e., cough, fever, fatigue, or myalgia) and seeking health care. Fever was defined as an axillary temperature of 37.5°C or higher. The severity of disease was evaluated according to NEWS2 Score, which is based on a logistic regression model designed to predict in-hospital patient mortality within 24 hours of a set of vital sign observations (respiratory rate, heart rate, blood pressure, Glasgow, oxygen saturation and temperature). [9].

Statistical analysis

Descriptive statistical measures were calculated for demographic and clinical data. Chi2 and logistic regression were performed to measure associations between categorical variables such as clinical characteristics and mortality. 95% confidence intervals and p values were used to assess the degree of statistical significance. Statistical analysis was performed with STATA version 15.0.

Results

Demographic and clinical characteristics

Table 1 shows the main characteristics by sex and final health outcome. The proportion of women and men were almost equal, 78% of patients were older than 50 years. High mortality was observed in patients older than 65 years, and the association between age and final health outcome was statistically significant (*p value* 0.03). Most patients had low educational attainment (61% reached just primary school) and women had lower levels of education. High proportion of comorbidities, mostly non-communicable diseases (around 45%), was identified. Women exhibited higher prevalence of comorbidities (57.33%) than men (34.15%). Hypertension had 17.83% prevalence, followed by diabetes with 14.65%, and in the same way these were higher in women than men (*p value* 0.00). People with comorbidities had a high mortality (36.36%) and it was higher in patients with hypertension 18.18%.

The average time from onset of symptoms until admission was 7.4 days, being longer in men (8.03) than women (6.73). Cough (77.07%) and dyspnea (75.64%) were the most prevalent signs and symptoms, followed by fever (58.60%) and fatigue (55.41%); all of these were higher in men than women. Regarding association between symptoms and mortality they had not significant differences. Overall, only fever had statistically significant differences between sex groups (*p value* 0.00). Anosmia, runny nose, exanthema, and conjunctive injection were almost absent. All patients had tachypnea (respiratory frequency mean 27.17) and the percentage of oxygen saturation was lower than 90% in all patients (mean 76.96%; women 76.85% and men 77.06%), no statistically significant differences were found in these rates. However, patients who died had significantly lower levels of saturation (69.27%) (*p value* 0.00). Temperature, systolic blood pressure, pulse and Glasgow scale were within normal parameters between sex groups.

In relation to illness severity, NEWS score was 6.68 points on average, and higher in men (6.90) than women (6.44). Most (50.96%) of the patients had a moderate NEWS Score but a high proportion (35.03%) had a severe NEWS score, and both were higher prevalent in men than women.

Mortality distribution

The final health outcome is displayed in Table 2. A high proportion of patients died 35.03% and this was higher in men (39.02%) than women (32.00%). Mortality in terms of NEWS score was varied, patients with moderate score had higher mortality (54.55%) more prevalent in women (60.87%). Patients with severe score showed a mortality prevalence of 41.82% and it was higher in men group (43.75%); and the differences were statistically significant (*p value*: 0.02). According to age, high mortality was observed in the more than 65 years group (52.73%) in which women had (56.52%) and men (50.00%); likewise, a high mortality was observed in the 50 to 64 age group in which men had (43.75%) and women (17.39%), besides those differences were statistically significant (*p value*: 0.02).

Results of the logistic regression analysis with all variables adjusted by age showed that for every day of illness the probability to die increased by 4% (OR 1.04, 95% IC: 0.95-1.12 and women had higher probability to die 96% (OR: 1.96, 95% IC: 0.82-3.22) than men.

The presence of comorbidities more than doubled the probability to die (OR: 2.38, 95% IC: 1.14-4.93); similarly, for diabetes (OR: 2.23, 95% IC: 0.76-6.48) whereas hypertension increased probability by 25% (OR: 1.25, 95% IC: 0.51-3.08). Those who had both pathologies diabetes and hypertension increased the risk to die but not significantly (OR: 2.43, 95% IC: 0.82-7.21). Men with diabetes had higher probability to die (OR: 2.54, 95% IC: 0.38-16.69) compared with women, while women with hypertension had more risk (OR: 2.70, 95% IC: 0.84-8.61).

Laboratory findings

Table 3 shows laboratory findings separately by sex and final health outcome. Means of leukocytes and neutrophils were higher than expected, while lymphocytes count, showed lymphopenia in men but not women (*p value*: 0.02). Patients who died had higher levels of leukocytes and neutrophils statistically significant comparing with those survived (*p value*: 0.00).

Deceased patients had significantly elevated inflammatory and infectious markers (*p value*: <0.05). In patients who died several blood parameters had higher mean levels, such as fibrinogen, urea, AST, LDH, PCR, D-dimer, troponin, ferritin, and lactate. Men, and patients who died, exhibited significantly worse results (*p value*: 0.05). Coagulation markers were lower than reference and were significantly different between men and women (*p value*: < 0.02). Most of the patients presented hypoxia (PO₂ mean: 56.58 mmHg (53.45-59.72) but differences were not significant between groups.

Discussion

This study describes the main clinical characteristics and risk factors associated with mortality by SARS-CoV-2 in adult patients admitted to emergency service. The results showed that during the study period higher mortality was found in patients with non-communicable diseases.

Clinical features showed that patient had a severe acute respiratory syndrome based in cough, dyspnea, fever and fatigue mainly. Data from NEWS2 Score led to identification of moderate and severe cases, however higher mortality was associated in moderate cases. These findings are similar with the initial reporting of cases in China and consistent with WHO concern had announced people with specific characteristics that could be more affected by infection [10, 11, 12]. Thus, results of this study showed that people aged more than 50 years, men, with a lower education and presence of comorbidities such as hypertension and diabetes are more prevalent in patients admitted to emergency care, similarly to other studies [13, 14, 15, 16]. A high prevalence of non-communicable diseases such as hypertension and diabetes in the population (Ecuador 44.6%, Latin American Region 33.5%) could be a main factor to contribute to an elevated death rate in Ecuador compared with other countries [18, 19].

As other studies, blood markers related to intensive inflammatory reaction were present in most of patients that include abnormalities in coagulation parameters. Nevertheless, men had significantly worse results, which

confirms the effect of sex in the clinical presentation based on the inflammatory response. Even though women had a higher probability to die, mortality in men was more prevalent as in other studies. [20, 21, 22, 23].

This study had some limitations. First, the study was limited to patients who accessed this hospital, therefore probably is not representative of the situation across the country. Second, many patients could not access to PCR test due several factors such as severity of illness, number of tests available and lack of time for sampling, probably became a under registration of mortality cases during this period.

Conclusion

Results are remarkably like other recent studies and reviews. However, there are limited information on the clinical features of patients in Latin American countries. Probably the high proportion of comorbidities related to non-communicable diseases and several access barriers to health care services increase the mortality in patients with severe respiratory diseases caused by novel coronavirus. This research also could contribute to consider the use of medical scales and blood marker testing during health care.

Abbreviations

COVID-19: Coronavirus disease 2019; SARS: Severe acute respiratory syndrome; SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2. VIEPI: Sistema de Vigilancia Epidemiológica. MoH: Minister of Health.

Declarations

Ethics approval and consent to participate.

The study protocol was approved by Teaching Department and General Management of Calderon Hospital (Quito - Ecuador) and presented to National Commission of COVID-19 Studies from MoH.

Consent for publication

Not applicable.

Availability of data and materials

All data is available in the data hospital source.

Competing interests

The authors declare no conflict of interest.

Funding

No funding.

Authors' contributions

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Acknowledgements

The authorities of General Teaching Calderon Hospital, Anni-Maria Pulkki-Brännström for overall comments and Diego Buitron by the design of graphical abstract.

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Tables

Table 1. Demographic and clinical characteristics in women and men with COVID-19

Variables	Total N (%)	Women N (%)	Men N (%)	<i>P</i>	Dead	Alive	<i>P</i>
	157 (100)	75 (47.77)	82 (52.23)		55 (35.03)	102 (64.97)	
Age group (years)							
20 to 49	35 (22.29)	18 (24.00)	17 (20.73)	0.30	8 (14.55)	27 (26.47)	
50 to 64	60 (38.22)	24 (32.00)	36 (43.90)		18 (32.73)	42 (41.18)	0.03
more than 65	62 (39.49)	33 (44.00)	29 (35.37)		29 (52.73)	33 (32.35)	
Education							
None	23 (14.65)	13 (17.33)	10 (12.20)	0.43	11 (20.00)	12 (11.76)	
Primary	96 (61.15)	48 (64.00)	48 (58.54)		29 (52.73)	67 (65.69)	0.27
Secondary	33 (21.02)	12 (16.00)	21 (25.61)		14 (25.45)	19 (18.63)	
High	5 (3.18)	2 (2.67)	3 (3.66)		1 (1.82)	4 (3.92)	
Comorbidities							
Yes	71 (45.22)	43 (57.33)	28 (34.15)	0.00	20 (36.36)	51 (50.00)	0.10
No	86 (54.78)	32 (42.67)	54 (65.85)		35 (63.64)	51 (50.00)	
Chronic diseases							
Hypertension	28 (17.83)	16 (21.33)	12 (14.63)	0.27	10 (18.18)	18 (17.65)	0.93
Diabetes	23 (14.65)	18 (24.00)	5 (6.10)	0.00	5 (9.09)	18 (17.65)	0.14
Signs and Symptoms							
Time of illness (days)	7.4 (6.73-8.06)	6.73 (5.87-7.59)	8.03 (7.07-8.99)	0.04	6.94 (8.85-8.03)	7.6 (6.85-8.48)	0.29
Cough	121 (77.07)	54 (72.00)	67 (81.71)	0.14	40 (72.73)	81 (79.41)	0.34
Dyspnea	118 (75.64)	58 (77.33)	60 (74.07)	0.63	45 (81.82)	73 (72.28)	0.18
Fever	92 (58.60)	34 (45.33)	58 (70.73)	0.00	24 (43.64)	68 (66.67)	0.00
Fatigue	87 (55.41)	42 (56.00)	45 (54.88)	0.88	28 (50.91)	59 (57.84)	0.40
Sore throat	27 (17.20)	14 (18.67)	13 (15.85)	0.64	10 (18.18)	17 (16.67)	0.81
Cephalaea	26 (16.56)	11 (14.67)	15 (18.29)	0.52	10 (18.18)	16 (15.69)	0.68
Productive cough	26 (16.56)	14 (18.67)	12 (14.63)	0.49	8 (14.55)	18 (17.65)	0.61
Diarrhea	23 (14.65)	11 (14.67)	12 (14.63)	0.99	6 (10.91)	17 (16.67)	0.33

Myalgia	17 (10.83)	8 (10.67)	9 (10.89)	0.95	9 (16.36)	8 (7.84)	0.10
Nausea	9 (5.73)	5 (6.67)	4 (4.88)	0.63	5 (9.09)	4 (3.92)	0.18
Runny nose	7 (4.46)	5 (6.67)	2 (2.44)	0.20	2 (3.64)	5 (4.90)	0.71
Anosmia	2 (1.27)	1 (1.33)	1 (1.22)	0.94	0 (0.00)	2 (1.96)	0.29
Basic measures							
Temperature	37.18 (37.04- 37.32)	37.07 (36.88- 37.25)	37.28 (37.07- 37.50)	0.13	37.16 (36.92- 37.40)	37.19 (37.01- 37.37)	0.82
Respiratory frequency	27.17 (25.97- 28.37)	26.16 (24.46- 27.85)	28.10 (26.40- 29.81)	0.10	28.69 (26.49- 30.88)	26.36 (24.94- 27.78)	0.06
Oxygen saturation (%)	76.96 (74.69- 79.22)	76.85 (73.31- 80.39)	77.06 (74.09- 80.02)	0.92	69.27 (64.84- 73.69)	81.10 (78.89- 83.31)	0.00
Systolic blood pressure	126.50 (123.11- 129.90)	128.14 (122.51- 133.77)	125.01 (120.95- 129.07)	0.36	124.10 (117.96- 130.25)	127.80 (123.70- 131.90)	0.30
Pulse (bpm)	99.06 (96.03- 102.09)	97.22 (93.13- 101.31)	100.74 (96.26- 105.22)	0.25	100.76 (95.33- 106.19)	100.74 (96.26- 105.22)	0.41
Glasgow scale	14.85 (14.72- 14.99)	14.80 (14.56 - 15.03)	14.91 (14.70 - 15.00)	0.40	14.60 (14.21 - 14.98)	15.00 (15.00 - 15.00)	0.00

Table 2. Distribution of degree of illness and mortality in women and men with COVID-19

Severity of illness	Total N (%)	Women N (%)	Men N (%)	P
NEWS2 Score	6.68 (6.36-6.99)	6.44 (5.97-6.90)	6.90 (6.48-7.32)	0.14
NEWS2 Score 1-4 (mild)	22 (14.01)	13 (17.33)	9 (10.98)	0.47
NEWS2 Score 5-7 (moderate)	80 (50.96)	38 (50.67)	42 (51.22)	
NEWS2 Score 8-10 (Severe)	55 (35.03)	24 (32.00)	31 (37.80)	
Mortality				
Overall	55 (35.03)	23 (30.67)	32 (39.02)	0.27
Mortality and NEWS2 Score				
NEWS2 Score 1-4 (mild)	2 (3.64)	0 (0.00)	2 (6.25)	0.02
NEWS2 Score 5-7 (moderate)	30 (54.55)	14 (60.87)	16 (50.00)	
NEWS2 Score 8-10 (severe)	23 (41.82)	9 (39.13)	14 (43.75)	
Mortality by age group				
20 to 49	8 (14.55)	6 (26.09)	2 (6.25)	0.03
50 to 64	18 (32.73)	4 (17.39)	14 (43.75)	
more than 65	29 (52.73)	13 (56.52)	16 (50.00)	

Table 3. Laboratory findings by sex and final health outcome in patients with COVID-19

White cells	Total (mean)	Women (mean)	Men (mean)	P	Died	Alive	P
Leukocytes (<4.5×10 ⁹ /L - >10×10 ⁹ /L) N=156	10.21 (9.45-10.97)	9.70 (8.70-10.70)	10.68 (9.53-11.82)	0.20	13.03 (11.62-14.45)	8.69 (7.94-9.44)	0.00
Lymphocytes (<1.1×10 ⁹ /L - >3.2×10 ⁹ /L) N=156	1.15 (1.06-1.24)	1.25 (1.13-1.37)	1.06 (0.94-1.18)	0.02	1.13 (0.93-1.33)	1.16 (1.08-1.25)	0.72
Neutrophils (<2.2×10 ⁹ /L - >4.8×10 ⁹ /L) N=156	8.52 (7.78 - 9.26)	7.97 (7.01-8.93)	9.02 (7.91-10.14)	0.16	11.19 (9.82-12.56)	7.08 (6.34-7.82)	0.00
Platelets (<150×10 ⁹ /L) N=156	280.23 (265.99-294.48)	282.30 (261.71-302.89)	278.34 (265.99-298.48)	0.78	281.23 (261.06-301.40)	279.69 (260.41-298.97)	0.91
Blood chemistry							
Fibrinogen (<350 mg/dl) N=96	639.82 (606.40-673.23)	627.43 (583.27-671.58)	650.30 (606.40-673.23)	0.50	634.52 (571.38-697.65)	643.29 (604.87-681.71)	0.80
Creatinine (<1.25 mg/dl) N=152	1.23 (0.96-1.49)	0.99 (0.71-1.28)	1.44 (1.01-1.88)	0.09	1.36 (1.05-1.66)	1.16 (0.79-1.53)	0.48
Urea (<42.9 mg/dl) N=154	46.77 (40.84-52.70)	38.97 (30.42-46.02)	53.89 (44.68-63.11)	0.01	59.46 (46.93-71.99)	39.99 (34.07-45.91)	0.00
TP (<13.7 s) N=140	12.12 (11.85-12.40)	11.78 (11.49-12.07)	12.43 (11.98-12.88)	0.02	12.44 (12.12-12.76)	11.95 (11.56-12.34)	0.09
TTP (<36.2 s) N=140	34.41 (33.34-35.48)	31.60 (30.41-32.79)	36.92 (35.40-38.44)	0.00	35.15 (33.21-37.10)	34.00 (32.72-35.28)	0.30
AST (<34 U/L) N=145	53.84 (48.15-59.53)	48.25 (41.44-55.06)	58.64 (49.82-67.45)	0.07	63.13 (50.01-76.26)	48.79 (43.71-53.88)	0.01
ALT (<55 U/L) N=140	51.65 (43.43-59.86)	41.57 (33.30-49.84)	60.13 (46.81-73.44)	0.02	59.57 (37.62-81.52)	47.64 (41.79-53.49)	0.17
LDH (M:<275 U/L W: <290 U/L) N=124	443.38 (412.08 - 474.6)	411.47 (368.43-454.51)	467.99 (423.55-512.43)	0.07	534.91 (472.89-596.92)	396.49 (365.08-427.91)	0.00
PCR (0.5 mg/dl) N=101	17.12 (13.31-20.94)	18.85 (11.65-26.04)	15.23 (13.59-16.86)	0.34	23.34 (12.31-34.37)	13.97 (12.53-15.42)	0.02
D-dimer (<500 ug/ml) N=113	1685.35 (1228.13-	1974.26 (1276.65-	1391.28 (790.04-	0.20	2998.11 (1671.68-	1120.36 (850.52-	0.00

	2142.57)	2671.87)	1992.53)		4324.55)	1390.20)	
Troponin (39.2 pg/ml) N=85	53.54 (21.40- 85.59)	46.55 (9.44- 83.65)	62.20 (5.15- 119.25)	0.63	64.06 (29.09- 99.04)	48.01 (2.24- 93.95)	0.63
Ferritin (<274 ng/ml) N=127	964.6 (837.9 – 1091.2)	816.5 (614.1 – 1018.9)	1119.8 (974.8 – 1264.8)	0.01	957.37 (765.95 – 1148.79)	967.72 (804.29 – 1131.15)	0.94
PCO2 (40 mmHg) N=149	32.51 (31.20- 33.81)	33.28 (30.95- 35.61)	31.83 (30.42- 33.23)	0.27	33.73 (30.61- 36.84)	31.82 (30.72- 32.92)	0.16
PO2 (60 mmHg) N=149	56.58 (53.45- 59.72)	58.25 (53.81- 62.68)	55.13 (50.64- 59.61)	0.32	52.98 (47.72- 58.25)	58.61 (54.69- 62.52)	0.08
Lactate (2.0 mmol/L) N=149	2.19 (1.96- 2.41)	1.87 (1.55- 2.19)	2.47 (2.16- 2.77)	0.00	2.72 (2.18- 3.25)	1.89 (1.72- 2.06)	0.00