ALTA TASA DE MORTALIDAD ENTRE PACIENTES MAYORES CON COVID-19 EN ECUADOR. ESTUDIO DE CASO EN RETROSPECTIVA (MARZO 15, 2020 – ABRIL 15, 2020)

HIGH MORTALITY RATE AMONG OLDER POPULATION WITH COVID-19 IN ECUADOR. A RETROSPECTIVE CASE-STUDY (MARCH 15, 2020 – APRIL 15, 2020)

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ABSTRACT

Ecuador registered an increasing number of cases and deaths related to COVID-19 during an extended period. This case study aims to evaluate the epidemiological data reported by the Ministry of Public Health of Ecuador during a limited period (March 15- April 15). It focuses on differentiating the mortality rates among different age groups. Case- Fatality ratios were calculated with overall results of 4,94% mortality for COVID-19 positive patients of all ages by the end of the data collection period. It also indicated that patients aged '65 years or more' had the highest Case-Fatality ratios (16,63%) followed by patients aged between '50-64 years old' (7,37%). The lowest rate was 0% for patients aged 5-19 years. Therefore, indicating a high mortality rate among older patients. Case-Fatality ratios found in elderly Ecuadorian patients also appear to be slightly higher than estimated ratios from other countries. Presence of age-related comorbidities may be responsible on the increasing mortality among this age group. Social, economic, and cultural behaviors related to ethnicity (Latin-American) also may facilitate the spread of the virus among vulnerable groups, therefore, increasing mortality.

Keywords: COVID-19, mortality, older patients.

RESUMEN

Ecuador registró un creciente número de casos y muertes relacionadas con COVID-19 durante un periodo extendido de tiempo. Este estudio de caso pretende evaluar los datos epidemiológicos reportados por el Ministerio de Salud Pública del Ecuador durante un periodo limitado de tiempo (marzo 15-abril 15). Se enfoca en diferenciar la tasa de mortalidad entre grupos de diferentes edades. La tasa de letalidad fue calculada con un resultado promedio de 4,94% de mortalidad para pacientes positivos de COVID-19 de todas las edades al final del periodo de recolección de datos. También indicó que los pacientes de '65 años o más' tuvieron la Tasa de Letalidad más alta (16,63%) seguidos de los pacientes con edades entre '50-64 años' (7,37%). La tasa más baja fue de 0% para pacientes con edades entre 5-19 años. Por lo tanto, indicando una alta tasa de mortalidad entre pacientes de edad avanzada. La Tasa de Letalidad encontrada en pacientes ecuatorianos ancianos también parecen ser ligeramente mayor a las tasas estimadas en otros países. Presencia de comorbilidades relacionadas a la edad podrían ser responsables del incremento en mortalidad en este grupo de edad. Comportamientos sociales, económicos y culturales relacionados con etnicidad (Latinoamericana) también podrían facilitar la propagación del virus ente la población vulnerable, por lo tanto, incrementando la mortalidad.

Palabras Clave: COVID-19, mortalidad, pacientes ancianos.

ISSN: 1390 - 5546

INTRODUCTION

In December 2019, hospitals in Wuhan, China, reported several cases of an unknown respiratory disease among their patients. The cause was later attributed to an emergent viral disease (COVID-19) caused by SARS-CoV-2, a human coronavirus of the Beta coronavirus genus. The high virulence of SARS-CoV-2 was mainly attributed to transmission mechanisms: direct contact and respiratory droplets (Leung, 2020). Studies conducted after the sudden emergence of the virus have reported that SARS-CoV-2 gains access to the host cell by targeting a protein (angiotensin converting enzyme 2 or ACE2) expressed in the human airway epithelia and lung parenchyma (Xu et al., 2020 and Jia et al., 2020). As of the end of July 2020, more than 17,4 million confirmed cases of COVID-19 and over 677,000 related deaths have been reported globally (Johns Hopkins, 2020).

Epidemiological studies have identified several risk factors for COVID-19 related mortality like sex and ethnicity (Promislow, 2020). Most importantly, a dramatic increase in mortality caused by COVID-19 within the elderly population has been reported (Le Couteur et al., 2020). Some of the clinical manifestations fluctuate from mild to critical, predominantly among older patients (Cascella et al., 2020). The susceptibility of elderly patients to develop severe illness that requires hospitalization at Intensive Care Unit (ICU) has been linked to underlying conditions like diabetes, hypertensions, cardiovascular disease and cerebrovascular disease (Liu et al., 2020). As a result of the rapid increase of COVID-19 infections, public institutions gradually implemented measures in response to epidemiological data, early estimates of the case-fatality ratio (CFR) from a determined population can provide crucial information for effective public responses (Mizumoto and Chowell, 2020).

Against this background, the present case-study aims to evaluate the severity of the epidemic among several age groups during a limited period of time (15 March to 15 April). For this purpose, epidemiological data provided by the Ministry of Public Health of Ecuador was reviewed and discussed to understand mortality trends and possible causes.

METHOD

Data Sources

Daily series of confirmed cases and deaths related to COVID-19 were extracted from daily reports published by the Ministry of Public Health of Ecuador between March 15, 2020, to April 15, 2020 (Ministerio de Salud Publica del Ecuador, 2020). For this study, only data from officially confirmed cases of COVID-19 was included. It is worth noting that the number of deaths attributed to unconfirmed cases increased during the last dates of data recollection, however, it was decided that only data from confirmed cases was going to be used for this analysis. During data recollection, it was observed that reports from several dates were missing. In addition, reports were published twice during the same date (March 26 and March 29). Therefore, only the reports published during the morning of those repeating dates were chosen for the analysis. In total, data from 24 Epidemiological reports was kept for the final analysis, the list of reports can be seen in **(Appendix 1)**.

Raw data from epidemiological reports was re-grouped according to social, educational and/or economical activities: 0-4 years old (pre-scholar), 5-14 years old (primary school), 15-19 years old (high school), 20-49 years old (working age), 50-64 years old (early retirement) and 65 years old or more (late retirement).

Case-Fatality Ratio

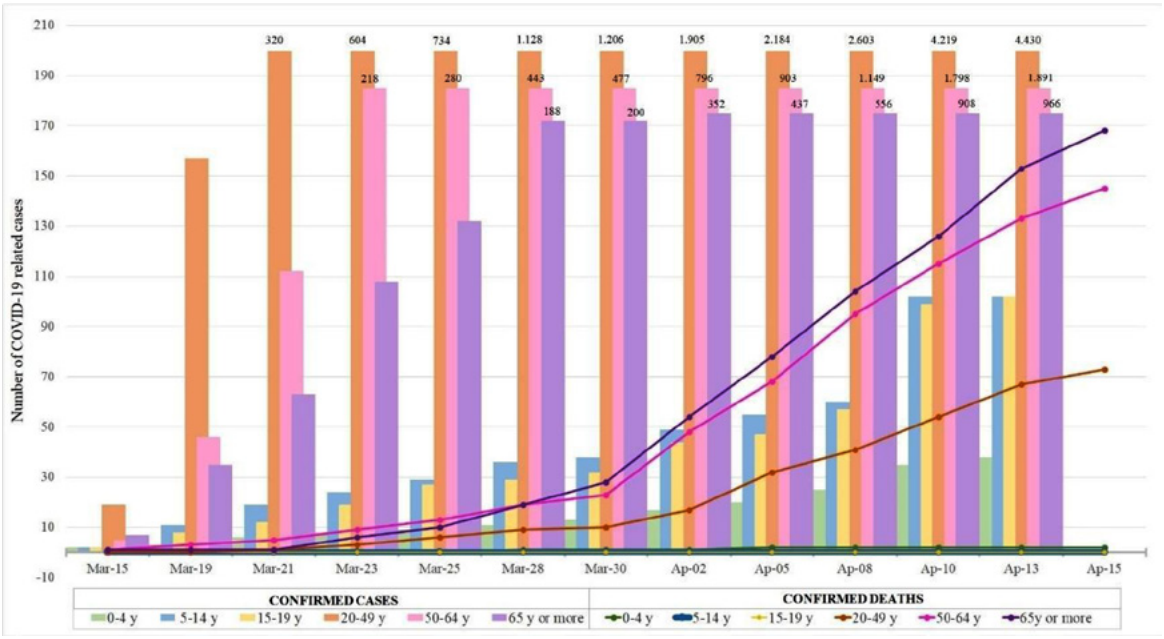
For this study, Case-Fatality ratio (CFR) is defined as the number of cumulative deaths caused by COVID-19 divided by the number of confirmed COVID-19 cases at a specific point in time. The equation used for these calculations **(Appendix 2)** was based on a guide for mortality frequency measures (Centers of Disease Control and Prevention, 2012) and can be found next:

$$CFR = \frac{\text{Number of deaths COVID-19 during a given time interval}}{\text{Number of new cases of COVID during the same time interval}} \text{ x } 100$$

Data accumulated until the last day of the compilation period, April 15 was used to calculate the final CFRs.

RESULTS

At the end of the data recollection period: April 15, 2020, 388 deaths were confirmed to be causally related to SARS-CoV-2 infection (Ministerio de Salud Publica del Ecuador, a2020). Age group '20-49 years old' listed the highest number of COVID-19 related cases (4,635 cases), followed by age groups: '50-64 years old' (1,967 cases) and '65 years old or more' (1,010 cases). Age group '65 years old or more' registered the highest number of deaths (168 deaths) as of April 15, 2020, even though this age group only accounted for 12.85% of the total confirmed cases, as seen in Figure 1. Age group '50-64 years old' registered the second highest number of deaths (145 deaths). Patients on the group '0-4 years old' still account for small number of fatalities (2 deaths) despite having the smallest number of COVID-19 related cases (38 cases) by the end of the period of data compilation. On the other hand, age groups '5-14 years old' and '15-19 years old' presented zero deaths despite having a higher percentage of cases than the previous group.



Source: *Compiled by the author based on data from the Ministry of Public Health of Ecuador (a2020).*
Figure 1*. Confirmed cases and deaths related to COVID-19 in Ecuador (March 15-April 15)*

Results of calculations for the Case-Fatality ratio on each day of the data compilation period can be found in **Appendix 3**. The results have been rounded off to 2 decimal digits. The final CFRs for all age groups at the end of can be seen in **Table 1**. Ecuador presented a total CFR (all ages) of 4,94%. Notably, the Case-Fatality ratios (CFRs) for '65 years old or more' are

higher than the CFRs of all the other age groups (16.63%). '5-14 years old' and '15-19 years old' groups generated a CFR of 0% at all time points taken during the data recollection period.

Table 1. *Case-Fatality rate by Age group as of April 15, 2015*

Age groups	No. of cases	No. of deaths	Percentage of deaths from total fatalities (%)	Case-fatality rate (%)
0-4 y	38	2	0.5	5.26
5-14 y	106	0	0	0
15-19 y	102	0	0	0
20-49 y	4,635	73	18.8	1.57
50-64 y	1,967	145	37.4	7.37
65 y or more	1,010	168	43.3	16.63
Total all groups	7,858	388	100	4.94

Note: y = years old

DISCUSSION

This study analyzed epidemiological data publicly available by the Ministry of Public Health of Ecuador. As a result, the Case-Fatality ratio for several age groups was estimated from data recollected between March 15 and April 15.

In terms of overall results, the CFR for all age groups at the end of the compilation period was 4.94%. This result rests among the upper range of the CFRs reported previously in other studies. For instance, Niu et al., (2020) described CFRs oscillating between 2-5% on their study. Initial estimations of the effective reproductive number (Rt) in Latin American countries suggested that Ecuador was one of the countries with the highest Rt values of Latin America: 3.95 (3.70-4.21) (Caicedo-Ochoa et al., 2020). As it is known, Rt values describe the number of secondary cases derived from one initial infectious case during an outbreak and can account for transmissibility rate fluctuation after safety measures get implemented (Yuan et al., 2020). This high number of new derived cases per individual can overwhelm most health care systems around the world, as it was initially warned (Memish et al., 2020). Health-care systems from developing countries like sub-Saharan Africa and Latin America already experienced a high level of saturation before the SARS-CoV-2 epidemic and were not prepared to withstand the sudden influx of severe COVID-19 related cases (Bates et al., 2020). This deficit in Health-care attention combined with the high Rt values calculated in Ecuador at the time of data compilation on this study, explain why the Ecuadorian Health-care system became quickly overwhelmed (Cobos, 2020). Overall, this over-saturation of health-care facilities could be appointed as one of the causes of the high mortality rate observed on this study.

The highest rate of mortality was found among patients of older age. Age groups '50-64 years old' and '65 years old or more' had a CFR of 7.37% and 16.63% respectively. A report published by Centers for Disease, Control and Prevention (2020) found a CFR of around 1% to 3% for patients aged 55 - 64 years in the USA. They also indicated a CFR of 3% to 11% for people aged 65-84 years. Comparison of the American reports with the results obtained on this study suggest that COVID-19 lead to a higher mortality rate in Ecuador among those age groups. In addition, Centers for Disease, Control and Prevention also reported a CFR of 10% to 27% for people aged 85 years or more. The epidemiological reports used for this study did not provide a breakdown for mortality between Ecuadorian patients aged 70 years and 85 years. Consequently, there is a possibility that the higher mortality registered in our group '65 years old or more' could be influenced by the decease of Ecuadorian patients aged 85 years or more. Nevertheless, the CFR values reported by a study

in China (Wu and McGoogan, 2020) also supports the idea that Ecuador faced a higher rate mortality in older patients in comparison with other countries. They reported a CFR of 8.0% (70-79 years old) and 14.8% (80 years old or more).

This study also found a CFR of 5.56% for the youngest age group: '0-4 years old'. Data for young patients has been scarce in literature until now. Only one of the previous studies reported the mortality rates for this age group: 0% (Centers for Disease, Control and Prevention, 2020). This could indicate a dramatic difference between the results obtained in Ecuador and those reported in other countries. However, the number of Ecuadorian cases for this age group were very reduced (36 cases and 2 deaths by the end of the data compilation period) so the limited number of samples may have affected the CFR value obtained for this age group. It is advisable to calculate this value once new reports provide data with a bigger sample size for more significant conclusions.

The high number of patients who develop severe illness significantly increases the burden of the health care system (Mizumoto and Chowell, 2020). Other countries that faced shortage of capacity on their health institutions were forced to prioritise health treatment for patients younger than 65 years old as they had higher rates of survival (Le Couteur, 2020). It has been suggested that age-specific mortality could be attributed to an age- related deterioration of the immune system (Wu et al., 2020). However, the presence of comorbidities has been identified as another decisive factor. Some of the comorbidities that appear to increase COVID-19-related mortality are hypertension, diabetes, coronary heart disease and obesity (Zhou et al., 2020; Ryan et al., 2020). The Ministry of Public Health of Ecuador (b2020) has already contemplated the presence of these pre-existing conditions as risk factors on their Multidisciplinary Settlement for COVID-19 treatment. They also included chronic asthma, chronic obstructive pulmonary disease, pulmonary fibrosis, chronic renal disease, and cancer as risk factors. Generally, increasing age has always been related to development of multiple comorbidities and lower life expectancy (Dugoff et al., 2014).

The mechanism of host cell entry used by SARS-CoV-2 could explain why these pre- existing conditions in the respiratory and cardiovascular systems seem to generate higher risks of mortality (Pan et al., 2020). It is known that SARS-CoV-2 enters the cell by targeting ACE2 receptors present on the respiratory tissue (Xu et al., 2020 and Jia et al., 2020). Binding of SARS-CoV-2 to respiratory tissue may downregulate the expression of ACE2 and subsequently, lead to the development of acute respiratory distress syndrome (ARDS) (Kuba et al., 2005). Similarly, ACE2 has a well-recognized role in myocardial recovery and injury response, therefore, binding of SARS-CoV-2 to this receptor on the heart tissue could lead to myocardial damage (Vaduganathan et al., 2020).

In the context of epidemiological and socio-demographic distribution of COVID-19 related cases, studies on developing countries have found differences on the mortality rates of different racial/ethnic minorities. Some minorities like the Latino population usually express higher predisposition to develop certain comorbidities and biological- based vulnerabilities to the disease. As a result, Latinos were found to be the second population most impacted by COVID-19 in developed countries (Webb Hooper et al., 2020). At the same time, further considerations have suggested that cultural, behavioral, and socio-economic factors may have influenced viral spread among minority groups on developed countries (Pan et al., 2020). Many of these behavioral patterns are also heavily ingrained in Latin-American countries like Ecuador. Some of the risk behavioral patterns are co-habiting in inter-generational familial units, living in more crowded conditions, differences in educational background and poor health-seeking behaviors. These ethnicity-related customs could also explain the high rate of viral transmission to vulnerable groups within a family unit (Webb Hooper et al., 2020; Pan et al.,2020). Consequently, all the risk factors mentioned above could explain the high risk of mortality in Ecuador.

This study faced several limitations. First, only COVID-19 confirmed cases published between March 15 and April 15 were considered. At the time, self-confinement measurements had just been implemented so any result obtained by this study could seriously underestimate the severity of disease at later dates in Ecuador. Unfortunately, epidemiological reports were not published with continuity after the data compilation period of this study, so the inclusion of continuous

data from future dates was not possible. Another situation that could affect the results of this study is the high number of unreported cases due to saturation of the COVID-19 testing system. Many cases are prompt to go unreported because of mild symptoms and lack of access to the COVID-19 testing centers. As a result, using only official data on this analysis could have led to over- estimation of the CFR as the data on official epidemiological reports may overlook a significant number of COVID-19 positive patients who recovered successfully without referring to a health facility.

CONCLUSION

This case study compilated epidemiological data provided by the Ministry of Public Health of Ecuador regarding COVID-19 positive patients between March 15 and April 15. Data was divided into 6 age groups and analyzed to determine their Case-Fatality ratios (CFRs). Results indicate a high rate of mortality among old patients ('50-64 years old' and '65 years old or more'). Literature stated that older patients were more susceptible to experience severe disease and death by COVID-19 due to the presence of age-related comorbidities. Importantly, comparison with CFRs reported in other countries suggest that Ecuador may have experienced even higher mortality rates for people of older age. It is believed that social, economic, and cultural behaviors related to ethnicity (Latin- American) may facilitate the spread of the virus and therefore, explain the high CFR values obtained on this study. The present study aimed to offer some insigne into the mortality trends caused by COVID-19 during the initial stage of the pandemic in Ecuador. This knowledge is crucial as it offers a retrospective analysis of the COVID-19 outbreak and identify vulnerable populations. It also could aid in the creation of prevention tactics in case of future pandemics.

CONFLICT OF INTEREST

The author has no conflict of interest to declare. The entire study was completely self-funded.

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Appendix 1. List of Epidemiological reports used on this study

Date	Epidemiological Reports published by the Ministry of Public Health of Ecuador
Mar-15	Boletín Epidemiológico Covid-19, coronavirus 2
Mar-17	Boletín Epidemiológico Covid-19, coronavirus 3
Mar-19	Boletín Epidemiológico Covid-19, coronavirus 4
Mar-20	Boletín Epidemiológico Covid-19, coronavirus 8
Mar-21	Boletín Epidemiológico Covid-19, coronavirus 9
Mar-22	Boletín Epidemiológico Covid-19, coronavirus 12
Mar-23	Boletín Epidemiológico Covid-19, coronavirus 15
Mar-24	Boletín Epidemiológico Covid-19, coronavirus 17
Mar-25	Boletín Epidemiológico Covid-19, coronavirus 19
Mar-26	Boletín Epidemiológico Covid-19, coronavirus 20
Mar-28	Boletín Epidemiológico Covid-19, coronavirus 23
Mar-29	Boletín Epidemiológico Covid-19, coronavirus 25
Mar-30	Boletín Epidemiológico Covid-19, coronavirus 26
Mar-31	Boletín Epidemiológico Covid-19, coronavirus 31
Apr-02	Boletín Epidemiológico Covid-19, coronavirus 34
Apr-04	Boletín Epidemiológico Covid-19, coronavirus 36
Apr-05	Boletín Epidemiológico Covid-19, coronavirus 37
Apr-06	Boletín Epidemiológico Covid-19, coronavirus 38
Apr-08	Boletín Epidemiológico Covid-19, coronavirus 40
Apr-09	Boletín Epidemiológico Covid-19, coronavirus 41
Apr-10	Boletín Epidemiológico Covid-19, coronavirus 43
Apr-12	Boletín Epidemiológico Covid-19, coronavirus 45
Apr-13	Boletín Epidemiológico Covid-19, coronavirus 46
Apr-15	Boletín Epidemiológico Covid-19, coronavirus 48

Available at: https://www.salud.gob.ec/boletines-epidemiologicos-coronavirus-por- semanas/

Appendix 2. Raw data and Calculations to determine the CFR. Available at:https://drive.google.com/file/d/1Rh5m-1chWcGQ3ApFA5a1AUvtoJ74CTirJ/view?usp= sharing

Appendix 3. Summary results of CFR per age group, March 15-April 15

Date	0-4 y (%)	5-14 y (%)	5-19 y (%)	20-49 y (%)	50-64 y (%)	65 y or more (%)	Total all groups (%)
Mar-15	0	0	0	0	20.00	14.29	5.41
Mar-16	0	0	0	0	10.00	11.11	3.45
Mar-19	0	0	0	0	6.52	2.86	1.54
Mar-20	0	0	0	0	5.41	2.27	1.36
Mar-21	0	0	0	0.31	4.46	1.59	1.32
Mar-22	0	0	0	0.21	4.57	5.68	1.77
Mar-23	0	0	0	0.50	4.13	5.56	1.83
Mar-24	0	0	0	0.61	5.33	8.47	2.50
Mar-25	0	0	0	0.82	4.64	7.58	2.39
Mar-26	0	0	0	0.83	4.69	7.95	2.46
Mar-28	9.09	0	0	0.80	4.29	10.11	2.62
Mar-29	8.33	0	0	0.86	4.82	12.44	3.02
Mar-30	7.69	0	0	0.83	4.82	14.00	3.15
Mar-31	6.67	0	0	0.78	5.09	16.05	3.43
Apr-02	5.88	0	0	0.89	6.03	15.34	3.79
Apr-04	11.11	0	0	1.49	7.51	18.27	4.96
Apr-05	10.00	0	0	1.47	7.53	17.85	4.94
Apr-06	10.00	0	0	1.48	7.59	18.68	5.10
Apr-08	8.00	0	0	1.58	8.27	18.71	5.44
Apr-09	7.14	0	0	1.74	8.25	18.81	5.48
Apr-10	5.71	0	0	1.28	6.40	13.88	4.15
Apr-12	5.41	0	0	1.41	6.66	15.05	4.46
Apr-13	5.26	0	0	1.51	7.03	15.84	4.72
Apr-15	5.26	0	0	1.57	7.37	16.63	4.94
Total	5.26	0	0	1.57	7.37	16.63	4.94