

# Impact of COVID-19 Pandemic on Stroke Severity and Mortality in the South-East of Santiago, Chile

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Background and purpose; Chile has been one of the most affected countries by the COVID-19 pandemic, with one of the highest case rates per population. This has affected the epidemiological behaviour of various pathologies. We analyze the impact of the pandemic on the number of admissions due to stroke, its severity and mortality in Santiago, Chile.

**Methods:** a multicenter observational study based on the records of the 3 hospitals of the South East health service in Santiago, Chile. We recorded the number of patients admitted for ischemic stroke between 01 January 2020 and 30 June 2020. We grouped the cases into two periods, pre-pandemic and pandemic, according to the setting of the state of emergency in Chile. **Results:** 431 patients were admitted with ischemic stroke during the study period. There was a non-significant decrease in weekly admissions (17 vs 15 patients per week). No differences were observed in the proportion of patients with medical treatment ( $p = 0.810$ ), IVT ( $p = 0.638$ ), EVT ( $p = 0.503$ ) or IVT + EVT ( $p = 0.501$ ). There was a statistically significant increase in the NIHSS on admission (7.23 vs 8.78,  $p = 0.009$ ) and mortality (5.2% vs 12.4%,  $p = 0.012$ ). In a multivariate analysis the NIHSS on admission was associated with the increased mortality (RR 1.11, CI 1.04-1.19,  $p = 0.003$ ). **Conclusion:** We found an increase in the severity of ischemic stroke on admission and in-hospital mortality during the pandemic period. The main factor to increase in-hospital mortality was the NIHSS on admission.

**Key Words:** COVID-19—Stroke—Mortality—Latin America

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## Introduction

Coronavirus disease 2019 (COVID-19) pandemic impact in healthcare. Excess deaths from the COVID-19

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pandemic might arise both in those infected (direct effects) and those affected by altered access to health services (indirectly, not infected).<sup>1</sup> In Chile, by 30th June, 279,393 total COVID-19 cases, and 5,688 deaths had been confirmed.<sup>2</sup>

Many extreme measures have been taken to contain the spread of the disease, such as quarantine communities, which could have affected the optimal stroke care.<sup>4–6</sup> Chile has been in one of the countries more heavily stricken by COVID-19 in Latin America, but this pandemic has not affected all regions equally, even in Santiago there are communes with a greater number of cases and mortality, especially in areas with a lower level of socioeconomic status.<sup>2,3</sup>

In Chile, a significant decrease in stroke consultations was reported during the first 8 weeks of quarantine.<sup>7</sup>

We aimed to analyze the impact of the COVID-19 pandemic outbreak on hospital ischemic stroke admissions as well as the use of reperfusion therapies and in-hospital mortality in tertiary referral hospitals from the south-east of Santiago

## Materials and methods

### *Study population*

Santiago is the capital of Chile, it has a population that exceeds 7 million inhabitants. The South East health service includes the communes of Puente Alto, Florida, La Granja, San Ramón, La Pintana and San Jose de Maipo, with a population of approximately 1.5 million. In this region, there are two Primary Stroke Centers, Padre Hurtado (HPH) and Eloisa Diaz (HLF) hospitals, and 1 Comprehensive Stroke Center, Sotero del Rio hospital (HSR).

We reviewed the data from these 3 hospitals and recorded the number of patients admitted for ischemic stroke between 01 January 2020 and 30 June 2020. We grouped the cases in two periods, pre-pandemic and pandemic, according to the setting of the state of emergency in Chile (March 18, 2020).

We also registered the NIHSS on admission, the number of patients with medical treatment, intravenous thrombolysis (IVT) and endovascular thrombectomy (EVT), the COVID-19 status and in-hospital mortality.

Epidemiological data of COVID-19 cases were obtained from the Ministry of Health.

### *Statistical analysis*

Results were reported using mean  $\pm$  standard deviation and percentages. Two groups, the First and Second period were compared. Differences in qualitative variables between the groups were established using Fisher exact test. For quantitative variables, Mann–Whitney U test was used. Potential risk factors for mortality among recognized prognostic clinical variables were assessed. Binomial logistic regression was performed to analyze the

probability of death using Relative Risk (RR) and 95% confidence interval (95% CI). First, we performed a univariate analysis and then selected for the multivariable analysis, all variables that had  $p < 0.1$ . Differences were considered significant at  $p < 0.05$ . For statistical analysis, IBM SPSS Statistics 21 was used.

### *Ethics*

The Registry was approved by the local Ethics Committee of each participating centre. Treatment of every data obtained in the registry was done following the Chilean data protection law and patients' rights.

## Results

In total, 431 stroke patients were admitted to any of the South East Metropolitan health service hospitals between 01 January and 30 June 2020, most of them (226) in the comprehensive stroke centre. 204 patients were admitted in the first period and 227 in the second.

Table 1 summarizes the distribution and the clinical characteristics of the population comparing the pre-pandemic with the pandemic periods. There were no significant differences between the groups in terms of gender distribution (male 55.4% vs 54.7) or age ( $68.74 \pm 13.02$  vs  $67.64 \pm 12.51$ ). There was a little decrease in weekly admissions (17 vs 15 patients/week), which only was significant in HLF. Nor differences were observed in the proportion of patients with medical treatment ( $p = 0.810$ ), IVT ( $p = 0.638$ ), EVT ( $p = 0.503$ ) or IVT + EVT ( $p = 0.501$ ). All COVID cases were concentrated in the second period (0 vs 35 patients,  $p = 0.0001$ ).

There was a statistically significant increase in the NIHSS on admission (7.23 pre pandemic vs 8.78 pandemic,  $p = 0.009$ ) and mortality (5.2% pre pandemic vs 12.4% pandemic,  $p = 0.012$ ).

As shown in Table 2, the mortality increase was associated with age (RR 1.04; CI 1.01–1.08,  $p = 0.003$ ), NIHSS on admission (RR 1.14; CI 1.09–1.20,  $p = 0.0001$ ) and with being admitted during the pandemic period (RR 2.49; CI 1.21–5.15,  $p = 0.014$ ). Importantly, there were no differences between the different treatment modalities or due to COVID infection. When performing a multivariate analysis the NIHSS on admission maintained an association with increased mortality (RR 1.11, CI 1.04–1.19,  $p = 0.003$ ).

## Discussion

Our study is one of the first registries of the epidemiological behaviour of stroke during the pandemic period in Latin America and has one of the largest number of patients. It demonstrates a significant increase in severity (measured by NIHSS) and mortality in patients admitted for stroke in the South East Health Service of Santiago. It also highlights that it is a multicenter study conducted in

**Table 1.** Prepandemic and pandemic period.

	First period 1-12 weeks (n: 204) 17 cases/week	Second period 13-27 weeks (n: 227) 15 cases/week	p value
Center cases			
- HSR	103	123	0.439
- HLF	<b>41</b>	<b>26</b>	<b>0.017</b>
- HPH	60	78	0.256
Gender			
- Female	91	104	0.846
- Male	113	123	
Age	68.74 ± 13.02	67.64 ± 12.51	0.542
NIHSS	<b>7.23 ± 7.75</b>	<b>8.78 ± 7.55</b>	<b>0.009</b>
Treatment			
- Medical	162 (79%)	183 (81%)	0.810
- IVT	23 (11%)	22 (10%)	0.638
- EVT	8 (4%)	13 (6%)	0.503
- IVT + EVT	11 (5%)	9 (4%)	0.501
COVID-19	<b>0</b>	<b>35 (15,7%)</b>	<b>0,0001</b>
Mortality	<b>11 (5,2%)</b>	<b>28 (12,4%)</b>	<b>0.012</b>

the public system that serves the vast majority of its population.

In Chile, a state of exception was decreed for the COVID-19 pandemic on March 18, 2020. This led to a limitation of social mobility and to multiple changes in the public health system, intended to contain a large number of infected patients. As expected, these changes had epidemiological repercussions on other diseases, including stroke.

Our results showed no significant changes in the number of admissions or patients treated with medical treatment, IVT and/or EVT. Other studies have shown a significant decrease in admissions,<sup>5,7-9</sup> probably because patients with milder neurological symptoms delay or avoid medical consultation due to fear of contamination.<sup>9</sup> This same reason could explain the significant increase in the severity of patients admitted for stroke since by not consulting patients with mild symptoms, those with the greatest severity were concentrated. Another reason for the increase in severity upon admission may be the worse control of chronic pathologies, due to the decrease in consultations.

Regarding the treatment received by the patients, we could observe that there was no significant decrease in the patients who received IVT and/or EVT, this follows the line of other studies that show that although there was a decrease in the global number of IVT and EVT,<sup>9</sup> this was proportional to the decrease in admitted patients, without changing the percentage of patients with reperfusion treatment.<sup>5</sup>

The increase in mortality, also observed in other studies,<sup>5,10</sup> can be explained by multiple factors, one of which is the greater severity of patients upon admission as measured by NIHSS, but there are several non-quantifiable factors such as saturation of patients in the emergency services, the reduced availability of critical wards and beds and the fatigue of health personnel as a result of the pandemic.

Among the limitations of the study, it should be noted that it is an observational study, that the aetiology of the stroke or the percentage of occlusion of large vessel occlusion was not recorded and that the mortality measurement is in-hospital and not at 3 months.

**Table 2.** Mortality.

Variables	Univariate analysis			Multivariate analysis (with $p < 0.05$ variables in Uni analysis)		
	RR	95%CI	p-value in-hospital	RR	95%CI	p-value
2 <sup>nd</sup> period	2.49	1.21-5.15	0.014	2.42	0.51-11,5	0.267
Male gender	0.60	0.31-1.17	0.136	-	-	-
Age	1.04	1.01-1.08	0.003	1.04	0.99-1.08	0.056
NIHSS	1.14	1.09-1.20	0.0001	1.11	1.04-1.19	0.003
Treatment	1.47	0.69-3.16	0.320	-	-	-
COVID-19	1.76	0.64-4.82	0.275	-	-	-

Particular attention has been paid to the impact of COVID-19 in developing countries, given the low availability of comprehensive stroke centres and intensive care for COVID-19 patients.<sup>8</sup> The results of our study can be of great relevance when taking measures to maintain standards in the management of stroke patients, even more so at a time when several Latin American countries are facing a second or third wave of infections due to COVID-19 and that the number of people vaccinated by COVID-19 in Latin America is worryingly low.

## References

1. Banerjee A. Estimating excess 1-year mortality associated with the COVID-19 pandemic according to underlying conditions and age: a population-based cohort study. *Lancet* 2020;395:1715-1725.
2. <https://www.gob.cl/coronavirus/cifrasoficiales/#datos> <https://www.uc.cl/noticias/plataforma-permite-saber-el-impacto-del-coronavirus-en-las-comunas-de-chile/>
3. Mena GE, Martinez PP, Mahmud AS, Marquet PA, Buckee CO, Santillana M. Socioeconomic status determines COVID-19 incidence and related mortality in Santiago, Chile. *Science* 2021:eabg5298 <https://doi.org/10.1126/science.abg5298>.
4. Nogueira R. Global impact of COVID-19 on stroke care and intravenous thrombolysis. *Neurology* 2021. <https://doi.org/10.1212/WNL.0000000000011885>. First published March 25.
5. Tejada Meza H. Impact of COVID-19 outbreak on ischemic stroke admissions and in-hospital mortality in North-West Spain. *Int J Stroke* 2020;15(7):755-762.
6. Ortega-Gutierrez S. Svin COVID-19 multinational registry and task force. decline in mild stroke presentations and intravenous thrombolysis during the covid-19 pandemic: the society of vascular and interventional neurology multicenter collaboration. *Clin Neurol Neurosurg* 2021;201:106436.
7. Toro L. Epidemia de COVID-19 en Chile: impacto en atenciones de servicios de urgencia y patologías específicas. *Rev Médica De Chile* 2020;148(4):558-560.
8. Markus HS. COVID-19 and stroke-A global World Stroke Organization perspective. *Int J Stroke* 2020;15(4):361-364. <https://doi.org/10.1177/1747493020923472>.
9. Pop R. Impact of the Covid-19 outbreak on acute stroke pathways – insights from the Alsace region in France. *Eur J Neurol* 2020. <https://doi.org/10.1111/ene.14316>. Epub Ahead Print 3 June.
10. Tullius Silva M. The impact of the COVID-19 pandemic on a stroke centre in Latin America. *Int J Stroke* 2020;15(7):813-814. <https://doi.org/10.1177/1747493020941637>. OctEpub 2020 Jul 14. PMID: 32589117.