Survival of COVID-19, in the subregions of the department of Antioquia from 2020 to 2022

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Abstract

Objective: Calculate the survival of people with COVID-19 in the subregions of the department of Antioquia according to demographic characteristics and comorbidities. Methods: Descriptive survival study of a cohort of patients with COVID-19, with information by SIVIGILA and open data Ministry of Health and Social Protection of Colombia. Mortality and survival, overall and by subregion, were characterized by adjusted rates and the Kaplan Meier and log rank test techniques. With the adjusted Weibull model, the contributions of demographic variables and comorbidities in the outcome were determined.

Results: The total number of records of detected cases was 922 533 (18 308 deaths). 58,9% of the deaths corresponded to men, occurring on average at 69 years of age (SD=15,33). The risk of dying was higher in men, in people aged 60 and over, in those with hypertension, chronic renal failure, diabetes mellitus, COPD, especially obesity, and in the subregions of the Southwest and Bajo Cauca, in contrast to the subregion from the North ($p < 0,001$).

Conclusions: Both age, sex and suffering from one or more comorbidities decreased survival to COVID-19 in the department of Antioquia.

Keywords: COVID-19, survival, comorbidities, geographical locations.

Resumen

Objetivo: Calcular la supervivencia de personas con COVID-19 en las subregiones del departamento de Antioquia según características demográficas y comorbilidades.

Métodos: Se realizó un estudio descriptivo de supervivencia en una cohorte de pacientes con COVID-19 desde 2020 hasta el 31 de mayo de 2022, utilizando información del Sistema de Vigilancia en Salud Pública (SIVIGILA) y datos abiertos del Ministerio de Salud y Protección Social. Se caracterizó la mortalidad y la supervivencia, tanto general como por subregiones, mediante tasas ajustadas y las técnicas de Kaplan-Meier y log-rank test. Con un modelo ajustado de Weibull, se determinaron las contribuciones de variables demográficas y comorbilidades al desenlace.

Resultados: Se registraron 922 533 casos detectados, de los cuales 18 308 finalizaron en muerte. El 58,9 % de las defunciones correspondieron a hombres, con una edad promedio de 69 años (DE = 15,33). El riesgo de morir fue mayor en hombres, en personas de 60 años o más y en quienes padecían hipertensión, insuficiencia renal crónica, diabetes mellitus, EPOC y obesidad. Además, las subregiones del Suroeste y del Bajo Cauca mostraron mayores riesgos en comparación con la subregión del Norte ($p < 0,001$).

Conclusiones: La edad, el sexo y la presencia de una o más comorbilidades disminuyeron la supervivencia al COVID-19 en el departamento de Antioquia.

Palabras clave: COVID-19, supervivencia, comorbilidades, ubicaciones geográficas.

Introduction

The expansion of COVID-19 has, in part, been the result of international mobility, leading it to become a pandemic that, during its course, has caused millions of deaths. The first cases were recorded at the end of 2019 in the city of Wuhan (China), with manifestations of pneumonia of unknown origin. By early 2020, it was declared a global pandemic by the World Health Organization (WHO) (1).

In November 2021, a new variant was identified in the Gauteng province, the most populous in South Africa, which set global records for infections. This variant, known as Omicron, spread throughout Europe and Asia, where, during the first week of January 2022, over seven million new cases were reported (1).

In Colombia, COVID-19 cases were the leading cause of death in 2020. During the pandemic, the country experienced three pandemic peaks: the first in mid-July, with more than 13,000 daily cases; the second at the end of 2020; and the third in April 2021 (2).

In January 2022, Colombia was the third country in Latin America with the highest number of infected individuals. In the department of Antioquia, between 2020 and 2022, the event predominantly affected women aged between 20 and 69 years. At that time, maximum alert was requested due to the high incidence rate of the virus and the 98.91% occupancy rate in the Intensive Care Unit (ICU) beds (3,4). More than half of the active cases were concentrated in major cities such as Bogotá (75,278 cases), Cali (13,047), and Medellín (12,584) between 2020 and May 2022.

Each region has demographic characteristics and other factors that influence the timely detection and management of cases to prevent deaths, effectively combat the virus, and achieve the highest possible survival rate. Among these factors, demographic characteristics and comorbidities play a key role in the survival of patients with COVID-19 (2).

The development of the COVID-19 pandemic has raised numerous hypotheses and myths surrounding the survival of patients with comorbidities and specific demographic characteristics (5). From this perspective, the present study presents the survival experience of people with COVID-19 in the subregions of the department of Antioquia between 2020 and May 2022.

Furthermore, this work significantly contributes to the understanding of how COVID-19 has impacted survival in the department of Antioquia. While existing literature has addressed issues such as inequality in access to healthcare and deficiencies in the national healthcare system, there is a significant gap in research on regional dynamics, particularly in Antioquia. This region presents unique socioeconomic and geographical characteristics that have influenced the response to the pandemic and the COVID-19 survival rates, especially in rural and hard-to-reach areas (5,6).

The department of Antioquia was one of the regions most affected by COVID-19 between 2020 and 2022 in Colombia. The subregions that make up the department showed significant variations in the levels of virus impact, with no clear scientific evidence regarding the demographic and clinical factors associated with the event. Therefore, the subregions were chosen to analyze the demographic characteristics and comorbidities of

their population, with the goal of determining the most affected subregion and the variation in cases.

The aim of this article is to calculate the survival of people with COVID-19 in the subregions of the department of Antioquia based on demographic characteristics and comorbidities, answering the question: What is the magnitude of survival and the influence of demographic characteristics and comorbidities in the subregions of the department of Antioquia up to May 2022.

Methods

A descriptive cohort study was conducted on patients with COVID-19 in the department of Antioquia and its subregions, between March 2020 and May 31, 2022, to determine the survival of patients with this disease. For the analysis of detected cases and deaths, the database provided by the COVID-19 Management in Antioquia was used, which was collected from the Public Health Surveillance System (SIVIGILA) and open data from the Ministry of Health and Social Protection.

The survival tracer variable was time, in days, from the onset of symptoms to the final patient status (alive or deceased), which defined the condition as censored or non-censored. The date of symptom onset and the date of death (if not censored) or recovery (if censored) were considered.

Records of detected COVID-19 cases that occurred in the department of Antioquia between March 2020 and May 31, 2022, were included, with a total of 922,533 records corresponding to 45 variables related to comorbidities, symptom onset dates, recovery, or death. Records of patients not diagnosed with COVID-19 and those who died from causes other than the disease were excluded.

To control for selection, information, and confounding biases, the following strategies were applied:

1. It was verified that patients were diagnosed with COVID-19 by cross-referencing different databases using a common identification number.
2. Explicit criteria were established for the classification of subjects, eliminating incomplete records in the variables of interest for the study.
3. A multivariate Weibull analysis was conducted to control for the confounding effect of comorbidities and other demographic and clinical variables.

In the statistical analysis, the Mann-Whitney U test was used to assess differences between the final condition (alive or deceased) and continuous variables, while the Chi-square independence test was used for categorical variables. Crude and adjusted rates were calculated using the direct method, with the 2022 DANE population projection for Antioquia as the standard population. Age-specific rates were applied to obtain the "expected" cases, and the adjusted rate was obtained by dividing the total expected cases by the standard population.

In the survival analysis, the Kaplan-Meier method was used, accompanied by survival plots for general estimates and comparisons between the outcome of interest and demographic variables and comorbidities using the log-rank test or the Peto and Peto test, with 95% confidence intervals for the cumulative survival probability.

Initially, the classical Cox proportional hazards model was used; however, due to the violation of its assumptions, more robust parametric methods were chosen. After comparing the Weibull, exponential, log-normal, Gompertz, and gamma models, the Weibull model was selected based on statistical criteria and its ability to meet the Proportional Hazards (PH) and Accelerated Failure Time (AFT) characteristics. Simple Weibull parametric regression models were constructed, calculating the accelerated failure time (AFT) and hazard ratio (HR) with their respective 95% confidence intervals. To define the variables to be included in the multiple parametric Weibull model, the backward elimination strategy was used.

Ethical Aspects:

The source of information for this study was secondary, and therefore, it did not require direct contact with the study population. The study was approved by the Health Information Systems Management Program Committee on June 13, 2022, through Act No. 07. The guidelines outlined in Article 11 of Resolution 8430 of 1993, which establishes scientific, technical, and administrative standards for health research, were followed. This work is considered a low-risk study as it uses retrospective methods for document analysis, such as reviewing medical records and other non-identifiable data not related to sensitive aspects of individuals' behavior (10). A survival analysis script was developed in R Project using the RStudio interface, which allowed for obtaining the results.

Results

In the department of Antioquia, between 2020 and May 2022, there were 922,533 confirmed cases of COVID-19, of which 18,308 were deaths. These occurred mainly within the first 20 days after the onset of symptoms. Of the total deaths, 58.9% were men. The average age of the deceased individuals was 69.1 years, with a standard deviation of 15.3 years

Deaths by Subregion

When considering the subregions that make up the geography of Antioquia, the highest adjusted mortality rate was recorded in the Valle de Aburrá, with 310.4 deaths per 100,000 inhabitants, in contrast to the subregion of the Southwest, where the lowest rate was recorded, with 111.4 deaths. It was observed that, for every death in the Southwest of Antioquia, approximately 2.8 deaths occurred in the Valle de Aburrá. Regarding the distribution of adjusted rates by subregion according to age groups, the Bajo Cauca and Valle de Aburrá subregions presented the highest indicators in four and three age groups, respectively. In Bajo Cauca, the affected groups were 0-9, 20-29, 40-49, and 60-69 years, while in Valle de Aburrá, they were 30-39 and 70 years or older. The lowest rates were recorded in the Southwest and North subregions, with lower rates in five and two age groups, respectively. Additionally, the highest lethality was observed in the Bajo Cauca subregion, with 4.1%, while the lowest was recorded in the Valle de Aburrá, with 1.8% (Table 1).

Table 1. Frequencies of the number of alive and deceased from COVID-19 in the department of Antioquia and crude and adjusted rates by subregion and age groups. March 2020 to May 2022.

	Antioquia	*Bajo Cauca*	*Magdalena Medio*	*Nordeste*	*Norte*	*Occidente*	*Oriente*	*Suroeste*	*Urabá*	*Valle de Aburrá*
Vivos	904.225	12.029	4.692	10.890	13.672	12.021	75.527	15.994	28.050	731.350
Muertos	18.308	515	167	305	305	344	1.414	494	999	13.765
Total	922.533	12.544	4.859	11.195	13.977	12.365	76.941	16.488	29.049	745.115
Tasa de letalidad (%)	1,98	4,11	3,23	2,72	2,21	2,78	1,84	2,99	3,44	1,85
Tasa mortalidad ajustada	280,49	169,83	164,80	134,74	152,27	190,81	111,42	287,55	310,42	
Tasas ajustadas *por Subregión**										
Grupos de edad	*Antioquia*	*Bajo Cauca*	*Magdalena Medio*	*Nordeste*	*Norte*	*Occidente*	*Oriente*	*Suroeste*	*Urabá*	*Valle de Aburrá*
0 a 9	1,82	3,41	0	0	2,43	2,64	1,99	1,91	0	2,11
10 a 19	1,62	0	5,67	2,75	2,28	2,75	0,96	0	2,81	1,50
20 a 29	16,92	26,30	17,5	12,08	7,31	25,21	14,99	14,71	23,36	16,45
30 a 39	55,39	53,17	29,75	47,46	29,20	38,03	51,29	29,76	53,02	61,35
40 a 49	140,38	190,02	66,77	82,87	73,29	113,81	127,07	60,01	163,76	154,21
50 a 59	310,88	367,52	314,79	260,27	159,45	264,59	235,21	122,82	388,28	343,43
60 a 69	681,04	930,29	514,48	525,58	337,24	389,97	473,88	295,04	884,31	770,77
70 a 79	1.458,44	1.579,36	831,33	825,56	816,17	648,82	1.019,44	567,87	1.481,17	1.740,33
80 y más	3.473,61	2.201,89	1.575,58	1.435,40	1.583,9	1.536,83	2.282,57	1.432,75	3.015,68	3.015,68

In the construction of the survival table, made by 30-day intervals, it was observed that 918,087 patients entered the first period, of which 848,205 were lost to follow-up, either due to death from causes other than COVID-19, loss to follow-up, or recovery. Of the patients exposed to risk, 15,834 died from COVID-19 during this period. The survival probability from the onset of symptoms was 97%.

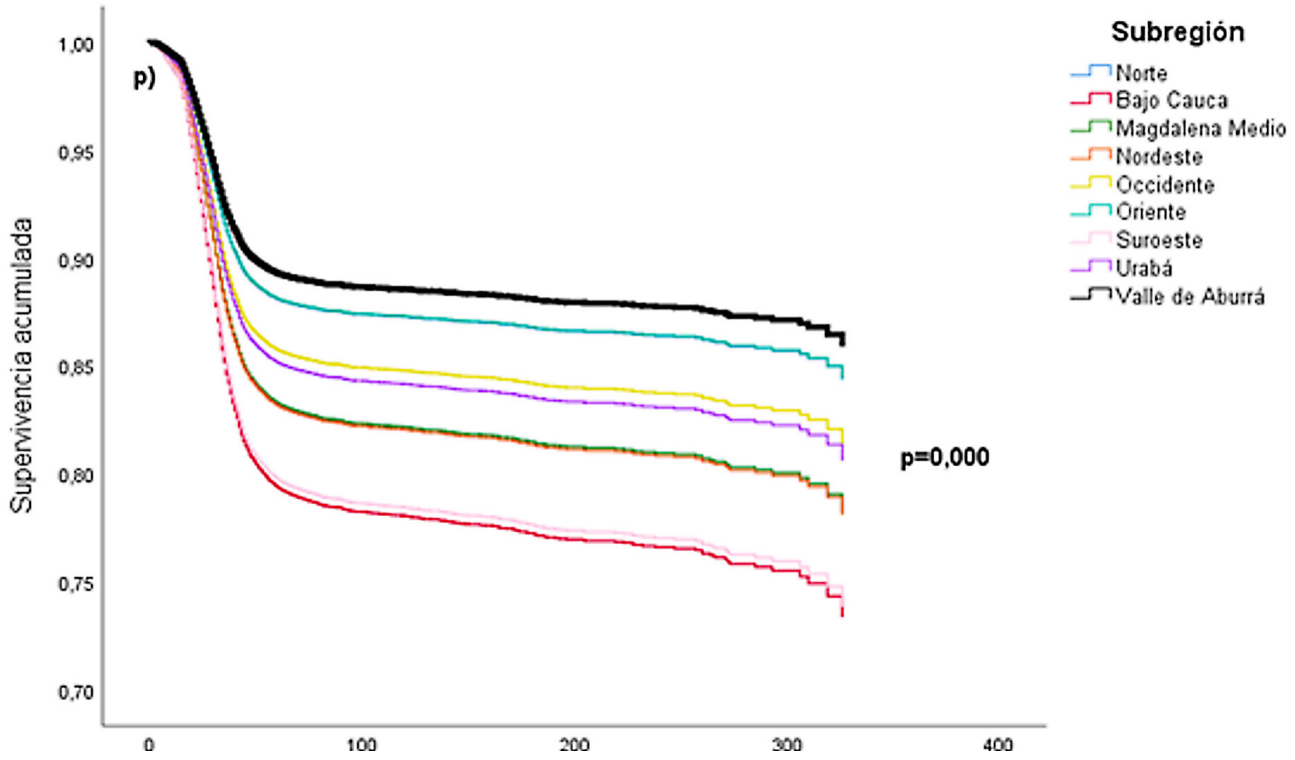
The cumulative survival probability showed minimal variations from the first month to the eighth month. During this interval, the survival probability from the onset of symptoms decreased by 5% compared to the first month.

Survival vs. Demographic Variables

Higher survival rates were observed in women, individuals in the early childhood, childhood, adolescence, and youth stages, as well as residents of the Norte, Oriente, and Valle de Aburrá subregions. Specifically, in the Oriente subregion, the survival of COVID-19 patients was 13% higher compared to the Norte subregion.

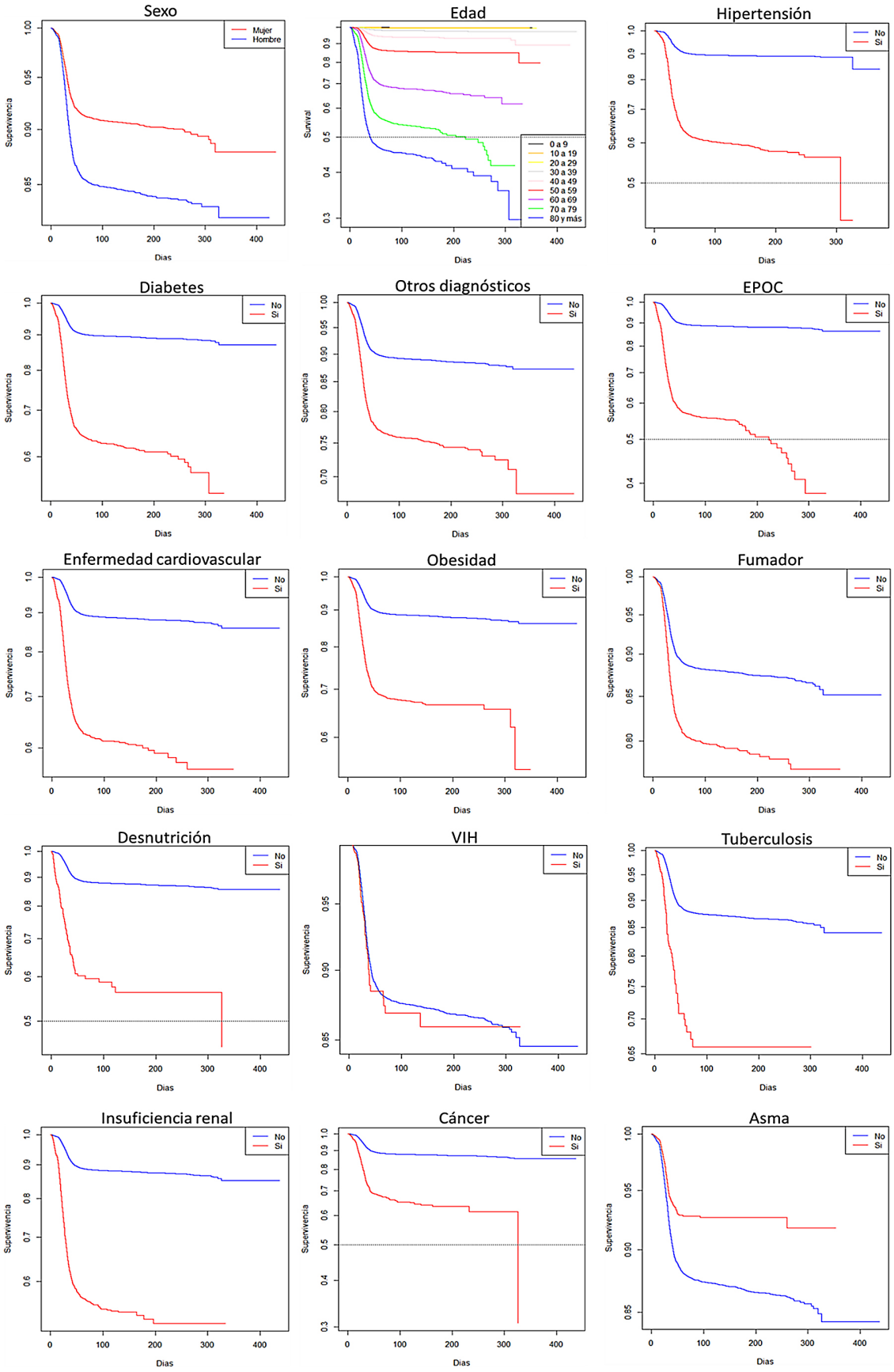
On the other hand, the risks of dying from COVID-19 increased by 62%, 63%, 117%, 80%, and 62% in men, older adults, elderly individuals, and residents of the Bajo Cauca and Suroeste subregions, respectively (Figure 1).

Figure 1. Risk by subregion



The graphs showed higher survival rates in women and in patients without comorbidities such as hypertension, diabetes mellitus, COPD, cardiovascular disease, obesity, smoking, kidney failure, cancer, malnutrition, and tuberculosis. However, survival rates for patients with HIV were similar between those with and without the disease, as the survival curves showed no significant differences. Regarding asthma, no significant relationship with mortality was established (Figure 2).

Figure 2. Survival curves and comorbidities



A Cox proportional hazards model was constructed considering the significant variables. However, when assessing compliance with the proportional hazards assumptions, it was observed that most individual and model variables had a p value < 0.05, indicating that the proportional hazards assumptions were not met (Table 2).

Table 2. P values for Cox proportional hazards assumptions.

COMORBIDITIES	Individual p-value	P-value - final model
Hypertension	0,00	0,00
Malnutrition	0,00	0,00
Tuberculosis	0,00	0,05
Life cycle	0,00	0,00
COPD	0,00	0,00
Diabetes	0,00	0,00
Other diagnoses	0,00	0,00
Kidney failure	0,00	0,00
Obesity	0,00	0,00
Cancer	0,00	0,09
Smoker	0,59	0,03
Sex	0,00	0,00

Survival vs. Comorbidities

There was a higher survival rate from the onset of COVID-19 symptoms in patients without COPD, diabetes, HIV, heart disease, cancer, tuberculosis, obesity, kidney failure, hypertension, or tuberculosis, and in nonsmokers. Overall, patients without comorbidities showed higher survival rates against COVID-19.

The specific comorbidities that represented a higher risk of mortality were, in decreasing order: COPD (HR = 8.98), kidney failure (HR = 7.46), malnutrition (HR = 7.18), heart disease (HR = 6.70), hypertension (HR = 6.57), and diabetes mellitus (HR = 6.12). Overall, the risk of mortality increased significantly in patients with two or more comorbidities, with HRs of 9.32 and 18.38, respectively.

Multivariate Analysis

A parametric multivariate Weibull model was constructed using demographic and comorbidity variables associated with the outcome and in accordance with the modeling strategies designed for this purpose. Regarding sex, a 0.64-fold shorter survival time was found in men; that is, they had a 69% higher probability of dying from COVID-19 than women over the en-

tire time period, as long as the other variables constituting the model were held constant. According to the life cycle, it was found that elderly patients, aged 60 and older, had a higher risk of dying from COVID-19 over the entire time period, which exceeded the risk in early infancy and childhood by 138.2%, holding the other variables constant (Table 3).

Table 3. Simple and multiple Weibull explanatory models for the days elapsed from the onset of COVID-19 symptoms to the final condition.

Variables	Simple Weibull Models						Multivariate Weibull Model					
	FC	IC 95% FC		HR	IC 95% HR		FC	IC 95% FC		HR	IC 95% HR	
		Inf	Sup		Inf	Sup		Inf	Sup		Inf	Sup
Sex*												
Male	0,67	0,66	0,69	1,62	1,57	1,66	0,63	0,61	0,65	1,72	1,66	1,78
Life cycle**												
Adolescence and youth	0,81	0,53	1,24	1,28	0,77	2,14	0,67	0,39	1,13	1,62	0,86	3,04
Adulthood	0,1	0,06	0,14	16,25	10,09	26,16	0	0	0	17,48	9,67	31,62
Old age	0,01	0,01	0,02	216,49	134,54	348,35	0	0	0	130,1	71,97	235,2
Subregión***												
Bajo Cauca	0,62	0,55	0,69	1,8	1,56	2,07	0,61	0,53	0,71	1,78	1,5	2,11
Magdalena Medio	0,72	0,62	0,84	1,49	1,23	1,8	0,71	0,58	0,86	1,51	1,19	1,91
Nordeste	0,77	0,67	0,87	1,38	1,18	1,62	0,77	0,66	0,9	1,36	1,14	1,63
Occidente	0,85	0,75	0,96	1,22	1,05	1,43	0,86	0,74	0,99	1,2	1	1,43
Oriente	1,12	1,01	1,24	0,87	0,77	0,99	1,16	1,03	1,31	0,83	0.73	0,96
Suroeste	0,67	0,56	0,76	1,62	1,4	1,86	0,81	0,71	0,93	1,29	1,1	1,51
Urabá	0,79	0,71	0,88	1,33	1,17	1,51	0,7	0,62	0,8	1,51	1,31	1,76
Valle De Aburrá	1,16	1,06	1,27	0,83	0,74	0,93	1,06	0,95	1,18	0,93	0,82	1,06
Comorbidities†												
Asthma												
Yes	1,64	1,51	1,77	0,55	0,5	0,60	1,67	1,52	1,85	0,54	0,48	0,61
COPD												
Yes	0,16	0,15	0,16	8,98	8,6	8,31	0,82	0,78	0,86	1,27	1,2	1,34
Diabetes												
Yes	0,22	0,21	0,23	6,12	5,92	6,33	1	0,96	1,05	1	0,94	1,05
HIV												
Yes	0,88	0,75	101,99	1,17	0,98	1,41	1,2	1	1,44	0,81	0,65	1
Heart disease												
Yes	0,2	0,19	0,21	6,7	6,43	6,98	1,02	0,97	1,07	0,98	0,92	1,03

Cancer												
Yes	0,3	0,29	0,32	4,28	4,01	4,56	0,86	0,81	0,92	1,19	1,1	1,29
Malnutrition												
Yes	0,19	0,17	0,22	7,18	6,26	8,24	0,62	0,54	0,72	1,75	1,49	2,06
Obesity												
Yes	0,29	0,28	0,3	4,36	4,17	4,55	0,65	0,62	0,69	1,65	1,56	1,75
Kidney failure												
Yes	0,19	0,18	0,2	7,46	7,09	7,86	0,77	0,72	0,81	1,37	1,28	1,46
Smoker												
Yes		0,61	0,66	1,73	1,65	1,82	1,62	1,53	1,71	0,57	0,53	0,6
Hypertension												
Yes	0,23	0,22	0,23	6,57	6,37	6,78	1,14	1,08	1,19	0,86	0,81	0,91
Tuberculosis												
Yes	0,31	0,26	0,36	4,32	3,59	5,21	0,81	0,68	0,98	1,28	1,03	1,59
Other diagnoses												
Yes	0,36	0,35	0,37	3,32	3,21	3,44	0,93	0,88	0,97	1,1	1,04	1,15
Number of comorbidities****												
One comorbidity	0,34	0,32	0,35	3,71	3,54	3,89	0,51	0,48	0,53	2,24	2,11	2,38
Two comorbiditie	0,16	0,15	0,16	9,32	8,87	9,79	0,38	0	0,41	3,15	2,88	3,45
Three + comorbidities	0,09	0,09	0,09	18,38	17,53	19,26	0	0	0	4,03	3,52	4,61

Reference: *Female; **Early childhood and infancy; *** North; † No; **** No comorbidities; HR: Weibull contraction factor; HR: Hazard ratio; Inf: Lower limit of the confidence interval; Sup: Upper limit of the confidence interval.

Regarding the subregions, significant differences in survival times were found. Notably, survival time was reduced by 0.60 times for patients from Bajo Cauca, 0.69 for Magdalena Medio, 0.76 for Nordeste, 0.83 for Occidente, 0.78 for Suroeste, and 0.68 times for patients from Urabá. This indicates that the risk of death from COVID-19 was 83%, 54%, 39%, 25%, 34%, and 57% higher, respectively, compared to patients from the Norte subregion. In contrast, in the Oriente subregion, survival time increased by 1.15 times, and in the Valle de Aburrá by 1.07 times, corresponding to a 15% and 8% lower risk of death from COVID-19, respectively, compared to patients from the Norte subregion.

Significant differences in patient survival were also observed based on comorbidities. Specifically, survival time was reduced by 0.79 times for those with COPD and cancer, and by 0.59 and 0.72 times for those with obesity and renal failure, respectively. This means that patients with these

comorbidities had a 32% (COPD and cancer), 86%, and 47% higher probability of death compared to those without any comorbidities (Table 4).

Table 4. Parametric Weibull Multivariate Model for COVID-19 Survival in the Department of Antioquia.

Variables	FC	IC 95% FC		HR	IC 95% HR	
		Inf	Sup		Inf	Sup
DEMOGRAPHICS						
Sex*						
Male	0,64	0,62	0,66	1,69	1,63	1,75
Life cycle**						
Adolescence and youth	0,68	0,40	1,15	1,60	0,85	2,99
Adulthood	0,00	0,00	0,00	17,65	9,76	31,90
Old Age	0,00	0,00	0,00	138,20	76,46	249,78
Subregión***						
Bajo Cauca	0,60	0,52	0,69	1,83	1,54	2,16
Magdalena Medio	0,69	0,57	0,85	1,54	1,22	1,95
Nordeste	0,76	0,65	0,88	1,39	1,16	1,66
Occidente	0,83	0,72	0,96	1,25	1,05	1,48
Oriente	1,15	1,02	1,29	0,85	0,74	0,98
Suroeste	0,78	0,69	0,90	1,34	1,14	1,57
Urabá	0,68	0,60	0,77	1,57	1,36	1,82
Valle De Aburrá	1,07	0,96	1,19	0,92	0,81	1,05
COMORBIDITIES						
COPD****						
Yes	0,79	0,76	0,83	1,32	1,25	1,39
Cancer****						
Yes	0,79	0,75	0,85	1,32	1,22	1,42
Obesity****						
Yes	0,59	0,57	0,62	1,86	1,76	1,97
Kidney Failure****						
Yes	0,72	0,68	0,77	1,47	1,38	1,57
Other diagnoses ****						
Yes	0,82	0,79	0,85	1,26	1,21	1,32
Number of comorbidities †						
One comorbidity	0,60	0,57	0,63	1,84	1,75	1,93
Two comorbidities	0,49	0,47	0,52	2,33	2,20	2,46
Three + comorbidities	0,47	0,44	0,49	2,48	2,32	2,65

Reference: *Female; **Early childhood and infancy; *** North; † No; **** No comorbidities; HR: Weibull contraction factor; HR: Hazard ratio; Inf: Lower limit of the confidence interval; Sup: Upper limit of the confidence interval.

The overall survival rate in the department of Antioquia was 99%, although it decreased to as low as 85% during the study period. In the Norte subregion, survival reached 99%, whereas in the Suroeste subregion it dropped to 75%. Women exhibited a higher survival rate—approximately 90%—compared to men, whose rate was below 85%. The highest survival was observed among individuals under 20 years of age, ranging between 99% and 98% throughout the study, with particularly notable rates among women.

The Weibull model indicated that the Bajo Cauca subregion showed the greatest reduction in survival time, while the Valle de Aburrá displayed the most significant acceleration in survival time.

Some variables were identified as having missing data, which led to their exclusion from the survival analysis. However, these estimates may not accurately reflect the original values due to their artificial nature.

Discussion

The pandemic marked a turning point globally; however, the research conducted has provided valuable guidelines for addressing future epidemics. This study identifies, within the department of Antioquia, the subregions with the highest risk of COVID-19 transmission, the most vulnerable population groups, and the main comorbidities that influence symptom severity and mortality risk. By identifying these factors, it becomes possible to implement various strategies for mitigation, prevention, and containment of the virus or disease, as well as to develop treatments and actions that support effective recovery across different population groups.

The objective of this research was to determine the survival of COVID-19 patients in the population of Antioquia and its subregions between 2020 and May 2022, considering the combined effect of comorbidities reported in the literature.

To obtain an initial overview of survival, a mortality analysis was conducted, yielding results consistent with data published by health authorities [11–13]. In this study, conducted in the department of Antioquia, the COVID-19 mortality rate was 265.8 deaths per 100,000 inhabitants, closely aligning with the figure reported by the Pan American Health Organization (PAHO) in May 2022 for Colombia by departments (273.9) [11]. Likewise, the case fatality rate estimated in this study was 1.98, similar to that reported by PAHO (2.0) [11]. This indicator was lower than those recorded in other studies, such as in Mexico, Peru, and Colombia (9; 9.34; and 2.5,

respectively), but higher than in the Netherlands, Iraq, and India in 2021 (1.01; 1.21; and 1.33, respectively) [14]. These differences could be explained by demographic factors, unmet basic needs, and the health profiles of the studied populations. In the case of Iraq and India, beyond demographic aspects, the lower fatality rate may also be attributed to prevailing cultural and religious characteristics in those countries.

In Antioquia, of the total number of deaths due to COVID-19 (18,308), 58.9% were men. A study conducted in China in 2020 on COVID-19 patients also found higher mortality among men—similar findings were reported in Peru and Mexico in 2021, where an increased risk of death with age was also observed. This result is consistent with PAHO reports, which showed that individuals over the age of 60 had the most fatal outcomes [14, 11].

Regarding age and sex, the findings of this study align with those from Peru and El Salvador in 2021 (Antioquia: mean age of 69 years; Peru and El Salvador: over 60 years of age) [15, 16]. As previous research has demonstrated [17, 18], the harmful effect of COVID-19 on older adults is irrefutable.

In terms of Antioquia's subregions, the age-adjusted mortality rate per 100,000 inhabitants in 2022 was highest in Valle de Aburrá, with 310 deaths. This trend has remained constant since the beginning of the pandemic, as supported by ProAntioquia in a study based on INS data (as of June 4, 2021), which reported high mortality levels—approximately 89 deaths per day [19]. Other subregions, such as Urabá, Bajo Cauca, and Oriente, also showed high mortality rates (288, 280, and 191 deaths per 100,000 inhabitants, respectively), consistent with data reported by the Government of Antioquia in November 2021 [12].

When estimating survival probability, the median time from symptom onset to death was 18.7 days, consistent with international studies (15 days in China and El Salvador; 14 days in Lima, 2020–2021) [20, 16, 21]. Overall survival in Antioquia at 1, 10, 20, and 30 days was 100%, 99%, 97%, and 94%, respectively—results similar to those reported in Bogotá during the early phase of the pandemic (100%, 99%, 98%, and 96%, respectively) [22].

Survival varied significantly by sex, age, and comorbidities. Women had a higher probability of survival than men from the onset of symptoms. Regarding age groups, older adults exhibited lower survival rates compared to younger age groups. These findings are consistent with studies conducted in China, El Salvador, Peru, and Bogotá during 2020 and 2021 [20, 16, 21, 22].

Comorbidities played a significant role in mortality risk. Of the 922,533 confirmed COVID-19 cases in the department, 122,902 individuals had at least one comorbidity, 39,032 had two, and 1,746 had five or more, representing 13.32%, 4.23%, and 0.19% of cases, respectively. In other studies, such as those conducted in China (2020) and Peru, the reported rates were 25.1% and 68.56%, respectively [23, 15]. These discrepancies may be due to demographic characteristics, lifestyle factors, and differences in healthcare system capacity.

The multivariate Weibull model revealed significant differences in survival by sex, with men having a 74% higher probability of mortality. Additionally, individuals over the age of 80 had the lowest survival rate (60%), with a probability of death 488 times greater than that of the 0–9 age group [26].

In a systematic review of 11 studies on COVID-19, conducted in Havana from the beginning of the pandemic through 2020, a significant association was identified between comorbidities and the clinical severity of the disease. Among the comorbidities with the greatest impact were arterial hypertension, cardiovascular diseases, and diabetes mellitus, all of which increased the risk of severe clinical presentation by more than 3.5 times [27]. Consistently, this analysis also revealed a higher probability of mortality in patients with comorbidities, with the most frequent being hypertension, diabetes mellitus, and COPD. Conversely, in line with previous studies, asthma does not appear to be a determining risk factor in COVID-19-related mortality [27–30].

Conclusion

The magnitude of the impact of COVID-19 showed significant variation across the subregions and municipalities of the department, which could be attributed, in part, to demographic differences present in each region. Likewise, social and economic disparities, along with the characteristics of the healthcare network, influence patients' access to health services, which in turn directly affects their health status.

Scope and Limitations

This study provides valuable insights into the survival probability of the population of Antioquia in the face of COVID-19, as well as the risk factors associated with the disease. The findings can be used to guide decision-making in public policy and in the clinical care of patients, especially those with comorbidities.

Based on the results, the importance of closely monitoring the most vulnerable populations is highlighted—particularly older adults, individuals with

comorbidities, and residents of the most affected subregions.

Moreover, the implementation of effective measures is essential, such as improving physical infrastructure and strengthening information systems within healthcare institutions. The creation of a unified COVID-19 information system at both the subregional and departmental levels is crucial. This challenge requires a significant investment in physical and technological infrastructure, with shared responsibility among the government, healthcare workers, and users. It is essential to minimize fragmentation of electronic records and to ensure that clinical information is complete, up-to-date, accurate, and free from duplication or missing data.

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References

1. 1. Organización Panamericana de la Salud. Enfermedad por el Coronavirus (COVID-19) [Internet]. [citado 2023 mar 24]. Disponible en: https://www.paho.org/es/enfermedad-por-coronavirus-covid-19
2. Muñoz M, Pachón M. COVID en Colombia: Una crisis de gobernabilidad y respuesta. Rev Cienc Política (Santiago) [Internet]. 2021;41(ahead):291–320. [citado 2023 ago 29]. Disponible en: https://www.scielo.cl/scielo.php?pid=S0718-090X2021000200291&script=sci_arttext&tlng=en
3. Área Metropolitana del Valle de Aburrá. INFORMACIÓN EN TIEMPO REAL COVID-19 [Internet]. [citado 2023 mar 24]. Disponible en: https://www.metropol.gov.co/tableros/tablero_covid_19.aspx
4. Gobierno de Colombia. Casos positivos de COVID-19 en Colombia [Internet]. Plataforma de datos abiertos. [citado 2023 mar 24]. Disponible en: https://www.datos.gov.co/Salud-y-Protecci-n-Social/Casos-positivos-de-COVID-19-en-Colombia-/gt2j-8ykr/data
5. Acosta LD. Capacidad de respuesta frente a la pandemia de COVID-19 en América Latina y el Caribe. Rev Panam Salud Publica [Internet]. 2020;44:1. [citado 2024 sep 20]. Disponible en: https://doi.org/10.26633/RPSP.2020.109
6. De la Hoz Restrepo F. La respuesta del sistema de salud colombiano en tiempos de pandemia: Una evaluación rápida desde los indicadores epidemiológicos. Rev Salud Publica (Bogotá) [Internet]. 2022;24(1):1–5. Disponible en: http://dx.doi.org/10.15446/rsap.v24n1.107846
7. Manterola C, Otzen T. Los sesgos en investigación clínica. Int J Morphol [Internet]. 2015;33(3):1156–64. [citado 2023 mar 23]. Disponible en: https://scielo.conicyt.cl/pdf/ijmorphol/v33n3/art56.pdf
8. Wei LJ. The accelerated failure time model: a useful alternative to the Cox regression model in survival analysis. Stat Med [Internet]. 1992;11(14–15):1871–9. [citado 2023 mar 23]. Disponible en: http://dx.doi.org/10.1002/sim.4780111409
9. Sparling YH, Younes N, Lachin JM, Bautista OM. Parametric survival models for interval-censored data with time-dependent covariates. Biostatistics [Internet]. 2006;7(4):599–614. [citado 2023 mar 23]. Disponible en: http://dx.doi.org/10.1093/biostatistics/kxj028
10. Ministerio de Salud de Colombia. RESOLUCIÓN 8430 DE 1993 [Internet]. Santafé de Bogotá D.C.; 1993 oct 4. Disponible en: https://normograma.supersalud.gov.co/normograma/docs/resolucion_minsalud_r8430_93.htm

11. Organización Panamericana de la Salud, Ministerio de Salud de Colombia. Situación COVID-19 Colombia. Corte 19 de mayo 10:00pm. 20 de mayo de 2022. [citado 2023 mar 23]. Disponible en: https://www.paho.org/es/reportes-situacion-covid-19-colombia

12. Gobernación de Antioquia. Situación actual del Coronavirus en Antioquia [Internet]. [citado 2023 feb 23]. Disponible en: https://www.dssa.gov.co/index.php/situacion-actual-coronavirus-en-antioquia

13. ArcGIS Dashboards [Internet]. Arcgis.com. [citado 2023 mar 23]. Disponible en: https://www.arcgis.com/apps/dashboards/166f4091267246ff89060e3b624c099f

14. Pinzón JED. Letalidad por SARS-COV-2 a nivel mundial. Repert Med Cir. 2021;30(1):84–8. [citado 2023 mar 23]. Disponible en: http://dx.doi.org/10.31260/RepertMedCir.01217372.1255

15. Mejía F, Medina C, Cornejo E, Morello E, Vásquez S, Alave J, et al. Características clínicas y factores asociados a mortalidad en pacientes adultos hospitalizados por COVID-19 en un hospital público de Lima, Perú [Internet]. SciELO Preprints. 2020 [citado 2023 mar 23]. Disponible en: https://researchonline.lshtm.ac.uk/id/eprint/4664503/

16. Franco Escobar VD, Morales Chorro L, Baltrons Orellana R, Rodríguez CR, Urbina O, López de Blanco C. Mortalidad por COVID-19 asociada a comorbilidades en pacientes del Instituto Salvadoreño del Seguro Social. Alerta [Internet]. 2021;4(2):28–37. [citado 2023 mar 23]. Disponible en: https://docs.bvsalud.org/biblioref/2021/05/1224721/mortalidad-por-covid-19-asociada-a-comorbilidades-en-pacientes_rndBadD.pdf

17. Lapo-Talledo GJ, Talledo-Delgado JA, Fernández-Aballí LS. Un análisis de supervivencia de riesgos competitivos de los factores sociodemográficos de la mortalidad intrahospitalaria por COVID-19 en Ecuador. Cad Saude Publica [Internet]. 2023;39(1): e00294721. [citado 2023 mar 23]. Disponible en: https://www.scielo.br/j/csp/a/s69jb4S6XQVDKt6kB9gb8gk/abstract/?lang=es

18. Suleyman G, Fadel RA, Malette KM, Hammond C, Abdulla H, Entz A, et al. Clinical characteristics and morbidity associated with Coronavirus disease 2019 in a series of patients in metropolitan Detroit. JAMA Netw Open [Internet]. 2020;3(6): e2012270. [citado 2023 mar 23]. Disponible en: http://dx.doi.org/10.1001/jamanetworkopen.2020.12270

19. Medellincomovamos.org [Internet]. [citado 2023 mar 23]. Disponible en: https://www.medellincomovamos.org/system/files/2021-06/docuprivados/SITUACION%20COVID%20MEDELLIN%20Y%20VALLE%20DE%20ABURRA.pdf

20. Jin J-M, Bai P, He W, Wu F, Liu X-F, Han D-M, et al. Gender differences in patients with COVID-19: Focus on severity and mortality. Front Public Health [Internet]. 2020;8:152. [citado 2023 mar 24]. Disponible en: http://dx.doi.org/10.3389/fpubh.2020.00152

21. Escobar G, Matta J, Taype-Huamaní W, Ayala R, Amado J. Características clínico epidemiológicas de pacientes fallecidos por COVID-19 en un hospital nacional de Lima, Perú. Rev Fac Med Humana [Internet]. 2020;20(2):180–5. [citado 2023 mar 24]. Disponible en: http://dx.doi.org/10.25176/rfmh.v20i2.2940

22. Rodríguez CSE, López AR, Uriza GA, Bustos EA, Ibáñez EA, Malagón JN. Supervivencia y mortalidad por COVID-19 en Bogotá, Colombia durante marzo y julio de 2020. Res Soc Dev [Internet]. 2020;9(11): e81291110049. [citado 2023 mar 24]. Disponible en: http://dx.doi.org/10.33448/rsd-v9i11.10049

23. Guan W-J, Liang W-H, Zhao Y, Liang H-R, Chen Z-S, Li Y-M, et al. Comorbidity and its impact on 1590 patients with COVID-19 in China: a nationwide analysis. Eur Respir J [Internet]. 2020;55(5):2000547. [citado 2023 mar 24]. Disponible en: http://dx.doi.org/10.1183/13993003.00547-2020

24. Fernández Ibáñez JM, Morales Ballesteros MDC, Galindo Andújar MÁ, Fernández Anguita MJ, Arias Arias Á, Barberá-Farré JR. Factores de riesgo de mortalidad en pacientes mayores de 65 años hospitalizados por COVID-19. Rev Esp Geriatr Gerontol [Internet]. 2022;57(1):6–12. [citado 2023 mar 24]. Disponible en: http://dx.doi.org/10.1016/j.regg.2021.09.004

25. Gobernación de Antioquia. Capítulo IV: Atlas de desigualdades. En: Análisis de situación de salud Antioquia - 2022 [Internet]. 2022 [citado 2023 may 29]. p. 522–40. Disponible en: https://www.dssa.gov.co/images/2023/documentos/ASIS/versiones/Capitulo%20IV%20Atlas%20desigualdades%20Antioquia.pdf

26. Malagón-Rojas J, Ibáñez E, Parra BL, Toloza-Perez YG, Álvarez S, Mercado M. Analysis of COVID-19 mortality and survival in Colombia: A prospective cohort study. Infectio [Internet]. 2021;25(3):176. [citado 2023 mar 24]. Disponible en: http://dx.doi.org/10.22354/in.v25i3.943

27. Plasencia-Urizarri TM, Aguilera-Rodríguez R, Mederos LEA. Comorbilidades y gravedad clínica de la COVID-19: revisión sistemática y meta-análisis. Rev Habanera Cienc Méd [Internet]. 2020 [citado 2023 may 4];19(0):3389. Disponible en: https://revhabanera.sld.cu/index.php/rhab/article/view/3389

28. Laurora M, Gómez LV, Flamenco Marucco A, Santoro FM, Ottonello F, Rearte R. Factores de riesgo asociados a la mortalidad en personas con COVID-19: Estudio de supervivencia en Argentina, 2020. Rev Argent Salud Pública [Internet]. 2021 dic 30 [citado 2023 mar 24];13. Disponible en: https://rasp.msal.gov.ar/index.php/rasp/article/view/730

29. López JJ, Contreras EA, Cruz NN, Camargo MA, Cabrera EO, Ramírez GI, et al. Asthma and COVID-19. Rev Alergia Mex (Tecamachalco Puebla) [Internet]. 2022;69(Suppl 1):s15–23. [citado 2023 mar 24]. Disponible en: http://dx.doi.org/10.29262/ram.v69iSupl1.1009

30. Broadhurst R, Peterson R, Wisnivesky JP, Federman A, Zimmer SM, Sharma S, et al. Asthma in COVID-19 hospitalizations: An overestimated risk factor? Ann Am Thorac Soc [Internet]. 2020;17(12):1645–8. [citado 2023 mar 24]. Disponible en: https://doi.org/10.1513/AnnalsATS.202006-613RL