Analysis of stroke cases during the COVID-19 pandemic in a municipality in southern Brazil

Análise dos casos de AVC durante a pandemia de COVID-19 em um município da região sul do Brasil

Luciana Ferreira Karsten [1*], **Juliana Safanelli** [2], **Leticia Fernandes Lucas** [3], **Milena Lopes** [4]

[1] Coordinator of the Academic Nursing Leagues called (LAENCAC) and Academic Nursing League in Neurology (LANENF). Professor of undergraduate programs in Physical therapy (curricular component of Fundamentals of Pulmonology and Cardiology) and Dentistry (curricular component of Immunology and Pathology) at the University of the Joinville Region (UNIVILLE), Joinville (SC), Brazil. [2] Professor of the Nursing Program, at the University of the Joinville Region (UNIVILLE), Joinville (SC), Brazil. [3] Nursing Undergraduate, at the University of the Joinville Region (UNIVILLE), Joinville (SC), Brazil. [4] Nursing Undergraduate, at the University of the Joinville Region (UNIVILLE), Joinville (SC), Brazil.

*Corresponding author: Luciana Ferreira Karsten – *E-mail*: luciana.ferreira@univille.br

ABSTRACT

To analyze whether data on deaths from stroke cases occurring in Joinville, state of Santa Catarina, were influenced during the COVID-19 pandemic period. Method: quantitative, documentary analytical study with data from the Stroke Epidemiological Registry. The sample consisted of 362 hospital deaths. Data were analyzed in the Jamovi software, using a p-value <0.05, 95% confidence interval. The results were presented as mean, frequency, and standard deviation. Results: There was no increase in the absolute number of deaths due to stroke over the three years; the general characteristics of the sample remained unchanged concerning the disease. COVID-19 as a complication appeared in only 2.7% of deaths; only cases that had SARS-CoV-2 infection during hospitalization for stroke were described, not considering previous COVID-19 as a complication. Conclusion: The COVID-19 pandemic did not impact hospital deaths due to stroke.

Keywords: Stroke. Death. SARS-CoV-2.

RESUMO

Analisar se os dados dos óbitos de casos de AVC ocorridos em Joinville sofreram influência no período da pandemia da COVID-19. Método: estudo analítico documental, quantitativo, utilizando dados do Registro Epidemiológico de AVC. A amostra foi de 362 óbitos hospitalares. Os dados foram analisados no programa de estatística *Jamovi*, utilizando valor de p <0,05, intervalo de confiança de 95%, os resultados foram apresentados por média, frequência e desvio padrão. Resultados: Não foi observado aumento no número absoluto dos óbitos por AVC nos 3 anos, as características gerais da amostra permaneceram inalteradas em relação à doença. A COVID-19 como complicação apareceu em apenas 2,7% dos óbitos, é necessário ressaltar que foram descritos apenas os casos que tiveram infecção por SARS-CoV-2 durante a internação por AVC, não considerando a COVID-19 prévia como complicação. Conclusão: A pandemia da COVID-19 não provocou impacto nos óbitos hospitalares por AVC.

Palavras-chave: Acidente Vascular Cerebral. Óbito. SARS-CoV-2.

INTRODUCTION

According to the World Health Organization (WHO), cerebrovascular accident (CVA) ranks second among the main causes of mortality in adults worldwide, surpassed only by cancer and heart attack. Estimates indicate that around six million stroke-related deaths occur every year, with the majority of them occurring in developing countries. In Brazil, the situation is even more worrying, with stroke leading the mortality statistics.[1,2] During the period between January 1 and October 13, 2022, stroke resulted in 87,518 deaths, which represents an average of 12 deaths per hour or 307 fatalities per day. These numbers reiterate stroke as the main cause of death in the country.[3]

Within this scenario, in Brazil, in-hospital stroke care follows Ordinance 665 of the Ministry of Health, created in 2012, which provides for the criteria for the creation of Stroke Units (U-CVA), seeking to train services for care and approving the line of care for patients affected by stroke. U-CVA represent an effective model for treatment in the acute phase, and multidisciplinary care and rehabilitation help people recover after a vascular event, reducing morbidity and possible functional sequelae.[4] In Joinville, the Stroke Unit was started in 1996 at the São José Municipal Hospital, becoming a model for the Ministry of Health.

In addition to in-hospital treatment, health promotion is understood as another essential pillar in the context of stroke, as it aims to improve preventive measures against risk factors for the disease. Promoting health is crucial to preventing stroke and reducing its incidence. Bessa et al.[5] discuss the impact on the incidence of hospital admissions, expenses, and deaths of stroke patients in 2002 when the Plan for the Reorganization of Care for Arterial Hypertension and Diabetes Mellitus (Hiperdia) was implemented. This plan focused on controlling risk factors for cardiovascular diseases, as well as medication adherence and health guidelines, resulting in greater control of blood pressure than in individuals not monitored by the program.

Raising awareness about modifiable risk factors, such as high blood pressure, high cholesterol, smoking, physical inactivity, and inadequate diet, is essential. The risk of stroke can be significantly reduced through education and healthy habits.

However, unexpected factors can directly impact medical care for acute diseases such as stroke; with the emergence of COVID-19, a pathology from infection with the SARS-CoV-2 virus, the entire hospital network in the world had to quickly reorganize for the care of those infected.[6] Studies are evaluating the association of COVID-19 with neurological pathologies such as stroke; this association may be related to the neurotropism of the virus, the inflammatory process, and other changes in coagulation generated by the infection.[7]

Considering this context, it is crucial to understand whether there was an impact of COVID-19 on the outcome of stroke, including death. This research sought to check for any effect of the COVID-19 pandemic on hospital mortality from stroke.

METHODOLOGY

DESIGN

This was a study characterized as a quantitative document analysis.

LOCAL

The Joinville Epidemiological Registry of Cerebrovascular Diseases (JOINVASC) database was used.

PERIOD

The research was carried out with data from the period from January 2019 to December 2021, in the municipality of Joinville, state of Santa Catarina.

POPULATION

The study sample for analysis was composed of 362 deaths.

SELECTION CRITERIA

To compose the sample, the following inclusion criteria were considered: over 18 years of age, all hospital deaths due to stroke that occurred between January 2019 and December 2021, registered in JOINVASC, and complete records.

Therefore, the exclusion criteria were incomplete data or patients who had a stroke during hospitalization for other causes or those whose cause of death was not a stroke, according to the death notification investigation.

SAMPLE DEFINITION

The total number of stroke cases in the municipality of Joinville in three years (2019, 2020, and 2021) totaled 2,813; of this total, 362 deaths were considered to be analyzed and comprised the study sample.

STUDY VARIABLES

The research used the following variables: number of deaths from stroke, NIHSS scale, acute phase treatment, complications, gender, age, occupation, risk factors, and length of stay.

DATA COLLECTION

Data were collected in two stages as described below:

- Stage 1: the researchers searched for the sample available in the JOINVASC database.
- Stage 2: the data were organized and entered into a Microsoft Excel® spreadsheet for analysis in the *Jamovi* software.

DATA ANALYSIS PROCESSING

Deaths were characterized by stroke subtypes, gender, age, NIHSS scale, main complications, main risk factors, and length of hospital stay.

For the descriptive analysis of quantitative data, the Shapiro-Wilks normality test was applied, with a p-value <0.05 and a 95% confidence interval. The study variables showed a value of $p<0.01$, i.e., proving a significant difference between the data. Thus, the results were described by mean, frequency, and standard deviation.

A weakness in the study can be observed, as the risk factors were not addressed in an associated way in the contribution of stroke cases.

ETHICAL ASPECTS

The research respected the confidentiality of the identity of those researched as recommended by Resolution 466/12 of the National Health Council (2013) and was carried out after the opinion of the Ethics Committee number 5.223.829 issued by the Research Ethics Committee of the University of the Joinville Region (UNIVILLE).

RESULTS

Figure 1 illustrates the survey carried out through The Joinville Epidemiological Registry of Cerebrovascular Diseases (JOINVASC) in the years 2019, 2020, and 2021, which comprise the study data.
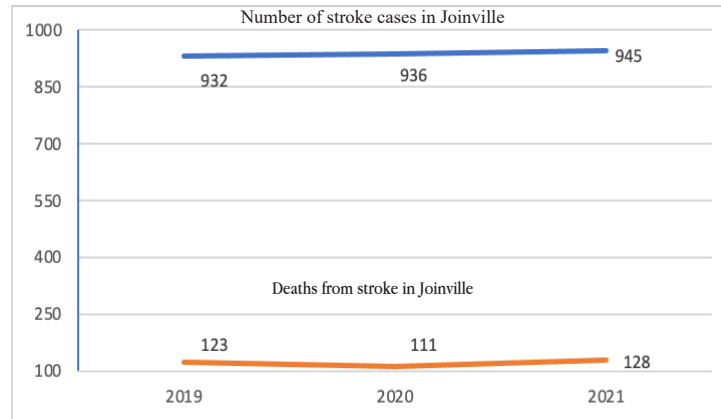
Figure 1. Total stroke cases x Number of deaths from stroke, from Jan 2019 to Dec 2021. Joinville, state of Santa Catarina, Brazil, 2022.

Source: Research data (2022).

The number of cases had a small increase over the three years but remained stable. The same premise remained for the number of deaths, where in 2020, there was a drop that may be associated with low demand for the healthcare system due to fear of infection with the SARS-CoV-2 virus, and in 2021, a slight increase compared to 2019.

Table 1 lists the general characteristics of deaths by stroke subtype in the municipality of Joinville, in the period covering the years 2019, 2020, and 2021.

Table 1. General characteristics of deaths by stroke subtype in the period between Jan 2019 and Dec 2021 (n=362). Joinville, state of Santa Catarina, Brazil, 2022.

	Sample	ICS	ICH	SAH
Deaths	362	234 (64.6%)	93 (25.7%)	35 (9.7%)
Gender				
Female	202 (55.8%)	130 (55.6%)	44 (47.3%)	28 (80%)
Male	160 (44.2%)	104 (44.4%)	49 (52.7%)	7 (20%)
Age (mean 69 years, SD = 14.2)				
18 to 59 years	83 (22.9%)	27 (11.5%)	34 (36.5%)	22 (63%)
>60 years	279 (77.1%)	207 (88.5%)	59 (63. 5%)	13 (37%)
Risk factors				
Hypertension (SAH)	290 (80%)	202 (86.3%)	67 (72%)	21 (60%)
Sedentary lifestyle	290 (80%)	197 (84%)	70 (75%)	23 (65%)
Diabetes (DM)	132 (36.4%)	96 (41%)	31 (33%)	5 (14%)
Smoking (active)	61 (17%)	27 (11.5%)	26 (28%)	8 (23%)
Ocuppation				
Retired	237 (65.4%)	174 (74.3%)	52 (56%)	11 (31.4%)
Working	60 (16.9%)	24 (10.2%)	24 (25.8%)	12 (34.2%)
Housekeeping	50 (13.8%)	29 (12.3%)	12 (12.9%)	9 (25.7%)
Unemployed	8 (2.3%)	4 (1.7%)	2 (2.1%)	2 (5.7%)

Source: Research data (2022).

Post-thrombolysis hemorrhagic transformation was not considered a complication of multidisciplinary care. In addition, ages over 60 years old were considered as elderly, following what is recommended by the Statute of the Elderly by Law 10741/03 | Law 10741, of October 1, 2003.

As for Table 1, which describes the characteristics of the sample studied a total of 362 deaths from stroke were observed. A higher incidence of deaths related to Ischemic Stroke (ICS) stands out, especially among women and those aged over 60 years, with an average age of 69 years. Furthermore, the main risk factors associated with deaths from stroke include, in increasing order of prevalence, Systemic Arterial Hypertension (SAH), sedentary lifestyle, Diabetes

Mellitus, and, to a lesser extent, smoking. To finalize the characteristics of the sample, still in the same Table 1, deaths had a higher incidence among retirees.

Table 2 presents the percentage of the sample evaluated concerning the severity of the stroke (NIHSS), the treatment during hospitalization, length of stay, and the complications the patients had during hospitalization. Bleeding complications were not evaluated after acute phase treatment, and for COVID-19, only cases that had SARS-CoV-2 infection during hospitalization for stroke were described, not considering previous COVID-19 as a complication.

Table 2. Hospitalization characteristics of patients who died between Jan 2019 and Dec 2021 (n=362). Joinville, state of Santa Catarina, Brazil, 2022.

(Continued)

	ICS	ICH	SAH
	234 (64.6%)	93 (25.7%)	35 (9.7%)
Admission NIHSS			
0 a 4 (mild)	24 (10%)	4 (4%)	11 (31%)
5 to 9 (moderate)	35 (15%)	3 (3%)	-
>10 (severe)	154 (66%)	71 (76%)	16 (46%)
Not informed	21 (9%)	15 (16%)	8 (23%)
Acute phase stroke treatment ICS			
Thrombolysis	19 (8%)	-	-
Thrombectomy	14 (6%)	-	-
Combined	6 (3%)	-	-
Conservative treatment	195 (83%)	-	-
Length of stay			
0 to 6 days	99 (42%)	58 (62%)	15 (43%)
7 to 14 days	54 (23%)	19 (20%)	13 (37%)
>15 days	81 (34%)	16 (17%)	7 (20%)
Average length of stay	14.9 days	9 days	11 days
SD	(SD=16.1)	(SD=132)	(SD=13.5)
Care-related complications			
Pneumonia	35 (15%)	4 (4.3%)	2 (5.7%)
Urinary tract infection	11 (4.7%)	2 (2.1%)	-
Pressure injury	18 (8%)	6 (6.4%)	1 (2.8%)
COVID-19	4 (1.7%)	1 (1%)	-

(Conclusion)

Deep Vein Thrombosis	3 (1%)	1 (1%)	-
Other causes *	5 (2%)	4 (4.3%)	1 (2.8%)
No complications	158 (67.5%)	75 (80.6%)	31 (88.5%)

*Exacerbated COPD, endocarditis, meningitis, tracheitis.
Source: Research data (2022).

In the patients' hospitalization characteristics, the severe NIHSS scale (score >10) presented a higher percentage, indicating that most patients arrived at the tertiary care service with a severe stroke.

Regarding the treatment of the acute phase practiced in cases of ICS, most patients underwent conservative treatment, emphasizing the hypothesis that these patients arrived outside the therapeutic window and in severe clinical conditions, not being eligible for thrombolysis, thrombectomy, or combined therapy. Based on the severity of the cases, patients required hospitalization, varying between 0 and 6 days, and in some cases exceeding 15 days. The highest percentage of patients remained hospitalized for between 0 and 6 days, resulting in death, reinforcing the severity of the cases upon admission, as many did not have enough time in the hospital to develop secondary complications.

When analyzing the complications patients developed during hospitalization, it was possible to list, in ascending order: pneumonia, urinary tract infection, pressure injury, deep vein thrombosis, COVID-19, and other causes (exacerbated Chronic Obstructive Pulmonary Disease, endocarditis, tracheitis). With regard to COVID-19, the low percentage of cases may be related to the fact that only cases that had SARS-CoV-2 infection during hospitalization for stroke were counted, not considering previous COVID-19 as a complication.

Furthermore, the most significant number found were cases without complications, raising two possibilities, one contributing to the fact that the short period of hospitalization was not enough for the development of complications, relating deaths mainly to the severity of the stroke. And the other possibility is related to quality care in the hospital environment.

DISCUSSION

In the 362 hospital deaths from stroke in the period studied, the ICS subtype was prevalent, corroborating the characteristics of the disease concerning its incidence. Previous studies[8] in Brazil demonstrate that in the state of São Paulo, in 2019, ICS was responsible for 73,320 deaths in the Brazilian population and showed that the increase in numbers is concentrated in age groups over 60 years old. The highest frequency of ICS occurs in people over 70 years of age.[9] In the present study, most deaths occurred in patients over 60 years of age. Stroke becomes more common in older age groups due to the accumulation of comorbidities over the years, such as hypertension, DM, and heart disease, in addition to habits such as smoking and a sedentary lifestyle, factors that contribute to the accumulation of atherosclerotic plaques, which can result in thrombi that lead to interruption of blood flow and ischemia.[10]

Therefore, the patient's initial condition associated with the severity of the stroke is believed to be a determining factor for the outcome of death. However, in this study, a relevant fact was observed: 22.9% of deaths occurred in patients under 60 years of age. This can be justified by relating lifestyle, highlighting sedentary lifestyle and obesity, in addition to drug and alcohol consumption as the main conditions associated with this development.[11] Other research shows

that ICS is unusual in patients >60 years old, and when it occurs, it is mainly related to cardiovascular and metabolic conditions, as well as the individual's lifestyle.[12]

Regarding gender, there was a higher rate in the female population. Women correspond to a slight increase in relation to men. The American Stroke Association indicated that stroke affects approximately 55,000 more women than men. The research links the increase in cases in women to risk factors such as the use of oral contraceptives, pregnancy with a history of pre-eclampsia and eclampsia, as well as systemic diseases such as systemic arterial hypertension (SAH), and habits such as smoking.[9-12]

In the different types of stroke analyzed in this study, systemic arterial hypertension (SAH) proved to be prevalent. This chronic condition contributes to dysfunction of the cardiac endothelium, resulting in inadequate regulation of arterioles during systole and diastole. Over time, if not properly treated, this can weaken the endothelium, affecting its integrity. Understanding this pathophysiology, it becomes evident that these physiological changes can influence several blood vessels, including those in the brain. Due to this complex interaction, hypertension is considered a significant predisposing factor for the development of stroke. Authors show in their studies that, of the 1,547 patients evaluated, 1,068 had SAH, totaling 69.04% of the sample.[13] This perspective is found in another study, where it was demonstrated that in a sample of 101 patients, that is, 81.2 % had SAH as the main comorbidity in stroke cases admitted to emergency services in the region.[14]

In Sobral, state of Ceará, a study evaluated the incidence of stroke in the region's population, pointing out that among the risk factors, a sedentary lifestyle stood out in second place among the main factors; in a sample of 365 patients, it represented 61%, behind only SAH, present in 66.3% of the studied population. The results were similar to those identified here, in

which hypertension and a sedentary lifestyle presented similar results, both representing 80% when evaluated by type of stroke.[3]

In addition to a sedentary lifestyle, we sought to evaluate smoking, which is related to lifestyle habits and is an important risk factor for NCDs. During the period from 1999 to 2015, Brazil experienced a significant drop in the number of smokers, probably due to health policies implemented nationally. However, in 2015, approximately 156,337 deaths attributed to smoking were recorded, with stroke representing 13% of this total, behind lung cancer (78%), COPD (74%), and AMI (18%). This study revealed the presence of smoking but with a lower incidence compared to hypertension, sedentary lifestyle, and (DM)[15]. Notably, smoking had its highest occurrence in cases of Hemorrhagic Stroke (ICH), confirming other studies that highlight tobacco as a risk factor, and SAH is identified as a predominant risk factor.

When analyzing the occupation of the target population, retirees had a higher percentage of deaths from stroke. The elderly population, as well as retirees, represented the highest rate of deaths from stroke, making it possible to understand a relationship between these two factors in this study, which addresses the existence of a higher rate of deaths in the retired population due to the age of these patients, most of whom are aged over 60.[10]

Regarding the stroke complications analyzed in this study, the presence of pneumonia was observed in all types of strokes, being more common in ICH. Furthermore, this disease subtype had the longest average length of stay, with pneumonia being the most prevalent complication. In 2015, 27% of patients were diagnosed with pneumonia unrelated to mechanical ventilation, of which 33% used NG.[16]

This complication is related to the patient's clinical condition and the care provided. As recommended in the stroke care line, a speech therapist evaluation is mandatory before

starting the diet, and the nurse is responsible for some essential care such as carrying out the NG appropriately, fixing it, requesting an x-ray for evaluation, and discussing with the team about the necessary conduct. A previous study reported that post-stroke pneumonia is a common complication, especially in acute stroke, with a prevalence ranging from 11.3% to 31.3%.[17]

Another complication reported in the study is the development of Pressure Injury (PU), which was found to be the second major complication in cases of ICS and ICH. This complication is directly related to the length of hospital stay of patients after stroke, being an indicator of assistance care. In cases of stroke, the average length of stay was longer, with 34% of deaths occurring after 15 days of hospitalization. In ICH, the average length of stay was shorter. Moderate NIHSS scores were observed in ICS and ICH, which may contribute to the development of PU, as the patient arrives with moderate severity, impaired mobility, and bedridden. The longer the length of stay, the greater the risk of developing a PU, with an average length of stay of 10 days becoming sufficient for the development of this complication.[18] In the present study, there is no possibility of stating that the development of PU was due to care practices, which brings a bias to this finding. Nevertheless, as verified with the present data, a previous study[19] reports that risk factors (SAH, DM, and stroke) and advanced age are predictive factors for PU.

Current studies have presented possible relationships between COVID-19 and vascular diseases, including stroke. This complication was also highlighted here. The relationship occurs due to the exacerbated infectious response that occurs in the body due to the release of pro-inflammatory cytokines. This inflammatory process is linked to coagulation, as it can lead to vessel damage and the development of thrombi. This hypercoagulability generally occurs in more advanced stages of the disease, worsening its prognosis.[20] A survey carried out in India[21]

evaluated 115 patients with acute and subacute stroke with COVID-19 at the time of stroke or with an average interval of 10 days until stroke from the diagnosis of COVID-19 and found that 87.8% of cases were ICS. Among the patients, 74% were in severe condition due to COVID-19 and had a late diagnosis of stroke, but a high mortality rate (47.9%) was identified in patients who presented both pathologies associated with admission to the ICU and two or more vascular risk factors. In this study, COVID-19 was considered a complication during hospitalization for stroke, which is why it represented a low percentage compared to other studies, being present in only 2.7% of cases; previous COVID-19 infections were not considered; only those that occurred during hospitalization for stroke, which may be related to failures in care. Several studies have been developed regarding the complications of this new pathology, and it is not yet possible to clearly identify the associations, but it already appears as a factor that must continue to be investigated.

Regarding the complication of deep vein thrombosis (DVT), a small percentage of deaths developed DVT as a complication. This is because of the implementation and use of care protocols, which begin DVT prophylaxis using heparin or enoxaparin 24 hours after thrombolysis as treatment.[22]

The present study also highlighted other complications (exacerbated COPD, endocarditis, meningitis, and tracheitis), and other studies show that these causes are rarely identified as secondary complications to stroke; in some cases, there may be a worsening of already established clinical conditions, as in the case of COPD. The cases of death due to ICS and ICH did not have any secondary complications to the stroke. This can be associated with the length of stay between 0 and 6 days in most cases and the high severity indicated by the NIHSS. This is because[9], in the pathophysiology of ICH, it can occur due to extravasation of blood within the brain or in the meninges, becoming responsible for 15% of

deaths, representing a survival probability rate 1.37 times lower than ICS, contributing to the high mortality and severity.

In the present study, the average length of stay was 11.6 days, which does not differ much from previous studies.[23-24] In the 3 subtypes of stroke, most patients remained between 0 and 6 days, which contributes to the fact that 233 patients died without any complications.

As for the severity of the stroke, measured by the NIHSS scale, the average score indicated a classification above 10 points (severe), leading to worse prognoses. This scenario was observed mainly in the ICH and SAH. Other studies point to ICH as the most lethal type of cerebrovascular disease.[25]

Treatment of the acute phase is essential to change the patient's fate[26]; therefore, the administration of thrombolysis must be carried out within a window of up to 4 hours and 30 minutes from the onset of symptoms, while thrombectomy can be performed within the first 6 hours up to 24 hours in specific cases. However, this study identified that the minority were able to undergo this type of treatment, with conservative treatment prevailing. This happens when the patient is outside the therapeutic window or there is a contraindication.

Despite the severity evidenced by the admission NIHSS, previous conditions such as SAH, and age, 67.5% of patients did not present complications during hospitalization. This finding is possibly related to the care protocols used, and probably the deaths did not occur due to a failure in care but rather due to the severity of the clinical condition. The control of underlying diseases can also be an influencing factor for this reality.

The pandemic period could have affected the logistics of stroke care and impacted the increase in complications during hospitalization, but no significant differences were detected between the periods evaluated. Therefore, the existence of a structured service is suggested, with well-established protocols, triggering quality

of care. Leading to the fact that the patient's previous conditions impact stroke mortality.

With all the data collected and discussed throughout the research, the implications of the disease on the population must be understood. To this end, health promotion measures positively affect the stroke outcome, as well as a structured and efficient Stroke Care Line in the municipality.

CONCLUSION

Stroke is a multifactorial disease of global concern and is considered a public health problem, affecting individuals of different age groups. In the present study, it can be highlighted that health promotion is of fundamental importance for reducing stroke cases, their complications, and the outcome of death.

The behavior of the sample did not differ considering the characteristics of the disease, that is, involvement with a higher prevalence of ICS in people over 60 years of age and an average hospitalization time of 11.6 days. The risk factors present, such as SAH, DM, and sedentary lifestyle, prove that their prevention and control must be increasingly worked on within the scope of public health.

Regarding stroke complications, pneumonia and the development of pressure injuries are also prevalent outcomes in the population affected by stroke. However, in the study sample, a significant number of deaths did not have any complications. Proving that in severe NIHSS, there is a predominance of deaths.

Despite the severe NIHSS, above 10 points, most patients underwent conservative treatment, and this occurred because the therapeutic window time (4h30min) or contraindications for invasive treatment were more prevalent. The importance of providing information to the population about recognizing stroke and quickly seeking hospital medical support is highlighted here.

When measuring the number of deaths during the COVID-19 pandemic and the previous

year, there was no significant difference. This can be explained by the existence of a well-structured and efficient Stroke Care Line in the municipality of Joinville.

With this study, we were able to reinforce the importance of understanding better the disease for the investigation of weaknesses in caring for stroke victims. From that moment on, it is possible to plan promotion, prevention, and care actions for the population.

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