

# Stroke Hospital Admissions during the COVID-19 Outbreak in São Paulo, Brazil

Laura Silveira Tanisaka<sup>a, b</sup> Laércio da Silva Paiva<sup>a</sup>  
Luis Eduardo Werneck de Carvalho<sup>a, c</sup> Fernando Luiz Affonso Fonseca<sup>d</sup>  
David Feder<sup>d</sup> Vânia Barbosa do Nascimento<sup>a</sup> Fernando Adami<sup>a, c</sup>

<sup>a</sup>Laboratório de Epidemiologia e Análise de Dados do Centro Universitário FMABC, Santo André, Brazil;

<sup>b</sup>Bolsista da Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), São Paulo, Brazil;

<sup>c</sup>Oncológica do Brasil Ensino e Pesquisa (OBEP), Belém, Brazil; <sup>d</sup>Departamento de Análises Clínicas do Centro Universitário FMABC, Santo André, Brazil

## Keywords

Coronavirus disease pandemic · Stroke · Stroke management · Spatio-temporal analysis

## Abstract

**Background:** Globally, stroke remains an important cause of death and long-term disability, and the impact of coronavirus disease (COVID-19) on the health system may have impaired stroke care. Previous studies suggest significant reduction in hospital admissions for stroke after COVID-19 onset as patients may hesitate seeking medical help due to fear of exposure. **Methods:** This cross-sectional study included cases of hospital admissions for stroke, identified from the Hospital Information System of the Unified Health System (Sistema Único de Saúde), which contains official and public data in Brazil. Data were collected in duplicate, then categorized according to the International Classification of Diseases, tenth revision (ICD-10), considering codes I60–I69. Linear regression was used to estimate the variation in hospital admissions for stroke in the city of São Paulo (SP) – the largest and most populous city in Brazil and Latin America, between January and June of each analyzed year (2017–2020). The percentage variation between June and January 2020 was

also compared. The level of significance was set at 5%, and the statistical program used was Stata, version 14.0. **Results:** In the city of SP, during the first wave of COVID-19, from January to June 2020, there were registered decreases in absolute numbers and mean monthly admissions for stroke. Compared to January 2020, data from June 2020 showed 17% reduction in hospitalizations for intracerebral hemorrhage, 32% for cerebral infarction, 26% for stroke unspecified, and 47% for other cerebrovascular diseases. **Conclusion:** We argue for policies aimed at improving stroke care and developing awareness campaigns regarding the importance of early diagnosis and treatment, as even in less severe presentations, stroke can trigger an increase in mortality, cost, and long-term disability.

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## Introduction

Globally, the coronavirus disease (COVID-19) pandemic has posed a significant challenge to healthcare systems owing to difficulties in the reallocation of resources, increased demand in intensive care centers, and the implementation of social distancing. Consequently, care of

**Table 1.** Estimation of linear regression of hospital admissions by stroke subtypes between January–June 2017 and 2020

Stroke subtype	Hospital admissions, <i>N</i>	$\beta$ (95% CI)*	<i>p</i> value
<b>2017</b>			
Intracranial hemorrhage (I60–I62)	913	6.8 [–4.4; 17.9]	0.17
Cerebral infarction (I63)	695	0.6 [–10.6; 11.2]	0.95
Nonspecified (I64)**	3,456	10.9 [–11.8; 33.6]	0.25
Other cerebrovascular diseases (I65–I69)	391	–0.3 [–6.2; 5.7]	0.91
<b>2018</b>			
Intracranial hemorrhage (I60–I62)	1,007	3.1 [–8.4; 14.7]	0.49
Cerebral infarction (I63)	788	9.5 [0.007; 19.1]	0.050
Nonspecified (I64)**	3,550	–3.3 [–33.1; 26.5]	0.77
Other cerebrovascular diseases (I65–I69)	388	0.1 [–2.1; 2.3]	0.89
<b>2019</b>			
Intracranial hemorrhage (I60–I62)	932	9.5 [–2.4; 21.4]	0.09
Cerebral infarction (I63)	821	0.9 [–8.1; 9.9]	0.79
Nonspecified (I64)**	3,551	4.6 [–4.8; 14.0]	0.24
Other cerebrovascular diseases (I65–I69)	406	0.9 [–3.4; 5.1]	0.60
<b>2020</b>			
Intracranial hemorrhage (I60–I62)	927	–5 [–10.6; 0.6]	0.06
Cerebral infarction (I63)	811	–11.6 [–18.7; –4.5]	0.01
Nonspecified (I64)**	3,159	–30.9 [–49.2; 12.5]	0.01
Other cerebrovascular diseases (I65–I69)	293	–6.8 [–13.3; –0.4]	0.04

95% CI, 95% confidence interval. \* Values between January and June of each year. \*\* Stroke not specified as ischemic or hemorrhagic.

clinical emergencies with time-dependent prognosis, such as stroke, has become impaired. Stroke remains the second leading cause of death worldwide and the third cause of death and disability combined [1, 2]. In this context, delayed admission of patients with stroke may lead to worse outcomes [3].

In Brazil, only few studies have evaluated the influence of the pandemic on stroke care attendance during the first wave of COVID-19. In this study, we compared stroke admissions between January and June 2020 to the same periods of the last 3 years, in hospitals of São Paulo (SP). The city of SP is the largest and most populous city in Brazil and Latin America.

## Methods

This cross-sectional study included cases of hospital admissions for stroke, identified from the Hospital Information System of the Unified Health System (Sistema Único de Saúde), which contains official and public data in Brazil. Data were collected in duplicate and then categorized according to the International Classification of Diseases, tenth revision (ICD-10). We considered the following stroke subtypes: nontraumatic intracranial hemorrhage (ICD-10 codes I60–I62), cerebral infarction (ICD-10 code I63), stroke not

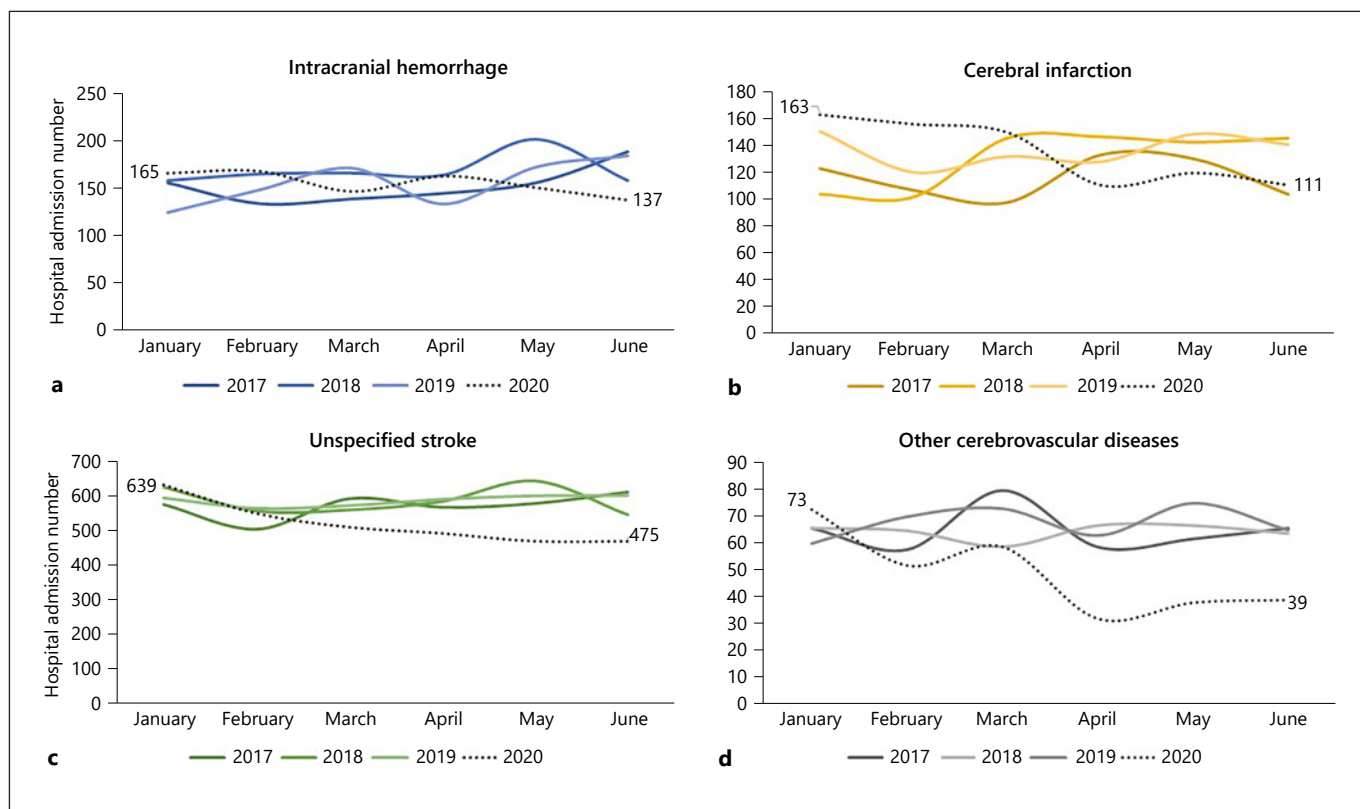
specified between ischemic and hemorrhagic (ICD-10 code I64), and other cerebrovascular diseases (ICD-10 codes I65–I69).

Linear regression was used to estimate the variation in hospital admissions for stroke in the city of SP, Brazil, between January and June of each analyzed year (2017–2020). Moreover, the percentage variation between the months of June and January 2020 was compared, with the latter corresponding to the month before the first case of COVID-19 was reported in the city (February 26, 2020). The level of significance was set at 5%, and the statistical program used was Stata, version 14.0.

As these were secondary data, no approval from the Brazilian Research Ethics Committee was required, in reference to resolution 510/2016 of the Brazilian Ministry of Health. The STROBE guidelines for observational studies in epidemiology were followed.

## Results

During 2017–2020, there were 40,867 hospitalizations for stroke in the city of SP, Brazil. Between January and June of the years 2017–2019, there were no significant changes in hospital admissions for stroke. However, from January to June 2020, there were registered decreases in absolute numbers and mean monthly admissions of 11.6 (95% confidence interval [CI]: 4.5; 18.7) for cerebral in-



**Fig. 1.** Distribution of the number of hospital admissions by stroke subtype between January and June of each year from 2017 to 2020. Intracranial hemorrhage (I60–I62) (a); cerebral infarction (I63) (b); stroke not specified between ischemic or hemorrhagic (I64) (c); other cerebrovascular diseases (I65–I69) (d).

fraction, 30.9 (95% CI: 12.5; 49.2) for stroke not specified, and 6.8 (95% CI: 0.4; 13.3) for other cerebrovascular diseases, except for intracranial hemorrhage, which was stable (–5; 95% CI: –10.6; 0.6) (Table 1). Compared to January 2020, data from June 2020 showed 17% reduction in hospitalizations for intracerebral hemorrhage, 32% for cerebral infarction, 26% for stroke unspecified, and 47% for other cerebrovascular diseases (shown in Fig. 1).

## Discussion

In this cross-sectional study, we provide evidence for a reduction in hospital admissions after the onset of the COVID-19 pandemic. This may be attributed to the fear of exposure to severe respiratory syndrome coronavirus-2 (SARS-CoV-2), which may have caused patients to hesitate seeking medical help in the face of acute symptoms, especially for mild stroke cases. A study that compared pre-COVID-19 period with the COVID-19 lockdown period found a reduction in ischemic stroke admis-

sions to emergency departments from 73.9% to 56.8% in Brazil. Furthermore, the study evidenced a substantial increase in the proportion of stroke admissions beyond 48 h from symptoms onset. Therefore, it is possible that the delay in diagnosis and treatment of stroke, demonstrated by a larger time to consultation during lockdown period, may have contributed to an increase in mortality [4].

The decrease in the absolute number and mean monthly hospitalizations is consistent with the information reported in literature. Nogueira et al. [5] demonstrated a significant global decline for overall stroke admissions (19.2%), ischemic stroke/transient ischemic attack admissions (15.1%), and intracranial hemorrhage hospitalization (11.5%), when comparing COVID-19 pandemic period during 3 months to the immediately preceding tertile. It is important to notice that the stable trend for intracranial hemorrhage in our findings is also revealed in this study, in which there was no significant statistical difference in admission numbers for intracranial hemorrhage when considering high-volume COVID-19 centers. Also, compared to the same 3 months of the prior year, the

study indicated that there was a decline in the monthly admissions for stroke, ischemic stroke, and transient ischemic attack, but not for intracranial hemorrhage [5].

Furthermore, a population-based study in Joinville, Brazil, correlated the onset of the pandemic with a significant reduction in hospital admissions for cases of milder strokes [6]. Another study in Iran, an upper middle-income country like Brazil, indicated a decrease in hospital admissions, especially for cases of less severe neurological deficit strokes, and indicated a significant increase in disability on discharge [7]. These data, together with the present study, constitute an alarming scenario wherein even in less severe presentations, stroke can trigger an increase in mortality, cost, and long-term disability.

Limitations of this study include its cross-sectional design and the possibility of incomplete or inaccurate records in the official system, which were collected during the pandemic. To minimize these issues, data from the first 6 months of 2020 were compared with those from the same period in each of the previous 3 years.

## Conclusion

Recent studies have quantified the change in hospital admissions for stroke or other pathologies during the COVID-19 pandemic in upper middle-income countries such as Brazil [7, 8]. Given that the impact of the pandemic will be sustained, our results may be considered by hospital systems, healthcare providers, and authorities for strategic management and stroke care efficiency. Moreover, the development of awareness campaigns regarding the importance of early diagnosis and treatment of stroke can help reduce its economic consequences and prevent worsening of the burden on the healthcare system.

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## Statement of Ethics

As these were secondary data, no approval from the Brazilian Research Ethics Committee was required, in reference to resolution 510/2016 of the Brazilian Ministry of Health. The STROBE guidelines for observational studies in epidemiology were followed.

## Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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## Author Contributions

L.S.T., L.S.P., and F.A. participated in the design of the study. L.S.T., L.S.P., and F.A. participated in the statistical analysis. L.S.T., L.S.P., L.E.W.C., F.L.A.F., D.F., V.B.N., and F.A. contributed to writing and revising the manuscript. All authors read and approved the final version of the manuscripts.

## Data Availability Statement

All data generated or analyzed during this study are included in this article.