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ORIGINAL ARTICLE

Individual and contextual determinants of COVID-19 mortality in Pernambuco: a case-control study

Determinantes individuais e contextuais da mortalidade por COVID-19 em Pernambuco: estudo caso-controle

Determinantes individuales y contextuales de la mortalidad por COVID-19 en Pernambuco: un estudio de casos y controles

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ABSTRACT

Background and Objectives: to analyze individual and contextual factors associated with mortality from COVID-19 in the state of Pernambuco. **Methods:** a case-control study, with secondary data from the Center for Strategic Information on Health Surveillance in Pernambuco (CIEVS-PE - *Centro de Informações Estratégicas de Vigilância em Saúde de Pernambuco*), where cases were deaths from COVID-19 and controls were those recovered. To develop the multilevel analysis, hierarchical regression listed the individual and contextual levels (healthcare and municipality), considering a statistical significance of 10%. **Results:** the study presented 18,198 cases and 27,647 controls, and the final model indicated 13 variables as determining factors for mortality in the state, ten of which were at the individual level (sex, age group, symptoms, O2 saturation <95%, respiratory distress, dyspnea, comorbidities, heart or vascular diseases, diabetes and obesity). At the contextual level, three variables were identified, two of which were related to healthcare (adult Intensive Care Unit beds and respirators/ventilators) and one to the municipality (health macroregion). **Conclusion:** the individual-level factors presented showed a greater determination for death by COVID-19 in the state of Pernambuco, making it necessary to reinforce healthcare for the most vulnerable groups.

Keywords: *COVID-19. Mortality. Social Determinants of Health. Health Inequality Monitoring.*

RESUMO

Justificativa e Objetivos: analisar os fatores individuais e contextuais associados à mortalidade por COVID-19 no estado de Pernambuco. **Métodos:** estudo de caso-controle, com dados secundários do Centro de Informações Estratégicas de Vigilância em Saúde de Pernambuco (CIEVS-PE), onde os casos foram os óbitos por COVID-19 e os

controles foram os recuperados. Para o desenvolvimento da análise multinível, a regressão hierárquica elencou os níveis individual e contextual (assistência à saúde e município), considerando a significância estatística de 10%. **Resultados:** o estudo apresentou 18.198 casos e 27.647 controles, sendo que o modelo final indicou 13 variáveis como fatores determinantes para mortalidade no estado, sendo dez do nível individual (sexo, faixa etária, sintomas, saturação O2<95%, desconforto respiratório, dispneia, comorbidades, doenças cardíacas ou vasculares, diabetes e obesidade). No nível contextual, foram identificadas três variáveis, sendo duas da assistência à saúde (leitos de Unidade de Terapia Intensiva adulto e respiradores/ventiladores) e uma do município (macrorregião de saúde). **Conclusão:** os fatores de nível individual apresentaram uma maior determinação para o óbito por COVID-19 no estado de Pernambuco, tornando-se necessário reforçar o cuidado em saúde para os grupos mais vulneráveis.

Descritores**:** *COVID-19. Mortalidade. Determinantes Sociais da Saúde. Monitoramento das Desigualdades em Saúde.*

RESUMEN

Justificación y Objetivos: analizar los factores individuales y contextuales asociados a la mortalidad por COVID-19 en el estado de Pernambuco. **Métodos:** estudio de casos y controles, con datos secundarios del Centro de Informaciones Estratégicas de Vigilancia de la Salud de Pernambuco (CIEVS-PE - *Centro de Informações Estratégicas de Vigilância em Saúde de Pernambuco*), donde los casos fueron las muertes por COVID-19 y los controles los recuperados. Para desarrollar el análisis multinivel, la regresión jerárquica enumeró los niveles individual y contextual (atención de salud y municipio), considerando una significación estadística del 10%. **Resultados:** el estudio presentó 18,198 casos y 27,647 controles, y el modelo final indicó 13 variables como factores determinantes de la mortalidad en el estado, diez de las cuales fueron a nivel individual (sexo, grupo etario, síntomas, saturación de O2 <95%, malestar respiratorio, disnea, comorbilidades, enfermedades cardíacas o vasculares, diabetes y obesidad). A nivel contextual se identificaron tres variables, dos de atención a la salud (camas de Unidad de Cuidados Intensivos de adultos y respiradores/ventiladores) y una del municipio (macrorregión de salud). **Conclusión:** factores a nivel individual presentados mayor determinación por la muerte por COVID-19 en el estado de Pernambuco, por lo que fue necesario reforzar la atención en salud a los grupos más vulnerables.

Palabras clave: *COVID-19. Mortalidad. Determinantes Sociales de la Salud. Monitoreo de las Desigualdades en Salud.*

INTRODUCTION

At the end of 2019, the Chinese government reported cases of pneumonia with an unknown etiological agent in the population, with the first cases being recorded in the city of Wuhan, China. The agent was later identified as a new coronavirus of Severe Acute Respiratory Syndrome (SARS), and was named SARS-CoV-2. The new coronavirus is responsible for the development of Coronavirus Disease 2019 (COVID-19), characterized as an infectious disease that affects individuals with mild or severe symptoms.[1,2]

Due to the high transmissibility and mortality, the World Health Organization (WHO) declared a Public Health Emergency of International Concern.[3] In Brazil, the first cases were registered in February 2020, and a Public Health Emergency of National Concern was declared. In this context, the main preventive measure adopted was social distancing, culminating in the so-called lockdown in the main Brazilian cities. The measure included the blocking of borders, the cancellation of cultural events and the temporary closure of businesses and educational institutions.[4,5]

Epidemiologically, by the end of March 2023, confirmed cases of COVID-19 had already surpassed 600 million worldwide, with more than 6 million deaths recorded. In the world ranking, Brazil was one of the countries with the most registered cases, accumulating more than 30 million cases and 650 thousand deaths. Regarding the distribution of morbidity and mortality from the disease in the national territory, the Southeast and Northeast regions stand out in absolute numbers, with the state of Pernambuco recording a total of more than 1 million cases and 20 thousand deaths.[6,7]

In Brazil, the distribution of infectious diseases across the territory has always been marked by immense social inequality.[8] Regarding COVID-19, the spread of the disease occurred with different magnitudes and effects in different population groups, in which socioeconomic determinants were found to be possible risk factors. The presence of inequalities reinforces an unfair scenario for the most vulnerable population, implying barriers to access to healthcare services and indicating that, in addition to the COVID-19 pandemic, the population faces an epidemic of social inequities.[9,10]

Therefore, the dimension of health inequalities permeates the issue of mortality from COVID-19, and the use of different analytical strategies can contribute to a more concrete statement about the association between risk factors and the determination of mortality. The use of multilevel models is an alternative to traditional multivariate models, considering the hierarchical nature present in the data and analyzing the autocorrelation between the risk factors of a given condition at the aggregation levels.[11,12]

From this perspective, the present study aimed to analyze the individual and contextual factors associated with mortality from COVID-19 in the state of Pernambuco.

METHODS

This is a case-control study with secondary data and a multilevel approach. The study used severe cases of SARS due to COVID-19 registered at the *Centro de Informações Estratégicas da Vigilância em Saúde de Pernambuco* (CIEVS-PE, Strategic Information Center for Health Surveillance of Pernambuco), between March 2020 and March 2022, being residents of the state of Pernambuco.

CIEVS/PE is one of the units of the Brazilian National Network for Monitoring and Response to Public Health Emergencies, and is responsible for the process of detecting, monitoring and coordinating the response to public health emergencies. In this context, it is made up of mandatory notifications, outbreaks and epidemics as well as events with health impact.[13]

For the study, confirmed deaths were considered cases, while controls were made up of recovered individuals. To compose the study sample, the inclusion criteria were to have the records made available by CIEVS/PE and to have the fields of independent variables filled in. Regarding the exclusion criteria, records without the final classification and the *Cadastro Nacional de Estabelecimentos de Saúde* (CNES, Brazilian National Registry of Health Establishments) number of the establishments were not considered.

Death from COVID-19 was considered as a dependent variable, and independent variables were allocated at the individual and contextual levels (subdivided into two levels, healthcare and municipalities).

Individual-level variables consisted of data made available in CIEVS-PE for each individual, such as sex, age group, presence of symptoms, O2 saturation <95, respiratory discomfort, dyspnea, presence of comorbidities, obesity, diabetes, and heart or vascular diseases.

The first contextual level (healthcare) consisted of data related to the hospital where a patient was admitted, made available in CNES, such as the establishment's legal nature, number of Adult Intensive Care Unit (ICU) beds and number of respirators/ventilators. To define the categories of Adult ICU beds and respirators/ventilators, the average of the period analyzed was considered, and the K-means method was used, which is used to construct automatic data groupings based on the degree of similarity (clusters).[14]

Therefore, for both variables, the units were grouped into three clusters (low, medium and high). Regarding Adult ICU beds, the low (0-3 beds), medium (4-44 beds) and high (> 45 beds) clusters were considered. While for ventilators/respirators, the low (0-4 ventilators/respirators), medium (5-50 ventilators/respirators) and high (> 51 ventilators/respirators) clusters were considered.

The second contextual level (municipality) was composed of the individuals' health macro-region of residence (I - Recife, II - Caruaru, III - Serra Talhada, IV - Petrolina), obtained from CIEVS-PE and the *Centro de Integração de Dados e Conhecimentos para Saúde* (CIDACS, Center for Data and Knowledge Integration for Health) Social Inequalities Index (COVID-19-SII), which is characterized as a marker of inequalities associated with COVID-19 formed by socioeconomic, sociodemographic information and difficulties in accessing healthcare services, being divided into very low, low, medium, high and very high.[15]

Initially, univariate analysis was performed to identify the association between the outcome (death from COVID-19) and each independent variable, calculating the Unadjusted Odds Ratio (Unadjusted OR) and its respective 95% Confidence Intervals (95% CI), in addition to statistical significance (p-value), based on the chi-square test (χ^2). For multivariate analysis, the regression included the independent variables that presented statistical significance below 20% ($p < 0.20$).

The multilevel model used in this study was adjusted using Generalized Linear Latent and Mixed Models (GLLAMM), considering information related to individuals as the first level, the hospital of admission as the second level, and adjustment for the municipality of residence (third level). This type of three-level model allowed estimating the measures of association between exposures and outcomes, considering that observations (individuals) taken within the same group (contexts) are not independent.

At this stage, the model was adjusted using the stepwise method. Thus, the model began with all significant variables in the bivariate model, and then variables whose statistical significance was greater than 10% ($p > 0.10$) were removed (a process called backward). Finally, to assess the quality of regression models, the study used the Akaike criterion (AIC) and the Bayesian Information Criterion (BIC) for all stages of multivariate analysis. The best models were those that presented results with the lowest AIC and BIC values.

In descriptive data analysis and processing, the Microsoft Excel 2013 spreadsheet editor was used to store the database, and the Data Analysis and Statistical Software (STATA) version 12.0 was used to develop the statistical analyses.

The study was approved by the Research Ethics Committee, under *Certificado de Apresentação para Apreciação Ética* (CAAE, Certificate of Presentation for Ethical Consideration) 60944122.8.0000.5190 and Opinion 5.652.161.

RESULTS

Table 1 presents the number and proportion of cases and controls at the first level (individual) according to variables, where the absolute number was 18,198 cases and 27,647 controls. Regarding individuals' sex, there is a predominance of men: 53.25% in cases and 54.33% in controls.

Concerning age group, it was observed that both groups had a greater predominance of individuals under 60 years of age, however, with high proportional differences. In cases, the proportion was 30.45%, and in controls,

it was 61.71%. Still regarding age group, it was observed that the most advanced ages (80 years or older) were those that presented the lowest proportion of controls, i.e., individuals who were diagnosed with SARS due to COVID-19 and recovered (Table 1).

In relation to symptoms, the results indicate that they were present in almost all individuals. In cases and controls, the proportion was higher than 98%. When analyzing the presence of symptoms (O2 saturation <95%, respiratory discomfort and dyspnea), it is noted that cases presented a higher proportion than controls (Table 1).

Regarding comorbidities, there was a difference between the groups. In the cases, the predominant presence was the presence of some comorbidity, being 66.15%, while, in the cases, the absence was more predominant, with a proportion of 57.90%. When analyzing the presence of comorbidities (heart or vascular diseases, diabetes and obesity) separately, it is noted that, in both groups, the absence was more predominant. However, in general, the proportions of the presence of these comorbidities were higher in cases when compared to controls (Table 1).

Table 2 presents data on the variables of the level of healthcare, containing the number and proportion of cases and controls. As for the legal nature, it was found that the majority of establishments had a link with the *Sistema Único de Saúde* (SUS, Brazilian Health System), being private or public. Approximately 72.66% of the cases occurred in public SUS establishments, while controls were 66.60%.

Concerning the number of adult ICU beds available, in both groups, it is worth noting that establishments with a number considered average (4 to 44 beds) presented the highest number of cases (53.12%) and controls (45.08%) (Table 2).

Regarding the number of ventilators/respirators, similar results were observed. The value considered average (5 to 50 ventilators/respirators) was the category that presented the highest proportion of cases and controls, equivalent to 52.62% and 51.12%, respectively (Table 2).

Table 1. Number and proportion of cases and controls and p-value of individual-level variables. Pernambuco, March 2020 to March 2022.

Variables	Cases		Controls		p-value
	N	%	N	%	
Sex					
Female	8,507	46.75	12,627	45.67	0.024
Male	9,691	53.25	15,020	54.33	
Age range					
Under 60 years	5,542	30.45	17,062	61.71	0.000
60 to 69 years	3,971	21.82	4,748	17.17	
70 to 79 years	4,409	24.23	3,502	12.67	
80 years old or older	4,276	23.5	2,335	8.45	
Symptoms					
Absent	252	1.38	467	1.69	0.010
Present	17,946	98.62	27,180	98.31	
O2 saturation<95%					
Absent	4,674	25.68	10,088	36.49	0.000
Present	13,524	74.32	17,559	63.51	
Respiratory discomfort					
Absent	9,595	52.73	17,558	63.51	0.000
Present	8,603	47.27	10,089	36.49	
Dyspnea					
Absent	3,441	18.91	6,986	25.27	0.000
Present	14,757	81.09	20,661	74.73	
Comorbidities					
Absent	6,160	33.85	16,007	57.9	0.000
Present	12,038	66.15	11,640	42.1	
Heart or vascular disease					
Absent	10,230	7.968	21,054	76.15	0.000
Present	56.21	43.79	6,593	23.85	
Diabetes					
Absent	12,494	68.66	22,828	82.57	0.000
Present	5,704	31.34	4,819	17.43	
Obesity					
Absent	16,468	90.49	25,835	93.45	0.000
Present	1,730	9.51	1,812	6.55	

Source: prepared by the author based on data from CIEVS-PE (2020 to 2022).

Table 2. Number and proportion of cases and controls and p-value of healthcare level variables. Pernambuco, March 2020 to March 2022.

Variables	Cases		Controls		
	N	%	N	%	p-value
Legal nature					
Private non-SUS	1,433	7.87	1,945	7.04	0.000
Private SUS	3,389	18.62	7,017	25.38	
Public non-SUS	153	0.84	273	0.99	
Public SUS	13,223	72.66	18,412	66.6	
ICU beds					
High (>45)	4,686	25.75	7,987	28.89	0.010
Medium (4-44)	9,667	53.12	12,463	45.08	
Low (0-3)	3,845	21.13	7,197	26.03	
Ventilators/respirators					
High (>51)	5,194	28.54	7,360	26.62	0.000
Medium (5-50)	9,576	52.62	14,133	51.12	
Low (0-4)	3,428	18.84	6,154	22.26	

Note: SUS – Brazilian Health System; ICU – Intensive Care Unit.
Source: prepared by the author based on data from CIEVS-PE (2020 to 2022).

In Table 3, it is possible to observe the results of bivariate analysis related to the municipality level. Regarding COVID-19-SII, it is noteworthy that the predominance of cases (34.58%) and controls (34.85%) was in the category listed as a high index.

As for the location of residence of individuals, it is noted that the majority of the proportion of cases and controls was concentrated in health macroregion I (Recife), with a total of 69.91% and 67.00%, respectively (Table 3).

Table 3. Number and proportion of cases and controls and p-value of variables at the municipal level. Pernambuco, March 2020 to March 2022.

Variables	Cases		Controls		
	N	%	N	%	p-value
COVID-19 Social Inequality Index					
Very low	5,159	28.35	7,658	27.7	0.683
Low	0	0	0	0	
Medium	1,496	8.22	2,510	9.08	
High	6,293	34.58	9,635	34.85	
Very high	5,250	28.85	7,844	28.37	
Health macroregion					
I (Recife)	12,723	69.91	18,523	67	0.000
II (Caruaru)	2,796	15.36	4,130	14.94	
III (Serra Talhada)	1,288	7.08	1,842	6.66	
IV (Petrolina)	1,391	7.64	3,152	11.4	

Source: prepared by the author based on data from CIEVS-PE (2020 to 2022).

Table 4 presents the consolidation of the final results of the multilevel model for the association between mortality from COVID-19 and individual and contextual determinants in the state of Pernambuco. Initially, the model consisted of 15 variables, of which only two did not make up the final model: one from the level of healthcare (legal nature) and one from the municipal level (COVID-19-SII).

The individual level was composed of ten variables, showing a statistical association with the final outcome and all with p = 0.000. The level of healthcare was composed of two variables: number of Adult ICUs and number of ventilators/respirators. Meanwhile, the municipal level was composed only of the variable referring to the health macroregion (Table 4).

In Pernambuco, being male (OR = 1.17) and aged 80 years or older (5.65) represented a risk factor for mortality from COVID-19. In the symptom variables, it is noteworthy that the presence of O2 saturation <95% was characterized as the greatest risk factor, being 1.56 times higher. However, the presence of respiratory distress and dyspnea was also found to be a risk factor, with an adjusted OR of 1.45 and 1.31, respectively. The presence of comorbidities (adjusted OR = 1.71) was also found to be a risk factor, with the presence of obesity (1.36) also standing out (Table 4).

Concerning healthcare, individuals admitted to establishments belonging to the medium category of the number of Adult ICU beds and ventilators/respirators had a higher chance of death from COVID-19.

The health macroregion variable was the only one at the municipal level that remained in the final model, which presented an adjusted OR lower than 1.

Table 4. Adjusted Odds Ratio, Confidence Interval and significance (p-value) values obtained through multilevel analysis. Pernambuco, March 2020 to March 2022.

Variables	AdjustedOR	CI	p-value
Sex			
Female	1	-	-
Male	1.17	1.12-1.23	0.000
Age range			
Under 60 years	1	-	-
60 to 69 years	2.22	2.10-2.36	0.000
70 to 79 years	3.48	3.27-3.70	0.000
80 years or older	5.65	5.28-6.04	0.000
Symptoms			
Absent	1	-	-
Present	0.65	0.54-0.78	0.000
O2 saturation<95%			
Absent	1	-	-
Present	1.56	1.48-1.65	0.000
Respiratory discomfort			
Absent	1	-	-
Present	1.45	1.39-1.53	0.000
Dyspnea			
Absent	1	-	-
Present	1.31	1.24-1.39	0.000
Comorbidities			
Absent	1	-	-
Present	1.71	1.59-1.83	0.000

Heart or vascular diseases			
Absent	1	-	-
Present	1.31	1.23-1.39	0.000
Diabetes			
Absent	1	-	-
Present	1.17	1.10-1.24	0.000
Obesity			
Absent	1	-	-
Present	1.36	1.25-1.48	0.000
Adult ICU beds			
Absent	1	-	-
Present	1.25	1.12-1.39	0.000
Absent	0.85	0.71-1.02	0.088
Ventilators/respirators			
Present	1	-	-
High (>45)	0.86	0.78-0.96	0.006
Medium (4-44)			
Health macroregion	0.66	0.56-0.79	0.000
I (Recife)	1	-	-
II (Caruaru)	0.97	0.87-1.09	0.688
III (Serra Talhada)	0.87	0.74-1.02	0.088
IV (Petrolina)	0.77	0.64-0.94	0.010

Note: number of units at level 1: 45,763; number of units at level 4,176; number of units at level 183; Model adjustment: AIC 51029.06 / BIC 51221.15; level 2 (adjusted by the health facility), variance 0.50762424 (0.03671655); level 3 (adjusted by the municipality), variance: 8.92700000 (3.18200000); ICU – Intensive Care Unit; CI – Confidence Interval.
Source: prepared by the author based on data from CIEVS-PE (2020 to 2022).

DISCUSSION

The results obtained in the present study showed that the individual level presented greater determining factors with mortality from COVID-19 in the state of Pernambuco, highlighting men, age group of 80 years or older, presence of symptoms, comorbidities, O2 saturation <95%, respiratory discomfort, dyspnea, heart or vascular diseases, diabetes and obesity.

In Pernambuco, there was a predominance of cases and controls in the male population, where men had a 17% higher chance of death. In a study conducted in the state of Rio Grande do Norte, the results indicate that being male was found to be a risk factor for mortality from the disease, with men having a 45% higher chance of death than women; therefore, they had a lower chance of survival.[16] A meta-analysis study found that the number of cases and fatality rates were more prevalent in the male population.[17]

From this perspective, it is worth noting that the chances of men dying more than women from COVID-19 can be characterized as a warning sign, and may present multivariate factors. However, the identification and recognition of this mortality factor are essential to support public policies and actions aimed at combating the disease, with ensuring equal access to healthcare services being a crucial device for men's healthcare.

Older adults aged 80 years or older presented a higher risk of death from COVID-19, as was observed for the fatality rates from the disease.[18] The pandemic attenuated the social inequalities that exist in the various scenarios in the country, being deepened in the most vulnerable older adults. The permanence in economic activities and in remote mode was found to be a barrier for this population. From this perspective, in addition to health, the pandemic brought about a series of social consequences.[19]

The presence of symptoms was predominant in both groups (cases and controls), being a determining factor for death, a similar result in a study that indicated cough, myalgia and other respiratory signs as the most frequent symptoms in the population.[20] However, it is noteworthy that the present study presents a prevalence of symptoms, as it is a study with a database of serious and hospitalized cases. This fact may have influenced the lack of differentiation between case and control groups, since almost all cases that generate hospitalization are symptomatic individuals.

Still regarding the presence of symptoms, individuals who presented O2 saturation <95%, respiratory distress and dyspnea had a higher risk of death in the state of Pernambuco. In Recife, the state capital, results indicate similar findings, where severe respiratory symptoms were also associated with death in the city.[21] Respiratory symptoms have also been identified in patients worldwide, such as the presence of dyspnea.[17] From this perspective, continuous monitoring of symptoms, through different strategies, is a strategy for preventing worsening and death from the disease.[22]

The presence of comorbidities as a risk factor was more prevalent in the case group than in the control group. Among the comorbidities analyzed in the study, heart or vascular diseases and diabetes were the ones that presented the highest proportions in the case group. In a cohort study carried out to identify the clinical characteristics of patients diagnosed with COVID-19, it was found that the presence of some comorbidity was more prevalent in deaths (48%) than in those who recovered (14%), with cardiovascular diseases standing out.[23]

This population requires differentiated healthcare, in which mapping these individuals can be a fundamental tool for healthcare. In this context, the pandemic reaffirmed the importance of coordination between health surveillance services and Primary Care, with multidisciplinary and interdisciplinary action constituting one of the main healthcare strategies within SUS.[24]

At the contextual level, in the context of healthcare, the number of ICU beds was found to be a determining factor in mortality, with individuals admitted to facilities with the average number of beds having the highest risk. Sometimes, hospitals with the highest number of beds received patients with the most critical conditions, which can increase mortality rates in these facilities. A national survey found that the health regions with the highest mortality rates were marked by a shortage of beds and equipment.[25] However, it is worth noting that the present study did not necessarily seek to analyze the availability of beds and ventilators/respirators, but rather the dimen-

sion of healthcare.

As for the second contextual level, initially, due to the history of social disparities in the distribution of infectious and parasitic diseases, the presence of higher risk variables was expected, but this result was not observed. This result may indicate that proximal (individual) factors are stronger than distal (contextual) factors. However, this finding does not imply that there is no association between COVID-19 and the context of individuals. The pandemic has led to the development of several studies, with different methodological approaches, with the source of information being one of the main differences between the studies.

Therefore, this result points to the need for future studies that consider other contextual variables and methodologies. Even with the advancement of coverage and quality of health information systems, limitations regarding the completion and completeness of variable records are constant. However, despite the limitations exposed, the construction of research based on secondary databases allows the development of longitudinal studies with a low operational cost.

Given the scenario identified in the results of this study, it is essential to humanize the data. The deaths that occurred in the state of Pernambuco are not just epidemiological numbers, but information about individuals with names, families and stories. Part of the Brazilian population died because the right to life was denied, mainly due to living conditions and access to healthcare services.

The fight against COVID-19 and the search for improvements in the quality of life of the population of the state of Pernambuco necessarily involve strengthening SUS as the main state policy for guaranteeing citizenship and the right to health, reducing social inequalities and inequities. Finally, the pandemic has exposed the Brazilian health system weaknesses, but it has also made clear the greatness of SUS.

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Maria Tatiane Alves da Silva contributed to bibliographic research, abstract writing, introduction, methodology, discussion, interpretation and description of results, preparation of tables, conclusions, review and statistics. **Lívia Teixeira de Souza Maia** contributed to project management, bibliographic research, abstract writing, introduction, methodology, discussion, interpretation and description of results, conclusions, review and statistics. **Gabriella Morais Duarte Miranda** contributed to bibliographic research, abstract writing, introduction, methodology, discussion, interpretation and description of results, preparation of tables, conclusions, review and statistics. **Ana Lúcia Andrade da Silva** contributed to bibliographic research, abstract writing, introduction, methodology, discussion, interpretation and description of results, preparation of tables, conclusions, review and statistics.

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